PHYSICAL ACTIVITY GUIDE FOR CHILDREN AND ADOLESCENTS WITH CHRONIC DISEASES

ANKARA 2019

PHYSICAL ACTIVITY GUIDE FOR CHILDREN AND ADOLESCENTS WITH CHRONIC DISEASES

ANKARA - 2019

ISBN: 978-975-590-708-6
Ministry of Health Publication No: 1123
1st Edition

www.beslenme.gov.tr

This publication was prepared and printed by the Republic of Turkey (TR) Ministry of Health, General Directorate of Public Health, Department of Healthy Nutrition and Mobile Life. General Directorate of Public Health Institution reserves all the rights of this publication. No quotations shall be allowed without citing the source. Quotation, copying or publishing, even partly, is not allowed. When quoted, the source indication should be as "*Physical Activity Guide for Children and Adolescents with Chronic Diseases*" General Directorate of Public Health, Publication No, Ankara and Publication Date".

(Authors are written in alphabetical order by surname)

It is free. It cannot be sold.

Interpreter : Mustafa AY

Printing
Artı6 Medya Tanıtım Matbaa Ltd. Şti.
Özveren Sokak No:13/A Kızılay - ANKARA
Phone: +90 312 229 37 41 - 42

EDITORS

Elif Nursel ÖZMERT, MD Prof.
Hacettepe University, Faculty of Medicine, Department of Pediatrics, Division of Developmental Pediatrics

Aynur Ayşe KARADUMAN, PT PhD Prof.
Hacettepe University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation

Nuray KANBUR, MD Prof.
Hacettepe University, Faculty of Medicine, Department of Pediatrics, Division of Adolescent Medicine

PREPARED BY

Nazan YARDIM, MD Assoc. Prof.
Head of Healthy Nutrition and Moving Life Department, General Directorate of Public Health, T.R. Ministry
of Health

Meral ÇARKÇI, Dietitian
T.R. Ministry of Health, General Directorate of Public Health, Healthy Nutrition and Moving Life Department

Duygu ÜNAL,MSc Dietitian
T.R. Ministry of Health, General Directorate of Public Health, Healthy Nutrition and Moving Life Department

Beytül YILMAZ, MSc Dietitian
T.R. Ministry of Health, General Directorate of Public Health, Healthy Nutrition and Moving Life Department

EDITORIAL COORDINATORS

Bekir KESKİNKILIÇ, MD Spec.
Deputy General Director of the Public Health, Ministry of Health

Nazan YARDIM, MD Assoc. Prof.
Head of Healthy Nutrition and Moving Life Department, General Directorate of Public Health, T.R. Ministry of Health

EDITORIAL BOARD

Hasan IRMAK,MD Spec.
Head of Publication Commission, General Directorate of Public Health, T.R. Ministry of Health

Nazan YARDIM, MD Assoc. Prof.
Head of Healthy Nutrition and Moving Life Department, General Directorate of Public Health, T.R. Ministry of Health

Kanuni KEKLİK, MD
Republic of Turkey Ministry of Health General Directorate of Public Health Head of Migration Health Department

Fehminaz TEMEL,MD Spec.
Health Threats Early Warning and Response Department, General Directorate of Public Health, T.R. Ministry of Health

PRESENTATION

Increase ofchronical diseases and prolongation of life both in developed and developing countries across the world became the most important cause of mortality and morbidity.The need to develop national policies and long term strategies was emerged on fight against the risk factors which cause chronic diseases.

Chronic diseases are defined as “prolonged states that are not fully curable and do not show improvement”. Chronic illnesses with rapidly increasing frequency are the most important causes of deaths and disabilities in the world. 36 million out of 57 million death worldwide, namely about two-third, in 2018; are result of non-communicable diseases including cardiovascular diseases, cancers, diabetes and chronic lung diseases. Similar to the situation in the world, the frequency of chronic diseases and risk factors is increasing in Turkey.

Physical inactivity, one of the common risk factors for chronic diseases, ranks fourth in the list of risk factors that cause death worldwide. According to the World Health Organization (WHO) 2008 Report, 31% of adults aged 15 years and over are not active enough. According to the “Chronic Disease Risk Factor Survey” conducted by the Ministry of Health in 2011, it is determined that 87% of women and 77% of men do not perform sufficient physical activity across Turkey. Inadequate physical activity is considered to be one of the important reasons for increasing chronic diseases. Inactive lifestyle and inadequate physical activity is an important public health issue in Turkey.

The World Health Organization and experts recommend that children should have at least 60 minutes of physical activity every day. Turkish Physical Activity Guide that was created by T.R. Ministry of Health was prepared in line with recommendations of the World Health Organization, including the physical activity recommendations for each age group.

Therefore, “Turkey Healthy Nutrition and Active Life Program” is conducted which was published as a Mandate of the Prime Ministry in the Official Gazette dated 29.09.2010 and No 27714 in order for the society to enhance the level of knowledge on struggle with obesity and to encourage gaining the habits of sufficient and balanced nutrition and regular physical activity. 30% of program activities involve physical activity.

I would like to thank the academicians and health workers who contributed knowledge and experience to the preparation of this country-wide guide, which includes recommendations and practices for increasing the quality of life of individuals with chronic diseases through the protection of health and increasing physical activity.

General Directorate of Public Health

PREFACE

Different problems were encountered in many fields starting from developing and changing living conditions, technology and medical practices and everyday life to the causes disease and death compared to previous years. As a reflection of such changes,causes of diseases and death other than infections occupy a large place in lives of children after adults. The prevalence of chronic diseases fell to younger ages and the number of children with chronic diseases increased.

Studies show that insufficient physical activity is amongst the top 10 risk factors for cardiovascular system diseases, diabetes, obesity and cancers that are very important in disease burden. The Mandate of Prime Ministry on the Program, which adopts a broad-based and multi-sectoral approach in this regard, entered into force by being published in the Official Gazette dated 29.09.2010 and No 27714. 30% of program activities involve physical activity. “Turkey Physical Activity Guide” is prepared for this purpose by the Turkish Ministry of Health, General Directorate of Public Health, Department of Healthy Nutrition and Active Life in 2014.

This present Guide includes physical activity recommendations for children and adolescentswith chronic diseases. As is known, physical activity not only prevents diseases but also is a part of the treatment processes and has great benefits for increasing the quality of life and participation in life. It is one of the most important goals that no individual in society should be deprived of the benefits that physical activity brings and the knowledge that everyone can reach. “Physical Activity Guide for Children and Adolescents with Chronic Diseases” was put at the disposal of those working to that end. We would like to thank everyone who contributed to the preparation of this guide.

Editors

CONTENTS

INDEX OF TABLES

INDEX OF FIGURES

ABBREVIATIONS

ACE	Angiotensin Converting Enzyme
ACR	American College of Rheumatology
ACSM	American College of Sports Medicine
ADHD	Attention Deficit Hyperactivity Disorder
AHA	American Heart Academy
AI	Aortic Insufficiency
AIDS	Earned Immune Deficiency Syndrome
AIS	Adolescent Idiopathic Scoliosis
ALL	Acute Lymphoblastic Leukemia
ALCAPA	Anomalous Origin of the Left Coronary Artery from the Pulmonary Artery,
ANA	Antinuclear Antibody
anti-GAD	Glutamic Acid Decarboxylase Antibody
APTT	Active Partial Thromboplastin Time
ARCAPA	Anomalous Right Coronary Artery from the Pulmonary Artery
ARF	Acute Rheumatic Fever
ARVC	Arrhythmogenic Right Ventricular Cardiomyopathy
ARVD	Arrhythmogenic Right Ventricular Dysplasia
AS	Aortic Stenosis
ASD	Autism Spectrum Disorder
AT	Antithrombin
BMI	Body Mass Index AVN Avascular Necrosis
BP	Blood Pressure
CAHP	Childhood Arthritis Health Profile
CBT	Cognitive Behavioral Therapy
CD	Crohn Disease
CF	Cystic Fibrosis
CF-CY	Functionality, Disability and International Classification of Health-Children and Youth
CHAQ	Childhood Health Assessment Questionnaire
CRF	Chronic Renal Failure
CP	Cerebral Palsy
CPVT	Catecholaminergic Polymorphic Ventricular Tachycardia
CRP	C-reactive Protein
DA	Dopamine
dACC	Dorsal Anterior Cingulate Cortex
DBP	Diastolic Blood Pressure

DDAVP	Desmopressin
DIC	Disseminated Intravascular Coagulation
DM	Diabetes Mellitus
DMD	Duchenne Muscular Dystrophy
DOT	Direct Observed Treatment
DSM-5	Diagnostic and Statistical Manual of Mental Disorders-5
EBV	Epstein-Barr Virus
ECG	Electrocardiography
EF	Ejection Fraction
EEG	Electroencephalography
EIB	Exercise-Induced Bronchospasm
EMG	Electromyography
ESC	European Society of Cardiology
ESRD	End-Stage Renal Disease
F	Coagulation Factors
FEV_1	Forced Expiration Volume
FIM	Functional Independence Measure
FITS	Functional Individual Therapy of Scoliosis
FMA	Familial Mediterranean Fever
F508del	Deletion of Code 508 Coding Phenylalanine Amino Acid
GABA	Gamma-Aminobutyric Acid
GER	Gastroesophageal Reflux
GERD	Gastroesophageal Reflux Disease
GFR	Glomerular Filtration Rate
HbA1c	Hemoglobin A1c
HCM	Hypertrophic Cardiomyopathy
HIV	Human Immunodeficiency Virus
HL	Hodgkin's Lymphoma
HLA	Human Leucocyte Antigen
HRQOL	Health-Related Quality of Life
HSCT	Hematopoietic Stem Cell Transplant
IBD	Inflammatory Bowel Diseases
IC	Indeterminate (Unspecified Type) Colitis
ICD	Implanted Cardioverter Defibrillator
ICF-ONK	Functionality, Disability and International Classification of Health-Oncology
ICF-CY	International Classification of Function Disability and Health in Children and Youth Method
ICH	Intracranial Hemorrhage

ILAE	International League against Epilepsy
ILAR	International League against Rheumatism
INR	International Normalized Ratio
ISAAC	International Study of Asthma and Allergies in Childhood
ITP	Immune Thrombocytopenic Purpura
JAQQ	Juvenile Arthritis Quality of Life Questionnaire
JCA	Juvenile Chronic Arthritis
JDM	Juvenile Dermatomyositis
JIA	Juvenile Idiopathic Arthritis
JRA	Juvenile Rheumatoid Arthritis
JRM	Joint Range of Motion
KDOQI	National Kidney Foundation Kidney Disease Outcome Quality Initiative
KFTRP	KF Transmembrane Regulator Protein
LMWH	Low Molecular Weight
LV	Left Ventricle
LVOT	Left Ventricular Outflow Tract
MI	Mitral Insufficiency
MLA	Medial Longitudinal Ark
MRI	Magnetic Resonance Imaging
MRI	Magnetic Resonance Imaging
NAFLD	Non-Alcoholic Fatty Liver Disease
NE	Norepinephrine
NMD	Neuromuscular Diseases
OGTT	Oral Glucose Tolerance Test
PA	Pulmonary Artery
PAP	Pulmonary Artery Pressure
PC	Protein C
PCC	Prothrombin Complex Concentrate
PCOS	Polycystic Over Syndrome
PDW	Platelet Distribution Width
PedsQL	Pediatric Quality of Life-Arthritis Module Inventory
PEF	Peak Expiratory Flow
PEDI	Pediatric Disability Assessment
PH	Pulmonary Hypertension
PPS	Peripheral Pulmonary Stenosis
PRQL	Pediatric Rheumatology Quality of Life Scale
PS	Protein S

PT	Prothrombin Time
PVC	Premature Ventricular Complex
RNA	Ribo Nucleic Acid
RVOT	Right Ventricular Outflow Tract
SBP	Systolic Blood Pressure
SCPE	Surveillance of Cerebral Palsy in Europe
SEAS	Scientific Exercise Approach to Scoliosis
SLE	Systemic Lupus Erythematosus
SMA	Spinal Muscular Atrophy
SNRIS	Selective Serotonin and Norepinephrine Reuptake Inhibitors
SSRI	Selective Serotonin Reuptake Inhibitors
TAFI	Thrombin Activatable Fibrinolysis Inhibitor
TFPI	Tissue Factor Pathway Inhibitor
tPA	Tissue Plasminogen Activator
TSA	Tricyclic Antidepressants
TVRV	Tricuspid Valve Regurgitation Velocity
UC	Ulcerative Colitis
USA	United States of America
WeeFIM	Functional Independence Measure for Children
WHO	World Health Organization
WPW	Wolff-Parkinson-White Syndrome
vWF	Von Willebrand Factor Heparin
vWF:RCo	Ristocetin Cofactor
VAS	Visual Analogue Scale
VO2	Maximal Oxygen Consumption
VSD	Ventricular Septal Defect

SECTION 1

PHYSICAL ACTIVITY AND EXERCISE IN PULMONARY DISEASES

AUTHORS:

Deniz İNAL İNCE (President), PT PhD Prof.	*Hacettepe University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation*
Saniye GİRİT,MD Assoc. Prof.	*Association of Pediatric Chest Diseases*
Yasemin GÖKDEMİR,MD Assoc. Prof.	*Association of Pediatric Chest Diseases*
Murat ÇEVİK, MD Spec.	*Federation of Family Physicians' Associations*
Aysun AKIN ALAKOÇ, MD	*Ankara Provincial Directorate of Health*
Şenay BENZEK, MSc Nurse	*T.R. Ministry of Health, General Directorate of Public Health*

ABSTRACT

Chronic lung diseases in children should be surveyed under two main categories; obstructive and restrictive. While the most common diseases which cause chronic airway disease are asthma and cystic fibrosis, primary ciliary dyskinesia and non-cystic fibrosis bronchiectasis, post-infectious bronchiolitis obliterans are among other obstructive lung diseases. Although restrictive lung diseases are seen rarely in children, neuromuscular diseases, breast deformities and diffuse parenchymal lung diseases are the most common diseases that cause chronic restrictive disease. Exercise training programs should include aerobic endurance, strength and flexibility exercises. Even though the exercises are preferred which particularly activate shoulder zone and have the child breathe deeply, the sportive activities and exercise programs that the child likes to do should be preferred. Children and adolescents should participate in physical training and sports (sports and physical activities) courses. When children are directed to exercise programs, exercise programs that are planned by family are also important in terms of sustainability in order for families to become role models. Being physically active should be encouraged. The time that children spend with screen (television, smart tablet etc.) activities should be limited as far as possible, activities to be performed with family and friends should be planned and an active and moving lifestyle development should be provided.

INTRODUCTION

Chronic lung diseases in children should be surveyed under two main categories: obstructive and restrictive.While the most common diseases which cause chronic airway disease are asthma and cystic fibrosis, primary ciliary dyskinesia and non-cystic fibrosis bronchiectasis, post-infectious bronchiolitis obliterans are among other obstructive lung diseases. Although restrictive lung diseases are seen rarely in children, neuromuscular diseases, breast deformities and diffuse parenchymal lung diseases are the most common diseases that cause chronic restrictive disease.

Asthma and CF among chronic airway diseases will be explained under two titles since their prevalence is the most and physical exercise study was conducted on them. Similar physical activities can be performed in other chronic airway diseases. Even though the exercises are preferred which move arms and shoulder zone and have the child breathe deeply, the sportive activities that child likes to do should be preferred. When children are directed to exercise programs, exercise programs that are planned by family are also important in terms of sustainability in order for families to become role models. The time that children spend with screen (television, tablet etc.) activities should be limited as far as possible, activities to be performed with family and friends should be planned and an active and moving lifestyle development should be provided.

ASTHMA

Definition

Asthma is a chronic inflammatory disease characterized by increased airway sensitivity to different stimuli and reversible airway obstruction. Over the years; it became a disease with increasing prevalence and morbidity. The prevalence varies according to the countries, the diagnostic methods, the race, geographical regions and environmental factors. The prevalence of asthma in developed societies was found to be between 4% and 23% with ISAAC (International Study of Asthma and Allergies in Childhood) method. It ranges between 13.7 - 15.3% in childhood prevalence studies performed byISAAC method in Turkey. Asthma prevalence is closely associated with low socioeconomic status, obesity and low physical activity levels.

The inflammation of the bronchus and bronchial in asthma is usually occurs afterexposure to allergens. Bronchial obstruction depends on contraction of the smooth muscles on the bronchial wall, edema, remodeling (structural changes in the airway's mucous membrane) and excessive increase of mucus production. These physiopathological mechanisms cause recurrent wheezing, cough, dyspnea and chest pain episodes. During these episodes, constrictions with different severe occur in the bronchus. Apart from these, symptoms may increase with non-specific stimulants such as cigarettes, smoke, smells or exercise. Prevalence of asthma in the childhood age group increased markedly in recent years. This increase depends on both environmental and individual factors. While genetic predisposition, atopy, obesity, airway hyperactivity, gender and race may be included in individual factors, environmental factors include viral and bacterial infections, diet, passive smoking, socioeconomic status and number of people in the family.

In asthma due to exercise in children; exercise is one of the most important factors that triggeracute asthma. Approximately 90% of patients with asthma and 40% of patients with allergic rhinitis may have **exercise-induced bronchospasm** (EIB). It is a clinical condition that reveals itself with symptoms such as coughing, dyspnea, chest tightness and wheezing, which usually develop within 2-10 minutes, reach maximum within 10-15 minutes and recover automatically within 30-60 minutes after starting to exercise. For children, EIB may be the first finding of asthma. Exercise-related dyspnea can often be diagnosed as EIB. However, bronchial hyperactivity is not associated with exercise-related dyspnea.

Exercise-related dyspnea or cough may be the only symptom of asthma and is called as**exercise-related asthma**. It is alleged that heat and fluid loss which occurs in the airways during exercise is the main cause of pathogenesis of exercise-related asthma; vasodilatation and secondary reactive hyperemia result in edema and mediator release in the airways during reheating and moistening after heat and fluid loss. Exercise-related asthma should be considered in cases such as dyspnea and cough following the exercise, quick recovery of the symptoms with inhalation of beta 2 agonist and prevention of symptoms by giving beta 2 agonist prior to exercise.

If at least 15% or more reduction is observed in forced expiration volume ($FEV_{1)}$ after exercise compared to pre-exercise period or peak expiratory flow (PEF) decreases by 15%, diagnosis of exercised-related asthma may be made. Although asthma can occur in all kinds of climate conditions, exercise in dry or cool air triggers asthma attacks. Exercise in hot and humid climates triggers asthma attack less frequently.

In asthma management, the weight and triggering factors of the disease are important; treatment plan should be made according to these criteria. Inhaled corticosteroids and/or leukotriene inhibitors should be initiated as anti-inflammatory treatments in patients with low persistent symptoms and low basic respiratory function test scores. Beta 2 agonists are used to prevent EIB before exercise.

For children with mild intermittent asthma that is triggered by exercise, non-pharmacologic interventions (nasal breathing and pre-exercise warm-up) are as effective as beta 2 agonists at least. Long-acting beta 2 agonists may also be beneficial before extended activities. A short-acting beta 2 agonist is recommended 15-30 minutes prior to exercise.

Benefits of Physical Activity

Regular exercise training reduces the risk of cardiovascular disease in healthy individuals and improves physical fitness levels. This also applies to patients with respiratory problems, provided they exercise regularly and adequately. Physical exercise training programs have positive effects on respiratory and circulatory systems of patients with asthma and provide with psychological support. For this reason, exercise training constitutes an important part of pulmonary rehabilitation programs in the management of the disease. Children with asthma can take part in regular exercise programs and sportive activities, taking certain criteria into account. Regular exercise and participation in physical activities increase physical fitness, quality of life and exercise performance in children with asthma. Neuromuscular coordination and self-confidence develop; the symptoms decrease. Extensive studies showed that high physical fitness in childhood reduces the risk of asthma progress. For this reason, patients with asthma should be encouraged to participate in regular physical activity programs and inappropriate lifestyles should be changed.

Children's participation in physical activity may be prevented by teachers and families for fear of asthma attack. Children with asthma who are pushed into an inactive lifestyle in this way lose their motivations and feel themselves dependent on others. Because of this wrong attitude, not only pathophysiological changes but also psychosocial problems are seen in patients. It is very important that school management, teachers and parents should be well informed of the participation of children with asthma in physical exercise programs.

Indications

Mucus accumulation due to the natural progression of asthma, recurrent asthma attacks may lead to; pathological respiratory pattern, postural disturbance, and circulatory system disorders. Later on in the disease, the use of continuous accessory respiratory muscles leads to spinal inactivity, shortening of the thoracic muscles, high and low shoulders, front to back displacement of the head, shortening of the muscles around the hips and knees. Participation in exercise and physical activity should be an integral part of treatment approaches to prevent the development of all these stages.

Physical Activity Prescription

Children with asthma should be encouraged to make sufficient and regular exercise and participate in physical activity in daily life in order to increase aerobic fitness. Although the starting age of exercise for the patients with asthma is not known precisely, new data suggests that children with atopy history should begin to exercise at pre-school age or at the earliest possible age. Exercise programs designed to increase the functional capacity should be person-specific. Exercise is planned according to type, severity, duration and frequency.

To improve exercise tolerance, activities which involve large muscle groups and lower extremity such as swimming, cycling, paddling, jogging and walking and exercises with aerobic features should be included in the exercise program. Swimming is a particularly recommended activity. Exercise in a humid environment does not provoke bronchial spasm. Expiration under water and inspiration out of water during swimming composes a kind of effect of breathing exercise. Since upper extremity training can reduce ventilator requirements, it should be included in the program. Physical activity programs should include aerobic exercises as well as strength training.

Activities such as basketball, cycling, football, which cause a rapid increase in minute ventilation, sports such as alpine discipline skiing, ice hockey and ice skating, which have additional effects due to performance in cold environment, are considered as activities with high risk. Long-distance running is not recommended due to the risk of excessive fluid loss and the development of bronchospasm. Tennis, volleyball, wrestling, weightlifting, short distance running and racquet sports are the sports with low risk of bronchospasm development. Children and adolescents with asthma should participate in physical training and sports (sports and physical activities) courses. In choosing physical activity, the severity of asthma, the control level of the disease, the respiration and exercise capacity and the activity preference of child should play an important role.

Individual characteristics are taken into consideration when adjusting the intensity of the exercise. Exercise intensity can be determined by the level of dyspnea, level of maximum oxygen consumption or the target heart rate. Exercise training can be started with light exercise intensity.

Intensity of the exercise should be arranged according to the patient's response to the exercise. Exercise should be repeated at least 20-30 minutes, 3-5 timesa week within the intensity determined. The duration and prevalence of exercise may vary according to the tolerance of the child with asthma. Intermittent exercise training can be used in individuals who cannot tolerate continuous exercise. Strength training and flexibility training should be included in the exercise program.

In children and adolescents with asthma, behavioral change approaches are used with the aim of sustaining the effects of exercise training and increasing participation in physical activity. The level of physical activity can be assessed using accelerometers, questionnaires and activity log. Pedometer and smartphone applications can also be used to monitor activity levels of children and adolescents with asthma.

Contraindications/Risks

Exercise in cold and dry air should be avoided. In winter, the patients are recommended to exercise in closed areas or cover their mouths and noses with a weft or breathing mask to warm and humidify the air they breathe. Breathing through nose as much as possible allows the breathing air to warm up, humidify and allergens to be filtered out. Proper heat and cooling processes should be provided before exercise.

During lower respiratory tract infections, exercise programs should be interrupted or the intensity of exercise should be alleviated. During the pollen season, outdoor exercises and physical activities and sensitive individuals should be restricted according to the concentration of pollens in the air.

Due to the risk of exposure to chlorine and chlorine products, asthma symptoms may be triggered in sensitive children. However, in a recent cohort study, children from birth to 10 years of age were followed up, children who were regularly swum in the pool were not found to have an increased case of asthma and patients with asthma did not show an increase in symptoms related to swimming. Scuba diving in the patients with asthma is recommended only for patients with asthma under control and normal respiratory function testing. Scuba diving is not recommended for patients whose asthma is induced due to mood and cold and who need rescue medication within the last 48 hours.

CYSTIC FIBROSIS

Definition

Cystic fibrosis (CF) is a disease frequently observed among white race and which is autosomal recessive andshortens life span. The disease occurs depending on mutations in the KF transmembrane regulator protein (KFTR) encoded by the CF gene. Although CF most frequently holds the upper and lower respiratory system, exocrine pancreas and digestive system, it affects all systems containing KFTR channels. The frequency of the disease is 1 / 2,500-1 / 3,500 in Caucasian race. The frequency of the disease in Turkey is estimated to be at similar rates. Nowadays, over 2000 mutations causing CF were detected. The most common mutation observed in the CFTR gene is F508del (deletion of the code 508 coding phenylalanine amino acid).

Clinical findings in CF vary with the age of the patient, the systems involved and the severity In CF, the symptoms vary according to the age groups being diagnosed. CF should be suspected in case of failure to thrive, dehydration, salty taste of skin and some respiratory system findings such as cough, wheezing, tachypnea and retraction, prolonged jaundice and meconium ileus. The most frequent symptoms during infancy are recurring lower respiratory tract infection, coughing, wheezing, sputum, recurring or chronic diarrhea, fatty, foul smell stool, rectal prolapses, invagination, growth retardation, salty taste of skin, dehydration and hyponatremic hypochloremic metabolic alkalosis. Recurring sinusitis, nasal polyps, recurring pulmonary infection, atelectasis, bronchiectasis, treatment resistant asthma, increase in the anteroposterior diameter of the chest, clubbing, chronic pancreatitis, cholestasis, biliary cirrhosis and sclerosant cholangitis may develop in childhood in addition to the symptoms during infancy. Patients may apply to hospital for hemoptysis, respiratory tract disease, diabetes, distal intestinal obstruction syndrome and delayed puberty in the adolescent period in addition to childhood symptoms.

Diagnosis of CF is made through sweat chloride test and/or by the detection of two CFTR mutations that cause CF in the presence of clinical symptoms. In Turkey, CF disease was incorporated into neonatal screening program as of January 2015. Thus, it is targeted to extend the life span of the patients and increase the life quality by starting the treatment in early stage with early diagnosis of these patients.

The treatments administered for CF are aimed at removing the symptoms caused by the disease. Treatments for respiratory system are airway cleaning and physical exercise, treatment of infections and treatment of inflammation. Treatments for the gastrointestinal system are pancreatic enzyme replacement therapy, support of A, D, E and K vitamins and high calorie nutritional support. In the last decade, drug trials to increase the function of CFTR protein have gained speed, two drugs that increase the function of CFTR protein were approved and come into use.

With the development of effective supportive treatment approaches in CF, the average life span was grown to over 40 years in North America and Europe. The average life span in CF is directly proportional to the weight of the pulmonary involvement. Regular use of respiratory tract therapies and physical exercise slows down the progression of the disease and prolongs the life span.

Chronic inflammation, malnutrition, hypoxia, hypercapnia, corticosteroid use and inadequate physical activity cause weakness in the peripheral muscles, in particular in the upper and lower extremities and diaphragm muscles. Electrolyte impairment also contributes to muscle weakness. The causes listed above and the impairment of vitamin D absorption cause osteopenia and osteoporosis by affecting bone metabolism.

Benefits of Physical Activity

All children and adolescents with CF should participate in physical activity. Physical activity has beneficial effects on circulation, ventilation and musculoskeletal system. Ventilation, tidal volume, air flow rate and increase of functional residual capacity increase mucus excretion through activity. Obstructed airways are opened by secretion; mucus moves from small airways to big airways. Exercise should be used in conjunction with other airway maneuver methods; however, it should not supersede airway maneuver techniques in secretion cleaning. Regular exercise ensures that pulmonary secretions are cleared, controls blood glucose and increases bone mineral development. Regular and adequate exercise and physical activity increase both life span and life quality in patients with CF. Regular exercise in patients with good condition protects lung function and prevents it from decreasing. This allows children to live like their healthy peers. In addition to the positive biological effects of exercise, there are also psychosocial contributions. Being an enjoyable activity and ensuring the persons to be socialized are other possible contributions of physical exercise. Benefits of physical exercise for CF are associated with frequency, severity and duration as in healthy peers.

Table 1. Main Effects of Exercise Training in Cystic Fibrosis

- It increases ventilator efficiency.
- It makes mucus easy to clean.
- It prevents loss of lung function during exacerbations; it accelerates recovery.
- It provides body uniformity.
- It protects bone mineral density.
- It prevents development of cough-related urinary incontinence.
- It makes it easier to cope with dyspnea.
- It develops self-confidence in children and adolescents.

Indications

High aerobic fitness in children with CF reduces impairment in lung function and increases survival rates. Exercise training programs improve exercise tolerance. This effect is particularly evident for individuals with low physical fitness. During intense exercise, an increase is achieved in mucus sanitation from the lungs. Swimming, walking and jogging increase the strength and endurance of respiratory muscles. Microorganisms; especially due to Pseudomonas Aeruginosa colonization possibility, it is advisable to swim in pools having hygienic condition.

In addition to routine treatments, performing aerobic and resistive exercise training together for patients with CF has a more positive effect on the prognosis of the disease. Aerobic exercises improve ventilator sufficiency and mucus sanitation. It improves bone mineral density and exercise capacity. It recovers psychosocial functions. Resistive exercises; reduces production of carbon dioxide, helps respiratory requirements and reduces dyspnea and fatigue. Strength training; recovers lean body mass and body weight muscle strength and forced expiratory volume in the first second (FEV_1).

Physical activity prescription

In order for the physiological effects of exercise training to emerge, the frequency, severity and duration of the exercise should be customized. The age, nutritional and functional status, the severity of lung disease, the severity of obstruction, the amount of secretion and the presence of bronchial hyperactivity of the individual with CF affect the exercise program. The most appropriate exercise program should be planned according to the clinical condition of the patient, so that the maximum adaption should be ensured. The exercise program that is planned by family in order for families to be role models while directing children to exercise programs is an important point in enabling the child to continue exercising. Participation of children and adolescents with CF in physical training lesson, sport and physical activities should be ensured.

Need for inhaled bronchodilator should be evaluated prior to exercise training. Exercisesession should start with warm-up and finish with cooling (active recovery). In patients with CF who are desaturated during exercise, if support oxygen is supplied so as to be oxygen saturation >90%, ventilator and cardiovascular load is controlled during exercise.

In CF patients with normal or mild respiratory dysfunction, exercise training is carried out in accordance with the recommendations of healthy persons. Exercise training should include aerobic exercise training, strength training and flexibility training. Severity of the exercise is determined by individual characteristics and target. In light to moderate CF, moderate/vigorousintensity aerobic exercise is recommended for 3-5 days per week. For advanced CF, light intensity exercise should be preferred. It should be kept in mind that the maximum heart rate in children with CF during the exercise test is lower than that of the healthy peers when the exercise program is planned.

In patients that do not fulfill constant aerobic exercise requirements, intermittent exercise training, where exercise and rest intervals are applied alternately, can be used. Cycling, walking, running, rowing, tennis, swimming, skating and trampoline are recommended for the children with CF in mild to moderate level. In advanced CF patients, walking, cycling ergometer, and light intensity strength exercises are recommended. In children with CP, active video games also contribute to pulmonary rehabilitation by increasing physical activity.

Strength training should be applied to upper and lower extremities, large and small muscles of the body and pelvic floormuscles. Exercise should be started with warming. Low-to-moderate exercise workloads can be started with. Intense should be increased according to the progressive loading principle of exercise training. For this, increase of weight, number of repetitions and number of sets can be made. Rest intervals between workloads can be reduced. It should be finished with cooling and flexibility exercises.

Group exercise training should not be applied in patients with CF. Exercise recommendations for age groups that may be valid for patients with CF are given in Table 2.

Table 2. Exercise and Physical Activity Examples for Children and Adolescents with Cystic Fibrosis by Age

Infant and play child (aged 0-5)	• Creep, stair climb, lie down, climb • Pushing of toys • Water games and swimming • Making various movements on the abdomen • Throwing a ball • Sounding and singing blowing games, candle extinguishing • Jumping on trampoline
Pre-school and school period (aged 5-11)	• Movable games such as hide-and-seek etc. • Bicycle, scooter, skateboard • Dance • Volleyball, basketball, football, tennis • Swimming • Climbing activities • Bubble blowing, breath holding competitions • Exercises for diaphragm muscle activity (Breathing instrument, singing)
Adolescence (aged 12-18)	• Walking, jogging, climbing stairs, • Volleyball, basketball, football, tennis • Swimming • Aerobic exercise in the gym, Yoga, • Pilates, plank exercise, Exercises for • diaphragm muscles activity (Breathing instrument, singing lessons, singing)

Increasing participation in physical activity requires the use of behavioral change approaches. The level of physical activity can be assessed with accelerometers, questionnaires and activity log. Pedometer and smartphone applications can also be used to monitor activity levels of children and adolescents with CF.

Contraindications/risks

There are exercises and physical activity for each level of lung involvement in CF. During the exercise, short term desaturation and cough, most of which are transient, can develop. The severity of the lung disease and the decrease in the ventilator capacity determine the degree of restriction on exercise. The CF (resting FEV_1<40%) patients with low throb volume and cardiac outflow may suffer severe cardiac dysfunction. Prior to the exercise and physical activity plan, patients with severe CF should also be evaluated by the cardiologist.

In all CF patients, the risk of air embolism and pneumothorax increases and localized air trapping may occur in the course of*scuba* diving. Activities such as bungee-jumping, scuba diving and high altitude sports should be avoided. Especially in CF patients with liver cirrhosis and splenomegaly, sports and activities (fighting sports, American football, etc.) that involve contact and collision, which are at risk of trauma, should be avoided, as liver damage can occur.

Exercise in hot and humid environments increases salt loss associated with perspiration. Long-term exercise (1,5 - 3 hours) may cause hyponatremic dehydration. To prevent this, consumption of drinks containing sodium-chloride (50 mmol/L) is recommended. Hypoglycemia and dehydration (polyuria) may occur in patients with diabetes mellitus (DM) associated with CF during long-term exercise. Additional carbohydrate support may be needed in that case.

Key Recommendations on physical activity for children with CF

- Participation of children with CP in physical activity should be encouraged. Child should be referred to department of chest diseasesprior to participation.
- The exercise program should be specific to the individual. In addition to aerobic exercise training, it should include strength training.
- In order to increase aerobic exercise tolerance directly supervised or unsupervised home-based exercises in appropriate intensityshould be done.
- There is no need to stop exercising in patients who cough during exercise.
- In severe CF, exercise test should be performed to determine the response of the level, which is limited by maximal heart rate, oxygen desaturation and ventilation, to bronchospasm caused by exercise and to treatment.

- *Scuba*diving should not be done at all.
- Drinks containing sodium chloride should be consumed to prevent hyponatremic dehydration. CF patients with DMshould take supplementary carbohydrate during long term exercise.
- Patients with splenomegaly or liver cirrhosis should avoid from sports involving contact and collision.

In conclusion, exercise training and participation in physical activity are important part of the treatment in asthma and CF. In CF, preservation of bone mineral density and assuming blood glucose control, as well as ventilatory competence and mucus sanitation, are crucial for improvement of muscle strength and exercise capacity. Proper and adequate physical activity in asthma is important to prevent, control and treat asthma. Care should be taken to ensure the type, duration and severity of exercise and appropriate conditions in the training programs. With well-planned exercise programs, application of patients with asthma and CF to hospital and their drug requirements can be reduced. Child and adolescent with asthma and CF and their families should be told about the importance and benefits of physical activity and exercise; patients should be encouraged to participate in physical exercise and sportive activities on a regular basis.

REFERENCES

1. *Behm DG, Faigenbaum AD, Falk B, et al. Canadian Society for Exercise Physiology position paper: resistance training in children and adolescents. Appl Physiol Nutr Metab 2008;33:547-61.*
2. *Bradley J, O'Neill B, Kent L, et al. Physical activity assessment in cystic fibrosis: A position statement. J Cyst Fibr 2015;14:e25–e32.*
3. *Coop CA, Adams KE, Webb CN. SCUBA Diving and Asthma: Clinical Recommendations and Safety. Clin Rev Allergy Immunol. 2016;50(1):18-22.*
4. *Cox NS, Alison JA, Holland AE. Interventions to promote physical activity in people with cystic fibrosis. Paediatr Respir Rev 2014;15:237–239.*
5. *de Groot EP, Duiverman EJ, Brand PL. Comorbidities of asthma during childhood: possibly important, yet poorly studied. Eur Respir J 2010;36:671-678.*
6. *Demir AU, Karakaya G, Bozkurt B, et al. Asthma and allergic diseases in schoolchildren: third cross-sectional survey in the same primary school in Ankara, Turkey. Pediatr Allergy Immunol 2004;15:531- 535.*
7. *Demir E, Tanac R, Can D, et al. Is there an increase in the prevalence of allergic diseases among schoolchildren from the Aegean region of Turkey? Allergy Asthma Proc 2005;26:410-414.*
8. *Fink G, Kaye C, Blau H, et al. Assesment of exercise capacity in asthmatic children with various degrees of activity. Pediatr Pulmonol 1993;15:41-43.*
9. *Font-Ribera L, Villanueva CM, Nieuwenhuijsen MJ, Zock JP, Kogevinas M, Henderson J. Swimming pool attendance, asthma, allergies, and lung function in the Avon Longitudinal Study of Parents and Children cohort. Am J Respir Crit Care Med. 2011; 183: 582-8.*
10. *Gruber W, Orenstein DM Braumann KM, Beneke R. Interval exercise training in cystic fibrosis - - effects on exercise capacity in severely affected adults. J Cyst Fibros. 2014 Jan;13(1):86-91.*
11. *Haskell WL, Lee IM, Pate RR, et al. Physical activity and public health. Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Circulation 2007;116:1081-1093.*
12. *Hebestreit H, Kriemler S, Radtke T. Exercise for all cystic fibrosis patients: is the evidence strengthening? Curr Opin Pulm Med 2015;21:591-595.*
13. *Mena KD, Gerba CP. Risk assessment of Pseudomonas aeruginosa in water. Rev Environ Contam Toxicol 2009;201:71–115.*
14. *Murphy D, O'Mahony M, Logan P, et al. Bilateral pneumothoraces following a bungee jump in a patient with cystic fibrosis. Respiration 2006;73:113.*
15. *Ones U, Akcay A, Tamay Z, et al. Rising trend of asthma prevalence among Turkish school children (ISAAC phases I and III). Allergy 2006;61:1448-1453.*
16. *Philpott J, Houghton K, Luke A, et al. Physical activity recommendations for children with specific chronic health conditions: juvenile idiopathic arthritis, hemophilia, asthma and cystic fibrosis. Pediatr Child Health 2010;15:213-225.*
17. *Radtke T, Nolan DJ, Hebestreit H, et al. Physical exercise training for cystic fibrosis. Cochrane Database Syst Rev 2015;28;(6):CD002768.*
18. *Randolph C. Exercise-induced bronchospasm in children. Clin Rev Allergy Immunol 2008;34:205-216.*
19. *Rasmussen F, Lambrechtsen J, Siersted HC, et al. Low physical fitness in childhood is associated with the development of asthma in young adulthood: the Odense schoolchild study. Eur Respir J 2000;16:866870.*
20. *Selvadurai HC, Blimkie CJ, Meyers N, et al. Randomized controlled study of in-hospital exercise training programs in children with cystic fibrosis. Pediatr Pulmonol 2002;33:194–200.*
21. *Speechly-Dick ME, Rimmer SJ, Hodson M. Exacerbation of cystic fibrosis after holidays at high altitude: a cautionary tale. Respir Med 1992;86:55–56.*
22. *Szefler SJ. Advances in pediatric asthma in 2010: addressing the major issues. J Allergy Clin Immunol 2011;127:102-115.*
23. *Westergren T, Berntsen S, Carlsen KC, et al. Perceived exercise limitation in asthma: the role of disease severity, overweight and physical activity in children. Pediatr Allergy Immunol. 2016. doi: 10.1111/pai.12670.*
24. *Willeboordse M, van de Kant KD, van der Velden CA, et al. Associations between asthma, overweight and physical activity in children: a cross-sectional study. BMC Public Health. 2016;16:919. doi: 10.1186/s12889-016-3600-1.*
25. *Williams CA, Benden C, Stevens D, et al. Exercise training in children and adolescents with cystic fibrosis: theory into practice. Int J Pediatr2010;2010:1–7.*

SECTION 2

PHYSICAL ACTIVITY AND EXERCISE FOR CHILDREN WITH CANCER

AUTHORS:

Tülin DÜGER, PT PhD Prof.	*Hacettepe University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Oncological Rehabilitation Unit*
Burça AYDIN, MD Assoc. Prof.(President)	*Hacettepe University, Faculty of Medicine, Department of Child Health and Diseases*
İlke KESER, PT PhD Assoc. Prof.	*Gazi University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Oncological Rehabilitation Unit*
Meral HURİ, PT PhD	*Hacettepe University, Faculty of Health Sciences, Department of Occupational Therapy, Oncological Rehabilitation Unit*
İsmet DEDE	*T.R. Ministry of Health, General Directorate of Public Health*

ABSTRACT

Childhood cancers cause problems not only during diagnosis and treatment but also have late effects.Children and adolescents with cancer should be supported with daily smooth exercises and physiotherapy implementations in accordance with their age and capacity beginning from their diagnosis and throughout treatment process. It is an adjuvant therapy be physically active during cancer treatment, and survivors should keep doing exercises during lifetime as long as they can do. Preventive physiotherapy and rehabilitation practices planned by interdisciplinary team as part of health protection should be organized on the basis of needs of child at diagnosis and maintained by observing the clinical issues at the various stages (surgery, chemotherapy and radiotherapy) of treatment. These practices should be chosen according to patients' ability and maintained during treatment to encourage the participation of patient. This will help for him/her to easily adjust normal life in the survival period.

This section provides information on the physical activities that should be performed for children with cancer. It is aimed to raise awareness of the health professionals on the importance of physical activity of children with cancer. In this section, information will be focused on regular physical activity and exercise programs and their effects on physical, emotional and cognitive changes of the child. Also, examples are given on how the physical activities should be organized and which physical activities are proper for age groups.

PHYSICAL ACTIVITY ON ONCOLOGICAL DISEASES

1) Problems to Which Physical Activity is Important for Children and Adolescents with Oncological Disease

a) Problems during diagnosis and treatment

- Frequent appointmentsto outpatient clinics for lab or imaging tests, or long-term inpatient admissions
- Nausea, vomiting, mucositis-related nutritional disorders and energy deficiency
- Infections, hemorrhages and fatigue caused by neutropenia, thrombocytopenia and anemia
- Pain

b) Late period problems of survivors

- Obesity
- Cardiovascular diseases
- Bone and soft tissue problems
- Neurological problems

2) Effects of Physical Activity in Oncological Diseases

- Effects on Immune Suppression and Growth Factors
- Effects on Cardiopulmonary System
- Effects on Musculoskeletal System
- Effects on Fatigue
- Effect on General Physical Functions
- Effect on Life Quality
- Psychosocial Effects
- Cognitive Effects

3) Physical Activity during Cancer Rehabilitation in Childhood

- During diagnosis
- During treatments
- During survival

4) Appropriate Physical Activity Recommendations for Children with Cancer

5) Points to be Considered during Physical Activity for Children with Cancer

6) Physical Activity Principles for Children with Cancer

PHYSICAL ACTIVITY IN CHILDREN AND ADOLESCENTS WITH CANCER

Problems to Which Physical Activity is Important for Children and Adolescents with Oncological Disease

Cancer is one of the most important public health problems in the world and Turkey. According to 2012 National cancer statistics, 175,000 new cancer patients are diagnosed each year in our country. The incidence of cancer is 110-150 per million for those under 15 years of age. According to 2013 data, population under the age of 20 almost became 19 million in Turkey. According to these numbers, approximately 2,500-3,000 new diagnoses of cancer among children are expected in Turkey every year. With the developments in cancer treatment, survival rates and outcome are gradually increasing. Childhood cancer survivors among healthy population have been increasing every year. According to statistics, one out of every 530 adults between the ages of 20-40 is a survivor who underwent cancer treatment in childhood.

Children with cancer face diverse and complex problems frequently during and after the cancer treatment compared to others.

a) Problems During Diagnosis and Treatment

Children with leukemia, lymphoma, unresponsive or progressive tumors and hematopoietic stem cell transplantation (HSCT) suffer more problems. Long hospital stays cause restriction of physical activities for many patients. Frequent outpatient visits for tests and treatments also restrict daily life and physical activity. Patients mayexperience constipation, mucositis, nausea and vomiting during chemotherapy, these side effects make daily life and nutrition difficult. Neutropenia, thrombocytopenia and anemia, which are common after chemotherapy, cause infections, hemorrhage and fatigue. Pain, as well, due to mucositis or medical interventionsis another important problem that limits the activities of the patient.

Surgical procedures considered necessary or planned as part of treatment during diagnosisaffect physical capacity. Early rehabilitation after surgical treatment of bone tumors and preparation for daily activities are among the issues that should be considered. Brain or spinal cord tumors or metastases can cause partial or complete motor neurological deficits, bladder or bowel dysfunctions. It is necessary to start rehabilitation at the beginning of the treatment and continue during cancer therapy.

b) Late Period Problems of Survivors

Seventy-five percent of survivors suffer at least one chronic health problem over the next 30 years after the diagnosis. In 40% of survivors, the health problem is severe, may threaten life or cause disability. Problems increase or get worse with age. Cancers causing more late effects are acute lymphoblastic leukemia (ALL), brain tumors and Hodgkin's lymphoma (HL). Those who receive hematopoietic stem cell transplantation are at risk at least four times more in terms of severe and disabling health problems than others. Obesity and cardiovascular diseases are important health problems in which exercise is particularly important. Patients with brain tumors, bone and soft tissue cancers have specific needs.

Obesity: Obesity is one of the most important problems for childhood cancerin survivors who were treated for cancer in childhood. Obesity developing in adolescents or young adults causes significant health problems in adulthood; including insulin resistance, prothrombotic and pro-inflammatory conditions, diabetes, hypertension, dyslipidemia, cardiovascular diseases, osteoarthritis and second, breast and colon cancers. High total fat and low muscle mass are determinants for morbidity in the long-term.

Obesity is frequently observed in children who had brain tumors, acute leukemia and non-Hodgkin lymphoma. Obesity frequency in ALL survivors at adulthood ranges between 11% and 40%; which is 1.5 times more than normal population. In children with leukemia, an increase may be observed in body mass index (BMI), even at early period, due to steroids during treatment. Risk factors are female gender, young age at diagnosis (<5years) and exposure to radiotherapy to the head, whole body or abdomen.

The most important factor for reducing obesity risk is regular and active physical activity. Nutrition and eating habits also need close monitoring,those overweight and obese survivors should be consulted with nutrition specialist and be encouraged on healthy diet options and for appropriate exercise plan.

Muscle and Skeletal Problems: Functional or cosmetic problems that affect bone, muscle and other tissues after childhood cancers are frequent. The most important problems are bone related problems such as scoliosis, atrophy or hypoplasia, avascular necrosis (AVN), osteoporosis and osteopenia. To that end, vulnerable individuals should be distinguished and late side effects of muscle, skeletal and connective tissue should be discerned and appropriate exercise program should be provided.

Radiotherapy to spinal column, laminectomy or osteoporosis can cause scoliosis. Hypoplasia occurs on the muscle, soft tissue and bones within the radiation field and scoliosis worsens during growth in adolescence. Surgery or radiotherapy to the long bones, which have not yet completed their growth during the diagnosis, causes atrophy or hypoplasia in the bone and adjacent soft tissue, probably causing a difference in length in the extremities. Soft tissue changes and length

differencereduce exercise capacity after amputation or endoprosthesis. In addition, osteopenia and osteoporosis, which are caused by tumor and anti-cancer treatment, do not often recover after quitting the treatment as well and insufficient calcium intake and low body mass index increase the problem. AVN is a well-known and frequently reported complication of childhood ALL and lymphoma treatment. Movement capacity may be impaired since mostly the joints bearing burden are involved and thus surgery may be needed to control symptoms.

Neurological Problems: Brain tumors are the most common cancers among children after leukemia and cause significant morbidity. In addition to damage caused by the tumor itself, chemotherapy and radiotherapy received at a young age also cause neurological and cognitive late problems. Survivors of brain tumor in childhood may have sleep problems, attention problems, difficulty in memory and perception, retardation in information processing speed, speech, visual and hearing impairments, inadequacies in motor skills and balance disorders. The neurocognitive and motor problems in these individuals create difficulties in education, occupation, earning money, survival and finding spouse. Therefore, cognitive and physical support approaches, which start after diagnosis of the brain tumors and maintain lifelong during and after the treatment, contribute positively to life achievements. For these individuals, exercise prescriptions should be given in consideration of physical and cognitive capacity.

Cardiovascular Issues: Cardiomyopathy, vascular diseases and heart failure may occur due to anthracyclines and radiotherapy used in the treatment of childhood cancers. The risk is highest in those who are treated at a young age, have high total anthracycline intake and received mediastina radiotherapy. Risk factors such as obesity, smoking, hypertension, diabetes and dyslipidemia may aggravate the existing problem. All survivors should be guided on a healthy lifestyle and diet and regular exercise recommendations should be given. Aerobic exercise is reliable for most of the individuals and should be encouraged. It is necessary to avoid vigorous isometric exercises such as weight training and wrestling. Women with cancer-related heart disease or at risk should be closely monitored during pregnancy and appropriate exercise plans should be recommended.

Importance and Benefits of Physical Activity for Oncological Diseases

In recent years, increasing numbers of studies showed the relationship between physical activity and cancer types and physical activity and physical activity and exercise became important in the treatment and rehabilitation of cancer. Increase in the incidence of cancer and the number of individuals who survive with the disease is shown to be related to the sedentary lifestyle. Physical activity is important for to achieve good physical health. Physical activity has significant positive effects on factors such as organ function, immune system, energy balance. It can also be efficient in the prevention of cancer development and recurrences with many biological mechanisms.

There are many studies indicating that physical fitness level is affected before and after childhood cancers. Affected physical activity occurs with reduced cardio-pulmonary function, muscle strength, increased fatigue and differentiated physical functions.

Treatments (radiotherapy, chemotherapy, surgical approaches) for childhood cancers affect the heart-lung-skeletal muscles negatively. Decreases in physical fitness level, cardiac condition insufficiency, atrophy in skeletal muscles and abnormalities in daily and recreational activities limit individuals' ability to participate in significant/purposeful activities and roles expected from individuals.

Exercise practices have the potential to improve cardio-pulmonary and musculoskeletal functions. It develops long-term physical fitness parameters with regular applications.

Another factor associated with impaired physical fitness is cancer-related fatigue in individuals surviving childhood cancers. Fatigue during and after active treatments can have negative effects on physical activity and psychosocial well-being. This is why cancer-related fatigue that is three times more common in children becomes the most powerful determinant of functional and health-related life quality. What supports that fatigue may be diminished and psychosocial well-being may be developed are the evidences of changes which occur through exercise and physical activity programs that are implemented in childhood cancers, as well, similar to adult cancer survivors.

Why physical activity is necessary?

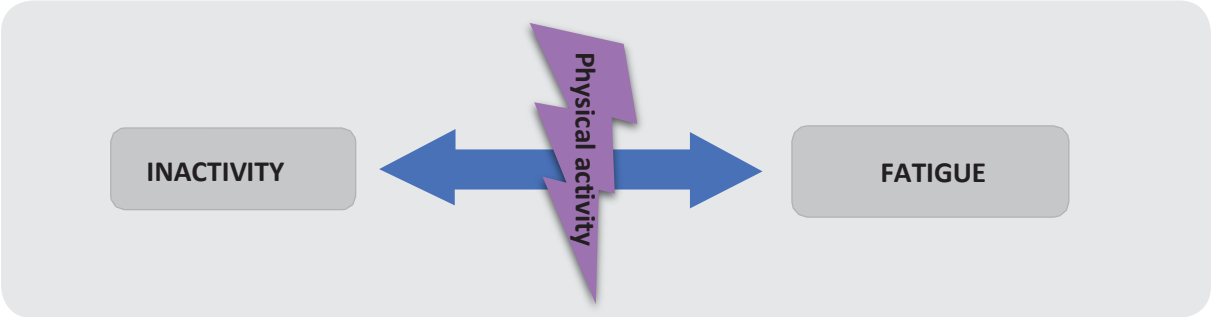
Importance and inevitability of physical activity is better understood in the case of inadequate physical activity.

Inactivity

Loss of body structure and function, activity limitations and attendance limitations are observed due to secondary and recurrent hospital processes related to many medical complications in childhood cancers. Throughout the disease process, the physical, emotional, social and cognitive capacity of the patient is affected. Many factors, which are caused by the cancer itself and the treatments applied, cause inactivity. It can be very difficult to motivate the child to physically active due to many problems, especially fatigue after intensive chemotherapy and radiotherapy or a tough operation. Imbalance in activity of child, an inactive life style and prolonged hospital stay are caused by several factors such as toxicities depending on chemotherapy/radiotherapy practices, protective approach of family, and lack of knowledge of health personnel, isolation, anxiety and depression.

Inactivity affects physical fitness parameters such as musclestrength, endurance and flexibility in a negative direction. Undesired weight loss during the active treatment period may be superseded by weight gain and insulin sensitivity in the chronic period. Inactivity and all these conditions caused by inactivity, negatively affect the ability to cope with cancer and cancer treatments by creating a vicious circle that interacts with each other.

In parallel with the treatments applied from diagnosis time, the exercises and physical activity programs to be planned by physiotherapist in line with the child's needs will maintain and increase the activity level of the child and eliminate the negative effects caused by inactivity. The most important task of the physiotherapist at this point is to break the vicious cycle between inactivity-fatigue-inactivity. Easy exercise and physical activity programs that start at the appropriate level according to the current physical fitness level of the patient should progress gradually and depending on the change in clinical condition and should be dynamic. It should be sustained until the targeted level even short interruptions occur depending on the treatment process. A motivated participation in the program should be ensured byproviding diversity. Thus, developments can be achieved not only in physically but also psychologically.



Benefits of Physical Activity in Oncological Diseases

I. Benefits on Immune Suppression and Growth Factors

In childhood cancers, chemotherapy may inhibit normal growth by suppressing the immune system, increase sensitivity to infections or cause retardations in development of musculoskeletal system. In studies investigating the effects of exercise and physical activity on numbers of neutrophil and immune function in children receiving treatment for ALL; it was demonstrated that the negative effects on growth factors can be reduced, the risk of infection caused by immune system suppression and immune system response associated with it can be regulated, development of normal musculoskeletal system can be achieved. It is thought to be useful to be physically active. The use of regular exercise and physical activity programs can change the response of the immune system and increase resistance to infections. It is also able to reduce the deviation from normal growth development parameters by regulating the functioning of the endocrine system.

ii. Benefits on Cardiopulmonary System

It was observed that exercises performed in company with physiotherapist during hospitalization and at home after discharge and physical activity programs planned by inter/intra disciplinary team have positive effects on the cardiopulmonary system. In children between 4-7 years of age receiving ALL diagnostic on-treatment, supervised exercise training produced beneficial effects in the cardiovascular system. In addition, it was detected that individualized physical activity programs developed oxygen consumption and anaerobic threshold when applied after hematopoietic stem cell transplantation.

Fatigue as a result of cancer and cancer treatments in children causes the child to be restricted from participating in physical activity. In this case, cardiovascular endurance, cardiac functions, lung volume and capacities decrease. Inactivity accompanying to side effects causes loss of cardiac and pulmonary system functions that are difficult to recover. The loss in performance and continuance of activities may become permanent over time. For this reason, exercise and physical activity programs to be applied during and after the treatment process prevent/reduce this change before occurrence. For this reason, it is important to maintain regular exercise and physical activities during and after the treatment and to improve the healing process.

iii. Benefits on the Musculoskeletal System

Childhood cancers also significantly affect the musculoskeletal system. The most common musculoskeletal problems in children surviving cancer are limitation of joint movement and decrease in muscle mass and strength. In all children with cancer diagnosis, in particular children with ALL, who take exercise training, joint range of motion and muscle strength are maintained and increased, preventing bone loss. Resistant exercises were found to lead to an increase in muscle strength. The amount of resistance to be applied should be determined by the physiotherapist according to the current potency of the patient. These values should be regulated according to the clinical situation during the treatment situation.

Loss of muscle mass and strength depending on side effects of cancer treatments andinactivity can be reduced/prevented with regular exercise. Exercise, device (orthosis, walking aids) and mobility aids can be used in the changes in musculoskeletal structure that may be seen accordingly. In case of need, participation of children in the activities compatible with their age and independence in daily living activities can be increased by supporting with assistive technology.

iv. Benefits on Fatigue

Fatigue is the most common symptom in children during and after cancer and treatment. Fatigue is a multidimensional (physical, cognitive, psychological, etc.) concept. So the patient should be treated in a multifaceted way while the treatment is planned. For example, fatigue in an inactive patient with atrophy in his muscles will continue. For this reason, the physiotherapist needs to plan the customized exercise program considering the treatments applied to the child, the level of functionality and the musculoskeletal symptoms. Regular exercises and physical activity exercises will strengthen the weak muscles, improve the balance and increase the cardiopulmonary and muscular endurance, thus protecting and enhancing the existing potential. Positive effects on fatigue and factors causing fatigue will be concretely seen as result of choosing the correct and effective physical activity and regularly applying for a long period of time.

In addition, fatigue in children may also occur as result of the toxicities in children during and after the period of active treatment and the problems of removing them from the body. Daily fluctuations in blood values during active treatment period particularly, fever, muscle atrophy, neuropathy, insufficiency in respiratory functions result in fatigue. All studies in this regard show that regular physical activity programs planned for the needs of the child are the most effective intervention in the treatment of fatigue.

v. Benefits on General Physical Functions

In children with cancer diagnosis, suppressed immune system function, decrease in cardiopulmonary fitness and muscle strength and increased fatigue level may reduce participation in regular physical activity programs. For this reason, children's musculoskeletal system effects should be carefully assessed and their problems should be treated with exercise programs. Aerobic, strengthening, stretching and relaxation exercises should be included in these exercise programs. As regular exercise programs continue to be implemented, motor functions, strength and physical fitness will improve functional mobility and reduce fatigue, thus ensuring participation in physical activity programs. At this stage, the patient should be directed to a physical activity program. Thus he will gradually turn to normal life by reaching the level of physical fitness closest to the healthy coevals.

vi. Benefits on Health-Related Quality of Life

In improvement of life quality of the child and family, the preservation/increase of participation in physical activity and recreational/purpose-related activities affects the well-being and quality of life of the child and his/her family in a positive way.

Depending on the effects that may occur during acute and chronic periods of treatment, the quality of life is adversely affected. The effects of the exercise and physical activity programs on the quality of life come out only in a regular program and in the long term. Therefore, applications should be maintained on the level of increasing-decreasing or constant by clinical status in a patient and consistent way.

The physical activity programs to be implemented in children with cancer need to be safe, effective and adaptable. Only if it is planned in this way, effective results will be achieved. It is possible for children and their parents to adapt to physical activity and include physical activities in their daily lives.

vii. Psychosocial Benefits

Long isolation, limitations in physical contact, fluctuations in health status, decrease in activity variety and socialization and fear of death cause both the child and his family to be seriously affected from the psychosocial aspect. Effects such as gains achieved through exercise practices, positive changes in the clinical situation, reduction of worsening and preservation of the existing potential provide significant contributions to psychological rehabilitation of children and their families. Increase of mobility, restoration of self-reliance and increase of the level of independence in the ambulation disclose positive impacts from the psychological aspect.

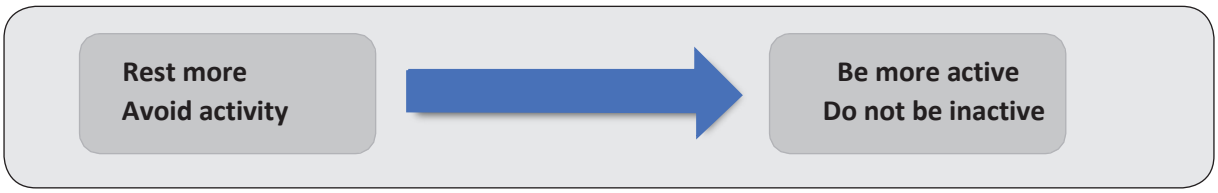
It is known that regular exercise practices reduce the level of depression and anxiety through the endocrine system and increase motivation. Energy control and raising the threshold level can increase the mobility of the individual.

viii. Cognitive Benefits

Cognitive impairments can be developed depending on drug toxicities, the prolonged hospital stay causes losses due to increase in socialization and activity diversity. Regular exercise and physical activity provide the facilitation and restoration of the cognitive system. Physical activities that can be planned in the form of play activities to be done inside and outside the hospital to help the child to develop his/her not only physical but also the cognitive skills. It protects/improves cognitive skills such as memory, attention, perception, problem solving, decision making and reasoning.

Physical Activity during Cancer Rehabilitation in Children

For cancer patients with fatigue and muscle weakness, the health professional's recommendation is "take more rest, avoid activity". Excessive rest and inactivity, however, result in physiological deterioration and increased fatigue. The patient faces the risk of losing her current potential. Studies on exercise and physical activity showed that this recommendation should change (ACSM 2010 Guide).



Recent studies showed that exercise during and after cancer therapy can be safely made and have positive effects on physical function, quality of life and cancer-related fatigue.

Physical activity program recommended for children should be re-determined when changes occur by the rehabilitation therapist in line with the needs that arise due to the general health status, treatments and side effects.

Physiotherapy and rehabilitation practices in childhood cancers begin with the implementation of the recommendations related to cancer prevention in healthy children. Following diagnosis in children, the physical activity schedule should be implemented in all phases of the cancer process, taking into account some of the following issues:

i. During diagnosis

General situation and musculoskeletal system examination should be made and program should be started by determining physical activity and exercise needs. In addition, children and their families should be educated about the changes that may occur during the treatment process and what to do in this case. It should be underlined that being physically active at every stage will increase the functional level of the child, positively affect the benefiting from treatments, contribute to regulating/reducing the side effects of the treatment and accelerate the return to social life, home and school environment during the survival period. Physical activity at this stage:

- It helps the child to preserve/improve physical well-being while waiting for the treatment andto emotionally cope with the disease.
- It improves health and physical fitness before compulsory treatments (surgery, some drugs, etc.).
- It relieves the symptoms of the disease and prepares the child for treatment.

It is suggested to have hiking, play with favorite friends, regulate training program without ending the regular sports habit, if any, play safe games with smaller groups by keeping him/her away from groups, games and activities at infection risk and ensure participation in physical activities. Thus, the level of physical fitness at the beginning of treatment with the regulations to be made at the activity level of the children is kept high. All these approaches psychologically prepare both the child and the family step by step in the pre-treatment period.

ii. During treatments

It is the period that a treatment is administered for the first time or the period of restarting active treatment in the periods of relapse. All systems should be evaluated. In this period, the aim of physical activity and exercise programs is to reduce the side effects depending on the treatments, to give support for maintenance of treatments in a regular and effective way, to keep the compliance/tolerance of the child-family at a high level and to accelerate daily participation in life by speeding up the recovery during the survival period as well. Physical activity at this stage:

Reduces the side effects and toxicity of the treatment, protects the physical function,

Increases the effectiveness of cancer treatments,

Positively affects the recovery rate by strengthening the immune system,

Provides optimal physical function and cardiovascular fitness,

Alleviates fatigue,

Prevents muscle loss,

Raises the pain threshold,

Maintains joint range of motion,

Maintains flexibility,

Provides fear reduction, self-reliance, self-esteem, body image restoration,

Reduces the feeling of loneliness formed during isolation,

Provides psychological support,

Reduces the frequency of admission to the hospital and shortens the duration of hospital stay depending on inactivity,

Regulates the quality of life.

Depending on the treatment protocols to be applied, the child's daily physical activity level will vary at this stage. For such reason, the physical activity program for this group of children should be planned by the physiotherapist considering these changes, especially during the treatment period, and should show daily/weekly changes based on the fluctuations in the clinical status. For example, tough physicalactivity programs, which require explosive power, should be avoided for children with

low thrombocyte level, level of fatigue should not exceed threshold value and excessive stretching exercises should not be performed. Physical activity program for a child with a fever over 38 degrees should be interrupted and the severity of physical activity should be reduced since a case may occur that oxygen need of the tissues may not be met in the event that hemoglobin level is low. The activities should be interrupted and exercises in/near bed should be applied within the period several days after the chemotherapy where the symptoms such as nausea and diarrhea are severe. Children who are given blood products should be rested for half a day after the application and the change of blood values should be monitored. In order to prevent possible accidents, considering orthostatic hypotension, positional vertigo, loss of balance, delayed reaction times, activity, exercise and physical activities on foot should be ensured under supervision of an adult. It is important to ensure active participation of the child using motivation, reward and entertainment factors during physical activity and exercise practices.

Table 3. Points to be considered duringtreatment

Complications	Precaution
Hemoglobin level < 8.0g/dl	•Should be avoided from activities (vigorous intense) significant oxygen transport • Complaints such as breathlessness and tightness in the chest should be followed and if occurs, child should be rested • Overload should be adjusted according to fatigue level
Number of neutrophils < $0.5x10^9$/L	• Mask should be used in one-to-one exercises • Contact is minimum, observation is maximum • Activities (such as swimming) with risk of bacterial infection should be avoided • Exercise materials must be sterilized and private • Exercise environment should be well ventilated and not crowded
Number of thrombocyte < $50x10^9$/L	• Avoid the activities (such as contact sports) with risk of bleeding • Avoid physical activity, sport and exercise with risk of pressure, beat, strike)
Fever > 38°C	• Avoid vigorous intensity exercise that shows systemic infection • Exercise should be resumed after achieving a stabilized level after fever-reducing treatments
Fever > 40°C	• Avoid exercise
Factor 8 - 9 Less than 1% is severe, 1-5% is moderate	• Avoid the activities with excessive pressure on joints and muscles
Severe cachexia	• Often give lightintensity activities due to musclemass loss • Begin with exercises appropriate to the child's physical fitness and functional level • Frequency of exercise should be kept low • Applications that require high energy expenditure should not be selected
Dyspnea	It should be planned depending on etiology and exercise tolerance • Avoid physical activity and exercises that increase water loss • Prefer the physical activities often activating the arm muscles since the intensive use of legs increases bowel functioning
Bone pain	Avoid the exercise that increases the risk of fracture (high intense, such as contact sports) • Recommend the physical activities that impose intermittent and gradual burden on the bone • Bone structure should be biomechanically assessed during physical activity and, if necessary, positional adaptations and supports should be used
Excessive fatigue and muscle weakness	• It should be planned for exercise tolerance • If muscle weakness is still felt the next day, the program should be eased and the areas where fatigue is not felt should be used more actively
Osteoporosis	Activities that burden intermittent stress such as walking on the spot, ascending and descending stairs should be made • Avoid activities that may cause fracture such as explosive, jumping and contact sports.

Perhaps half of the children need a special physiotherapy and rehabilitation program in this period. Sometimes in the hospital and sometimes in the home, the physical activity program needs to be maintained by changing dynamically, depending on the requirement-driven and clinical changes.

On the days that common impairments of child such as vomiting, fever and diarrhea depending on chemotherapy/radiotherapy practices alleviate, the activities can be preferred such as walking in the house, cycling at a light tempo, extremity movements with rhythmic repetition, sitting and getting up chair, ascending and descending the stairs, video games allowing body movements (virtual reality games) and games with light and erasable balls.

In all these activities, the criterion for ending the activity is child's feeling for moderate tiredness. It is important to perform it in a way rhythmic, repetitive, respiratory compatible, proper posture and at the dose that does not cause tiredness the next day. It is advisable to spread these activities throughout the day and at least 2 hours after the meal.

iii. During survival

All treatments are complete. However, children are monitored due to cancer recurrences and possible secondary chronic diseases. In this period, all systems should be evaluated, individual needs should be focused on and eliminating muscle weaknesses and increasing endurance should be targeted. Physical activity in survival from cancer:

- It cures, eliminates and alleviates chronic/late effects (such as fatigue, bone loss) associated with treatments,
- It reduces recurrent cancer risk,
- It increases the quality of life and physical functions,
- It enables them to return to their social roles earlier and increase their participation,
- It increases productivity, productivity,
- It supports the overcoming of psychological barriers,
- It decreases the risk of development of other chronic diseases (such as osteoporosis, cardiac diseases, diabetes).

The beginning of this period may continue with the physical activities suggested in the previous period. Sequelae patients can be supported by means of devices, orthosis, walking aid and adaptations by physiotherapists and physical activity programs can be modified. In the later periods when the symptoms of treatment are alleviated, it may be advisable to engage in outdoor brisk walking, exercising with light weights, cycling, hiking, swimming at sea, table tennis, badminton, gymnastics, home and garden works and games without blow and with slight risk of trauma. In all these activities, the criterion for ending the activity is child's feeling for moderate tiredness just as in the previous period. Physical activity program should be optimized by gradually increasing from moderate level. In this period, the protection of mobility, muscle mass and motivation is of great importance.

Appropriate Physical Activity Recommendations for Children with Cancer

It can be diversified in line with the environment in which the child lives, interests, gender, age, psychomotor skills. The following table shows examples of various physical activity and general activity:

Table 4. Physical Activity and Sports Recommendations to be applied during and after Cancer Treatments by Age

Age range	Physical activity example
Toddlerhood Period	Push-pull game, reaching toward objects while sitting, putting boxes/cushions on top of each other, climbing seats/chairs, dancing accompanied by music, crumpling and boxing papers, crawling games, ball games, puppet/finger games * Sandwich game, balance in the box games
2-3 Age Period	Walking around the immediate environment, child bowling, play of light in the dark, pin pong ball blowing, catching, puppet games, and finger games * Rolling
3-4 Age Period	Playing games with age-appropriate toys, dancing, cycling a three-wheel, playing ball games (without hit, by keeping hygiene), group activities, play with family and other children (e.g., game of imitating what I do) * Free open field games like running
4-5 Age Period	Concentration and balance games (take-give game), hopscotch, hide-and-seek, advancing to target among obstacles, ball games-individual without competition, dance with balloons, animal imitations, attention and card games * Puss-in-the corner, handkerchief grabbing, playing tag (as cat andmouse games),
5-7 Age Period	Holding and rolling games, gymnastics, displacement games (puss-in-the corner), hitting the target with ball, bowling, rhythmic games accompanied by music * Jumping (rope skipping, line games), gymnastics, swimming, for balance development; "not dropping the ball" game
8-9 Age Period	Catching games, table tennis, replacement games (find your turn, musical chair) games improving balance (turn disentangle), games for improving object control (hit the picture get the number, throw away), combined movement games (walk four steps-clap three times), dancing * Folk dances, court tennis, yoga, games that develop harmony with nature (Stopping (a ball game), hide and seek, kite flying, hiking)
10-11 Age Period	Activities as yoga, dance for posture disorders, direction finding, daily/day-long walks, participation in home and shopping activities, displacement games (ball bringing), basic and combined movement skills games (dodgeball, ribbon binding, arm-in-arm), jenga. * Nature sports such as scouting and camping and games (playing tag) improving body andspatial awareness.
12-18 Age Group	Rhythmic exercises using his/her own body weight * Sports such as sprinting, brisk walking, cycling

* Suitable for stable patients in chronic period.

Points to be Considered during Physical Activity for Children with Cancer

Considering the toxicities and complications during the treatment; physical activity and exercise programs will be effectively implemented with communication/cooperation of physician and physiotherapist due to changes in clinical condition of children, treatment complications and differences in emerging problems and thus possible risks will be avoided. The common and strong message that we will give to our society for all those healthy or with a chronic illness should be "**be active and stay active**".

The following rules should be observed when applying these activities and exercises to children in the oncology/hematology group.

1) Keeping the surface, tools, and materials played clean

2) Hand hygiene of playmates

3) No active infections of playmates

4) Use of masks and gloves when necessary

5) Avoiding competitions and games with blow

6) Selection of gaming equipment among those that are manufactured from lighter, soft and cleanable materials

7) Avoidance of stressful activities by hemophiliacs

8) Performing in the open area

9) Choosing appropriate shoes and floor

10) Proper draught

11) Monitoring the patients to take new medication treatments such as steroids and IG-G or hematopoietic stem cell transplantationunder individual programs.

Physical Activity Principles for Children with Cancer

Exercises:

1) Strengthening training (low-resistance training)

2) Stretch and flexibility training

3) Endurance exercises

4) Aerobic training

5) Physical activity: Walking, cycling, house work, garden works are recommended 150 minutes per week on average (moderate-vigorous exercise).

6) Activity Training: Ball games, artistic station exercises, target games, video games, racket sports, dance and movement exercises which are adapted three times a week can be performed.

Additional physiotherapy approaches such as respiratory exercises, relaxation exercises, balance training, coordination exercises, sense training and cognitive training may need to be applied by physiotherapist according to the needs of the child for various accompanying situations such as avascular necrosis, changes in bone quality, obesity, radiotherapy-related fibrosis, cardiac toxicity, insufficiency, peripheral neuropathy and lung infection.

In the stage of protecting healthy children from cancer, it is important to get into habit of regular exercise and to avoid overly challenging and loaded activities. The child should adopt a lifestyle that he/she can be physically active.

Health status, body structure and functions, activities, participation, environmental and personal factors of child should be examined in order to identify how those influence each other and thus current situation and needs of child can be identified in a standardize way. For this purpose, ICF-CY (International Classification of Function Disability and Health in Children and Youth Method) and ICF-ONK (Functionality, Disability and International Classification of Health-Oncology) can be used. All date in the ICF-CY and ICF-ONK models should be used in the evaluation and therapy of children and families with cancer. In a holistic approach, it enables to examine problems of child monitored with cancer diagnosis starting from body structure, to identify in which way the malfunctions to emerge affect the activity level and to evaluate the social participation which is the most important objective of the treatment. During such examination, it is possible to take into account the personal and environmental factors that affect the disorder, activity and participation.

In this section, examples of physical activity that can be used in the treatment of children with oncologic disease were proposed in accordance with the treatment stage and age group. It is aimed that health workers who monitor the child independently of the disease or treatment stage try to direct the child to be physically active. At this point, it will be possible for the child to gain achievements in line with the principles to be considered.

Table 5. Example ofTreatment Program

Activity Type	5-11 age group	12-18 age group
Moderate endurance (aerobics) Activities	• Fixed - normal cycling, Brisk walking, • Athletics, • Gymnastics	• Cycling • Home and garden works • Sports with catch-throw (like Frisbee)
Activities strengthening muscles	• Tug of war • Modified push-up (knees bent) • Exercises performed using body weight or resistant bands • Sit-up • Gymnastics	• Tug of war • Modified push-up (knees bent) • Exercises with body weight, resistant bands or weight equipment • Artificial wall climbing • Sit-up • Gymnastics
Activities strengthening bones	• Hopscotch • Jumping on the spot • Jumping rope • Jogging • Basketball (Individual) • Tennis (Individual) • Volleyball (Individual)	• Jumping on the spot • Jumping rope • Jogging • Basketball (Individual) • Tennis (Individual) • Volleyball (Individual)
Tension-relaxation	• Gentle stretching of muscle groups one • Child yoga • Respiratory exercises • Relaxation exercises • Dance therapy • Music therapy	

REFERENCES

1. *Ladha AB, Courneya KS, Bella GJ et al. Effects of acute exercise on neutrophils in pediatric acute lymphoblastic leukemia survivors: a pilot study. Journal of Pediatric Hematology/Oncology 2006; 28 (10):671–677.*
2. *Mertens AC, Yasui Y, Neglia JP et al. Late mortality experience in five-year survivors of childhood and adolescent cancer: the childhood cancer survivor study. Journal of Clinical Oncology 2001; 19 (13): 3163–3172.*
3. *San Juan AF, Chamorro-Vina C, Moral S et al. Benefits of intrahospital exercise training after pediatric bone marrow transplantation. International Journal of Sports Medicine 2008; 29(5): 439–446.*
4. *San Juan AF, Fleck SJ, Chamorro-Vina C et al. Effects of an intrahospital exercise program intervention for children with leukemia. Medicine and Science in Sports and Exercise 2007; 39(1):13–21.*
5. *Juan AFS, Wolin K, and Luc´ıa A. Physical activity and pediatric cancer survivorship Recent Results in Cancer Research 2011; 186: 319–347*
6. *San Juan AF, Chamorro-Vina C., Mat ˜ e-Mu´noz JL et al. Functional capacity of children with leukemia. International Journal of Sports Medicine 2008; 29(2): 163–167.*
7. *American College of Sports Medicine, & Ehrman, JK. ACSM's resource manual for guidelines for exercise testing and prescription. Wolters Kluwer Health/Lippincott Williams & Wilkins, 2010.*
8. *Sharkey AM, Carey AB, Heise CT, and Barber G. Cardiac rehabilitation after cancer therapy in children and young adults. American Journal of Cardiology 1993; 71(16):1488–1490.*
9. *Armenian SH, Sun CL, Kawashima T, et al. Long-term health-related outcomes in survivors of childhood cancer treated with HSCT versus conventional therapy: a report from the Bone Marrow Transplant Survivor Study (BMTSS) and Childhood Cancer Survivor Study (CCSS). Blood 2011; 118:1413–1420.*
10. *Attention games, Barbara Sher, published by jossey Bass, Amerika, 2006.*
11. *Bornbaum, CC, Doyle PC, Skarakis-Doyle E & Theurer JAA. Critical exploration of the International Classification of Functioning, Disability, and Health (ICF) framework from the perspective of oncology: recommendations for revision. Journal of multidisciplinary healthcare 2013; 6: 75-86*
12. *C. Chamorro-Vina, J. R. Ruiz, E. Santana-Sosa et al. Exercise during hematopoietic stem cell transplant hospitalization in children. Medicine and Science in Sports and Exercise 2010; 42 (6): 1045–1053.*
13. *Duggan C., Bechard L., Donovan K. et al. Changes in resting energy expenditure among children undergoing allogeneic stem cell transplantation. American Journal of Clinical Nutrition 2003; 78 (1): 104–109.*
14. *Yeh CH, Man Wai JP, Lin US et al. A pilot study to examine the feasibility and effects of a home-based aerobic program on reducing fatigue in children with acute lymphoblastic leukemia. Cancer Nursing 2011;34(1): 3–12.*
15. *Cox CL, Montgomery M, Oeffinger KC et al. Promoting physical activity in childhood cancer survivors. Cancer, 2009; 115 (3): 642–654.*
16. *Early interventon games barbara sher, published by jossey Bass, Amerika, 2009.*
17. *Speyer E, Herbinet A, Vuillemin A. et al. Effect of adapted physical activity sessions in the hospital on health -related quality of life for children with cancer: a cross-over randomized trial. Pediatric Blood and Cancer 2010; 55(6): pp. 1160–1166*
18. *Gurney JG, Ness KK, Stovall M, et al. Final height and body mass index among adult survivors of childhood brain cancer: childhood cancer survivor study. J Clin Endocrinol Metab 2003; 88:4731–4739.*
19. *Green DM, Cox CL, Zhu L, et al. Risk factors for obesity in adult survivors of childhood cancer: a report from the Childhood Cancer Survivor Study. J Clin Oncol 2012; 30:246–255.*
20. *Gurney JG, Ness KK, Sibley SD, et al. Metabolic syndrome and growth hormone deficiency in adult survivors of childhood acute lymphoblastic leukemia. Cancer 107:1303–1312.*
21. *Hudson MM, Ness KK, Gurney JG, et al. Clinical ascertainment of health outcomes among adults treated for childhood cancer. JAMA 2013; 309:2371–2381.*
22. *Johannsd. MI ´ottir, Hjermstad MJ, Moum T et al. Increased prevalence of chronic fatigue among survivors of childhood cancers: A population-based study. Pediatric Blood and Cancer. In press.*
23. *Argiles JM, opez-Soriano FJL´, Busquets S. Mechanisms to explain wasting of muscle and fat in cancer cachexia. Current Opinion in Supportive and Palliative Care 2007; 1(4): 293–298.*
24. *Ruiz JR, Fleck SJ, Vingren JL et al. Preliminary findings of a 4-month intrahospital exercise training intervention on IGFs and IGFBPs in children with leukemia. Journal of Strength and Conditioning Research 2010;24(5): 1292– 1297.*
25. *Meeske KA, Patel SK, Palmer SN et al. Factors associated with health-related quality of life in pediatric cancer survivors. Pediatric Blood and Cancer 2007; 49(3): 298–305.*

26. *Oeffinger KC, Mertens AC, Sklar CA et al. Chronic health conditions in adult survivors of childhood cancer. New England Journal of Medicine 2006; 355(15): 1572–1582.*
27. *Kourti M, Tragiannidis A, Makedou A et al. Metabolic syndrome in children and adolescents with acute lymphoblastic leukemia after the completion of chemotherapy. J Pediatr Hematol Oncol. 2005; 27:499–501.*
28. *Courneya KS. Exercise in cancer survivors: an overview of research. Medicine and Science in Sports and Exercise 2003; 35(11): 1846–1852*
29. *Kutluk T. First national pediatric cancer registry in Turkey: A Turkish pediatric oncology group study. Ped. Blood & Cancer. (Abstract) 2004; 43:452*
30. *Wolin KY, Ruiz JR, Tuchman H et al. Exercise in adult and pediatric hematological cancer survivors: an intervention review. Leukemia 2010; 24(6): 1113–1120.*
31. *Kremer LCM, Van Dalen EC, Offringa M et al. Anthracycline-induced clinical heart failure ˆ in a cohort of 607 children: long-term follow-up study. Journal of Clinical Oncology 2001; 19 (1):191–196.*
32. *Landier W, Bhatia S, Eshelman DA, et al. Development of risk-based guidelines for pediatric cancer survivors: the Children's Oncology Group Long-Term Follow-Up Guidelines from the Children's Oncology Group Late Effects Committee and Nursing Discipline. J Clin Oncol 2004; 22:4979–4990.*
33. *Smith MA, Seibel NL, Altekruse SF et al, Outcomes for children and adolescents with cancer: challenges for the twenty - first century. Journal of Clinical Oncology 2010;28 (15):2625–2634*
34. *Jenney MEM, Faragher EB, Jones PHM et al. Lung function and exercise capacity in survivors of childhood leukemia. Medical and Pediatric Oncology 1995; 24(4): 222–230.*
35. *Hockenberry MJ, Hooke MC, Gregurich M et al. Symptom clusters in children and adolescents receiving cisplatin, doxorubicin, or ifosfamide. Oncology Nursing Forum 2010; 37(1): E16–27.*
36. *Hudson MM, Mertens AC, Yasui Y et al. Health status of adult long-term survivors of childhood cancer: a report from the childhood cancer survivor study. Journal of the American Medical Association 2003; 290(12): 1583–1592.*
37. *Adams MJ, Hardenbergh PH, Constine LS et al. Radiation-associated cardiovascular disease. Critical Reviews in Oncology/Hematology 2003;45 (1): 55–75.*
38. *Keats MR and Culos-Reed SN. A community-based physical activity program for adolescents with cancer (project TREK): program feasibility and preliminary findings. Journal of Pediatric Hematology/Oncology 2008; 30 (4); 272–280.*
39. *Nottage KA, Ness KK, Li C, et al. Metabolic syndrome and cardiovascular risk among long-term survivors of acute lymphoblastic leukemia—from the St. Jude Lifetime Cohort. Br J Haematol 2014; 165:364–374.*
40. *Clanton NR, Klosky JL, Li C et al. Fatigue, vitality, sleep, and neurocognitive functioning in adult survivors of childhood cancer: a report from the childhood cancer survivor study. Cancer 2011; 117 (11): 2559–2568.*
41. *Oeffinger KC, Mertens AC, Sklar CA, et al. Chronic health conditions in adult survivors of childhood cancer. N. Engl. J. Med. 2006; 355:1572–1582.*
42. *Özbaran B, Erermiş S. Kanser tedavisi gören çocuk ve gençlerde uzun süreli izlem sürecinde psikososyal özelliklerin tanımlanması ve genel yaklaşım ilkeleri. Clinical Psychiatry 2006; 9: 185-90.*
43. *Blaauwbroek R, Bouma MJ, Tuinier W et al. The effect of exercise counselling with feedback from a pedometer on fatigue in adult survivors of childhood cancer: a pilot study. Supportive Care in Cancer,2008; 1–8.*
44. *Liu RDKS, Chinapaw MJM. Huijgens PC, and Mechelen WV, Physical exercise interventions in haematological cancer patients, feasible to conduct but effectiveness to be established: a systematic literature review. Cancer Treatment Reviews 2009; 35(2); 185–192.*
45. *Rogers PC, Meacham LR. Oeffinger KC, et al. Obesity in pediatric oncology. Pediatr Blood Cancer 2005; 45:881–891.*
46. *Bhatia SBJ and Meadows AT. "Late effects of childhood cancer and its treatment," in Principles and Practice of Pediatric Oncology, P. D. Pizzo Pa, Ed. Lippincott Williams & Wilkins, Philadelphia, Pa, USA, 2006: 1490–1514.*
47. *Lipshultz SE, Exposure to anthracyclines during childhood causes cardiac injury. Seminars in Oncology 2006; 33, (3) supplement 8: 8–14.*
48. *Lipshultz SE, Lipsitz SR, Sallan SE et al. Chronic progressive cardiac dysfunction years after doxorubicin therapy for childhood acute lymphoblastic leukemia. Journal of Clinical Oncology 2005; 23(12):2629–2636.*
49. *Gohar SF, Comito M, Price J et al. Feasibility and parent satisfaction of a Physiotherapy intervention program for children with acute lymphoblastic leukemia in the first 6 months of medical treatment. Pediatric Blood and Cancer 2011; 56(5): 799–804*
50. *Sklar CA, Mertens AC, Walter A, et al. Changes in body mass index and prevalence of overweight in survivors of childhood acute lymphoblastic leukemia: role of cranial irradiation. Med Pediatr Oncol 2000; 35:91–95*
51. *Smart play, Barbara Sher, john wiley and sons, new jersey, 2004.*

52. *T.C. Sağlık Bakanlığı Türkiye Halk Sağlığı Kurumu Obezite, Diyabet ve Metabolik Hastalıklar Daire Başkanlığı Çocuk ve Ergenlerde Fiziksel Aktivite Rehberi. Ankara: Kuban Matbaacılık ve Yayıncılık, 2014.*
53. *T.C. Sağlık Bakanlığı Türkiye Halk Sağlığı Kurumu Türkiye Kanser İstatistikleri, 2016. (http://kanser.gov.tr/Dosya/ca_istatistik/ANA_rapor_2013v01_2.pdf)*
54. *T.C. Sağlık Bakanlığı Türkiye Halk Sağlığı Kurumu Kanser Daire Başkanlığı Türkiye kanser kontrol programı (http://kanser.gov.tr/Dosya/Kitaplar/turkce/Turkiye_Kanser_Kontrol_Programi_-tr.pdf)*
55. *Hampton T. Cancer survivors need better care: new report makes recommendations, Journal of the American Medical Association, 2005; vol. 294, no. 23, pp. 2959-2960.*
56. *Takken T. van der Torre P, Zwerink M. et al. Development, feasibility and efficacy of a community-based exercise training program in pediatric cancer survivors. Psycho-Oncology 2009; 18(4): 440–448.*
57. *Van der Sluis, IM, & van den Heuvel-Eibrink MM. Osteoporosis in children with cancer. Pediatric blood & cancer, 2008; 50(S2), 474-478.*
58. *Marchese VG, Chiarello LA, and Lange BJ. Effects of Physiotherapy intervention for children with acute lymphoblastic leukemia. Pediatric Blood and Cancer 2004;42(2); 127–133.*
59. *Ward E, Desantis C, Robbins A, et al. Childhood and adolescent cancer statistics, CA Cancer J. Clin. 2014; 64: 83-103.*
60. *World Health Organization. International Classification of Functioning, Disability, and Health: Children & Youth Version: ICF-CY. World Health Organization. 2007.*

SECTION 3

PHYSICAL ACTIVITY AND EXERCISE IN HAEMATOLOGIC DISEASES

AUTHORS:

Lale OLCAY, MD Prof (President)	*BaşkentUniversity, Faculty of Medicine, Department of Child Health and Diseases, Pediatric Hematology and Oncology Unit*
Tülin DÜGER, PT PhD Prof.	*Hacettepe University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Oncological Rehabilitation Unit*
İlke KESER, PT PhD Assoc. Prof.	*Gazi University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Oncological Rehabilitation Unit*
Meral HURİ, PT PhD	*Hacettepe University, Faculty of Health Sciences, Department of Ergotherapy, Oncological Rehabilitation Unit*

ABSTRACT

Physical exercise affects the course of some hematologic diseases, in particular those with a tendency to hemorrhage and thrombosis positively.

Hemorrhagic diseases may appear as thrombocytopenia being due to inherited or acquired causes, thrombocyte dysfunction, hemophilia (Factor VIII, IX deficiencies), other factor deficiencies, von Willebrand disease, and fibrinolytic pathway disorders. It was observed that physical exercise temporarily increases Factor VIII and/or von Willebrand factor levels in patients with hemophilia A and von Willebrand patients, at varying rates depending on the severity of the disease. On the other hand, regular muscle strengthening exercises by hemophilia patients improve joint stability, thus reducing joint damage and bleeding risk. It also limits factor requirement and use, as well as it prevents osteoporosis and obesity. Personalization of factor therapy according to patient, resources and clinic and making factor injections before physical activities as far as possible are recommended. There are special guidelines that detail both sports and exercises that patients with hemophilia and other hemorrhage can reliably perform.

Immobilization for longer than 48 hours and hospitalization are reported in medical history of 39-45% of cases with venous thrombosis. Immobilization can increase the risk of thrombosis up to 80% when it exists with inherited thrombophilia factors and a major medical illness. It is also suggested that patients with inherited risk factors for thrombosis development should not pursue a sedentary lifestyle, even if they do not have any medical illnesses, and comply with age-appropriate physical activity and sports recommendations. Pediatric patients whose daily activities fall behind their normal activities since they are hospitalized should be encouraged to walk within the service and/or perform in-bed exercises.

Physical activity in patients with bone marrow failure is performed as in patients with chemotherapy induced cytopenia.

PHYSICAL ACTIVITY IN HEMATOLOGICAL DISEASES

1) Hemorrhagic Diseases

a) Overview on Hemorrhagic Diseases

b) Hemophilia

c) Acquired Factor Deficiencies, Hemorrhagic Predisposition due to Ingesting Anticoagulant Drugs

d) Thrombocyte Diseases

e) VonWillebrand Disease

f) Effect of Physical Activity on Hemostasis and Hemorrhagic Diseases

2)Physical Activity in HemorrhagiceDiseases

a) Effect of Physical Activity on Hemostasis in Healthy Individuals and Patients with Hemorrhagic Diathesis

b) Physical Activity and Its Role in Treatment in Patients with Hemorrhagic Diathesis
i. Hemophilia
ii. Von Willebrand Disease and Other Factor Deficiencies
iii. Immune Thrombocytopenic Purpura and Thrombocyte Function Defects

3) Thrombosis

a) General Information

b) Physical Activity in the Prevention of Thrombosis Development or Relapse

4) Bone Marrow Failure

PHYSICAL ACTIVITY IN HEMATOLOGICAL DISEASES

1) Hemorrhagic Diseases

a) Overview on Hemorrhagic Diseases

In our body, there are a number of mechanisms that work in a precisely interrelated manner to prevent blood loss through the injured blood vessel. When these mechanisms are impaired due to various reasons, a number of bleeding symptoms arise. These hemorrhagic diseases are classified as disorders of 'vascular phase', 'primary hemostasis', 'secondary hemostasis', and 'fibrinolytic pathway'. Herein we will focus on primary and secondary hemostatic disorders which are the most common in practice:

Primary hemostatic disorders arise as a result of low thrombocyte count or thrombocyte dysfunction. They appear as tiny and purple spots (ecchymosis) on the skin that arise after mild trauma or spontaneously, red spots (petechial) in the size of pin needle that arise especially in locations under pressure and mucosal bleeding (bleeding from gums, epistaxis, menorrhagia and less frequently gastrointestinal system or urinary tract bleeding). Ecchymosesare small and superficial. Cutaneous bleeding arises after minor cuts. Bleeding occurs immediately after trauma or surgical intervention.

Disorders of secondary hemostasis are due to either reduced levels or dysfunction of coagulation factors (F) which take role in formation of 'fibrin', the end product of coagulation. Typically bleedings in soft tissue, muscle and joints (hemarthrosis) develop. Petechiae is not observed. If ecchymosis develops, it is big, deep and palpable. Bleeding is rare after minor cuts. Bleeding after trauma or surgical intervention is delayed. The most important disease among the diseases with factor deficiency is hemophilia. Hemophilia A develops in factor VIII deficiency and hemophilia B in factor IX deficiency. In other factor deficiencies (Factor I -fibrinogen-, FII, V, VII, X, XI), which are involved in coagulation, similar symptoms may also be seen in or not in parallel with the degree of factor deficiency or dysfunction in the factor.

No bleeding is observed in deficiency of FXII, prekallikrein and high molecular weight kininogen, also referred to as 'contact factors'. On the contrary, the risk of thromboembolism increases in patients with FXII and some dysfibrinogenemia.

Von Willebrand factor (vWF) also plays a role in primary hemostasis by attaching to sub-endothelial structures and thrombocyte receptors in the field with vascular endothelial damage and also in secondary hemostasis by carrying FVIII in plasma. In von Willebrand disease in which von Willebrand factor is either deficient or dysfunctional, some findings of both primary and secondary hemostasis deficiencies are observed.

b) Hemophilia

It is the most frequent hereditary hemorrhagic disorder in children and adults after von Willebrand disease. Its frequency in all races and all over the world is the same. Hemophilia A due to deficiency of FVIII (FVIII: C, antihemophilic factor) and hemophilia B due to deficiency of FIX (FIX: C, Chrismas factor) are inherited in X-linked recessive fashion; namely, they pass from surrogate mother to the boys. Hemophilia A constitutes 80-85% of all hemophilia cases. FVIII is carried by binding to vWF in the plasma; thus being protecting from proteolysis. In the absence of FVIII and FIX, the formation of a fibrin plug at the end of the coagulation cascade is delayed and the formed clot is weak.

i. Symptoms and Findings

In both diseases, the aforementioned symptoms of secondary hemostasis disorders are encountered being in relation with the factor level. If the FVIII/FIX level is <1% ('severe hemophilia'), hemarthrosis, muscle and soft tissue hemorrhages may be seen spontaneously without any trauma. Severe hemophilia patients who do not receive prophylactic factor therapy may have bleeding once or twice a week. Spontaneous bleeding rarely develops when the factor level is between 1-5% (moderate hemophilia); but mild-moderate traumas may cause bleedings. If the factor level is above

5% (mild hemophilia) serious bleedings may develop only after moderate-severe trauma or in the course of surgery.

Mean diagnosis age is 9th and 22nd months for ***severe and moderate types.*** Symptoms usually become evident as the child begins to walk. The first symptoms are usually easy bruising, oral bleeding, hemarthrosis and intramuscular bleeding. 30% of the patients experience prolonged bleeding after circumcision and 1-2% develop intracranial hemorrhage in neonatal period.

Hemarthrosis: Hemarthrosis which is the most frequently observed type of bleeding and causes morbidity in hemophilia is observed, most commonly in the knee, ankle, elbow, shoulder and hip joints, in order of frequency, being rare in spinal joints and wrists. The bleeding joint is painful, swollen, hot and sensitive to touch. Pain recovers immediately after appropriate treatment; but it takes time for the signs of swelling and warmth to disappear. Single bleeding recovers usually without any trace; but recurrent bleeding in the same joint, causes thickening of the joint capsule, degeneration and joint contraction. Impaired walking and balance, decreased physical activity and reduced life quality are caused by osteoporosis in adjacent bones, muscle weakness and ankyloses. Patients may become dependent on crutch or wheelchair. Early and rapid administration of factor therapy whenever hemarthrosis develops plays a vital role in preventing these complications. Importance of physical activity in preventing these bleedings is discussed later.

Intramuscular Bleedings: Intramuscular bleedings, which begin with vague pain and are difficult to diagnose due to hard palpation, can cause muscle contractures or pseudotumor due to fibrosis and atrophy of the muscle. The most severe intramuscular bleeding is that in iliopsoas muscle. These patients have pain in the lower abdominal and upper thigh regions; their gait is characteristic since extension of hip joints is restricted but adduction and abduction are normal. Due to the large blood loss in the retroperitoneal area, patients may develop shock and the femoral nerve may also be injured. Diagnosis is made by ultrasound or computed tomography. Compression symptoms may occur because of compressed sciatic nerve in gluteal intramuscular hemorrhage, tibial nerve in the calf hemorrhage, perineal nerve in the hemorrhage of the anterior compartment of the leg, and median and ulnar nerves in the hemorrhage of the flexor muscles of fore arm.

Other Symptoms: Hematuria, intra-oral bleedings caused by tooth extraction and tongue bite, nasalbleedings, life-threatening bleedings (intracranial, intraspinal, retropharyngeal, gastrointestinal, retroperitoneal -iliopsoas-) may also be observed.

ii. Laboratory Findings

Prothrombin time (PT) is normal, active partial thromboplastin time (aPTT) is prolonged thrombocyte number, vWF are normal.

iii. Treatment

The basis of treatment is to replace the missing factor. 'Substitution therapy' (FVIII in hemophilia A, FIX in hemophilia B, fresh frozen plasma when factor is not available) with changing amount and frequency depending on factor level and type of bleeding is applied. Mild to moderate hemophilia A cases benefit from desmopressin (DDAVP). Local clotting materials (such as fibrin glue), antifibrinolytic agents (excluding those who are receiving prothrombin complex concentrate - PCC - as a factor therapy since inhibitor developed and those having bleeding in the urinary system) can be used. However, patients with severe hemophilia A or B (FVIII/IX<1%) are applied prophylactic factor 1-3 times per week without waiting for bleeding. Replacement therapy can be personalized according to the activities of the patient. It is proved that the best results in prophylaxis are achieved for those who start before the age of two or after the first intraarticular bleeding. On the other hand, inhibitor develops at a rate of 20-30% in patients with severe hemophilia and 5-10% in patients with mild to moderate hemophiliacs. In this case, depending on the level of inhibitor, the factor level given is doubled or continuously infused or the hog FVIII concentrate, PCC, recombinant factor VIIa are used in the treatment.

c) Bleeding Predisposition due to Other Factor Deficiencies and Ingestion of Anticoagulants

FVIIa or PCC is applied in Factor VII deficiency; PCC is applied in FII and FX deficiencies. Fresh frozen plasma, also antifibrinolytic agents and local clotting materials are used as described above in all factor deficiencies and in cases where specific factors are not provided, at various frequencies depending on the type of the missing factor.

In the treatment of classic thrombosis, heparin or low molecular weight heparin (LMWH) is used in the initial phase and warfarin (Coumadin) or LMWH is used in the subacute phase (for at least five days in combination with heparin in the acute phase). Heparin and LMWH slow down the run of clotting pathway by increasing the inhibition of thrombin and FXa by antithrombin III and by preventing the activation of FII, FVII, FIX, FX, which is bound to vitamin K, by warfarin. In order to avoid vital bleedings that may occur, aPTT (target 60-85 sec) or anti FXa (therapeutic range: 0.3-0.7) level in heparin users; anti FXa level (therapeutic range 0.5-1.0) in LMWH users; INR level (target: 2.0-3.0; for those with mechanical heart valves: 2.5-3.5) in warfarin users is monitored at regular intervals and dose of the given drug is increased or decreased so as to keep the determined parameters at safe ranges.

d) Thrombocyte Diseases

Thrombocyte diseases are the most common cause of bleeding. There is an anomaly in the number or function of thrombocytes.

i. Thrombocytopenia

The number of thrombocyte in whole blood of a healthy child is approximately 150,000-300,000/mm³. Thrombocytopenia may be due to the lack of thrombocyte production, increased destruction, as well as abnormal thrombocyte distribution (splenomegaly induced hypersplenism, hypothermic anesthesia) and dilution which develops in massive transfusion.

Among those, **reduction in thrombocyte production,** may be seen as acquired in acquired aplastic anemia, infections, drugs, toxic substances, radiation, myelophthisic conditions, ineffective thrombopoiesis, vitamin B12, folic acid, iron deficiency, paroxysmal nocturnal hemoglobinuria; while it may be seen as inhereditary in TAR syndrome, Fanconi aplastic anemia, Bernard Soulier syndrome, Wiskott- Aldrich syndrome, May-Hegglin anomaly, Chediak-Higashi syndrome, platelet type vWH, gray platelet syndrome, hereditary thrombopathic thrombocytopenia, metabolic disorders (Methyl malonic acidemia, glycaemia, isovaleric acidemia) and some other diseases (Alport disease, Trisomy 13,18). **Increased thrombocyte destruction,** develops due to immune [after transfusion and transplantation due to immune thrombocytopenic purpura (ITP), medication, infection, autoimmune or lymphoproliferative disease] or non immune causes (intravascular coagulation, hemolytic uremic syndrome, microangiopathic hemolytic anemia, artificial heart valve, massive transfusion, hemangioendothelioma, burns, spleen disorders, some cardiac diseases, glomerular diseases, preeclampsia).

ii. Immune Thrombocytopenic Purpura (ITP)

It is a disease that occurs when thrombocytes are destructed by thrombocyte antibodies through reticuloendothelial cells and is common in childhood. According to the recent guidelines, **'recently diagnosed ITP',** is used to define the ITP within the first 3 months after diagnosis, **persistent ITP',** is used to define the cases which have persisted and have not remitted **between** 3-12 months after the diagnosis and**'chronic ITP'** is used to define ITP cases that have lasted for 12 months or more.

Acute ITP is most commonly seen at the ages of 2-6. The majority of patients have developed a viral disease or have been vaccinated 1-3 weeks ago. 90% of the children have a chance to achieve complete remission within the first month (2-6 weeks). Chronic ITP, which accounts for 10% of all ITP cases, is more frequent in those older than ten and younger than one year of age and in girls. Bleeding attacks may last for several days or weeks. The number of thrombocytes temporarily increases during the period bleeding stanches; but then it is low. Spontaneous remission is achieved by 30% in five years and by 44% in 10 years.

Symptoms and Findings: Symptoms and findings of impairment of the primary hemostasis mentioned in Section 1a are observed. In laboratory studies, thrombocytopenia, mean thrombocyte volume and thrombocyte distribution width (PDW) increase; anemia I, if blood loss has developed; neutrophilia and lymphocytosis, if infection is present, are seen. The leukocyte count is normal. Thrombocyte's in the peripheral spread are large (3-10 µm) and in variable shape. Mild eosinophilia can be seen. Bleeding time is usually long, clot retraction is absent or insufficient, PT, PTT, coagulation time are normal. In bone marrow, the number of young megakaryocytes is normal or increased, eosinophil and eosinophil precursors are increased; erythroid and myeloid elements are normal.

Treatment: First of all, the patient should be told not to take anticoagulant or antiagregan medication, to avoid intramuscular injection, vaccination or desensitization, to comply with the following principles in physical activity and sports, to consult a doctor if symptoms occur and to have thrombocyte count established weekly or monthly.

In medication, the main goal is not to increase the number of thrombocyte at a normal level and keep there, but to keep the thrombocyte level at a level that does not cause significant and vital bleeding. Even if the number of thrombocyte is increased after treatment in this disease that may last for months, years, this level may fall again and serious bleeding may occur during follow-up. There is no clear evidence that medication changes the natural course of the disease. Moreover, acute ITP is a disease that is usually self-limiting, requiring minor treatment in the majority of patients; sometimes medication is not applied, as described below. In addition, thrombocytopenia induced bleeding predisposition in ITP is less than that of acquired thrombocytopenia (such as leukemia, aplastic anemia) and the value of the thrombocyte number in determining the severity of the clinical condition is limited because of the following reasons: large and also young thrombocytes that are in peripheric blood are not identified and counted by automated hemocytometers, however, they can be evaluated by peripheral blood smear. For this reason, the number of thrombocytes detected by the automatic counter does not accurately reflect the actual number in patients. 'Platelet microparticles', which emerge as a result of destruction of platelets, maintain its characteristic and cannot be detected by automatic hemocytometers and additionally substances stored in the platelet granules released during this destruction exhibit procoagulant properties and reduce bleeding predisposition.

So there is not a certain consensus between the centers on treatment indications. The main topic of treatment discussions is to identify and treat patients at risk for intracranial hemorrhage (ICH). However, the frequency of ICH is 0.1-0.9% and there is no evidence that medical treatment reduces ICH. 50% of patients with intracranial hemorrhage have risk factors such as head trauma,

aspirin use or arteriovenous malformation. Mucosal hemorrhages or only wet purpura (purpura or petechia on the oral buccal mucosa, gums, palate, tonsillar) are considered as the harbinger of vital hemorrhages. Those with platelet number of <20,000 / mm^3 + mucosal bleeding or with platelets <10,000 / mm^3 + minor purpura should be treated. However, treatment according to other groups is based on clinical findings. Patients with ecchymosis but without mucosal hemorrhage or without more severe hemorrhage or patients with large platelets in peripheral blood smear and without mucosal hemorrhage and with good social status can only be closely monitored without treatment, regardless of the number of their platelets.

Prednisolone, high dose methyl prednisolone, intravenous immunoglobulin, anti D, and in chronic ITP rituximab, thrombopoietic agents, danazol, dapsone, azathioprine, cyclophosphamide, vinca alkaloids, cyclosporine A, mycophenolate mofetil can be used in medical treatment. Splenectomy is performed in compulsory conditions since patients are likely to enter the remission spontaneously (prior to craniotomy in patients with ICH and who do not respond to any treatment).

iii. Platelet Function Disorders

Although platelet counts are normal (or mildly-moderately low), these patients show signs and symptoms of primary hemostasis disorder, described in Section 1a, as platelets have impaired functions.

These disorders may develop due to hereditary or acquired causes. **Hereditary disorders** are Glanzman thrombasthenia with normal platelet count, storage pool disease (dense granule storage pool disease), Hermansky-Pudlak syndrome, cyclooxygenase insufficiency, Wiscott-Aldrich syndrome with severe thrombocytopenia, Bernard-Soulier and gray platelet syndrome with mild-moderate thrombocytopenia, hereditary afibrinogenemia, hereditary disorders of connective tissue, mucopolysaccharidoses, Chediak-Higashi syndrome, Bartter syndrome and Lesch-Nyhan syndrome. **Acquired disorders** are those depending on the drugs used (Lidocaine, Ampicillin, Penicilline, Karbenesillin, Diphenhydramine (Benadril), alcohol, Imipramine (Tofranil), hydrocortisone, methylprednisolone, cyclosporine A, acetyl salicylic acid (aspirin), indomethacin, naproxen, furosemide, caffeine, dipyridamole, aminophylline, vincristine, vinblastine, colchicine, acetazolamide, heparin, dicoumarol, ethacrynic acid), hematological diseases (such as multiple myeloma, myelofibrosis, polycythemia vera, chronic myelogenous leukemia, acute and chronic leukemia, ITP-antiplatelet antibody induced-, pernicious anemia), diseases that fibrinogen degradation products increase (disseminated intravascular coagulation – DIC-, fibrinolysis, liver disease), uremia and other diseases (congenital cardiac disease, after extracorporeal circulation, microangiopathic hemolytic anemia, hypothermia, congenital agammaglobulinemia, essential fatty acid deficiency, after kidney

transplantation, fructose 1.6-diphosphate deficiency, glycogen storage disease type I, homocystinuria, scorbutus, Tangier disease, some allergies). In treatment of these diseases, general preventive measures applied in ITP are applied. Desmopressin or platelet transfusion may be applied.

Points to Take into Account: It should be kept in mind that patients with low platelet counts will have a higher expected bleeding if they have had medications that impair platelet function and/or if they have kidney or liver disease.

e) von Willebrand Disease

It is the most common hereditary hemorrhagic disease for both females and males which is autosomal dominant or recessive transmission and in which the factor VIII and vWF are both lacking. In this disease, secondary FVIII deficiency is also seen since vWF is also a carrier of the FVIII molecule. Nasal bleeding, ecchymosis, menorrhagia, post operation bleeding are frequent. Since the course of disease may be mild, the diagnosis can be made upon prolongation of the post-operative bleeding. While large hematomas and hemarthrosis are frequent in hemophilia, they are not frequent in vWF deficiency. Petechia is common in platelet function disorders, while it is rare in vWF deficiency (but may occur after aspirin intake). It is expected that PT is normal, PTT is long, FVIII level is low, bleeding time is prolonged. However, bleeding time and FVIII levels are normal in 20% of patients. VWF in serum increases in cases as stress (such as tough process of phlebotomy), inflammation (collagen vascular diseases, post-operatively), significant endothelial stimulation (intravascular coagulation, liver diseases), pregnancy, after exercise, adrenergic stimulations, and hyperthyroidism. It decreases in hypothyroidism; large molecular weight multimers of vWF may decrease and increase in DIC, hemolytic uremic syndrome, ventricular septal defect, thrombotic thrombocytopenic purpura. In addition, the level of vWF may fluctuate in tests taken in various times. Moreover, vWF antigen level and activity (ristocetin cofactor), ristocetin-stimulated platelet aggregation tests and vWF multimers, which are crucial for diagnosis, vary depending on the type of disease (Table 6).

Table 6. Subgroups and Properties of Von Willebrand Disease

	Type I	Type-2A	Type-2B	PT-vWH	Type-2N	Type-2M	Type 3
vWF-Ag	↓	↓	N – ↓	N – ↓	↓	↓	Absent
Ristocetin co factor	↓	↓↓↓	N – ↓	N – ↓	↓	↓↓↓	Absent
F VIII	↓	N – ↓	N – ↓	N	↓	N	Absen
With ristocetin stimulated platelet aggregation Normal dose Low dose	N – ↓ Absent	↓ (moderately) Absent	N Increased	N Increased	N Absent	↓ Absent	Absent Absent
DDAVP in Treatment	Complete response	Partial response	Objectionable, not	Not administered	Partial response	Partial response	Of no use
vWF/FVIII concentration in treatment	+	+	+	Not administered	+	+	+
Thrombocyte susp in therapy	Of no use	Of no use	In heavy bleedings	Only thrombocyte	Of no use	Of no use	Of no use
Multimeric structure	N	Large multimers absent	Large multimers absent	Large multimers absent	N	N	Absent

2) Physical Activity in Hemorrhagic Diseases

a) Effect of Physical Activity on Hemostasis

The Effect of Physical Activity on Hemostasis in Healthy Persons: In various studies on adult, child, amateur and professional athletes after vigorous exercise, it was demonstrated that platelet count, adhesion and aggregation temporarily (1-2 hours) increased, transient activation occurred in the intrinsic coagulation pathway, transient increase in FVIII and vWF (+/- FIX) also took place, fibrinolysis temporarily increased and natural anticoagulant levels also decreased by the type of sports made. On the other hand, there are also studies showing that the decrease in platelet aggregation occurs, that physical activity and factor levels (FVIII, FVII, FIX, fibrinogen) are inversely correlated and that fibrinolytic and antifibrinolytic pathways are activated at the same time.

Effect of Physical Activity on Hemostasis in Hemophilia: In a limited number of study in this regard, transient vWF increase was detected in all of the patients with *mild, moderate, severe hemophilia A* after exercise. However, in *severe hemophilia A* cases who performed maximal/submaximal exercise, there was no change in FVIII:C/activity level, tissue plasminogen activator (tPA) increased and clotting time was prolonged. *In mild and moderate hemophilia A,* FVIII increase was observed after exercise, in proportion to exercise intensity, being more in mild hemophilia A. It is thought that exercise makes effect through β-adrenergic receptor pathway by

Effect of Physical Activity on Hemostasis in Von Willebrand Disease: After exercise it was reported that vWF antigen, ristocetin cofactor (vWF:RCo), FVIII:C and active vWF levels increased only in Type-2B vWH, but not in Type-1. In animal experiments, after excessiveexercise, it was shown that vWF antigen and FVIII in normal dogs increased but vWF antigen and FVIII activity in dogs with lacking vWF did not increase.

Effect of Physical Activity on Hemostasis in Immune Thrombocytopenic Purpura: The effect of physical exercise on hemostasis in ITP patients is unknown.

As a result, it is seen that the effect of exercise changes according to the severity of hemophilia and type of vWD. It makes us think that we need further studies on many more patients in order to determine the role of exercise in treatment of these diseases.

b) Physical Activity and Its Role in Treatment in Patients with Hemorrhagic Diathesis

i. Hemophilia

Regular physical activity by hemophiliacs has a positive effect on the course of the disease. The strength of the muscles surrounding the joints of the hemophiliacs will protect the joints from hemarthrosis, provide joint stability and reduce the risk of bruising and intraarticular hemorrhage. In addition, it will affect the patient and his/her family positively in terms of psychosocial aspect by reducing factor use and preventing obesity. For this reason, hemophilia patients are recommended to perform some muscle strengthening exercises regularly and use joint-energy conservation techniques (www.wfh.org;https://www.hemophilia.org/sites/default/files/document/files/playingItsafe.pdf).

In the past years, it was shown that dynamic, isokinetic or isometric exercises increase muscle strength in hemophiliacs. In recent years, light weight exercises, proprioceptive and isometric exercises and electrical stimulation were shown to be safe and effective if they are organized according to the patient's needs.

It was shown that strength and proprioception, normal joint movements and body mass increased and the bleeding frequency decreased at the end of the exercises. Muscular tonus and balance improvement prevent the falls, in particular, which pose a severe bleeding risk in severe hemophilia.

Physical activity is also beneficial for the secondary osteoarthritis and osteoarthritic joint present in the majority of hemophiliacs. Also, overweight and obesity rates in hemophiliacs increase over the years and increase the risk of joint bleeding by reducing physical activity and providing another preliminary cause for joint damage. Physical activity also contributes to providing and maintaininghealthy body weight. These patients may have a bone mineral density decrease and osteoporosis as well and it was reported that low bone mineral density values are associated with low

activity scores. Physical activity provides body weight control by preventing treatment-related inactivity in hemophiliacs and intermittent exercises prevent osteoporosis by stimulating osteoblastic activity.

Physical activity should be begun at an early age. Muscle atrophy, joint instability and limitation of motion, which are symptoms of sedentary living in some hemophiliacs, may start and increase with age. In this context, in the 'Guideline on Safe and Effective Physical Activity in Hemophilia' published by Negrier et al. it is recommended that the patients should be made to perform age-appropriate physical activities and functional exercises, the activities that the patients are interested in should be determined, realistic goals according to patient's capacity, past experiences and severity of hemophilia should be determined and boys receiving prophylaxis especially in developed countries should be encouraged to sports. Before the start of the exercise, in the same guide, it is recommended that the patient should work with physical therapist or other professionals in the Hemophilia Treatment Center. First of all, the physical therapist should focus on joint and muscle functions (balance, coordination, flexibility, muscular atrophy, muscular strength, endurance and synovitis); if possible, gait analysis and kinetic superficial EMG (Electromyography) should be done, the person should be learned proper security activities, a physiotherapy should be started to overcome the physical deficiency that prevents participation; it is recommended that physical therapist should be able to make change in the required sports for safety of patients' participation, and the relevant written recommendations for father, mother, coach and school of a child with hemophilia regarding the prevention and treatment of the bleedings should be prepared.

Factor replacement therapy is recommended to be determined by the Hemophilia Center.

It is recommended here to administer treatment or prophylaxis customized according to patient, resources and clinic, to make factor injection ideally before the physical activity, to inject the factor in the morning when activity will be performed, to make sportive activity on the days of treatment or to make more intense physical activity (like competition) than usual since the factor replacement is done every 2-3 days under normal conditions.

In cases where factor provision is limited or not unavailable, it is, nonetheless, useful for the patients todo physical activities appropriate to their personal situation. If the factor to be used here is limited, these factors should be allocated for the activities planned and customized treatment should be initiated when it is possible. In the absence of factor therapy, the risk of activity induced damage should be carefully considered. Hemophiliacs should be treated for chronic synovitis, muscular atrophy, inflammation and pain before entering the sports or exercise program in developing countries. If the factor is not available, range of motion in the joint should be regulated and muscular strength should be recovered by, first of all, applying compression and elevation for joint bleeds and

joint immobilization, then initiating an exercise and physiotherapyprogram. Applying ice in case of joint damage will alleviate the hemarthrosis induced pain by reducing nerve conduction and reducing proinflammatory response and hence the formation of edema and initiating vasoconstriction. Use of appropriate shoes or orthoses may reduce the development of joint bleeding.

Current Practices for Physical Activity and Sport in Hemophilia

Today, hemophilia monitoring is made according to current national and international guidelines. Sportive activities for these patients are restricted by parents and physicians due to the risk of trauma induced bleeding. In moderate and severe hemophilia A and B patients, especially severe physical activity increases the risk of bleeding, although temporarily. For this reason, it is of particular importance that physical activity should be applied properly in these patients.

However, all these studies were performed in patients receiving prophylactic or customized replacement treatment (severe hemophilia) and exercise programs and a wide range of sports can be safely applied under appropriate prophylaxis. Particularly the patients who were receiving prophylaxis for a long period of time can be as active as their healthy peers and perform more severe activities than others.

However, prophylaxis can be initiated for patients with severe hemophilia and hemophiliacs who have undergone at least 4 bleedings per month as per the legislation, regardless of the factor level. Not to apply prophylaxis should not prevent the patient from beginning to the exercise program. Application of the factor therapy does not mean that patients can start the exercise programs with vigorous exercises. Regardless of their condition, the patients should perform their physical activities, taking into account the different risks they carry.

Bleeding in mild hemophiliacs develops only after significant trauma; so they can perform more severe activities; it is less likely to take home treatment programs. However, even if they are not severe hemophiliac, mild hemophiliacs, as well, should be so careful to perform the sportive activities in the safest manner since even a single bleeding attack may trigger the cycle of new recurring hemorrhage in the affected joint, leading to permanent joint damage.

Clinical histories of the moderate hemophiliacs determine which sports and activities are safe for them. If there are many bleeding attacks in their history as in severe hemophilia, they should be more protective in their choice of sport.

In the Turkish Hemophilia Guide 2014, sports recommended for patients with hemophilia are swimming, walking, table tennis, golf, archery, dance and yoga, which are non-contact sports. Swimming is also very useful for increasing overall fitness. However, breaststroke and butterfly swimming are not recommended since elbows and knees are overburdened. In the guideline which relates to sports and exercises for the patients with all kind of hemorrhagic diseases and the most common and detailed,(https://www.hemophilia.org/sites/default/files/document/files/playingItsafe.pdf), physical

activities safest for these patients were presented as archery, elliptical machine, static bicycle, fishing, frisbee, golf, long walk, Tai Chi, diving with snorkel and swimming aids, swimming and walking.

In all guides, it is suggested that hemophiliacs should definitely avoid 'contact' sports (boxing, skiing, football, motorcycle, wrestling, horse riding). Limited-contact sports, such as basketball, cycling, bowling, jogging, tennis, volleyball, are also sports that carry particular risk for hemophiliacs and we do not recommend.

ii. Von Willebrand Disease and Other Factor Deficiencies

It is still recommended that patients with von Willebrand disease should avoid close contact sports just like in hemophiliacs.

iii. Immune Thrombocytopenic Purpura and Thrombocyte Function Disorders

Also the ITP patients are forbidden from close contact sports that can cause head trauma. However, taking into consideration the obesity risk today, it would be appropriate for these patients and their families to be directed to sportive activities that would not be harmful. For these patients, the condition of usually being over<30.000 / $mm^3$is stipulated. However, for the above-mentioned reasons, it would be appropriate to evaluate the peripheral spread so that the actual platelet count of the patient can be understood. The topic of sports that these patients can do is not included in the guidelines of the ITP. However, the guide used for hemophilia and related to the sport and exercise of patients with all bleeding disorders (https://www.hemophilia.org/sites/default/files/document/files/playingItsafe.pdf) is advisable to follow. Patients with impaired platelet function can also be monitored according to the same guideline by the clinical severity of the disease.

3) Thrombosis

a) General Information

Thrombosis refers to the development of an abnormal mass composed of blood elements in the blood vessels. There are many acquired and hereditary factors (Table 7-9) that increase the risk of developing arterial or venous thrombosis. Reasons for the formation of thrombosis are divided into three: 1. Deceleration in blood flow (stasis) 2. Changes in coagulation factors and inhibitors in circulation leading to hypercoagulation 3. Endothelial damage (Virchow triad). Vascular endothelial lesions and changes in blood components, in particular, thrombocytes, play a role in the formation of arterial thrombosis, while stasis in the blood flow and hypercoagulability are at the forefront in the formation of venous thrombosis. The following tables include the acquired and hereditary causes for thrombosis through these mechanisms, frequency of risk factors in patients with venous thrombosis and the estimated risk of venous thrombosis caused by the disorders.

Thrombosis appears as venous (deep vein thrombosis, pulmonary emboli, Vena Kava Superior, Internal Jugular Vein, Renal Vein, Portal vein thrombosis, cerebral venous sinus thrombosis) or arterial (peripheral extremity arteries or central nervous system arteries) with the various signs and symptoms varying according to the localization of the circulatory disorder.

Table 7. Causes of Thrombosis Tendency

Acquired Causes	Hereditary Causes
1) Vascular endothelium disorders: Atherosclerosis, diabetes mellitus, vasculitis, artificial surfaces (prosthetic heart valves, vascular graft), homocysteinemia **2) Rheological disorders: Stasis (Inactivity)**, long-term immobilization (long-term air travel, paralyzed patients), congestive cardiac insufficiency, varicocytes, hyperviscosity (polycythemia vera, leukemia, sickle cell anemia), severe dehydration, cyanotic cardiac disease **3) Thrombocyte disorders:** Myeloproliferative diseases, thrombocytosis, diabetes mellitus, hyperlipidemia, paroxysmal nocturnal hemoglobinuria. **4) Clotting and fibrinolysis disorders:** Neoplasms, oral contraceptives, nephrotic syndrome, trauma, surgical intervention, infusion of vitamin K-induced coagulation factors, chemotherapeutic agents (L-asparaginase, steroid), tamoxifen, thalidomide, lenalidomide **5) Others:** Pregnancy, advanced age, being male, obesity, previous history of thrombosis, heparin induced thrombocytopenia and thrombosis, antiphospholipid antibody syndrome, central venous catheter, sickle cell anemia, thrombotic thrombocytopenic purpura, hemolytic uremic syndrome, DIC, hypertension, smoking	• Factor V-Leiden / APC resistance • Prothrombin gene mutation (G20210A) • MTHFR gene mutation (C677T) (if homocysteine does notincrease, it is not a thrombosis factor) • PAI 4G/5G or 4G/4G polymorphism • Antithrombin (AT) deficiency • Protein C (PC) deficiency • Protein S (PS) deficiency • Plasminogen deficiency • Decreased t-PA activity • Increased plasminogen activator inhibitor (PAI) • Dysfibrinogenemia • Increased fibrinogen, FVIII, FIX, FXI activity • Increase in vWF level • ADAMTS13 mutation • Heparin cofactor-II deficiency • Factor 12 deficiency (controversial) • Increased thrombin-activatable fibrinolysis inhibitor (TAFI) activity Decreased tissue factor pathway inhibitor (TFPI)

Table 8. Prevalence of Risk Factor for Patients with Venous Thrombosis

Acquired Causes	Hereditary Causes (10-74%)
☐ Immobilization more than 48 hours in the last month.....45% ☐ Hospitalization in the last three months.....39% ☐ Surgery within the last three months.....34% ☐ Malignity in the last three months.....34% ☐ Infection within the last three months.....34% ☐ Factor with three or more risk factors.....53%	☐ Factor V G1691A mutation..... 20-50% ☐ Prothrombin G20210A mutation.....6-8% ☐ PC deficiency.....3-9% ☐ PS deficiency.....2-7% ☐ AT III deficiency .....1-1.5% ☐ F VIII elevation..... Not fully known ☐ Dysfibrinogenemia..... 1-2% ☐ Homocysteine elevation.....Not fully known ☐ Elevation of lipoprotein a.....Not fully known

Table 9. Estimated Venous Thrombosis Risks of Disorders

Acquired Causes	Hereditary Causes	Independent
☐ **Medical illness** (Liver, kidney disease, rheumatoid arthritis, multiple sclerosis, cardiac insufficiency, arterial thrombosis, hemorrhagic stroke)..... 1,5-4,9 times ☐ **Major medical disease + immobilization**.....10.9 times	☐ Hyperhomocysteinemia .....2.5 times ☐ Prothrombin 20210 mutation, heterozygote .....3 times ☐ Oral contraceptive (standard dose estrogen)..... 4 times ☐ Factor V Leiden mutation, heterozygous.....2-7 times ☐ Factor V Leiden mutation, homozygous.....80 times ☐ Antithrombin III deficiency, heterozygote.....5 times ☐ Protein C deficiency, heterozygote.....7 times ☐ Elevation of lipoprotein a (>30 mg/dl).....7.2 times	☐ Familial history of venous thrombosis

Acquired + Hereditary Causes
• Factor V Leiden mutation, heterozygous + Oral contraceptive.....35 times • Major medical diseases + immobilization + increased FVIII.....80 times • Major medical illness + immobilization + increased FIX.....35 times • Major medical illness + immobilization + increased vWF.....88 times • Major medical illness + immobilization + Factor V Leiden.....84 times

For therapy, heparin (standard heparin or LMWH) and warfarin (Coumadin) are used as anticoagulants. In arterial thrombosis, antithrombotic agents (aspirin, dipyridamole) and in newly-emerging thrombosis cases that may cause extremity loss or severe damage, thrombolytic agents [tissue plasminogen activator (tPA), urokinase] are used. In special cases, thrombectomy is applied.

b) Physical Activity in the Prevention of Thrombosis Development or Recurrence

As seen in the tables above, immobilization (longer than 48 hours immobilization) and hospitalization are present in the medical history of 39-45% of the cases with venous thrombosis. Immobilization may increase the risk of thrombosis up to 80% when hereditary thrombophilia factors and a major medical illness coexist. It is defined as 'physical inactivity' when children spend time for sitting, for more than an uninterrupted one hour, excluding sleeping. For this reason, children that are far beyond the normal physical activity on day basis and within the limits of 'physical inactivity' since they are hospitalized should be encouraged to take for a walk within the service and make in-bed exercises at least.

It is also of a special importance for patients who have hereditary risk factors for thrombosis not to maintain a sedentary lifestyle and perform physical activities according to the 'Physical Activity and Sports Recommendations by Age' detailed in the previous section.

4) Bone Marrow Failure

Bone marrow failure is a numerical decrease or malfunction of one or more cell lines. These diseases can be encountered as those with only deficiency **of production in the erythrocyte series** (Congenital: Diamond Blackfan anemia and Aase syndrome, congenital dyseritropoietic anemia. Idiopathic: Transient erythroblastopenia of childhood. Secondary: Medications, infections, protein energy malnutrition, Riboflavin deficiency, thymoma, hematologic diseases (Parvovirus B19 infection on the basis of chronic hemolytic anemia, iron deficiency anemia, folate and B12 vitamin deficiency, pregnancy, collagen vascular diseases); **only deficiency of white blood cell formation** (Kostmann syndrome, Schwachman-Diamond syndrome, Reticular dysgenesis), **only deficiency of thrombocytopoiesis** (TAR syndrome), or **insufficiency in three cell lines (pancytopenia)** (Congenital: Fanconi anemia, dyskeratosis congenital, Dubowitz syndrome, Schwachman-Diamond syndrome, Acquired: idiopathic or secondary).

In these diseases, symptoms and findings are observed which vary depending on the type and number of the decreased cell line: anemia, neutropenia, thrombocytopenia or their combination (pancytopenia). These are applied supportive treatment and physical activity practices as in patients with chemotherapy-induced cytopenia and as described in the relevant section. Treatment is steroids, granulocyte colony stimulating factor, immunosuppressive and anabolisan drugs which are given depending on the type of the disease at different doses and durations, and, if necessary, hematopoietic stem cell transplantation.

REFERENCES

1) *Anderson A, Forsyth A. Playing it safe bleeding disorders sports and exercise https://www.hemophilia.org/sites/default/files/document/files/PlayingItSafe.pdf. National Hemophilia Foundation, New York, 2005, (download date: 16.11.2016)*
2) *Beyan C. Trombofili. In: Soysal T, Demir AM (ed). Tromboz. HematoLog Ekim 4: 389-400, 2014.*
3) *Bolton-Maggs PHB, Grainger JD. Management of activity in immune thrombocytopenia, Fat or Fit? Pediatr Blood Cancer 2015;62:2069-2070.*
4) *Bunn HF, Bauer KA. Trombotik Bozukluklar. In: Bunn HF, Aster JC (edl). Kan Hastalıklarının Patofizyolojisi. İstanbul Tıp Kitabevi, Lange, İstanbul, 2013, s.188-228.*
5) *Çapacı K, Çınar E. Hemofili Rehabilitasyonu. In: Kavaklı K (ed). Hemofili Rehberi 2014. Meta Basım Matbaacılık Hizmetleri, İzmir, 2014, s.115-141.*
6) *Demirel H, Özmert EN, Kayıhan H, Doğan A. Türkiye Fiziksel Aktivite Rehberi. Sağlık Bakanlığı Yayınları, Ankara, 2014, s. 9-40.*
7) *Di Paola J, Montgomery RR, Gill JC, Flood V. Hemophilia and von Willebrand Disease. In: Orkin SH, Fisher DE, Ginsburg D, Look AT, Lux SE, Nathan DG. Nathan and Oski's Hematology and Oncology of Infancy, Elsevier Saunders, Philadelphia, 2015, p.1028-1055.*
1) *Ek Olofsson H, Lövdahl S, Thorsson O, Berntorp E, Zetterberg E. Acute effects of exercise on specific and global coagulation parameters in severe haemophilia A. Hemophilia 2015, 21, e416-e419.*
2) *Groen WG, Den Uijl IEM, van der Net J, Grobbee DE, De Groots G. Protected by nature? Effects of strenuous physical exercise on FVIII activity in moderate and mild haemophilia A patients: a pilot study. Haemophilia 2013; 19:519-523.*
3) *Hastings C. The Children's Hospital Oakland Hematology/Oncology Handbook. Mosby, 2002, China, s. 93-100*
4) *Kaya Biçer E, Aydoğdu S. Hemofilide kas iskelet sorunlarına ortopedik yaklaşım. In: Kavaklı K (ed). Hemofili Rehberi 2014. Meta Basım Matbaacılık Hizmetleri, İzmir, 2014, s. 79-114.*
5) *Koch B, Luban NL, Galioto FM Jr, et al., Changes in coagulation parameters with exercise in patients with classic hemophilia. Am J Hematol 1984; 16:227-233.*
6) *Lippe G, Maffulli N. Biological influence of physical exercise on hemostasis. Sem Thromb Hemost 2009; 35:269-276.*
7) *Meyers KM1,Wardrop KJ, Dodds WJ et al., Effect of exercise, DDAVP, and epinephrine on the factor VIII:C/von Willebrand factor complex in normal dogs and von Willebrand factor deficient Doberman pinscher dogs.Thromb Res. 1990 Jan 1;57(1):97-108.*
8) *Mulder K. Exercises for people with hemophilia. World Federation of Hemophilia, Quebec, 2006, www.wfh.org. Playing in Safe*
9) *Negrier C, Seuser A, Forsyth A. et al., The benefits of exercise for patients with haemophilia and recommendations for safe and effective physical activity. Haemophilia 2013; 19:487-498.*
10) *Neunert C, Lim W, Crowther M. et al., The American Sciety of Hematology 2011 evidence-based practice guideline for immune thrombocytopenia. Blood 2011;117:4190-4207.*
11) *Ören H. Çocukluk çağında tromboz. In: Soysal T, Demir AM (ed). Tromboz. HematoLog Ekim 2014; 4: 496-517.*
12) *Pipe S, Goldenberg N. Acquired Disorders of Hemostasis. In: Orkin SH, Fisher DE, Ginsburg D, Look AT, Lux SE, Nathan DG. Nathan and Oski's Hematology and Oncology of Infancy, Elsevier Saunders, Philadelphia, 2015, p.1103-1124.*
13) *Rice SG. Medical conditions affecting sports participation. Pediatrics 2008;121:841-848.*
14) *Roya R, Giti T, Reza BM. et al., Effects of ergometric exercise on FVIII coagulant activity in mild and moderate haemophilia-A: a chance to reduce injective replacement therapy. Pak J Biol Sci 2006; 9:2823-2927.*
15) *Ünüvar A, Ören H, Balkan C. et al., Çocukluk Çağında Tromboz Tanı ve Tedavi Rehberi. İstanbul Tıp Kitabevi, İstanbul, 2014, p.1-24.*
16) *Srivastava A, Brewer AK, Mauser-Bunschoten EP. et al., Guidelines For The Management of Hemophilia.World Federation of Hemophilia. Blackwell Publishing, 2nd ed. Quebec, 2012.*
17) *Trenor CC, Bauer KA. Inherited Disorders of Thrombosis and Fibrinolysis. Nathan and Oski's Hematology and Oncology of Infancy, Elsevier Saunders, Philadelphia, 2015, p. 1062-1075.*
18) *Wilson DB. Acquired Platelet Defects. In: Orkin SH, Fisher DE, Ginsburg D, Look AT, Lux SE, Nathan DG. Nathan and Oski's Hematology and Oncology of Infancy, Elsevier Saunders, Philadelphia, 2015, p. 1076-1102.*

SECTION 4

PHYSICAL ACTIVITY AND EXERCISE IN CARDIOLOGICDISEASES

AUTHORS:

Tayfun UÇAR, MD Prof. (President)	*Turkish Pediatric Cardiology and Heart Surgery Society*
Melda SAĞLAM, PT PhD Assoc. Prof.	*Hacettepe University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation*
Kadir Can TUNCEL, MD	*Federation of Family Physicians' Associations*
Tuğba MANÇU TÜLEK, MSc Dietitian	*T.R. Ministry of Health, General Directorate of Public Hospitals*

ABSTRACT

The majority of childhood cardiac diseases are congenital cardiac diseases. Congenital cardiac diseases are seen from 6 to 10 in 1000 livebirths. Approximately half of these children require interventional or surgical correction and some problems may occur related to them in the following periods. Approximately one-third of congenital cardiac diseases require intervention (interventional-surgery) within the first year of life. These children may have a sedentary lifestyle because of limited effort capacities of such children in early period and of their families' protective approaches. Sedentary lifestyle may continue even in children whose effort capacities return to normal following the corrective operations. This situation brings with it the risks that sedentary lifestyle can pose in adulthood. In addition, psychosocial influences may emerge in children. It is very important to make appropriate exercise recommendations for children with congenital cardiac disease, which is quite a heterogeneous group as symptom and effort capacity.

Another important area of childhood is genetic cardiovascular diseases. Despite rare frequency, exercise recommendation should be done very carefully because of sudden death risks.

Congenital Cardiac Diseases and Exercise

Congenital cardiac diseases are the most common birth defects leading to infant deaths. However, some studies have reported that they affect less than 1% of births each year. The development of interventional and surgical techniques in congenital cardiac diseases and improvements in patient care conditions enabled more patients to reach adulthood.

A more sedentary lifestyle is in question as result of the limitations in infancy and early childhood and the excessive protective attitudes of the families. Even if the effort capacities have normalized after the interventional and surgical treatment, these habits may continue. This situation brings with it the risks that sedentary lifestyle can pose in adulthood.

Although congenital cardiac diseases are often recoverable diseases, complex cardiac pathologies often need to be recovered for those less than the age of one. While most of the congenital cardiac diseases do not require restriction in sportive activities, there are restrictions in complex pathologies in particular. Some pathologies cause restrictions in effort capacity. Mechanisms that may limit the effort capacities in the congenital cardiac diseases can be summarized as follows.

- Left to right shunt: Pathologies such as ventricular septal defect and atrial septal defectresulting in increased pulmonary blood flow.
- Right-to-left shunt: The defects such as Fallot tetralogy, tricuspid valve atresia and major vessel transposition which cause cyanosis by delivering the blood to systemic circulation of oxygen due to mixing of pulmonary venous blood and systemic venous blood flow.
- Obstructive lesions: Pathologies such as aortic valve stenosis and aortic coarctation that left ventricle needs to workmore in order to defeat resistance.

Many congenital cardiac diseases are treated surgically for significant physiological consequences. If repairs in congenital heart diseases are successful, hemodynamic values and physiology return to normal limits, cardiac output response to the need increased by exercise is normal. If residual problems are encountered, the exercise capacity may not be met adequately. In left-to-right shunt congenital cardiac diseases, hemodynamic parameters generally return to normal after surgery and the effort capacity is not affected. However, in complex pathologies, some of the surgical operations are palliative while some are full corrective. Examples are given below;

- Fontan application: After this practice, the reduction in exercise capacity will remain because the cardiac outflow is not increased enough in order to meet the needs.
- Despite reducing ventricular septal defects and pulmonary stenosis in TOF, aerobic capacity remains low at moderate to mild levels.

The major artery transposition should necessarily be corrected to be able to sustain life. The existing standard practice is anatomical displacement of major arteries; with placement of left ventricular aorta and right ventricular pulmonary artery. Even after this application, the exercise capacity is still at a certain level.

Working capacities of the children with simple congenital cardiac disease (ventricular septal defect and atrial septal defect) were found to be comparable with those of normal individuals. In more complex cases (Fallot tetroclosis, major arterial transposition and single ventricular physiology), it causes more functional limitations.

Benefits of and Consideration on Physical Activity in Congenital Cardiac Diseases

Previous recommendations in congenital cardiac diseases were stipulating the presence of supervised rehabilitation programs. To allow the child to be able to maintain the normal function following the congenital defect surgery, rehabilitation programs that promote the development of physical activity should be focused. Many surgical repairs allow maintaining normal active life. Many researchers now suggest that exercises should be performed in a supervised way in case of complex problems.

Rhodes et al. investigated the effects of a 12-week cardiac rehabilitation program on the exercise capacity of 16 congenital cardiac patients who had surgical operations. It was shown that exercise performance increased and morbidity decreased after structured cardiac rehabilitation in these patients. Increase in peak oxygen uptake and workload results in an increase in the peak oxygen pulse. In the follow-up study with the same patients, it was found that the benefits continued even after about 7 months after the exercise program was completed.

Patients with more serious congenital cardiac diseases cannot make higher levels of effort, while less complicated lesions respond normally or close to normal. However, exercise training was shown to improve exercise capacity, despite hemodynamic constraints. Most of children with congenital problems are recommended to participate in daily physical activity, structured exercise training and some part of the competitive sports.

Physical Activity and Sports Participation in Congenital Cardiac Diseases

Children who have undergone an asymptomatic and successful surgical intervention with minimal cardiovascular defects are recommended to be physically active and they can participate in sports. More complex anomalies, Fallot Tetralogy, and VSD pulmonary atresia require a more complex surgical repair and may result in residual symptoms. In this case, even after surgery, the hemodynamic response is not sufficiently effective. For this reason, in line with 36thBethesda Proposals of the

American Heart Association and the European Society of Cardiology,it limits the participation in the sports of those with low exercise capacities. Physical activity or exercise training increases exercise capacity even in this group of complicated circulatory problems. However, these children and adolescents tend to be physically inactive. Physical inactivity leads to increased prevalence of obesity and the emergence of additional cardiovascular problems in later life. Despite adverse effects on health, only 9% of congenital cardiac patients receive the recommendation of planned physical activity has a sedentary lifestyle as a consequence of overprotective approach. One reason for this is the vagueness that which physical activity types will be advised in what severity. On the other hand, young patients participate in unsafe sportive activities, refusing to restrict the exercise.

First of all, all patients should be evaluated clinically. Physician should take the medical and surgical history in detail and question the existing symptoms and perform a detailed physical examination. If the type of congenital cardiac disease is known, the awareness of potential hemodynamics and electrophysiological complications expands.

In particular, 5 basic parameters should be evaluated. These 5 basic parameters are: ventricularfunctions, pulmonary artery pressure, aorta, arrhythmia, oxygen saturation during rest and exercise (Table 10).

1. Examination of ventricular function: A transthoracic echocardiogram is often sufficient to assess left ventricular function. Characteristics of patients and past exercise and physical fitness levels should be definitely considered in interpretation of echocardiographic values.
2. Examination of pulmonary artery pressure: Pulmonary artery pressure is provided fromtricuspid valve regurgitation velocities (TVRV). In the diagnostic criteria, pulmonary hypertension is excluded if TVRV is ≤ 2.8 m/s. In case of doubt, right heart catheterization should be applied.
3. Examination of aorta: It is classified by the aortic diameter. It is classified as normal or mild dilatation if aortic diameter is ≤ 30 mm; it is classified as severe dilatation if it is ≥45-50 mm. Computed tomography or MRI may be required if the aortic diameter is not sufficient in echocardiography.
4. Examination of arrhythmia: Palpitations, pre-syncope, syncope and unexplained weakness in patient's history should be evaluated. Twenty-four-hour holter monitorization should be performed in addition to 12-derivation ECG.
5. Oxygen saturation during rest or exercise: Transcutaneous arterial oxygen saturation should be recorded at rest in patients with right-to-left shunt. Central cyanosis is excluded, if it is >95% during rest and exercise. Pulmonary diseases induced low arterial

saturation should be taken into consideration. Spirometer testing should be performed for lowness in oxygen saturation which does not have a cardiovascular explanation.

Patients are recommended cardiopulmonary exercise test and type and severity of exercises as result ofthese parameters (Figure 1: Algorithm).

Cardiopulmonary Exercise Test

The results of the exercise test help to determine the severity of the exercise. Exercises test which is performed routinely in the clinic and does not consume oxygen may be an alternative if cardiopulmonary test is not available. The following parameters are required for individual recommendations:

1. Peak oxygen consumption, maximal heart rate, Borg's scale:
   Peak oxygen consumption was shown to decrease in congenital cardiac patients. One of the most important determinants of morbidity and mortality in congenital cardiac patients is maximal oxygen consumption. The Borg's scale can help you understand how a patient feels about the level (the intensity of his/her exercise) at which he/she performs exercise.
2. Arterial blood gas or oxygen saturation:
   In the event that oxygen desaturation occurs during physical activity, it may be necessary to monitor it continuously during the exercise test.
3. Arrhythmia during exercise:
   If there is increased arrhythmia with exercise, the risk of sudden death increases 6.6 times. For this reason, exercise training should be given provided that it is taken under control clinically.
4. Blood pressure during exercise:
   Normal blood pressure response during exercise indicates ≥25 mmHg increase in systolic blood pressure. Diastolic blood pressure often lowers somewhat and >10 mmHg increase is normal.

After interpretation of the cardiopulmonary exercise test, individual exercise is recommended. Recommendations;

1. Physical activity at least 3-4.5 hours a week is recommended.
2. Each physical activity session should be a minimum of 30 minutes.
3. It should be performed every day or most days of the week.
4. For team sports, it is very difficult to individually limit the severity of physical activity.For this reason, the patients are recommended to make sports with the persons having similar levels of physical fitness.
5. Patients should monitor their own symptoms (Borg's scale).
6. They should not exceed the recommendation at heart rate.

Continuance of exercise habits by the patients and symptom follow-ups are important. In case of changes in the patient's performance, the physical activity recommendation should be readapted.

Recommendations for special physical activity and sports attendance of congenital cardiac patients:

- For the patients with mild involvement, many of the recreational exercises and competitive sports are safe.
- Moderate-intensity sportive activities may be recommended in congenital cardiac patients with moderate effects.
- Moderate and severe activities are often avoided in severe types of congenital cardiac diseases. Light intensity and daily physical activity are recommended.

Table 10. Variables in the Functional Assessment of Congenital Heart Diseases

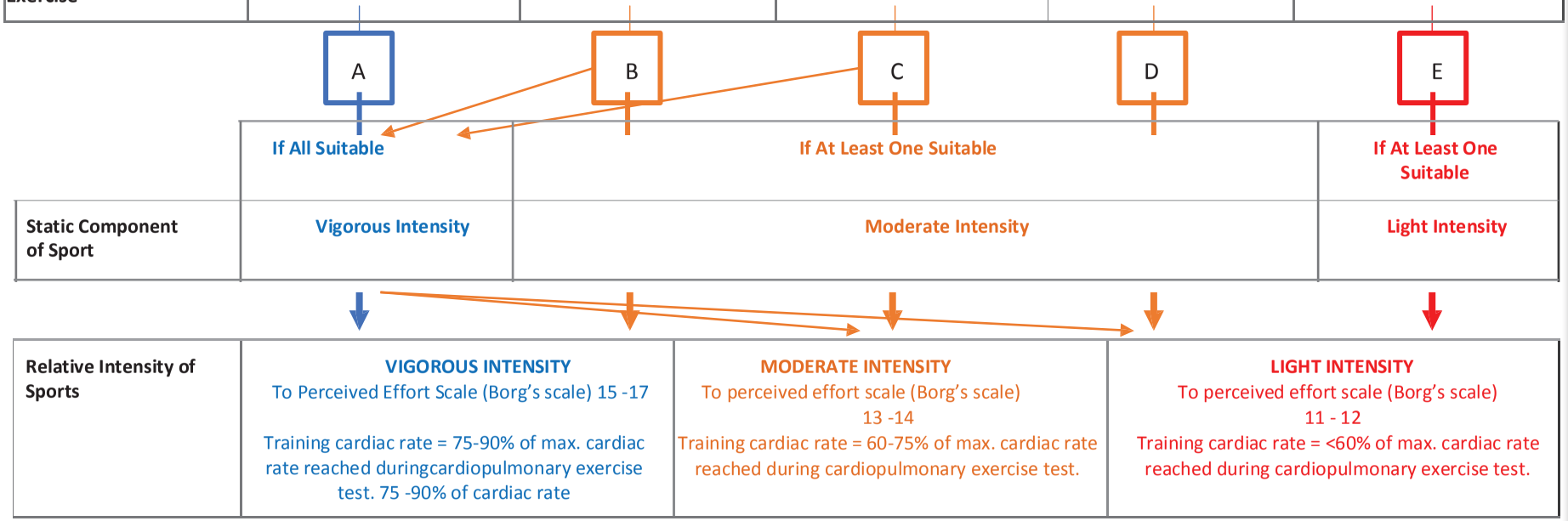
Variable	Definition
Ventricular Ventricular Dysfunction	None: EF≥55% Mild: 45% ≤ EF <55% (or normal systemic right ventricle) Moderate: 30%≤ EF <45% Heavy: EF < 30% (or impaired systemic right ventricular) Left ventricular:
Ventricular Hypertrophy	None: Septal/posterior wall thickness (cm): Male <1.1 female <1.0; LV mass (gr): male 88-224 female: 67-162 Mild: Septal/posterior wall thickness (cm): Male 1.1- 1.3 female 1.0-1.2 LV mass (gr): male 225-258 female: 163-186 Middle: Septal/posterior wall thickness (cm): Male 1.4-1.6 female 1.3-1.5 LV mass (gr): male 259-292 female: 187-210 Heavy: Septal/posterior wall thickness (cm): Male ≥1.7 women ≥ 1.6: LV mass (gr): male ≥ 293 women ≥ 211 Right ventricular: Qualitative echocardiographic evaluation
Ventricular Pressure Load • No Pressure Load • Mild Pressure Load • Medium Pressure Load • Heavy Pressure Load	 No LVOT or RVOT significant gradient (high systolic flow <2.6 m/s). No stenosis in major veins 2.6 m/s ≤ peak systolic velocity< 3 m/s LVOT and RVOT stenosis and PPS; for aortic coarctation, arm-leg gradient< 20 mmHg 3m/s ≤ peak systolic velocity≤ 4m/s for LVOT and RVOT stenosis and PPS Peak systolic velocity> 4m/s for LVOT and RVOT stenosis and PPS and PPS: aorticcoarctation, clinical gradient ≥ 20 mmHg
Ventricular Volume Load • No Volume Load • Light Volume Load • Moderate/Heavy Volume Load Ventricular Physiology	 Valve insufficiency is mild or not absent or no ventricular dilatation Mild: Left or right ventricular dilatation originating from severe regurgitation, i.e. systolic function is preserved Together with evident right or left ventricular dilation ventricular dysfunction Single ventricular or double ventricular Systemic left ventricular or systemic right ventricular
Pulmonary Artery Pressure • Low DAP • Medium high PAP • Moderate/heavy PAP	No PH: TVRV ≤ 2.8 m/s, systolic PAP ≤ 36 mmHg and/or additional findings of echocardiography indicating pulmonary hypertension PH possible: TVRV >2.8 m/s systolic PAP > 36 mmHg and no right ventricular systolicdysfunction Moral certainty PH: TVRV > 2.8 m/s, systolic PAP>36 mmHg, and right ventricular dysfunction
Aorta • No dilation • Moderate Dilatation • Severe Dilatation • Repair indications for dilatation	 Normal (≤ 30 mm) or borderline dimension (<35 mm) Aortic dimension ≥ 35 and <45 mm Aortic dimension ≥ 45 and <50 mm Aorta dimension ≥ 50 mm
Arrhythmia • No arrhythmia • Mild arrhythmia load / non-malignant arrhythmia • Evident arrhythmia load / potential malignancy enhancement	 Holter <500/ 24h PVC Fewer/coupled PVC controlled atrial fibrillation/atrial flutter, when not exercised Atrial fibrillation/atrial flutter, when exercised Interrupted ventricular arrhythmia or persistent ventricular tachycardia
Saturation during rest / exercise • No central cyanosis	When there is no clinical findings: transcutaneous saturation is 96-100%, during rest and exercise

Abbreviations: EF: ejection fraction, LV: left ventricular, LVOT: left ventricular outflow tract, RVOT right ventricular outflow tract, PPS: peripheral pulmonary stenosis, PAP: pulmonary artery pressure, PAP: TVRV: tricuspid valve regurgitation velocity, PH: pulmonary hypertension, PVC: premature ventricular complexes

(Source: *Budts W, Börjesson M, Chessa M et all "Physical activity in adolescents and adults with congenital heart defects: individualized exercise prescription", Eur Heart J. 2013 Dec;34(47):3669-74)*

Figure 1. TheFlowchart in Recommendations of Sportive activities for Congenital Cardiac Diseases

1. Ventricular	No Systolic Dysfunction No Hypertrophy No Pressure Load No Volume Load	No Systolic Dysfunction No Hypertrophy Moderate Pressure Load Moderate Volume Load	Mild Systolic Dysfunction Mild Hypertrophy Single Ventricle Physiology Systemic Ventricle	Moderate Systolic Dysfunction Moderate Hypertrophy Moderate Pressure Load	Severe Systolic Dysfunction Severe Hypertrophy Severe Pressure Load Moderate/Severe Volume
2. Pulmonary Artery Pressure	Lower Pulmonary Artery Pressure	Lower Pulmonary Artery Pressure	Mildly Increased Pulmonary Artery Pressure		Moderate/Severe Increased Pulmonary Artery Pressure
3. Aorta	None/ Moderate Dilatation	Normal Dilatation	High Dilatation	Dilatation Requiring Treatment	
4. Arrhythmia	No Arrhythmia	No Arrhythmia	Mild Arrhythmic Load No Malign Arrhythmia		No Evident Arrhythmia Malign Arrhythmia
5. Saturation during Rest/ Exercise	No Central Cyanosis	No Central Cyanosis	No Central Cyanosis	Central Cyanosis	



Source: Budts W et al.

Cardiac Insufficiency

Cardiac insufficiency is a clinical syndrome in which the heart loses the power of pumping the sufficient blood, systemic and/or pulmonary venous rotating blood cannot be sufficiently distributed by heart and the body's metabolic requirements cannot be met. The main cause of cardiac insufficiency in adults is coronary heart diseases, hypertension, valve diseases and arrhythmias, while the main cause in children is congenital cardiac diseases. Although the incidence of congenital cardiac defects varies in various studies, it is reported between 6 and 10 among 1000 births. Approximately half of these children require interventional-surgical treatment. Findings of cardiac insufficiency are observed in about half of these serious defects.

The incidence of cardiac congenital insufficiency is reported as 1-2 among 1000 deliveries. Most of the cardiac insufficiencies are caused by volume load to right or left ventricle. In such cases, it is aimed to control cardiac insufficiency until corrective operation or to cure the cardiac insufficiency continuing after surgery. Patients with cardiac insufficiency suffer from the decreases in cardiac outflow, cardiomyopathy or cardiac myocyte damage more seriously. The prognosis is so poor in this patient group and the 5-year mortality rate is over 80%. Digoxin, furosemide, hydrochlorothiazide, spironolactone, ACE (Angiotensin Converting Enzyme) inhibitors and beta-blockers are used in the treatment. Cardiac transplantation may be necessary in progressive cases not responding to the treatment.

Here, physical activity recommendations are given in congenital cardiac diseases and not discussed in a separate title.

Physical Activity in Genetic Cardiovascular Diseases

Genetic cardiovascular diseases include hypertrophic cardiomyopathy, arrhythmogenic right ventricular cardiomyopathy, ion channel diseases including Marfan syndrome and long QT syndrome, Brugada syndrome and catecholaminergic polymorphic ventricular tachycardia (CPVT). Although rare in the general population, it increases the risk of sudden death during exercise. 40% of the sudden deaths in athletesare due to genetic cardiovascular diseases. Most of deaths are induced by primary ventricular arrhythmias, secondary Marfan syndrome of aortic dissection. However, sudden deaths induced by arrhythmia in different etiologies are reported. Such deaths can be very devastating for families, communities and physicians.

Individuals with many asymptomatic (or mild symptoms) genetic cardiovascular diseasewant to maintain physically active lifestyle and participate in recreational and leisure time activities. There is not any valid international physical activity guide for children with

arrhythmia still. In children and adolescents with arrhythmia there is a disagreement between the benefits and the potential side effects of exercise. For example, in patients with hypertrophic cardiomyopathy, ventricular arrhythmia emerging as result of cell death and fibrosis of the myocardium may lead to recurring myocardial ischemic attacks which intensify with exercise during intensive exercise training. In patients with arrhythmogenic right ventricular cardiomyopathy, regular and intense physical activity may increase right ventricular volume load and cavity size. In Marfan syndrome, the increase in throbe volume and blood pressure during severe physical activity causes hemodynamic stress on the aorta and increases aortic expansion rate. However, in most patients with Brugada syndrome, ventricular arrhythmias can occur during resting and vagal activity increase and/or sympathetic activity decrease is observed at night in many cases. Adrenergic state that occurs during sportive activities can act as an inhibitor and reduce the risk of sudden death theoretically.

The benefits of physical activity were shown repeatedly in all age groups in community health. Regular physical activity improves aerobic capacity and maximal oxygen consumption, blood lipid levels and glucose tolerance. It also improves physical and psychological well-being, life quality and self-confidence. Regular exercise and physical activity will undoubtedly provide similar benefits in children and adolescents with genetic cardiovascular disease as well.

Since there are no clear resources, it is recommended to start exercise with common decision of patient, physician and physiotherapist. Children should be told that recreational activities are more useful than competitive sports. During organized and structured sportive activities, the patient may not be able to give the right decision by making a sudden and severe movement. In case of dizziness, palpitation, fatigue, excessive dyspnea or chest ailment during competitive sports, it is difficult for the child or adolescent to distinguish whether it is due to the normal nature of the sport or whether it is due to cardiac disease. In children participating in recreational activities, it is easier to adjust the level of exercise and to distinguish the cardiac symptoms that may occur during the activity. The child, thus, may stop the exercise. Some recreational activities such as football, basketball and tennis may include competition. Children with genetic cardiovascular diseases can safely participate in physical activities ranging between 4-6 metabolic equivalent (MET) (Table 11).

Table 11. Examples of Physical Activity and Sports in Genetic Cardiovascular Diseases

Intensity level	HCM	Long QT syndrome	Marfan	ARVC	Brugada syndrome
Vigorous intensity					
Basketball	Not recommended	Not recommended	According to Personal characteristics	Not recommended	According to Personal characteristics
Bodybuilding	Not recommended	Not recommended	Not recommended	Not recommended	Not recommended
Running	Not recommended	Not recommended	According to Personal characteristics	Not recommended	According to personal characteristics
Tennis	Not recommended	Not recommended	Recommendable	Not recommended	Recommendable
Moderate intensity					
Cycling	Recommendable	Recommended	Recommendable	Not Recommended	Recommended
Walking on a treadmill	Recommended	Recommended	Recommended	Recommended	Recommended
Weight lifting	Not recommended	Not recommended	Not recommended	Not recommend	Not recommend
Light intensity					
Bowling	Recommended	Recommended	Recommended	Recommended	Recommended
Quickstepping	Recommended	Recommended	Recommended	Recommended	Recommended
Light intensity					
Bowling	Recommended	Recommended	Recommended	Recommended	Recommended
Quickstepping	Recommended	Recommended	Recommended	Recommended	Recommended

Abbreviations: HCM: hypertrophic cardiomyopathy, ARVC: arrhythmogenic right ventricular cardiomyopathy

These recommendations are not valid for patients with a history of syncope or significant loss of consciousness attack, previous surgical history (surgical septalmyectectomy in obstructive hypertrophic cardiomyopathy and aortic root correction for Marfan syndrome), cardiac transplantation, implanted cardioverter defibrillator or cardiac pacemaker or arrhythmia with high risk. These patients should be recommended individual exercise.

Environmental effects (such as very cold or too hot air, high humidity or high altitude) can increase the risk of changes in blood volume, electrolytes and hydration. For this reason, it is recommended to exercise in a safe and suitable environment.

Isometric (static) effort-requiring activities, such as lifting free weights, are not recommended because they increase Valsalva maneuver or may cause obstruction in dynamic left ventricular flow. In Marfan syndrome, it increases stress on the aortic wall, particularly if dilatation is developed in aorta. For this reason, resistance or weightlifting trainings are not recommended in any of these diseases.

Participation in physical training courses should be decided in line with advices of a physician as it may involve activities that require immediate effort, contact or competition.

Special Recommendations

Children and adolescents with cardiac pacemaker

Cardiac pacemaker therapy does not prevent vigorous intensity physical activity. Modern cardiac pacemakers provide interventricular synchronization in order to optimize systemic ventricular ejection. The programming of the pacemaker requires adaptation of proper rate during exercise. Persistent sinus rhythm can be used for follow-up. Velocity response systems based on minute ventilation may be preferred to accelerometer based systems if more physiological speed response is desired. Exercise testing and Holter ECG monitorization can help adjusting the speed response during exercise. Ventricular dysfunction or ischemia response may exist in patients with chronotropic insufficiency so it may be difficult to adjust the speed responsive pacing.

Children and Adolescents with Implanted Cardioverter Defibrillator

Children and adolescents with implanted cardioverter defibrillators are recommended to perform only low and moderate physical activity. It is unclear how effective cardiac defibrillation is during the peak physical activity and ICD is not an instrument that directly restricts the activity when underlying cardiovascular disease is taken as basis. Participation in sportive activities is rare due to unfavorable shocking during sportive activities. In addition, contact sports are not suggested for any possibility of impact to the device.

ACUTE RHEUMATIC FEVER

Acute rheumatic fever (ARF) is a nonsuppurative inflammatory connective tissue disease that develops as result of autoimmune response of host after about 1-4 patient(s) after group A beta-hemolytic streptococcus infections. The prevalence of the disease is closely associated with economic and cultural development. The frequency of rheumatic cardiac disease is 5.7/1000 in Africa at south of the Sahara Desert; 3.5/1000 in Australia and New Zealand natives; 2.2/1000 in Central-South Asia and below 0.5/1000 in developed countries. ARF that is seen between the ages of 5 and 15 is a disease that often involves joints and heart, less frequently the central nervous system, skin

and subcutaneous tissue. There are five major findings among the diagnosticcriteria of the disease. These are carditis, arthritis, chorea, erythema marginatum and subcutaneous nodules. The finding that determines mortality and morbidity among these findings is carditis. Carditis is in the form of pancarditis and can involve endocardia, myocardium and pericardium. It may cause so serious cardiac insufficiency and serious valve insufficiencies, as well as mild cases of asymptomatic involvement. It most commonly involves endocarditis, causing valve damage. The most common is mitral valve involvement and less frequently aortic valve involvement. Valve deficiencies are seen in the early years accompanied by valve stenosis in older ages (adult). Findings that determine the prognosis of the disease in the chronic period are the shape and degree of valve involvements.

Long-term bed and home rest were recommended for children who had ARF diagnosis in the past years. This was associated with less relapse and less cardiomegaly at rest. Nowadays bed and home rest periods are rather short. Strict bed rest is no longer recommended for most of the patients with rheumatic carditis. Patients with cardiac deficiency or severe acute valve disease should be given gradual rest especially during the first 4 weeks or until the serum CRP level and sedimentation rate normalize and decline dramatically. Bed rest should be applied until other symptoms such as arthritis are taken under control in patients with mild carditis or no carditis. It is recommended to avoid excessive physical activity until the symptoms are controlled by treatment. Many of the patients without active carditis today undergo an outpatient treatment without being hospitalized. For these patients, home rest is recommended until the active symptom (arthritis) disappears and a significant reduction in CRP and sedimentation rate is achieved.

Section of the cardiac insufficiency and exercise, which was previously explained, should be considered for the patients with cardiac insufficiency that is induced by carditis and becomes chronic very rarely.

VALVULAR HEART DISEASES

Valvular diseases are more common in adult patients than in childhood. Childhood valvular diseases are mainly mitral and aortic valve deficiencies due to rheumatic fever sequelae. Mitral valve stenosis is a late complication of ARF, which is more commonly seen in adult ages. Since not quite observed in childhood, mitral stenosis will not be mentioned here. In addition, aortic valve deficiencies and stenosis are seen in childhood age group depending on bicuspid aorta. Some sportive activity recommendations are made on valvular diseases and also the types of activities that are inconvenient are indicated.

Mitral Insufficiency

Mitral insufficiency (MI) may be associated with mitral valve prolapses, rheumatic cardiac disease, infective endocarditis, coronary artery disease, colloid tissue disease and dilated cardiomyopathy. In general, exercise does not lead to a significant change in the regurgitant fraction due to decreased systemic vascular resistance. However, an increase in heart rate or an increase in blood pressure with exercise may show significant increases in regurgitant volume and pulmonary capillary pressures. Thereby the static exercise that increases arterial pressure is potentially harmful.

Recommendations:

1. The persons with mild to moderate MI and with normal left ventricular (LV) size and function in sinus rhythm and who have normal pulmonary artery (PA) pressure can perform all kinds of sports and participate in competitive sports.
2. Those with mild to moderate MI, sinus rhythm, normal LV function at rest, mild LV dilatation may perform some low and moderate static and low, moderate and advanced level dynamic competitive sports.
3. Those with severe MI and LV dilatation, pulmonary HT or LV systolic dysfunction at rest cannot perform any competitive sport
4. Patients with atrial fibrillation or patients who have atrial fibrillation history and underwent an anticoagulation therapy should notperform the sports that may include body contact or traumas.

AORT STENOSIS

Aortic stenosis is mostly congenital in the pediatric age group. In adults, rheumatic cardiac diseases are added. Symptoms may be chest pain and syncope, as well as it causes sudden deaths. So the sportive activities and exercise should be defined well.

Recommendations

1. Athletes with mild aortic stenosis (AS) can participate in all sportive activities, however, they should be subjected to a cardiac examination at least once a year.
2. Those with moderate AS may perform light intensity competitive sports. Thosewho asymptomatically complete the exercise test at satisfactory level, have not ST segment depression or ventricular arrhythmia and are with normal BP response can perform static and dynamic competitive sports at light and moderate intensity. Patients with supraventricular tachycardia or multiple or complex ventricular tachyarrhythmia with rest or effort may only be involved in light intensity sportive activities.
3. Those with severe AS or symptomatic moderate stenosis should not involve in any competitive sportive activity.

AORTA INSUFFICIENCY

Aortic insufficiency (AI) is mainly caused by congenital bicuspid aorta, rheumatic cardiac disease, infective endocarditis and aortic root disease. Patients with severe aortic regurgitation may remain asymptomatic for years. Symptoms are chest pain, syncope and ventricular arrhythmias. Sudden death is rather rare.

Recommendations

1. Those with mild to moderate AI and normal LV diastole end diameter can perform all competitive sports. Those, with moderate level of LV width, who achieve sufficient activity in the exercise test and are without asymptomatic and ventricular arrhythmias, can perform low and moderate static and low, moderate and advanced level dynamic competitive sports. Those who are asymptomatic and with nonsustained ventricular tachycardia during rest and exercise can perform light intensity sports.
2. Those with severe AI and markedly extensive LV and mild moderate AI and symptomscannot participate in any competitive sports.
3. Those with AI and proximal ascending aorta wider than 45 mm can involve in light intensity competitive sports. These criteria do not apply to those with Marfan syndrome.

BICUSPID AORTA AND ASCENDING AORTA EXTENSION

Recommendations:

1. Those with bicuspid aorta and without aortic root dilatation and without major AD and AI can participate in all competitive sports.
2. Those with bicuspid aorta and aortic root between 40-45 mm can participate in mild and moderate sportive activities. However, situations such as blows and traumas should be avoided.
3. Those with bicuspid aorta and aortic root with a diameter of more than 45 mm can engage in only low densitysportive activities.

PROSTHETIC CARDIAC

VALVESRecommendations

1. Those with bioprosthetic mitral valve or normal valve functions and LV functions but not anticoagulant treatment can participate in static and dynamic competitive sports at low and moderate level.
2. Those with normal valve function and normal LV function and with mechanical or bioprosthetic aortic valve can perform static and dynamic competitive sports at low and moderate intensity. Symptoms and hemodynamic response of those who will do exercise more than light intensity should be assessed and those who are found to be normal should be recommended.
3. Regardless of other factors, those who have mechanical or bioprosthetic valve and receive anticoagulant therapy should avoid sports and traumas with probability of contact and impact.

REFERENCES

1. *Barry J. Maron, Chair; Bernard R, Cochair; Michael J. Ackerman; Antonio Bayes de Luna, Domenico Corrado, Jane E. Crosson, Barbara J. Deal, David J. Driscoll, N.A. Mark Estes III, ClaudioGil S. Araújo, David H. Liang, Matthew J. Mitten, JD ; Robert J. Myerburg, AntonioPelliccia, Paul D. Thompson, Jeffrey A. Towbin, MD; Steven P. Van Camp, for the Working Groups of the American Heart Association Committee on Exercise, Cardiac Rehabilitation, and Prevention; Councils on Clinical Cardiology and Cardiovascular Disease in the Young, "Recommendations for Physical Activity and Recreational Sports Participation for Young Patients With Genetic Cardiovascular Diseases", Circulation 2004;109:2807-2816.*
2. *Budts W, Börjesson M, Chessa M, et al., "Physical activity in adolescents and adults with congenital heart defects: individualized exercise prescription", Eur Heart J. 2013 Dec;34(47):3669-74.*
3. *Giada F, Delise P, Biffi A. et al., "Exercise Prescription in Patients with Arrhythmias", Hospital Chronicles 2008, Supplement: 151-155.*
4. *Gilboa SM, Salemi JL, Nembhard WN. et al., Mortality resulting from congenital heart disease among children and adults in the United States, 1999 to 2006. Circulation 2010; 122 (22): 2254-63.*
5. *Huang M, Zhang X, Chen S, et al. The effect of carvedilol treatment on chronic heartfailure in pediatric patients with dilated cardiomyopathy: a prospective, randomized-controlled study. PediatricCardiology 2013; 34 (3): 680-5.*
6. *Kantor PF, Abraham JR, Dipchand AI. et al., The impact of changing medical therapy on transplantation-free survival in pediatric dilated cardiomyopathy. Journal of the American College of Cardiology 2010; 55 (13): 1377-84.*
7. *Longmuir PE, Brothers JA, de Ferranti SD, et al., American Heart Association Atherosclerosis, Hypertension and Obesity in Youth Committee of the Council on Cardiovascular Disease in the Young, "Promotion of physical activity for children and adults with congenital heart disease: a scientific statement from the American Heart Association", Circulation. May 2013 28;127(21):2147-59.*
8. *Miller KK, Vig KS, Goetz EM, et al., Pulse oximetry screening for critical congenital heart disease in planned out of hospital births and the incidence of critical congenital heart disease in the Plain community. J Perinatol. 2016 Sep 1. doi: 10.1038 / JP.2016.135*
9. *Norozi K, Gravenhorst V, Hobbiebrunken E, et al., Normality of cardiopulmonary capacity in children operated on to correct congenital heart defects. Arch Pediatr Adolesc Med 2005;159:1063e8.*
10. *Rhodes J, Curran TJ, Camil L, et al. Sustained effects of cardiac rehabilitation in children with serious congenital heart disease. Pediatrics 2006; 118: E586E93.*
11. *Riner WF, Sellhorst SH, "Physical activity and exercise in children with chronic health conditions", Journal of Sport and Health Science, 2013, 2, 12-20.*
12. *Takken T, Giardinia, Reybrouck T, et al.Recommendations for physical activity, recreation sport, and exercise training in paediatric patients with congenital heart disease: a report from the Exercise, Basic & Translational Research Section of the European Association of Cardiovascular Prevention and Rehabilitation, the European Congenital Heart and Lung Exercise Group, and the Association for European Paediatric Cardiology", Eur J PrevCardiol. 2012 Oct;19(5):1034-65.*
13. *RHD Australia (ARF/RHD writing group), National Heart Foundation of Australia and the Cardiac Society of Australia and New Zealand. Australian guideline for prevention, diagnosis and management of acute rheumatic fever and rheumatic heart disease (2nd edition). 2012*
14. *Carapedis JR, McDonald M, Wilson NJ. Acute rheumatic fever. Lancet 2005; 366: 155-68.*
15. *Gewitz MH, Baltimore RS, Tani LY, et al. American Heart Association Committee on Rheumatic Fever, Endocarditis and Kawasaki Disease of the Council on Cardiovascular Disease in the Young. Revision of the Jones criteria for the diagnosis of the rheumatic fever in the era of Doppler echocardiography: a scientific statement of the American Heart Association. Circulation 2015; 131: 1806-18.*
16. *Maron BJ, MD, Zipes DP. 36TH BETHESDA CONFERENCE Introduction: Eligibility Recommendations for Competitive Athletes With Cardiovascular Abnormalities—General Considerations. JACC 2005; 45: 2005 :1318 –21*
17. *Bonow RO, Cheitlin MD, Crawford MH, Douglas PS. Task Force 3: Valvular Heart Disease. JACC 2005; 45: 2005 :1334 –40*

SECTION 5

PHYSICAL ACTIVITY AND EXERCISE IN NEPHROLOGICAL DISEASES

AUTHORS:

Sevcan A. BAKKALOĞLU EZGÜ, MD Prof. (President)	*Pediatric Nephrology Association*
Ebru ÇALIK KÜTÜKÇÜ, PT PhD	*Hacettepe University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation*
Sibel GÖGEN, MD Spec.	*T.R. Ministry of Health, General Directorate of Public Health*
Asiye KAPUSUZ	*T.R. Ministry of Health, General Directorate of Public Health*

ABSTRACT

The leading cause of pediatric end stage renal failure in Turkey is;congenital kidney and urinary tract anomalies and recurring urinary tract infections. It is of capital importanceto prevent the development of renal disease, to start early treatment by finding out the cause of such diseases if detected and stop/slow down the progression of end stage renal failure. Increased morbidity and mortality in children with chronic renal disease are associated with complications of infections, chronic renal disease and renal transplantation treatment, as well as increased cardiovascular risk factors in these patients. There is also a significant degradation in the criteria that determine the life quality such as growth, school attendance and exercise tolerance. Reduction in physical activity is one of the preventable factors of decrease in muscle strength and exercise tolerance in these children compared to their peers.

Hypertension prevalence in children is increasing and this is mainly associated with the obesity epidemic. Childhood hypertension is transmitted to the adulthood and it may be the cause of morbidity, even mortality. Since target organ damage can be seen in hypertensive children, early diagnosis and effective treatment are of great importance. Through the physical activities, some positive effects may be obtained on metabolic mechanisms playing a role in increase of blood pressure such as the storage and distribution of fat mass, insulin resistance, activation of the sympathetic nervous system, sodium balance, renin-angiotensin system, regulation of vascular function. This compilation includes recommendations for physical activity for patients with pediatric dialysis and renal transplantation and children with essential hypertension.

1. PHYSICAL ACTIVITY AND EXERCISE IN CHRONIC RENAL DISEASE, DIALYSIS AND RENAL TRANSPLANTATION DISEASES

INTRODUCTION

Chronic renal failure (CRF) was staged in 2002 by glomerular filtration rate (GFR) and rearranged with small additions in 2005 and 2008. According to this, if GFR is <15 ml/min/1.73 m^2 it is referred as Stage 5 CRF (end stage renal failure-ESRF) and it is recommended to start renal replacement therapy (hemodialysis, peritoneal dialysis or renal transplantation) when GFR falls below this level. Most of the chronic renal disease induced complications (anemia, hyperparathyroidism, hyperphosphatemia, renal osteodystrophy, etc.) were reported to develop since Stage IIIB (GFR<45 ml/min/1.73 m^2) and significant morbidity and even mortality develops in Phase V due to these complications.

The incidence of ESRF in Turkey is 147 per million population according to the data of Turkish Nephrology Association, in an increasing trend in recent years. Even though a healthy data on children is not available, it is estimated that the incidence of ESRF is much lower.

The leading cause of pediatric ESRF in Turkey is; congenital renal and urinary tract anomalies and recurring urinary tract infections. In some of the patients in this group (vesicoureteral reflux, posterior urethral valve, obstructive lesions), the underlying preventable or treatable disorders are cause of ESRF, whereas in the other group the underlying renal hypo/dysplasia and complex renal and urinary tract abnormalities could not be treated and the patient progresses to ESRF. The second most frequent cause of ESRF is glomerular diseases, in which steroid resistant nephrotic syndrome - focal segmental glomerulosclerosis - is the most common reason. In addition, hereditary diseases (juvenile nephronophytosis, cystinosis, oxalosis) are among the major causes of ESRF in children.

Peritoneal dialysis is the preferred method of dialysis in children, in particular young children. Hemodialysis, on the other hand, was begun to be the preferred form of dialysis, especially for adolescents, as permanent catheters have become widely used. Even though the ideal vascular access route for hemodialysis is arteriovenous fistula, the use of double lumen catheters is very common. The most important complications of hemodialysis with peritoneal dialysis and catheterization are infections (peritonitis and catheter-associated bacteremia).

It is of capital importance to prevent the development of renal disease, to start early treatment by finding out the cause if detected and to stop/slow down the progression to ESRF. Renal transplantation should be the most preferred renal replacement therapy when this could not be achieved and the patient reached ESRF. The prevention of chronic renal disease complications and the stimulation of progression are most effectively achieved by renal transplantation. The success of renal transplantation treatment increased the life expectancy in children with CRF and ESRF. The

most significant complications after renal transplantation are infections and side effects of immune suppressivemedications. Increased morbidity and mortality in children with chronic renal disease and ESRF are associated with CRF and renal transplantation treatment, as well as increased cardiovascular risk factors in these diseases.

In children with chronic renal disease, general complaints such as inappetency, asthenia and fatigue are quite frequent as well as symptoms and findings related to bone mineral disorders. In addition to reduced peak bone mass, reduced bone mineral density, bone deformities and subclinical fractures, short length and non-skeletal calcifications cause significant morbidity. It is known that there is depletion in muscle strength and exercise tolerance in these children compared to their peers. Negative effects of anemia, uremia and metabolic acidosis on cardiac and skeletal muscle and decrease in physical activity are the factors for that. It was shown that physical inactivity in adults increases CRF progression and the course of inactive patients after transplantation worsens.

Protein energy consumption, which is a condition that protein and energy source is decreased, is frequently observed in people with CRF and its progression causes accumulation of uremic toxins, hypermetabolism, acidosis, advanced inflammation and nutritional deficiencies and growth retardation in children. In addition, the co-morbid conditions such as diabetes mellitus, cardiac insufficiency and hypertension were found to contribute to protein energy consumptions in adults. Protein energy consumption is responsible for sarcopenia, which leads to reduction in muscle mass, muscle strength and physical activity in persons with CRF. It was shown that sarcopenia increases fracture risk, decreases life quality and is the main determinant of mortality in persons with CRF. Lack of physical activity is one of the major components which reduce health-related life quality in children with ESRF compared to their healthy peers after renal transplantation. In these patients, musculoskeletal, metabolic and cardiopulmonary disorders, mostly associated with ESRF, are responsible for the low physical activity. In addition, osteopenia, which is also considered as a side effect of immune suppressive treatment, and increase in fat masscontribute.

It is known that exercise tolerance and maximal exercise capacity decrease as the renal reserve decreases in persons with CRF. Nevertheless, exercise training was not recommended for patients at predialysis CRF stage, as exercise was thought to reduce renal blood stream and glomerular filtration rate, to increase proteinuria and to lead to progression at the CRF stage. This view was begun to change recently, as exercise training was reported to show beneficial effects without causing impairment of renal functions. In these patient groups, 12-month exercise training was proved to have curative effects on peak VO_2, exercise tolerance and arterial stiffness. In another twelve-week exercise training study, exercise training was found to be effective in preventing loss of skeletal muscle even in patients on low protein diet. Exercise training also leads to reduction in the

inflammatory markers. Parallel to this, in a study on pediatrichemodialysis patients, protein-energy consumption and inflammation were shown to be the most important determinantsof decrease in exercise capacity.

In a survey on 2264 hemodialysis and peritoneal dialysis patients,35.1% of the patients were found to perform little or no exercise at all. A negative relationship was detected between exercise habits and mortality and hospitalization in hemodialysis patients. Also increased mortality was reported in patients with low maximal oxygen consumption (VO_2). In a meta-analysis involving 24 studies and 997 hemodialysis patients, it was reported that the exercise performed during dialysis has positive effects on VO_2 and physical performance, and that such effect is observed particularly in exercise programs lasting more than six months. Also an increase was observed in dialysis adequacy with exercise. In a study lasting 6 months on hemodialysis patients where endurance exercises such as callisthenic exercises, step-up exercises, swimming, ball games, low weighted resistance exercises and stretching exercises were performed together with aerobic exercises in 50-80% of maximal VO_2, it was detected that muscle atrophy of patients was recovered and peak VO_2 increased by 48%, exercise period increased by 29% and lower extremity muscle strength increased. It was also shown that there was an improvement in muscular atrophy and positive developments were observed in capillary and muscle mitochondria.

Strategies to prevent loss of muscle mass and increase physical activity in patients with dialysis and CRF take part in the American Sports Medicine Association *(ACSM)* and the National Kidney Foundation *(National Kidney Foundation Kidney Disease Outcomes Quality Initiative-KDOQI)* clinical practice guidelines. Patients are recommended regular exercise and physical activity. An increase in physical activity and performance could be achieved with exercise to be performed in rehabilitation center three days per week on non-dialysis days.

Patients with peritoneal dialysis have more time for exercise training compared to hemodialysis patients for they are not confined to bed during dialysis sessions. No rapid change in blood pressure and electroleptics is expected in peritoneal dialysis compared to hemodialysis for duration of ultrafiltration is longer for peritoneal dialysis. However, a three-month regular exercise training program in six patients with peritoneal dialysis showed a significant improvement in mental functions, but did not lead to improvement in physical function. There is a need for extensive long-term clinical studies in this area.

Six-minute walking test is recommended as a reliable and repeatable test to evaluate physical performance in patients with pediatric CRF, dialysis and renal transplantation and found to be two standard deviations lower in males and four standard deviations lower in females. Examining the physical activity status in 44 patients aged 7-20 (12 Stages, 1-4 CRF, 7 dialysis and 25 renal

transplantations), it is indicated that they are sedentary, take 6218 steps a day on the average, that females are more inactive, that there is not a difference between the patients with CRF, dialysis or transplantation in terms of physical activityand physical performance is lower in late adolescents (18-20 years) than in the younger ones. Increased fat tissue in muscles may have roles, as well, in the development of low physical performance in pediatric peritoneal dialysis patients. Physical activity is found to be directly proportional to maternal education and hemoglobin level and inversely proportional to body mass index. In children, pedaling exercise during hemodialysis showed that exercise was well tolerated after three months and that improvement was observed in physical performance as well as in some laboratory values.

In children with renal transplantation, maximum energy use and maximal oxygen consumption improve during the exercise compared to pre-transplantation time, whereas it is lower than their healthy peers. Fat mass increasing after renal transplantation could be the reason for that. In a study with involvement of children with similar GFR levels, renal transplantation application and congenital single kidney, aerobic capacity was found to be higher in children performing physical activity more than three hours per week compared to those performing less physical activity. The aerobic capacity of patients with renal transplantation was found to be lower than that of children with congenital single kidney. This suggests that the cardiac, metabolic and neuromuscular effects of uremic toxin exposure prior to renal transplantation are partially alleviated by renal transplantation, but not fully eliminated.

There are also publications demonstrating that there is no change in physical activity of dialysis and transplant patients. After a 12-week pedometer-based physical activity practice over 44 patients with a mean age of 15.1±3.4, 27% of which is at pre-dialysis CRF stage, 16% is dialyzed and 57% is with renal transplantation, a significant change was not observed in the mean number of daily steps within the groups. In transplant patients and children with CRF, physical activity increased by 100 steps/day and 73 steps/day, respectively, while physical activity in dialysis patients decreased by 133 steps/day.

Benefits of Physical Activity

Physical activity does not cause progression of renal disease or stop its progression; but it may reduce the cardiovascular risks that may occur. If the patients undergoing a dialysis treatment or with renal transplantation perform aerobic exercise, improvement is observed in exercise tolerance, life quality and urinemic symptom scores. Cardiovascular risks are reduced with a decrease in need for hypertension medication and weight loss due to physical activity. It is stated that renal transplantation increases physical activity, prevents or delays the development of cardiopulmonary complications in children. It is also known to improve the mood related to the body image of the

child and reduce theanxiety. Even though regular exercise has some potential side effects such as musculoskeletal injuries, arrhythmias, myocardial infarction and rhabdomyolysis, such risks are low with an appropriate exercise program.

Physical Activity Prescription for Patients with CRF, Dialysis and Renal Transplantation

Through regular and early-onset aerobic and resistive exercise programs, it possible to increase muscle function, exercise capacity and life quality in patients with diagnosis of CRF. Before starting any exercise program, medical evaluation and exercise test should be performed. Exercise program should be determined considering the physical condition of the child and possible opportunities after exercise test with bicycle ergometer or treadmill. It is necessary to make individual decisions by considering all the details about directing the children with diagnosis of CRF to different sportive activities.

In the ACSM guideline, exercise tests such as treadmill and bicycle ergometer are recommended in order to measure the peak VO_2, when assessing exercise tolerance and maximal exercise tolerance of persons with CRF. 3-10 maximum repeat tests are recommended instead of maximum repeat test in order to assess isotonic muscle strength and avoid bone fractures. A maximum repeat refers to, while performing a certain movement, the maximum weight that he/she can bear in only one performance of that movement.

Aerobic exercise training is the activities such as walking, jogging or cycling, during which large muscle groups are used. They have to be performed for a long time and with many repeats. Aerobic exercise training programs can be gradually increased by the increased tolerance of the person. The ACSM guideline recommends to all CRF patients (non-dialyzed, hemodialysis and peritoneal dialysis patients) light-moderate aerobic exercise training (40-60% of peak VO_2), 20-60 minutes/day and 3-5 days/week. Patients in stable conditions are recommended to have resistant exercise training 2-3 days/week. Resistant exercise training is performed with different equipment (such as sandbags, elastic bands, dumbbells, roll systems) to increase muscle strength. Recent guidelines recommend resistant exercise training as a minimum set of 10-15 repeats, 2-3 days/week at 70-75% of a maximum repeat.

KDOQI recommends moderate physical activity for hemodialysis patients every day, if not possible, 30 minutes on most days of the week. ACSM guideline recommends not applying exercise training just after the dialysis since these patients are confined to bed during hemodialysis and fluid-electrolyte balance changes rapidly with dialysis. If it is to be administered during dialysis, exercise training is recommended to be administered at early phase of the hemodialysis session to prevent hypotension. Patients, who exercise at the rehabilitation center on the day without dialysis, show more

increase in exercise training time and peak VO_2during the hemodialysis sessions and compared to those who perform uncontrolled exercise. Peritoneal dialysis patients should try to exercise when their abdomen is empty after the peritoneal dialysis fluid was discharged.

In a study evaluating the amount of weekly physical activity after a successful renal transplant, cardiorespiratory fitness and left ventricular mass of children with renal transplantation who perform at least 3-5 hours of physical activity per week were found to be similar to those of healthy ones (<3 hours of exercise/week). This study, which demonstrates that life quality of pediatric renal transplant patients with cardiovascular fitness, may improve and cardiovascular risks of them may decrease, is of great importance since it highlights the importance of sufficient physical activity performed by children and adolescents after a successful renal transplantation.

There is no consensus on participation of young athletes with single kidney in sports including intense contact. Since renal transplantation constitutes a group of patients in which a single kidney is subsequently transplanted, the sportive activities to be recommended should be carefully identified. Table 12 summarizes the proposed and prohibited sportive activities for renal transplantation patients.

Table 12. Recommended and Prohibited Sportive activities for Renal Transplantation Patients

Recommended sportive activities (without competition)	Sportive activities that should be prohibited
• Running	• Trampoline
• Basketball	• American football
• Swimming	• Karate/Judo/Boxing/Wrestling
• Jumping rope	• Ski/Ice hockey/Snowboard
• Rowing	• Apparatus gymnastics
• Frequent and light intensity weight lifting	
• Volleyball	
• Aerobic	
• Roller skating	
• Tennis	
• Cycling	
• Table tennis	
• Horseback riding	
• Football	
• Golf	

Risks of Physical Activities

Exercise causes changes in renal hemodynamics and fluid-electrolyte balance. Changes in proteinuria, hematuria and serum electrolyte balance during vigorous exercise are reported; although these transient changes can be explained by an increase in glomerular filtration, compression on the renal vein may also play a role. After vigorous exercise, hemoglobinuria and myoglobinuria can be observed. In chronic renal disease, the risk of fracture is increased due to bone mineral disorders. In addition, people with CRF have many cardiovascular risk factors. Consensus guidelines recommend a very careful physical assessment before participation for all children. Medical history and family history, especially physical examination focused on the cardiovascular and musculoskeletal system are fundamental in evaluation. The ACSM guidelines suggest that exercise testing of persons with CRF should be performed by trained health personnel. There is no study evaluating the risk of exercise in patients with chronic renal disease. Therefore, there is a need for further researches to evaluate the risks and disadvantages of exercise training in persons with CRF.

Patients with low peak bone mass and bone mineral density due to chronic renal disease tend to osteoporosis and fractures after renal transplantation also due to immunosuppressive drugs used. So especially the resistive exercise training should be performed carefully. Renal transplant patients tend to neutropenia and are susceptible to infections due to the use of intensive immune suppressive drugs. There is a significantly lower increase in neutrophils of renal transplantation patients after strenuous exercise. There are also renal transplantation patients that anuria is reported after avigorous exercise session and heavy lifting. Immune suppressive drugs also have side effects such as hyperglycemia and hyperlipidemia. So it is of great importance to monitor blood glucose, lipids, blood count, micturition and all vital findings during exercise training. As a result, the most appropriate recommendations regarding physical activity and exercise training should be given individually, taking careful consideration of history, physical examination and laboratory findings of all patients.

2. PHYSICAL ACTIVITY AND EXERCISE IN HYPERTENSIVE CHILDREN

INTRODUCTION

Hypertension prevalence increases in children and this situation is mainly identified withobesity epidemic. Fatty liver steatosis and Type-2 diabetes mellitus, whichwere previously rare, are now commonly observed in children other than hypertension and thousands of children are faced with early metabolic syndrome. Childhood hypertension is transmitted to the adulthood and it may be the cause of morbidity, even mortality. Since target organ damage can be seen in hypertensive children, early and true diagnosis and effective treatment are of great importance.

Secondary causes are detected in most of the non-obese hypertensive pediatric patients. Since essential hypertension is rare in children under five years of age, secondary causes must be carefully investigated and appropriate treatment must be applied definitely. Secondary causes are often renal, renovascular, endocrine and cardiac diseases. This section includes physical activity recommendations for children with essential hypertension.

A certain blood pressure threshold value that is valid for all childhood and used for diagnosis of hypertension in childrenis not available. Hypertension is defined if the blood pressure is found over 95 percentile for that age, gender and height as result of three measurements at proper conditions, proper cuff and proper intervals (blood pressure normal values for boys and girls by age and height are listed in Attached Table 1 and 2 at the end of the chapter) and it is recommended to investigate in terms of target organ damage, as well as investigations for etiology. Table 13 summarizes the normotension, prehypertension and hypertension phases. The classification on this tabulation was based on clinical measurements on children in the United States of America in 2004. Over the next decade, there is no reliable data to determine the normal blood pressure values in children. In the European Pediatric Hypertension Guideline in 2016, the American percentile values for the ages of 1-15 were again included, but for children aged 16 years and older, the adoption of adult data in the blood pressure class was recommended. Table 14 under this guideline includes hypertension classification in children and adolescents.

Table 13. Blood Pressure Classification in Children and Adolescents

Category	
Normal blood pressure	<90. Percentile Adolescents <120/80 mmHg
Pre-hypertension	>90-95. Percentile
Hypertension	>95 percentile ≥120/80 mmHg in adolescents
Stage 1 hypertension	≥95-99. percentile + 5 mmHg
Stage 2 hypertension	≥95-99. percentile + 5 mmHg

Source: American pediatric blood pressure normative data, 2004, Pediatrics 2004; 114 (2 Suppl 4th Report): 555-76, source no: 13

Table 14. Classification of Hypertension in Children and Adolescents

Category	0-15 age SBP and/or DBP percentiles	>16 age SBP and/or DBP values
Normal blood pressure	<90. percentile	<130/85 mmHg
High-normal blood pressure	≥90 – <95. Percentile	130–139/85–90 mmHg
Hypertension	**≥ 95. percentile**	**≥ 140/90 mmHg**
Stage 1 hypertension	95-99. percentile + 5 mmHg	140-159/90-99 mmHg
Stage 2 hypertension	≥95-99. percentile + 5 mmHg	160-179 / 100-109 mmHg
Isolated systolic hypertension	SBP >95. Percentile and DBP <90. Percentile	>140/<90 mmHg

SBP: Systolic blood pressure, DBP: Diastolic blood pressure

Source: European Pediatric Hypertension Manual, 2016. Lurbe E, et al. J Hypertens 2016; 34 (10): 1887-1920, reference no. 7

Physical inactivity alone causes development of hypertension by 5-13%. A new meta-analysis showed a reduction of 7/5 mmHg in blood pressure with physical fitness training. Another meta-analysis demonstrated a decrease in blood pressure through a reduction in systemic vascular resistance, plasma norepinephrine and plasma renin activity with exercise. Endothelial functions impaired by hypertension are also improved by exercise training.

In children and adolescents, primary hypertension is seen as a preventable disease. This can be achieved by interventions (overweight, inappropriate diet, salt intake, sedentary lifestyle, poor sleep quality and passive smoking exposure) on adjustable risk factors. Physical exercise can have an impact on overweight, sodium balance and poor sleep quality. Through the physical exercise, some indirect positive effects may be obtained on metabolic mechanisms playing a role in increase of blood pressure such as the storage and distribution of fat mass, insulin resistance, activation of the sympathetic nervous system, sodium balance, renin-angiotensin system, regulation of vascular function.

First-line treatment in both pre-hypertensive and hypertensive children is non-pharmacological methods. As in hypertensive adults, lifestyle change in the form of diet and exercise is also recommended for children. In obese individuals, a careful diet and weight loss are often helpful in lowering blood pressure. Avoidance of excessive weight gain, restriction of salt and caffeine in diet are primary recommendations. The salt in the diet can be harmful to the vein structure independently of the blood pressure. Specific recommendations include the intake of fresh fruits and vegetables and low-fat daily foods and the reduction of carbohydrate, fat and processed sugar intake. Diet should include 25-30% protein,40-60% carbohydrates and only 20-30% fat.

Children and adolescents should avoid the use or abuse of illegal substances (hormones, ephedrine, tobacco or alcohol) that cause an increase in blood pressure during physical activity. Energy drinks should be banned, consumption of caffeine-containing beverages should be limited. Energy drinks include caffeine, taurine, vitamins, herbal supplements, sugar or sweeteners. These beverages are marketed for energy, weight loss, durability, athletic performance and concentration. Half of these beverages in the market are used by children and adolescents. In a recent study, it was shown that systolic blood pressure increased by 3% in children consuming energy drinks.

Benefits of Physical Activity

Since many of children and adolescents with hypertension are also obese, active lifestyle is recommended other than weight loss. Fun based on physical activity or physical activity that is structured with regular sports is one of the cornerstones in the prevention and treatment of hypertension in the pediatric age group.

According to a new meta-analysis investigating the effects of childhood obesity prevention programs on hypertension, it is reported that a 6-12 month dietary intervention and an accompanying physical activity program result in a reduction in systolic blood pressure by 1.64 mmHg and in diastolic blood pressure by 1.44 mmHg on average. In addition, regular physical activity causes sodium loss by way of perspiration, thus establishing and/or maintaining sodium balance.

Sleep quality in children is associated with cardiometabolic risk, obesity and physical activity in a negative way.It is stated that children who sleep more than nine hours participate in more physical activity and are weaker than those who sleep less. In addition, regularity of weekday and weekend sleep periods is associated with greater levels of physical activity. The time spent with watching television or playing computer games causes the duration of sleep to be shorter.

Negative effects of the sedentary lifestyle should be taken into consideration, the time spent by children and adolescents in sedentary activities (TV, video games, and internet) should be monitored and families should be trained so as to reduce this period under two hours a day.

Children and adolescents spend most of their time at school outside their home. While most schools have programs providing physical activity, children need more physical activity than their current level. Below are the national recommendations developed by the Ministry of Health to improve the physical activity of children in schools:

- Schools should ensure that children and adolescents participate in moderate/severe physical activity for at least 30 minutes throughout the day. This may be the time spent actively in physical training courses or the physical activity provided by out-of-school and school-related community programs.
- Schools should provide health-related, evidence-based physical training programs which meet the standards of students at all school levels. These programs should provide moderate to severe physical activity in significant amounts (50% of the period) and teach the students the motor and behavior skills necessary for participation in lifelong physical activity.
- Schools should augment opportunities of physical activity by providing clubs, lectures, intramural sports and inter-school sports programs to meet the physical activity needs and interests of all students.

Blood Pressure Response to Different Physical Activity Approaches

Blood pressure increases slightly before physical activity and it decreases for longer periods after exercise. Reduction of blood pressure provided by intermittent short-time dynamic physical activity is more effective than a long and continuous period exercise. This prolonged effect may be explained with transient pulse volume and sympathetic tonus modulation.

Blood pressure during static exercise prominently increases than dynamic exercise; however, moderate intensity strength exercise reduces blood pressure by 3-5 mmHg. It is demonstrated that the relation between aerobic exercise and blood pressure reduction is independentof weight loss (Figure 2).

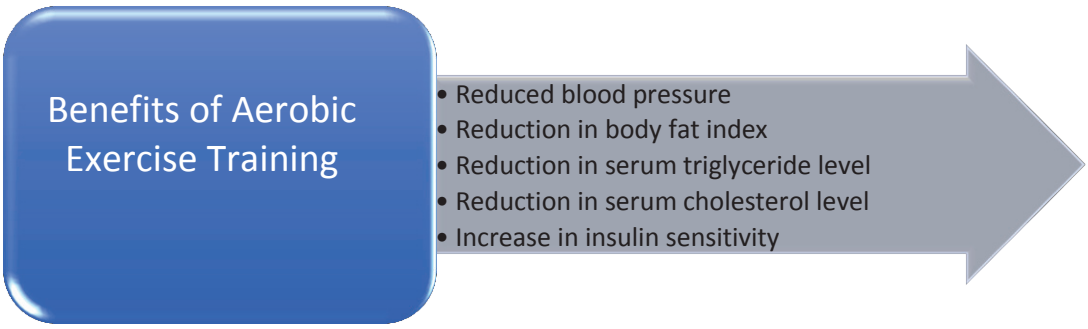


Figure 2: Benefits of Aerobic Exercise Training

Source: Samadian F, et al. Iran J Kidney Dis. 2016;10 (5): 237-263.reference no: 10)

Physical Activity Guide

Aerobic exercises involving large muscle groups are suitable for children and adolescents. These exercises are activities such as long-term walking, cycling or swimming. Resistive exercise training includes the activities performed with sandbags, elastic bands or hand weights to improve muscle strength and cure the cardiac and circulatory system. Studies on children with hypertension showed that aerobic exercise is more effective especially in reducing systolic blood pressure compared to resistive exercise (1.39 mmHg reduction in systolic blood pressure, 0.39 mmHg in diastolic blood pressure, while 0.61 mmHg in systolic blood pressure and0.51 mmHg in diastolic blood pressure). It was shown that aerobic exercise training programs, which last three days a week for more than 60 minutes, have a more significant effect on systolic blood pressure reduction, while the programs performed more than three days a week are more effective on diastolic blood pressure.

Moderate-severe physical activity at least five days a week for 30-60 minutes is recommended for children and adolescents with hypertension (moderate physical activity: activity that reaches 55-75% of maximum cardiac rate, severe physical activity: activity that reaches 65-85% of maximum cardiac rate). Physical activity can be applied as a non-regular activity or as a regular and structured exercise program or sport. Aerobic exercises such as walking, running, cycling, swimming and rowing are usually preferred. Strength training for hypertensive persons should be done in conjunction with aerobic exercise training. Resistive exercise training is recommended two-three days a week for children and adolescents with hypertension. Exercises targeting the main muscle groups and for upper and lower extremities are given. Target muscle groups in the lower extremity are usually quadriceps, hamstring muscles, gluteus maximus/medius and gastrosoleus muscles.

In the upper extremity, the target muscle groups are biceps, triceps, deltoid, trapezius, latissimus dorsi and pectoralis major/minor. These exercises are recommended to perform 1-3 sets, 8-12 repeats in 60-80% of a maximum repetition of 8-10 different exercises to increase both muscle strength and endurance. (A maximum repeat refers the maximum weight that can be lifted. Exercises in resistive training should be done rhythmically, under a slow-moderate controlled speed, avoiding the Valsalva maneuver).

American Academy of Pediatrics does not put a limitation on children and adolescents with prehypertension and phase-Ihypertension without target organ damage for competitive sports. Dietary changes that are applied in conjunction with regular exercise are suggested in lifestyle regulation. Since isometric resistive exercises (such as weight lifting or push-ups) may cause sudden increase in blood pressure, they are not recommended for children with phase 2 hypertension and without target organ damage. It is recommended to restrict the competitive sports and high static sports for children and adolescents with target organ damage and without uncontrolled Phase 2 hypertension.

Table 15 essentially indicates the sports where blood pressure-related cardiac and circulation involvementis intense. These are sports that are not suitable for hypertensive children and adolescents.

Table 15. Sports not appropriate for Hypertensive Children and Adolescents

Mountaineering, climbing
Athletics: speed, leap, jump, heptathlon, decathlon
Sledding
Weightlifting, body building
Speed bike, downhill mountain bike
Artistic gymnastics
Synchronized swimming
Motorcycle (motocross, enduro, trial drive)
Water skiing
Skiing: slalom, giant slalom, downhill, alpine, snowboard, grass skiing
Surfing

Risks of Physical Activities

It should be confirmed that any underlying cardiovascular abnormality (e.g. hypertensive cardiomyopathy) is not observed in hypertensive children before any exercise training is suggested.

Key Recommendations According to the Severity of Hypertension

- In children and adolescents with high-normal blood pressure, there is no restriction on the type of sporting activities and it is recommended that blood pressure values be checked at least twice a year.
- In cases with stage 1 hypertension, a detailed assessment should be made to understand if there is target organ damage in addition to the recommendations in cases with high-normal blood pressure. Patients who do not have normal levels of blood pressure despite medication should not start physical activity. If there is no target organ damage, medical treatment with no negative effect on performance should be initiated. Thus, children and adolescents can participate in sportive activities more easily.
- In stage 2 hypertension, it is not advisable to perform mainly isometric and vigorous intensity sports such as weightlifting and repetitive shuttles, push-ups even if there is no organ damage. These activities can lead to sudden and rapid increases in blood pressure.
- Children and adolescents with resting blood pressure >200/110 mmHg should not be allowed to doexercise and sports.
- People suffer dehydration and loss of sodium during exercise and sportive activities, thus stimulating the renin angiotensin system which increases hypertension. For this reason, it is important to have adequate water consumption during and after exercise.

Although there is little information about exercise training in pediatric hypertension, physical activity and exercise is an important non-pharmacological treatment approach that helps controlling blood pressure in this disease group. It will be possible to get evidence-based data through the studies on pediatric hypertension and physical activity, which are new and promising research areas.

ANNEXES

1. Blood pressure percentiles in boys by age and height

		SBP (mmHg) percentile of height							DBP (mmHg) percentile of height						
Age (years)	BP percentile	5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
1	90th	94	95	97	99	100	102	103	49	50	51	52	53	53	54
	95th	98	99	101	103	104	106	106	54	54	55	56	57	58	58
	99th	105	106	108	110	112	113	114	61	62	63	64	65	66	66
2	90th	97	99	100	102	104	105	106	54	55	56	57	58	58	59
	95th	101	102	104	106	108	109	110	59	59	60	61	62	63	63
	99th	109	110	111	113	115	117	117	66	67	68	69	70	71	71
3	90th	100	101	103	105	107	108	109	59	59	60	61	62	63	63
	95th	104	105	107	109	110	112	113	63	63	64	65	66	67	67
	99th	111	112	114	116	118	119	120	71	71	72	73	74	75	75
4	90th	102	103	105	107	109	110	111	62	63	64	65	66	66	67
	95th	106	107	109	111	112	114	115	66	67	68	69	70	71	71
	99th	113	114	116	118	120	121	122	74	75	76	77	78	78	79
5	90th	104	105	106	108	110	111	112	65	66	67	68	69	69	70
	95th	108	109	110	112	114	115	116	69	70	71	72	73	74	74
	99th	115	116	118	120	121	123	123	77	78	79	80	81	81	82
6	90th	105	106	108	110	111	113	113	68	68	69	70	71	72	72
	95th	109	110	112	114	115	117	117	72	72	73	74	75	76	76
	99th	116	117	119	121	123	124	125	80	80	81	82	83	84	84
7	90th	106	107	109	111	113	114	115	70	70	71	72	73	74	74
	95th	110	111	113	115	117	118	119	74	74	75	76	77	78	78
	99th	117	118	120	122	124	125	126	82	82	83	84	85	86	86
8	90th	107	109	110	112	114	115	116	71	72	72	73	74	75	76
	95th	111	112	114	116	118	119	120	75	76	77	78	79	79	80
	99th	119	120	122	123	125	127	127	83	84	85	86	87	87	88
9	90th	109	110	112	114	115	117	118	72	73	74	75	76	76	77
	95th	113	114	116	118	119	121	121	76	77	78	79	80	81	81
	99th	120	121	123	125	127	128	129	84	85	86	87	88	88	89
10	90th	111	112	114	115	117	119	119	73	73	74	75	76	77	78
	95th	115	116	117	119	121	122	123	77	78	79	80	81	81	82
	99th	122	123	125	127	128	130	130	85	86	86	88	88	89	90
11	90th	113	114	115	117	119	120	121	74	74	75	76	77	78	78
	95th	117	118	119	121	123	124	125	78	78	79	80	81	82	82
	99th	124	125	127	129	130	132	132	86	86	87	88	89	90	90
12	90th	115	116	118	120	121	123	123	74	75	75	76	77	78	79
	95th	119	120	122	123	125	127	127	78	79	80	81	82	82	83
	99th	126	127	129	131	133	134	135	86	87	88	89	90	90	91
13	90th	117	118	120	122	124	125	126	75	75	76	77	78	79	79
	95th	121	122	124	126	128	129	130	79	79	80	81	82	83	83
	99th	128	130	131	133	135	136	137	87	87	88	89	90	91	91
14	90th	120	121	123	125	126	128	128	75	76	77	78	79	79	80
	95th	124	125	127	128	130	132	132	80	80	81	82	83	84	84
	99th	131	132	134	136	138	139	140	87	88	89	90	91	92	92
15	90th	122	124	125	127	129	130	131	76	77	78	79	80	80	81
	95th	126	127	129	131	133	134	135	81	81	82	83	84	85	85
	99th	134	135	136	138	140	142	142	88	89	90	91	92	93	93
16	90th	125	126	128	130	131	133	134	78	78	79	80	81	82	82
	95th	129	130	132	134	135	137	137	82	83	83	84	85	86	87
	99th	136	137	139	141	143	144	145	90	90	91	92	93	94	94
17	90th	127	128	130	132	134	135	136	80	80	81	82	83	84	84
	95th	131	132	134	136	138	139	140	84	85	86	87	87	88	89
	99th	139	140	141	143	145	146	147	92	93	93	94	95	96	97

Source: American pediatric blood pressure normative data, 2004, Pediatrics 2004; 114 (2 Suppl 4th Report): 555-76 and EuropeanPediatric Hypertension Manual, 2016. Lurbe E, et al. J Hypertens 2016; 34 (10): 1887-1920

It is recommended to refer to adult guide values instead of reference values for boys older than the age of 16 in the framed section (See Table 2).

2. Blood pressure percentiles in girls by age and height

		SBP (mmHg) percentile of height							DBP (mmHg) percentile of height						
Age (years)	BP percentile	5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
1	90th	97	97	98	100	101	102	103	52	53	53	54	55	55	56
	95th	100	101	102	104	105	106	107	56	57	57	58	59	59	60
	99th	108	108	109	111	112	113	114	64	64	65	65	66	67	67
2	90th	98	99	100	101	103	104	105	57	58	58	59	60	61	61
	95th	102	103	104	105	107	108	109	61	62	62	63	64	65	65
	99th	109	110	111	112	114	115	116	69	69	70	70	71	72	72
3	90th	100	100	102	103	104	106	106	61	62	62	63	64	64	65
	95th	104	104	105	107	108	109	110	65	66	66	67	68	68	69
	99th	111	111	113	114	115	116	117	73	73	74	74	75	76	76
4	90th	101	102	103	104	106	107	108	64	64	65	66	67	67	68
	95th	105	106	107	108	110	111	112	68	68	69	70	71	71	72
	99th	112	113	114	115	117	118	119	76	76	76	77	78	79	79
5	90th	103	103	105	106	107	109	109	66	67	67	68	69	69	70
	95th	107	107	108	110	111	112	113	70	71	71	72	73	73	74
	99th	114	114	116	117	118	120	120	78	78	79	79	80	81	81
6	90th	104	105	106	108	109	110	111	68	68	69	70	70	71	72
	95th	108	109	110	111	113	114	115	72	72	73	74	74	75	76
	99th	115	116	117	119	120	121	122	80	80	80	81	82	83	83
7	90th	106	107	108	109	111	112	113	69	70	70	71	72	72	73
	95th	110	111	112	113	115	116	116	73	74	74	75	76	76	77
	99th	117	118	119	120	122	123	124	81	81	82	82	83	84	84
8	90th	108	109	110	111	113	114	114	71	71	71	72	73	74	74
	95th	112	112	114	115	116	118	118	75	75	75	76	77	78	78
	99th	119	120	121	122	123	125	125	82	82	83	83	84	85	86
9	90th	110	110	112	113	114	116	116	72	72	72	73	74	75	75
	95th	114	114	115	117	118	119	120	76	76	76	77	78	79	79
	99th	121	121	123	124	125	127	127	83	83	84	84	85	86	87
10	90th	112	112	114	115	116	118	118	73	73	73	74	75	76	76
	95th	116	116	117	119	120	121	122	77	77	77	78	79	80	80
	99th	123	123	125	126	127	129	129	84	84	85	86	86	87	88
11	90th	114	114	116	117	118	119	120	74	74	74	75	76	77	77
	95th	118	118	119	121	122	123	124	78	78	78	79	80	81	81
	99th	125	125	126	128	129	130	131	85	85	86	87	87	88	89
12	90th	116	116	117	119	120	121	122	75	75	75	76	77	78	78
	95th	119	120	121	123	124	125	126	79	79	79	80	81	82	82
	99th	127	127	128	130	131	132	133	86	86	87	88	88	89	90
13	90th	117	118	119	121	122	123	124	76	76	76	77	78	79	79
	95th	121	122	123	124	126	127	128	80	80	80	81	82	83	83
	99th	128	129	130	132	133	134	135	87	87	88	89	89	90	91
14	90th	119	120	121	122	124	125	125	77	77	77	78	79	80	80
	95th	123	123	125	126	127	129	129	81	81	81	82	83	84	84
	99th	130	131	132	133	135	136	136	88	88	89	90	90	91	92
15	90th	120	121	122	123	125	126	127	78	78	78	79	80	81	81
	95th	124	125	126	127	129	130	131	82	82	82	83	84	85	85
	99th	131	132	133	134	136	137	138	89	89	90	91	91	92	93
16	90th	121	122	123	124	126	127	128	78	78	79	80	81	81	82
	95th	125	126	127	128	130	131	132	82	82	83	84	85	85	86
	99th	132	133	134	135	137	138	139	90	90	90	91	92	93	93
17	90th	122	122	123	125	126	127	128	78	79	79	80	81	81	82
	95th	125	126	127	129	130	131	132	82	83	83	84	85	85	86
	99th	133	133	134	136	137	138	139	90	90	91	91	92	93	93

Source: American pediatric blood pressure normative data, 2004, Pediatrics 2004; 114 (2 Suppl 4th Report): 555-76 and European Pediatric Hypertension Manual, 2016. Lurbe E, et al. J Hypertens 2016; 34 (10): 1887-1920

It is recommended to refer to the adult guide values instead of the reference values for girls older than the age of 16 in the framed section (See Table 2).

REFERENCES

1. *Akber A, Portale AA, Johansen KL. Use of pedometers to increase physical activity among children and adolescents with chronic kidney disease. PediatrNephrol 2014; 29 (8): 1395-1402.*
2. *Alayli G, Ozkaya O, Bek K, et alPhysical function, muscle strength and muscle mass in children on peritoneal dialysis. PediatrNephrol 2008; 23 (4): 639-4.*
3. *American College of Sports Medicine. ACMS's Guidelines for Exercise Testing and Prescription Medicine. 9th ed.Philadelphia: Lippincott Williams & Wilkins/Wolters Kluwer Health; 2013.*
4. *American College of Sports Medicine. ACMS's Resource Manual Guidelines for Exercise Testing and Prescription. 6th ed.Philadelphia: Lippincott Williams & Wilkins / Wolters Kluwer Health; 2010.*
5. *Bakkaloglu SA, Ekim M, Sever L, et al. Chronic peritoneal dialysis in Turkish children: a multicenter study. PediatrNephrol2005; 20 (5): 644-51.*
6. *Bakkaloglu SA, Wesseling-Perry K, Salusky IB. Chronic kidney disease-mineral and bone disorder (CKD-MBD) in children. In: Klaus Olgaard, Justin Silver, Isidro Salusky (eds). The Spectrum of Mineral and Bone Disorder in Chronic Kidney Disease.2nd ed., 2010, Oxford University Press, Oxford, pp 485-508.*
7. *Cai L, Wu Y, Wilson RF, et al. Effect of childhood obesity prevention programs on blood pressure. A systematic review and meta-analysis. Circulation 2014; 129 (18): 1832-9.*
8. *DerakhshanA, Derakhshan D, Amoozgar H, et al. Exercise test in pediatric renal transplant recipients and its relationship with their cardiac function. Pediatr Transplant 2014; 18 (3): 246-53.*
9. *Expert panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents: summary report. Pediatrics 2011;128 Suppl 5: S213–56.*
10. *Garcia-Hermoso A, Saavedra JM, and Escalante Y. Effects of exercise on resting blood pressure in obese children: a meta-analysis of randomized controlled trials. Obesity Rev 2013; 14 (11): 919-28.*
11. *Goldestein SL. Physical functioning in children with end stage renal disease: small step first. Pediatr Transplant 2009; 13 (7): 802-4.*
12. *Graham L. AAP updates policy statement on athletic participation by children and adolescents with systemic hypertension.Am Fam Phys 2010; 82 (10): 1285.*
13. *Hamiwka LA, Cantell M, Crawford S, et al. Physical activity and health quality of life in children following kidney transplantation. Pediatr Transplant 2009; 13 (7): 861–867.*
14. *Harris KC, Benoit G, Dionne J, et get; CHEP Guidelines Task Force. Hypertension Canada's 2016Canadian Hypertension Education Program Guidelines for Blood Pressure Measurement, Diagnosis, and Assessment ofRisk of Pediatric Hypertension. Can J Cardiol 2016; 32 (5): 589-97.*
15. *K/DOQI Workgroup. K/DOQI clinical practice guidelines for cardiovascular disease in dialysis patients. Am J Kidney Dis2005;45 (4 Suppl 3): S1–S153.*
16. *Kavey RE, Allada V, Daniels SR, et al., American Heart Association Expert Panel on Population and Prevention Science; American Heart Association Council on Cardiovascular Disease in the Young; American Heart Association Council on Epidemiology and Prevention; American Heart Association Council on Nutrition, Physical Activity and Metabolism; American Heart Association Council on High Blood Pressure Research; American Heart Association Council on Cardiovascular Nursing; American Heart Association Council on the Kidney in Heart Disease; Interdisciplinary Working Group on Quality of Care and Outcomes Research. Cardiovascular risk reduction in high-risk pediatric patients: a scientific statement from the American Heart Association Expert Panel on Population and Prevention Science; the Councils on Cardiovascular Disease in the Young, Epidemiology and Prevention, Nutrition, Physical Activity and Metabolism, High Blood Pressure Research, Cardiovascular Nursing, and the Kidney in Heart Disease; and the Interdisciplinary Working Group on Quality of Care and Outcomes Research: endorsed by the American Academy of Pediatrics. Circulation 2006; 114 (24): 2710-38.*
17. *Kouidi E, Albani M, Natsis K, et al. The effects of exercise training on muscle atrophy in haemodialysis patients. NephrolDial Transplant 1998; 13 (3): 685–699.*
18. *Lubrano R, Tancredi G, Bellelli E, et al. Influence of physical activity on cardiorespiratory fitness in children after renal transplantation. Nephrol Dial Transplant 2012; 27 (4): 1677-1681.*
19. *Lubrano R, Tancredi G, Falsaperla R, et al. Cardiorespiratory fitness: a comparison between children with renal transplantation and children with congenital solitary functioning kidney. Ital J Pediatr 2016; 42 (1): 90.*
20. *Lurbe E, Agabiti-Roseic E, Cruickshank JK, et al. 2016 European Society of Hypertension guidelines for the management of high blood pressure in children and adolescents. J Hypertens 2016; 34 (10): 1887-1920*
21. *Morishita Y, Nagata D. Strategies to improve physical activity by exercise training in patients with chronic kidney disease. Int J NephrolRenovasc Dis 2015; 8: 19-24.*
22. *National Kidney Foundation. K/DOQI clinical practice guidelines for chronic kidney disease: evaluation, classification, and stratification. Am J Kidney Dis 2002; 39 (Suppl 1): S1–S266.*

23. *Oded Bar-Or, Rowlands TW. Hematologic, oncologic and renal disease. In: Oded Bar-Or, Rowlands TW, eds. PediatricExercise Medicine: From Physiologic Principles to Health Care Application. Champaign, IL: Human Kinetics, 2004: 305–322.*
24. *Paglialonga F, Lopopolo A, Scarfia RV, et al. Correlates of exercise capacity in pediatric patients on chronic hemodialysis. J Ren Nutr 2013; 23 (5): 380-386.*
25. *Paglialonga F, Lopopolo A, Scarfia RV, et al. Intradialytic cycling in children and young adults on chronic hemodialysis. PediatrNephrol 2014; 29 (3): 431-8.*
26. *Pate RR, Davis MG, Robinson TN, et al; American Heart Association Council on Nutrition, Physical Activity, and Metabolism(Physical Activity Committee); Council on Cardiovascular Disease in the Young; Council on CardiovascularNursing.Promoting physical activity in children and youth: a leadership role for schools: a scientific statement from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Physical Activity Committee) in collaboration with the Councils on Cardiovascular Disease in the Young and Cardiovascular Nursing. Circulation 2006; 114 (11): 1214-24.*
27. *Pattaragarn A, Warady BA, Sabath RJ. Exercise capacity in pediatric patients with end-stage renal disease. Perit Dial Int2004; 24 (3): 274-80.*
28. *Pescatello LS, Franklin BA, Fagard R, et al. American College of Sports Medicine. American College of Sports Medicine position stand. Exercise and hypertension. Med Sci Sports Exerc 2004; 36 (3): 533-53.*
29. *Samadian F, Dalili N, Jamalian A. Lifestyle Modifications to Prevent and Control Hypertension. Iran J Kidney Dis 2016; 10 (5): 237-263.*
30. *Samuels J, Bell C, Samuel J, et al. Management of Hypertension in Children and Adolescents. CurrCardiol Rep 2015; 17 (12): 107.*
31. *Schaar B, Feldkötter M, Nonn JM, et al. Cardiorespiratory capacity in children and adolescents on maintenance haemodialysis. Nephrol Dial Transplant 2011; 26 (11): 3701-3708.*
32. *Schultz M, Park C, Sharman Jet al. Exaggerated Exercise Blood Pressure is Associated with Higher Left Ventricular Mass inAdolescence. The Avon Longitudinal Study of Parents and Children. J Hypertens 2016; 34 (Suppl 1): e 55.*
33. *Sheng K1,Zhang P, Chen L, et al. Intradialytic exercise in hemodialysis patients: a systematic review and meta-analysis.Am J Nephrol 2014; 40 (5): 478-90.*
34. *Tangeraas T, Midtvedt K, Fredriksen PM, et al. Cardiorespiratory fitness is a marker of cardiovascular health in renal transplanted children. PediatrNephrol 2010; 25 (11): 2343–2350.*
35. *The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents.Pediatrics 2004; 114 (2 Suppl 4th Report): 555-76.*
36. *TürkNefrolojiDerneği 2014 KayıtRaporu. http://www.tsn.org.tr/folders/file/2014-REGISTRY-KITABI.pdf.*
37. *TürkiyeBöbrekHastalıklarıÖnlemeveKontrolProgramı (2014-2017), Ankara 2014.*
38. *Watanabe FT, Koch VH, Juliani RC, et al. Six-minute walk test in children and adolescents with renal diseases: tolerance, reproducibility and comparison with healthy subjects. Clinics (Sao Paulo) 2016; 71 (1): 22-7.*
39. *Whelton SP, Chin A, Xin X, et al. Effect of aerobic exercise on blood pressure: a meta-analysis of randomized, controlled trials. Ann Intern Med 2002; 136: 493-503*

SECTION 6

PHYSICAL ACTIVITY AND EXERCISE IN NEUROLOGICAL DISEASES

AUTHORS:

Hatice YAĞMURDUR, MD Prof. (President)	*Kafkas University, Faculty of Medicine, Department of Anesthesiology and Reanimation*
Öznur YILMAZ, PT PhD Prof.	*Hacettepe University, Faculty of Health Sciences,Department of Physiotherapy and Rehabilitation*
Burcu Semin AKEL, PT PhD Assoc. Prof.	*Hacettepe University, Faculty of Health Sciences,Department of Physiotherapy and Rehabilitation*
Kürşat Bora ÇARMAN, MD Assoc. Prof.	*Osman Gazi University, Faculty of Medicine, Department of Child Health and Diseases*
Bülent ELBASAN, PT PhD Assoc. Prof.	*Gazi University, Faculty of Health Sciences,Department of Physiotherapy and Rehabilitation*
Bahadır KONUŞKAN, MD Asst. Prof.	*Hacettepe University, Faculty of Medicine, Department of Child Health and Diseases*
Selda TEKİNER, MD Asst. Prof.	*Ankara University, Faculty of Medicine, Family Medicine Department*
İnci YANIKOĞLU, MD	*Turkish Social Security Institution*
Ceren ARMUT Dietitian	*T.R. Ministry of Health, General Directorate of Public Health*

ABSTRACT

Children with chronic neurological disease are less active than their healthy peers. Many sub-optimal reasons, including biological, psychological and social factors,fitness may cause this. Physical activity contributes to overall health and affects the recovery of the disease in positive way. Every child with chronic neurological disease should be assessed by an experienced specialist to identify any contraindications that may pose and obstacle for physical activity. The lack of safe physical activity guidelines to raise activity in these children is an important issue. This guideline is compiled to reveal the importance, benefits, method and possible risks during activity with regard to Down syndrome and other diseases that course with cerebral palsy, neuromuscular diseases, neurodegenerative diseases, epilepsy and hypotonia.

In children with chronic illness, physical activity should be planned specifically for the child, taking into account the clinical features of the disease. It is of great importance to select the right physical activity, determine the duration and intensity in the course of practice, give appropriate intervals of rest, take care of individual tolerance of child and end the physical activity. Furthermore, it will increase the success if physical activity is performed in the appropriate environment, in the right positions and by considering possible risks. In addition to this, the active participation of the child in physical activity and performance with support and supervision of family and friends is an important criterion.

2. 1. CEREBRAL PALSY

Definition

Cerebral Palsy (SP) defines a group of permanent impairments in movement and posture development, resulting in activity limitations, due to non-progressive disorders that occur in the developing fetal and neonatal brain. Lesion in the brain, progressive musculoskeletal insufficiency, even static, is seen in most of children. Secondary problems such as contractures, torsional deformities, hip protrusion, and spinal deformities contribute to functional retardation. Most of these problems continues throughout life and are related to physical growth, spasticity, muscle weakness, ageing and other factors.

Classification

There are some classifications in SP by localization of the lesion, tonus changes, type of movement impairmentand affected body parts (anatomical).

Table 16. Cerebral Palsy Classification

SCPE (Surveillance of Cerebral Palsy in Europe) **Cerebral Palsy Classification**		All subtypes of CP have abnormal motion patterns and postures.
Spastic Cerebral Palsy	• Bilateral spastic CP (Diparetic and quadriparetic) • Unilateral Spastic Cerebral Palsy (hemiparetic)	Additional features according to subtypes: Spastic type SP is characterized by at least two: Increased tonus Pathological reflexes Increase in reflexes Pyramidal symptoms Abnormal posture and/or movements
Dyskinetic Cerebral Palsy	• Dystonic • Choreoid-Athetoid	Involuntary, uncontrolled, repetitive, stereotype movements, primitive reflex patterns, intermittent spasm, muscle fluctuation
Ataxic Cerebral Palsy		Loss of muscle control that makes movements in an abnormal force, rhythm and accuracy form

ICF-CY (International Classification of Functionality, Disability and of Health for Children and Youth) provides a framework for explaining the interaction between health, body structure, function, activity and disability, environmental and personal factors in the general state of an individual. All date in the ICF-CY model should be used in the evaluation and therapy of children with CP and families. It enables us to evaluate the problems of the individuals with CP starting from body structure in theholistic approach and to understand how the accompanying impairments affect the activity level and also to evaluate the community involvement, which is the most crucial target, as result of the therapy.

It also enables us to take into consideration the personal and environmental factors which affect theimpairment, activity and involvement during such an evaluation (Figure 3).

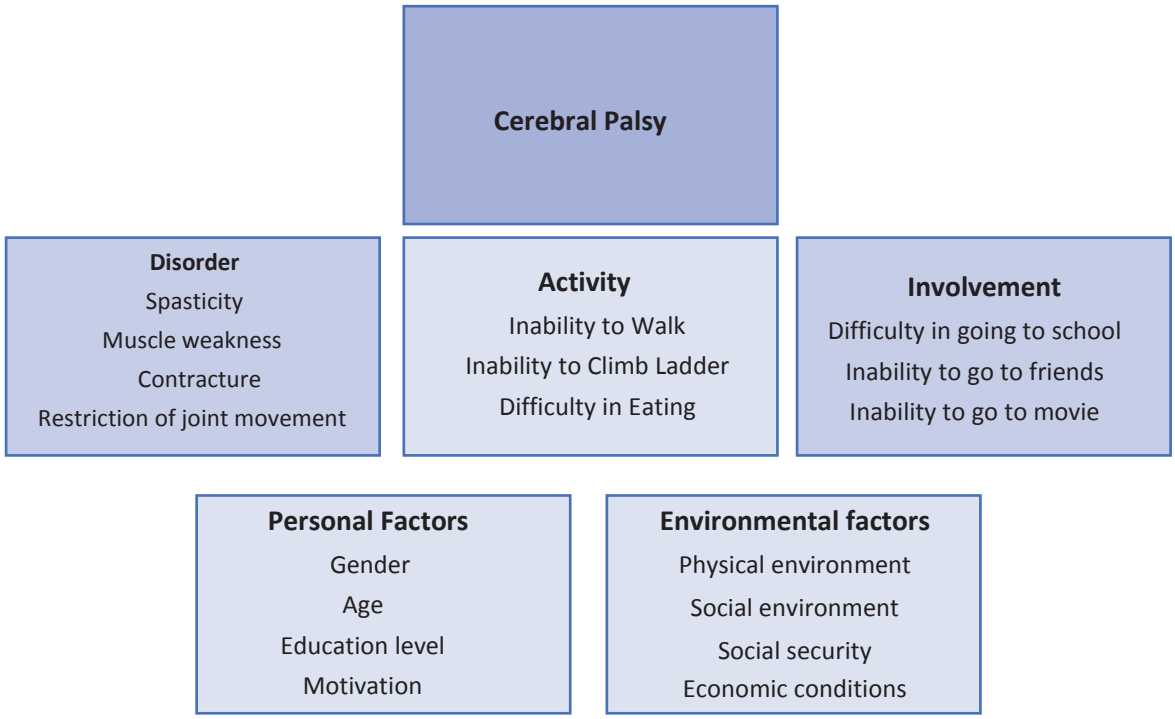


Figure 3. Cerebral Palsy and ICF

Prevalence/Incidence

CP prevalence is indicated as 2-2.5 per 1000 live births. In a study in Turkey, CP prevalence was reported to be 4.4 per 1000 live births. CP may be caused by prenatal, natal or postnatal conditions. The causes include intrauterine infections, high frequency of fever and infectious diseases in infants, diseases during pregnancy, negative delivery conditions and nutritional deficiencies.

Prognosis

The prognosis in cerebral palsy varies according to CP type, severity and accompanying comorbidities. In general, children who have neck control up to 9 months, can sit without support for up to 24 months and crawl up to 30 months are expected to walk.

Treatment

CP therapy is a disease that requires a lifelong multidisciplinary approach. Treatment should be individually planned and should aim to prevent primary musculoskeletal problems, eliminate additional medical problems and ensure independence in daily life and social involvement.

Benefits of Physical Activity

- Promotion of psychomotor development
- Preservation of bone mineral balance
- Weight control and prevention of obesity
- Social skill improvement
- Preservation of cardiopulmonary functions
- Developing of visual, sensory, tactual and motion perceptions
- Protecting and enhancing physical fitness by increasing durability, balance, coordination, strength and flexibility
- Control of abnormal and reflex movement patterns
- Providing improvement in level of impairment, activity and involvement
- Establishing appropriate behavioral responses
- Developing of cognitive functions such as attention
- Improving hand skills
- Reduction in pain and fatigue

Indications

Increased muscle stiffness, postural disturbances, involuntary movements make daily living activities difficult. It causes the individuals with CP to move away the society, their involvements to be restricted and eventually a progressive inactive lifestyle causes obesity. For this reason, physical activity is important for individuals with CP. In children with CP, physical activity is organized individually, taking into account the individual performance of the children.

Physical Activity Prescription

Physical activity should be planned and implemented taking into account the patient's existing physiotherapy rehabilitation program.

For these children, physical activity is described as daily living activities (personal care, food, dressing, etc.),creative activities (game, school, etc.) and leisure time (sports, entertainment, etc.). Physical activity is planned according to each individual's age, clinical status, severity of influence, activity level and other accompanying conditions.

Children with Cerebral Palsy should be ensured to involve in daily activities at the highest possible level. They should be independent by reducing family support as far as possible.
As part of creative activities, activities such as functional and symbolic games, imitation, sense- motor activities, street and home games, park games, walking the pet and trampoline.

Physical Activity Recommended for Children according to Type of Cerebral Palsy

In children with CP, physical activity is suggested to be intermittently planned depending on delayed motor response at every day of week and to be completed to 60 days, at least 10 minutes each.

Walking/Running and Cycling: In addition to physical activity and exercise training, the technological supports as the bicycle and/or treadwheel have an important role in increasing the movement capacity of the person. In this way, as the body systems such as circulation, excretion and digestion work better and more effectively, the burden on the heart is reduced and the oxygen utilization capacities of the tissues are improved. The development of durability provides prevention of fatigue.

Swimming: It enables the individual to perform the physical movements, which are difficult to do on land, with the help of buoyancy of water. Gross motor functions improve muscle strength, walking endurance, balance and aerobic capacity.

Dancing/Gymnastics Activities: While increasing overall flexibility, they constitute a basis for proper posture and movement in the individual with CP. Increased self-confidence thus increases motivation, allowing for further motor skills.

Virtual reality practices: Increased motivation, frequent repetition and increased adaptation to exercise facilitate the performance of the individual to improve among functional skills. If exercise becomes enjoyable, continuity and program participation will be affected positively.

Horseback Riding: They are practices that offer motivation, entertainment, education and/or therapeutic benefits to improve the quality of life of those who will benefit from the practice. It is important to improve balance and coordination.

Spastic Type: For children in this group, activities that generally control muscle strain and improve general balance coordination skills are included. For example, while it is the main target to involve in affected side in a hemiparetic child, it is aimed to develop bilateral activities by involving healthy parts in movement. In the meantime, it must be observed that tonus may increase

in compelling activities to be performed with healthy part. On the other hand, a child with diparetic CP should be considered to be able to increase tonus in the lower extremities by coercive activities with the upper extremity. For this reason, it is suggested that children with spastic type CP should generally perform activities that reduce muscle tonus, prevent muscle shortening and extend the extremities in the direction of extension. For example; swimming is an activity frequently recommended for spastic patients in terms of reducing spasticity and extending the extremities. Horseback riding activity and vestibular training are the activities that are alternative for reducing tonus, improving balance and coordination skills. On the other hand, stretching effect could be utilized in holding and throwing activities such as ball-balloon which could be used during the game. Activities involving dance and gymnastic are very effective methods to increase overall flexibility and gain control. The use of auxiliary equipment could be beneficial in situations where tonus is increasing during walking and running.

Dyskinetic and Ataxic Type: The main purpose of this group is to provide stability and control in children. For this purpose, games involving activities such as pulling-pushing, weight transferring and lifting are recommended. Trampoline activities that are performed with hands, weight exercises, and proprioceptive exercises performed with ball and theraband should be benefited. For example, it is necessary to emphasize the weight transfer by child during the walking with determined targets and boundaries.

Contraindication and Risks

Accompanying problems and troubles, physical activity planning and implementing should be considered in children with CP. These problems are as follows:

a) Epilepsy
b) Malnutrition
c) Bone pathologies
d) Endocrine and metabolic problems
e) Sensory problems such as hearing and vision
f) Mental Retardation

- Children with CP who also have epilepsy should participate in swimming activity under supervision.
- In children with severe malnourished CP, duration and severity of physical activity should be adjusted according to performance.

- Attention should be paid due to bone, joint pathologies (hip dislocations, contractures, joint deformities) and osteoporosis, which may lead to limitations during activity in children with CP, and physical activities that may pose risk should be avoided.
- It is recommended that physical activity should be done in suitable environment, with appropriate equipment and environmental safety for children having impaired hearing, sight and/or mental disabilities.

3.2. Neuromuscular Diseases

Neuromuscular diseases (NMD) are a heterogeneous group of diseases caused by any abnormalities in hereditary or acquired anterior horn motor neuron cells, peripheral nerves, neuromuscular end plate or muscle.

Prevalence and Incidence

The most common NMD is Duchenne Muscular Dystrophy (DMD), which occurs in 1/3600-6000 live male births. Spinal Muscular Atrophy (SMA) is the second most common disease. It is seen at a rate of 1/6000-10000 and the carrier frequency in the general population is 1/40-60.

Causes/Risks

These diseases are inherited. DMD is X-chromosome-related recessively inherited, while SMAis an autosomal recessive disease.

Prognosis

Looking at the prognosis of these diseases, which have a progressive course, a large majority of patients may be confined to bed over the months-years. Life duration does not change in light forms, whereas motor skills failures and decreases in life quality are observed.

Treatment

It is possible to partially treat or fully cure some of the acquired neuromuscular diseases. However, except for a small group of genetic diseases, treatment is currently not possible. In general, therapy focuses on multidisciplinary approaches to symptoms, increasing the life quality, increasing the functioning of the patient and improving survival rate.

Benefits of Physical Activity

- Maintaining muscle strength and delaying the strength loss
- Prevention of shortnesses in muscles and deterioration of joints
- Keeping walking as long as possible
- Prevention of respiratory problems
- Preservation of cardiac capacity
- Prevention of scoliosis development and/or progression
- Promotion of psychomotor development
- Preservation of bone mineral density
- Weight control and prevention of obesity
- Protecting and enhancing physical fitness by increasing durability, balance, coordination, strength and flexibility
- Providing improvement in level of impairment, activity and involvement
- Improving hand skills
- Social skill improvement

Indications

Muscle weakness, postural disturbances, loss of functional capacity make daily living activities difficult. Life functions are affected by the adverse effects of the child's whole body systems. For this reason, physical activity is important for children with neuromuscular disease. In these children, physical activity is organized individually, taking into account the individual performance of the children.

Physical Activity Prescription

If the physical activities are adaptable to daily life, activity level will be ensured. Physical activity prescription to be planned by taking into account the child's functional status and needs will provide more benefits to the child.

While planning physical activity for these children, the activities that bring flexibility and improve/preserve muscle strength and improve aerobic capacity should be included. In order to maintain and improve the breathing capacity, games involving activities such as candle blow out, balloon blow up, etc. should be included in the program.

Physical activity should start with 10 minutes a day and be gradually increased according to the patient's original pathology. Physical activity should continue up to 45 minutes at a time and fatigue should be monitored.

It is recommended to apply stretching exercises for at least 20 minutes before physical activity.

Recommended Activities

Maintaining daily life skills in children in this group is considered to be the most important physical activity. It should be ensured that the child is independent with the least amount of physical support possible, taking into account the individual performance of the child.

It is of great importance to accurately position the body parts of both walking patients and ambulatory and wheelchair-bound patients during physical activities.

Swimming: While tension effect can be created on shortened muscles by games and activities to be done in non-cold water, it is also possible to improve muscle strength and respiratory functions. Proper use of speed during movements is important in save muscle strength.

In these children with muscular weakness, in-water exercises facilitate voluntary movement and increase motivation since the water facilitates movement. However; hygiene, safety and expert supervision are required. Gross motor functions improve muscle strength, walking endurance, balance and aerobic capacity.

Respiratory activities: It is important to take advantage of gaming activities such as blowing, ballooning and triflow in reducing respiration muscles involvement and respiratory distress, which is caused by secondary posture impairment.

Walking: It is important to walk and stand for a long time. As to walking recommendations, physical fitness of child should be taken into consideration and overloading should be avoided. Physician and physiotherapist recommendation are important in recommendations of physical activity and exercise in neuromuscular diseases. Stretching exercises before walking are very important. It causes increase in warm-up and performance.

Virtual reality practices: They should be planned according to the activity level and functional status of the child. It creates activity demand, may provide aerobic performance improvement.

Physical Activities on Wheelchair: Children at this level should be encouraged to use the wheelchair themselves as much as possible, especially in order to improve upper extremity functions. Besides, it is possible to benefit activities such as bowling, table tennis in order to ensure the daily use of the upper extremity.

Contraindications and Risks

- For children with severe malnutrition, duration and severity of physical activity should be adjusted according to performance.
- Attention should be paid during physical activity in terms of cardiac problems (syncope, dyspnea, and arrhythmia).
- Children with swallowing impairment should be cautious during activities.
- Vigorousexercises that may cause any injury to the musculoskeletal system should be avoided.
- Necessary precautions should be taken in regard to the fall that may occur due to muscle strength loss.
- Attention should be paid due to bone, joint pathologies (hip dislocations, contractures, joint deformities) and osteoporosis, which may lead to limitations during activity in children, and physical activities that may pose risk should be avoided.
- It is recommended that physical activity should be done in suitable environment, with appropriate equipment and environmental safety for these children.

3. 4. Epilepsy and Physical Activity

Definition

Convulsion/seizure is short-lived, transient, behavioral or organoleptic changes that occur in the brain due to impairment of the normal functioning of nerve cells due to sudden, excessive, abnormal electrical discharges. Loss of consciousness may or may not accompany. Epilepsy is a condition characterized by recurrent seizures. Epilepsy is in question in the presence of two or more recurrent seizures without any facilitating cause such as fever, drug intake or head trauma.

Classification

Epilepsy is categorized by the International League against Epilepsy (ILAE) as follows:

International Classification of Epilepsy and Epileptic Syndromes

1.Localization-related (focal, local, partial) epilepsies and syndromes

1.1. Idiopathic associated with age of onset

A. Centro temporal prickling benign childhood epilepsy

B. Childhood epilepsy with occipital paroxysmal

1.2. Symptomatic

A. Childhood chronic progressive epilepsy segmental continuous

B. Seizures triggered by specific activation pathways

C. Temporal lobe epilepsies

D. Frontal lobe epilepsies

E. Parietal lobe epilepsies

F. Occipital lobe epilepsies

1.3 Cryptogenic

2. Generalized epilepsies and syndromes

2.1. Idiopathic by age of onset (ordered by age of onset)

- A. Benign neonatal familial convulsions
- B. Benign neonatal convulsions
- C. Infant period benign myoclonic
- D. Childhood absence epilepsy (picnolepsi)
- E. Juvenile absence epilepsy
- F. Juvenile myoclonic epilepsy (impulsive petit mal)
- G. Grand mal epilepsy during waking
- H. Other generalized idiopathic epilepsies not described above
- I. Seizure-induced epilepsies triggered by specific activation pathways

2.2. Idiopathic and/or symptomatic (ordered by age of onset)

- A. West syndrome (infantile spasms)
- B. Lennox Gastaut syndrome
- C. Myoclonic-astatic seizure epilepsy
- D. Myoclonic absence epilepsy

2.3. Symptomatic

- A. Nonspecific etiology
  - a. Early myoclonic encephalopathy
  - b. Early infantile epileptic encephalopathy with "suppression burst"
  - c. Other symptomatic generalized epilepsies not described above
- B. Specific etiology
  - a. Epileptic seizures can be a complication in many diseases

3. Epilepsies and syndromes that have not been identified as focal or generalized

3.1. With both focal and generalized seizures

- A. Neonatal seizures
- B. Severe myoclonic epilepsy in infancy
- C. Continuous spike-wave epilepsy during slow wave sleep
- D. Acquired epileptic aphasia
- E. Other undefined epilepsies not described above

3.2. Without precise generalized or focal findings

4. Special syndromes

4.1. Situation-related seizures

- A. Febrile convulsions
- B. Significant non-provoked epileptic conditions
- C. Seizures not related to defined conditions such as stress, hormonal changes, drug, and alcohol or sleep deprivation

Prevalence/Incidence: Although epilepsy frequency varies by age and country, it is thought that 50 million people are suffering from epilepsy all over the world. In Turkey, epilepsy frequency was found to be 8.6/1000 in a study among school children. In another study, the prevalence of epilepsy in children was reported as 1%.

In the majority of epilepsy patients (60-75%) a cause for seizures cannot be indicated and this type of epilepsy is called as idiopathic epilepsy. In some patients (25-40%) the cause can be indicated and this type of epilepsy is called as symptomatic epilepsy. Causes of epilepsy vary by age.

The most common causes of epilepsy in children are;

- Genetic (chromosomal diseases),
- Congenital family inherited metabolic diseases,
- Causes that negatively affect development the of brain in mother's womb (infectious diseases,excessive bleeding in pregnancy, some medications used by your mother, trauma in pregnancy, vitamin deficiencies),
- Problems during delivery (oxygen insufficiency in brain, cerebral hemorrhage, trauma due to difficultbirth),
- Brain infections, meningitis and very-high jaundice values that develop at any time after delivery),
- Accidental cerebral damage,
- Sudden cerebrovascular disorders (obstruction or hemorrhage)
- Poisoning
- Brain neoplasms

Prognosis

The prognosis in patients with epilepsy depends on the type and cause of epileptic seizure and comorbid problems. In general children, whose seizure activity is well-controlled, not having comorbid disorder,have a good prognosis.

Treatment

The most important point in epilepsy therapy is the regular and planned use of the medications selected for preventing the seizures. Seizures stop if appropriate medications are selected in four out of five patients and taken at adequate doses. Physicians often prefer to start treatment with a single epilepsy medication. If this medication is not able to take the seizures under control adequately, then medication may be changed or a second medication may be added. Surgical interventions may be performed in some selected patients and/or patients where medication is ineffective.

Benefits of Physical Activity

- Promotion of psychomotor development
- Ensuring participation in social activities and increasing self-esteem
- Preventing obesity
- Maintaining and increasing the level of physical fitness
- Enhancing physical fitness by increasing durability, balance, coordination, strength and flexibility
- Establishing appropriate behavioral responses
- Developing cognitive functions such as learning and attention

Indications

Children with epilepsy have the same physical characteristics as their peers only if they have no comorbid except seizures. There are some studies showing that physical activity reduces seizure activity in EEG (Electroencephalography).

Physical Activity Prescription

In children with epilepsy, physical activity can be planned for every day of the week and is recommended to be completed in 60 min, with duration of at least 10 minutes each.

There are three groups of physical activities that children with epilepsy can perform:

Group 1: Activities with low seizure and injury risk; walking, bowling, cycling(using helmet), basketball, volleyball, dancing, table tennis, tennis

Group 2: Activities with medium risk; athletics, skiing, marathon, boxing, karate, horse riding, ice hockey, swimming, shooting

Group 3: Physical activities with high-risk; diving, climbing, competitive horseback riding, parachuting, surfing, jumping

While planning the physical activities, group of activity, possibility of stimulating seizure, frequency and characteristics of the seizure of the patient and demands of child should be considered.

Contraindications and Risks

It is advisable for children with epilepsy to avoid games and/or activities with competition and physical contact that cause extreme fatigue. These children should be absolutely kept under supervision in the course of swimming. It may be beneficial to have an adult nearby who can provide appropriate first aid during the seizure. It is important to consider environmental and personal factors in order to prevent possible injuries during recommended activities in terms of risk control.

3.5. Physical Activity for Neurodegenerative Diseases

Definition

Neurodegenerative diseases are progressive diseases coursing with neuronal damage and loss of function. Brain white matter changes are observed in Pelizaeus-Merzbacher's disease, adrenoleukodystrophy, metachromatic leukodystrophy, while neuronal ceroid lipofucsinosis, Rett Syndrome, Menkes disease as the most common pathologies are associated with gray matter.

Causes and Risks

There are more than 600 diseases that are described under the title of neurodegenerative diseases and those may be of metabolic or genetic origin. A great majority of diseases show autosomal recessive trait.

Prognosis

In these diseases, which progressively involve in many systems, particularly central nervous system damage, a large majority of patients may be confined to bed over months/years. In severe cases, loss of life may be the case in the early stages. In mild forms of the disease,motor/cognitive skills deficiencies and impairment in life quality are observed.

Treatment

There is not an effective therapy for a large proportion of these rarely seen diseases, symptomatic treatment is applied. Multidisciplinary approaches in treatment will help increase the life quality, functioning and prolong the life span of patients.

Benefits of Physical Activity

- Maintaining muscle strength and delaying the strength loss
- Prevention of shortnesses in muscles and deterioration of joints
- Keeping walking as long as possible
- Prevention of respiratory problems
- Preservation of cardiac capacity
- Prevention of scoliosis development and/or progression
- Promotion of psychomotor development
- Preservation of bone mineral density
- Weight control and prevention of obesity
- Protecting and enhancing physical fitness by increasing durability, balance, coordination, strength and flexibility
- Providing improvement in level of impairment, activity and involvement
- Improving hand skills
- Social skill improvement
- Control of abnormal and reflex movement patterns

Indications

Increased muscle stiffness, postural disturbances, involuntary movements make daily living activities difficult. Neurodegenerative diseases cause the individuals to drop out of society, their involvements to be restricted and eventually a progressive inactive lifestyle causes obesity. For this reason, physical activity is important for individuals with neurodegenerative disease. In these children, physical activity is organized individually, taking into account the performance of the children.

Physical Activity Prescription

Physical activity should be planned and implemented taking into account the patient's physiotherapy rehabilitation program.

For these children, physical activity is described as daily living activities (personal care, food, dressing, etc.),creative activities (game, school, etc.) and leisure time (sports, entertainment, etc.). Physical activity can be increased from 10 minutes up to 60 minutes according to child's age, clinical status, exposure density, activity level and other accompanying cases. Physical activity can be planned for each day of the week for children with neurodegenerative disease.

Children with neurodegenerative disease should be involved in daily activities at the highest level possible. They should be independent by reducing family support as far as possible.

As part of creative activities, activities such as functional and symbolic games, imitation, activities supporting sense-motor development, street and home games, park games, walking the pet outside and trampoline.

Independent participation in the activities of eating, dressing, personal care (tooth brushing, haircombing), toilet and bathroom activities as part of daily life routine should be ensured. Verbal and physical assistance may be provided where necessary.

In the context of leisure time activities, the games which improve cognitive and motor functions and advance balance/coordination skills such as drop the handkerchiefs, hide and seek, ball throwing/catching games, push/pull games, imitation games, sand games, rhythm and dance activities in music accompaniment, catching/rolling games, hopscotch, jumping rope, checkers and chess are recommended. In addition to motor development, activities that support cognitive, language-speaking, psychomotor and emotional development should be included.

If spasticity, movement disorders and epilepsy are in question, the above recommended physical activity programs should be used for children with CP and epilepsy.

Contraindications and Risks

Children with neurodegenerative disease are advised to avoid games and/or activities, which include competition and/or physical contact that cause overfatigue and physical contact. It is important to consider environmental and personal factors in order to prevent possible injuries during recommended activities in terms of risk control.

- For children with severe malnutrition, duration and severity of physical activity should be adjusted according to performance.
- A grownup should be nearby in order to do appropriate first aid during the seizure.
- Attention should be paid during the activities for children with swallowing impairment.
- Vigorousexercises that may cause any injury to the musculoskeletal system should be avoided.
- Necessary precautions should be taken in regard to the fall that may occur with the cause of neuromotor problems (loss of strength, spasticity, etc.).
- Attention should be paid due to bone, joint pathologies (hip dislocations, contractures, joint deformities) and osteoporosis, which may lead to limitations during activity in children, and physical activities that may pose risk should be avoided.
- It is recommended that physical activity should be done in suitable environment, with appropriate equipment and environmental safetyfor these children.

3.6. Physical Activity in the Diseases Coursing with Down Syndrome and Hypotonia

3.6.1. Down Syndrome

Definition

Down syndrome is the most common chromosomal disorder. The patient has dysmorphic findings, hypotonia and mental retardation. Down syndrome may have additional medical pathologies such as endocrine problems (hypothyroidism), congenital cardiac disease, and retarded development.

Classification

Down syndrome could be classified as the plethora of chromosome 21 (47 XX/XY +21), translocation or mosaic form by its genetic cause.

Prevalence/Incidence

As the most common chromosomal disease, it is reported that down syndrome is detected in every one out of732 pregnancies in the United States of America. There are 6 million persons with down syndrome live in the world and approximately 100 thousand in Turkey. Encountered in one birth out of 800 on average, Down syndrome is observed in pregnancies over 35. In pregnancies with advanced maternal age, prevalence of Down syndrome increases depending on age.

Prognosis

Since being a chromosomal disease, Down syndrome has multisystemic effects. The prognosis of patients depends on additional medical problems, in particular cardiac pathologies. In the long term, there is an increased risk of leukemia in these patients.

Treatment

The main objective of treatment in Down syndrome is to treat comorbid pathologies (hypothyroidism, congenital cardiac disease, hypotonia). Physical activity programs should be planned in addition to physiotherapy rehabilitation practices to increase the patient's functional capacity and life quality.

3.6.2. Diseases Coursing with Hypotonia

Definition

It is a group of diseases coursing with generalized hypotonia in the body. The hypotonia may be central or peripheral.

Causes/Risks

It is a group of diseases known to be originated from metabolic causes; however, the cause is not identified.

Prevalence/Incidence

A definite prevalence/incidence was not reported.

Prognosis

The prognosis varies depending on the underlying etiologic factors and accompanying pathologies. While development of some of the children catches up with those of the peers within several years, developmental retardation continues in otherpart of the children.

Treatment

The main aim of the therapy is to treat comorbid pathologies (hypotonia, epilepsy, mental retardation). Physical activity programs should be planned in addition to physiotherapy rehabilitation practices to increase the patient's functional capacity and life quality.

Benefits of Physical Activity in Diseases Coursing with Down Syndrome and Hypotonia

- Acquisition of postural control (stability, posture and balance)
- Development of motor skills
- Ensuring proper posture
- Increase the quality of gross and fine motor movements
- Providing sensory integrity
- Muscle tone regulation, muscle strength and durability increase
- Preventing the compensatory movements and deformities
- Increasing the life quality
- Promoting the healthy psychomotor development
- Ensuring and increasing participation in social activities
- Weight control and prevention of obesity
- Regulation of blood pressure and cardiac rate

Indications

The most important indications of physical activity in these children are to provide normal tonus by controlling of hypotonia and to prevent obesity. In addition, physical activity is very important in controlling hemodynamic responses in children with cardiac problems.

Physical Activity Prescription

Physical activity can be increased from 10 minutes up to 60 minutes according to child's age, clinical status, exposure density, activity level and other accompanying cases.

The physical activity program to be prepared in parallel with the rehabilitation program initiated from the early period should cover the following practices:

It is advisable to begin with the activities such as grabbing, leaving and stretching on the activity carpet, by which visual monitoring could be made during object manipulation, and then to advance to the activities such as table tennis, jewelry design, painting etc. by their age and development levels in order to improve hand-eye coordination in children.

It is recommended to start with hit the target games, toy block bucket, pyramid ring toy and to continue with basketball, hopscotch, rope jumping, push-pull games, which stabilize body posture, use the upper and lower extremities for the purposeand improve the postural control and balance.

In all selected physical activities, vestibular, tactile and proprioceptive stimulations should be used to regulate sensory processing. For this purpose; the suggested activities are playing on the swings, climbing, teeter totter activities, walking-running activities on different grounds, sand pool games and ball games.

In addition to the activities listed above, aerobic content swimming, running, team sports (tennis, basketball, handball, volleyball, etc.) can be recommended depending on the functional status and tolerance to improve overall performance. Attention should be paid to prevent the risk of injury by taking into account personal and environmental factors during the activities.

Contraindication and Risks

- Attention should be paid to the subluxation that may be caused by increased joint laxity.
- The risk of fracture due to frequently seen falls and injuries by hypotonia should be considered.
- Necessary individual and environmental safety precautions should be taken in case of epilepsy.
- Hemodynamic responses (syncope, rhythm disturbances, dyspnea, etc.) should not be ignored in children with advanced cardiac problems.

REFERENCES

1. *Alemdaroğlu İ, Bozgeyik S, Bulut N et al. Pediatrik Nöromüsküler Hastalıklarda Fizyoterapi Rehabilitasyon. Ed. Bülent Elbasan. Pediatrik Fizyoterapi Rehabilitasyon. 1. Baskı. İstanbul, İstanbul Tıp Kitabevi; 2017. s 153-162.*
2. *Arısoy G, Bayraktaroğlu F. Down Sendromlu Çocuklarda Fizyoterapi Rehabilitasyon. Ed. Bülent Elbasan. Pediatrik Fizyoterapi Rehabilitasyon. 1. Baskı. İstanbul, İstanbul Tıp Kitabevi; 2017. s 163-174.*
3. *Berg A, Berkovic S, Brodie M, et al. Revised terminology and concepts for organization of seizures and epilepsies: report of the ILAE Commission on Classification and Terminology, 2005–2009. Epilepsia 2010; 51:676–685.*
4. *Boustany RMN, El-Bitar MK. Degeneartive Disorders Primarily of Gray Matter. In Swainman KF, Ashwal S, Ferriero DM, Schor NF, eds. Swainman's Textbook of Neurology. Fifth edition, Philedelphia, Elsevier Saunders; 2012, p 518-543.*
5. *Capovilla G, Kaufman KR, Perucca E, et al. Epilepsy, seizures, physical exercise, and sports: A report from the ILAE Task Force on Sports and Epilepsy. Epilepsia. 2016 Jan;57(1):6-12.*
6. *Elbasan B, Duzgun İ. Fiziksel Aktivite Skalaları-Kanıta Dayalı Fiziksel Aktivite. Turkiye Klinikleri J Physiother Rehabil-Special Topics 2016;2(1):36-9.*
7. *Elbasan B, Koçyiğit MF, Çelik Hİ, et al. Serebral Palsi'de Fiziksel Aktivite ve Spor. E-Sağlık Fizyoterapi ve Rehabilitasyon, Vize Yayıncılık 2016; Cilt: 1 Sayı 1; 57-62 (http://e-vizeyayin.com/default.aspx).*
8. *Elbasan B, Turker D. Serebral Pasli'de Fizyoterapi Rehabilitasyon. Ed. Bülent Elbasan. Pediatrik Fizyoterapi Rehabilitasyon. 1. Baskı. İstanbul, İstanbul Tıp Kitabevi; 2017. s 87-124.*
9. *Fowler Jr, W. M. Consensus conference summary: role of physical activity and exercise training in neuromuscular diseases. American Journal of Physical Medicine & Rehabilitation, 2002; 81(11), S187-S195.*
10. *Gönül A. Nöromusküler Problemli Çocuklarda Egzersiz Tedavisi Türkiye Klinikleri 2016;2(1):94-100.*
11. *Gucuyener K. Riskli Bebeklerde Nörolojik Muayene. Ed. Bülent Elbasan. Pediatrik Fizyoterapi Rehabilitasyon. 1. Baskı. İstanbul, İstanbul Tıp Kitabevi; 2017. s 13-28.*
12. *Izquierdo-Gomez R, Veiga ÓL, Sanz A, et al; UP&DOWN Study Group. Correlates of objectively measured physical activity in adolescents with Down syndrome: the UP & DOWN study. Nutr Hosp. 2015 Jun 1;31(6):2606-17.*
13. *Karaduman A., Yılmaz O., Alemdaroğlu I. Pediatrik Nöromusküler Hastalıklarda Fizyoterapi ve Rehabilitasyon. Ankara: Pelikan Yayınevi. 2014*
14. *Özaydın E, Ürey T, Gündüz M ve ark. Hipotonik İnfantların ayırıcı tanısında algoritma faydalı mıdır? 53 olgunun değerlendirilmesi. Türkiye Çocuk Hastalıkları Dergisi, 2013, 3: 128-133.*
15. *Philpott J, Houghton K, Luke A. Physical activity recommendations for children with specific chronic health conditions: Juvenile idiopathic arthritis, hemophilia, asthma and cystic fibrosis. Paediatr Child Health. 2010 Apr;15(4):213-25.*
16. *Pimentel J, Tojal R, Morgado J. Epilepsy and physical exercise. Seizure. 2015 Feb;25:87-94. doi: 10.1016/j.seizure.2014.09.015. Epub 2014 Oct 14.*
17. *Serdaroglu A, Cansu A, Ozkan S, et al. Prevalence of cerebral palsy in Turkish children between the ages of 2 and 16 years. Developmental Medicine & Child Neurology, 2006; 48(6); 413-416.*
18. *Seron BB, Goessler KF, Modesto EL, et al. Blood Pressure and Hemodynamic Adaptations after a Training Program in Young Individuals with Down Syndrome. Arq Bras Cardiol. 2015 Jun;104(6):487-91.*
19. *Soyluer F, Erdoğan F. Fiziksel aktivite ve epilepsi. Sağlık Bilimleri Dergisi 2011: 20; 77-81.*
20. *Yılmaz ÖT, Karaduman AA. Nöromusküler Hastalıklarda Fizyoterapi Yaklaşımları. Türkiye Klinikleri Journal of Physical Medicine Rehabilitation Special Topics, 2010; 3(3), 26-33.*

SECTION 7

PHYSICAL ACTIVITY AND EXERCISE IN ENDOCRINE AND METABOLICDISEASES

AUTHORS:

Zehra AYCAN, MD Prof. (President)	*Pediatric Endocrinology and Diabetes Association*
Baran YOSMAOĞLU, PT PhD Assoc. Prof.	*Başkent University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation*
Cihan FİDAN, MD Asst. Prof.	*Başkent University, Faculty of Medicine, Family Medicine Department*
Hasan GÖKTEN	*Sabahattin Zaim Social Sciences High School*
Arzu BEKTAŞ	*T.R. Ministry of Health, General Directorate of Public Health*

ABSTRACT

As the most common form of diabetes in childhood, Type-1 diabetes is a chronic disease that requires insulin use lifelong since absolute insulin deficiency develops. In Type-1 Diabetics management,Nutrition and exercise are other components of diabetes management as well as insulin replacement therapy. Improving the habits of healthy nutrition and physical activity/exercise will positively contribute to diabetes management by reducing insulin need and thus recovering body and mental health. Children and adolescents with Type-1 diabetes can do all kinds of exercise and sportive activities and participate in physical training classes in their schools. Children with Type-1 diabetes should be encouraged to exercise by the diabetes team and their educators. Regular exercises can increase insulin sensitivity and provide better metabolic control with less insulin. It also regulates lipid metabolism, helps control weight, improves cardiovascular functions and regulates blood pressure, improves joint movements and muscle strength. It improves life quality by increasing the feeling of goodness. Children and adolescents with Type-1 diabetes need to exercise, especially at moderate intensity, 3-7 times a week, 30-60 minutes each. It is possible to do all kinds of exercises by acting in accordance with diabetes management (such as taking additional carbohydrates, if necessary, by measuring and evaluating blood sugar) taught by the diabetes team before, during and after the exercise.

Obesity is one of the most important health problems in childhood all over the world and in Turkey. One of the most important risks of obesity isType-2 diabetes. Type-2 diabetes, also known as adult disease in previous years, is now also seen in childhood. Type-2 diabetes is a preventable disease. Prevention of obesity in children and adolescents will also prevent development of Type-2 diabetes. For this reason, it is of great importance to get children adopt the habit of active lifestyle, namely, of healthy nutrition and physical activity/exercise. If Type-2 diabetes develops, exercise and physical activity should be maintained as well as other medical treatments. Exercise should be started with short -term in the first weeks and should be done regularly 5-7 days per week and 30-60 minutes per day. Aerobic, muscle and bone strengthening exercises are recommended as type of exercise.

TYPE-1 DIABETES

Definition

Type-1 diabetes is a chronic disease coursing with absolute insulin deficiency and requiring life-long insulin therapy. Since it is seen in every age group during childhood, it's management has some difficulties.

Prevalence/Incidence

Type-1 diabetes is common in childhood, although it is seen in all age groups. More than 90% of childhood diabetes is Type-1 diabetes. Itsprevalence varies among countries. The prevalence of Type-1 diabetes was found to be 0.75/1000 in Turkey. The incidence was reported to be 11.3/100,000 in females and 10.4/100,000 in males.

Causes

Type-1 diabetes is an autoimmune disease triggered by environmental factors in children with genetic predisposition. In children with HLA tissue group prone to diabetes; environmental factors such as viral infections and stress initiate the autoimmune process and damage the insulin-producing Beta cells. The resulting absolute insulin deficiency leads to the development of diabetes.

Symptoms

Despite polyuria (need to urinate), polydipsia (drinking plenty of water), nocturia (night urinary incontinence) and increased appetite, weight loss is the most common symptom. Fatigue, asthenia and constipation may be seen rarely. Symptoms are acute onset, with a maximum of one to two months symptom history. If the patient does not get a diagnosis during this period, the symptoms progress; respiratory distress (Kussmaul -*+Inhalation), acute abdomen may develop and ketoacidosis coma may be seen.

Diagnosis

Diabetes is diagnosed if the value of blood sugar is found to be over 200 mg/dl at any time for a child with symptoms that the fasting blood sugar is above 126 mg/dl.For the Type-1 diabetes differential diagnosis; it is expected that symptomatology is acute, serum and urine C-peptide levels are low, diabetes autoantibodies (anti-insulin, anti-GAD, islet antibodies) are positive.

Treatment

It is necessary to use insulin in the treatment of Type-1 diabetes. Insulin can be administered either by the pen needles or insulin pump method. Often intensive insulin therapy is administered four times a day as basal insulin and bolus insulin applied before meals. Besides insulin, healthy nutrition and physical activity are the other components of insulin treatment.

EFFECTS OF PHYSICAL ACTIVITY ON TYPE-1 DIABETES

There is no preventive effect of physical activity on occurrence of Type-1 diabetes. However, regular physical activity and exercise is a therapeutic component of Type-1. Regular exercises are reported to bring blood sugar levels and HbA1c levels to desired levels in diabetic children and significantly reduce complications that may emerge in the future. Daily insulin injections and pump can easily be combined with physical activity.

Benefits of Exercise

- It reduces insulin resistance by increasing insulin sensitivity in tissues.
- It increases the effect of the insulin used and reduces the need for insulin.
- It reduces blood sugar level, improves metabolic control.
- It reduces ketone formation.
- It provides weight control and weight loss, preventing obesity.
- It reduces high blood cholesterol and triglyceride levels, reducing vascular disease risk.
- It increases HDL cholesterol, reduces LDL cholesterol.
- It provides an increase in lung ventilation and respiratory capacity.
- It improves cardiovascular functions and helps regulate blood pressure.
- It increases joint movements, muscle mass and strength.
- It increases the sense of well-being, raises life quality.

Key Recommendations on Exercise

- All diabetic children and adolescents should exercise regularly.
- Exercise should be done every day after the main meals.
- Physical activity/game should be appropriate to the age, desire and ability of the child with diabetes.
- The exercises that put the child into a team and make him/her enjoy should be preferred.
- Exercise should be started with short and less intensive programs and the duration and severity should be increasedgradually.

- Blood sugar should be monitored before, during and after exercise. If blood sugar is below 100 mg/dl before exercise, avoid vigorous exercises. If it is 100-200 mg/dL, 15 g additional complex carbohydrate (about 1-1.5 g/kg) should be taken.
- A diabetic child or adolescent must absolutely have cut sugar or fruit juice (preferably cherry juice) with him/her during exercise because of the risk of hypoglycemia.
- Exercise should not be done when hungry or immediately after the meal, it should ideally be done 1-2 hours aftermeals.
- Exercise time should be planned with attention to the peak hours of short and rapid-acting insulin used (peak time for rapid-acting insulin is 30-60 min, 1-2 hours for short-acting insulin).
- Since it will cause rapid absorption of insulin, the insulin should not be administered to the part where exercise actively affected. For example: If he/she will ride a bicycle, insulin should not be administered to leg.
- It may be necessary to reduce the dose of insulin before exercise. The diabetes team should be consulted for planning, as this will depend on the duration and severity of the exercise.
- In order to prevent hypoglycemia after exercise during the period of increased insulin sensitivity, foods with high carbohydrate content should be consumed shortly after exercise.
- Since alcohol inhibits gluconeogenesis, possibility of hypoglycemia is high during alcohol consumption. Alcohol is not recommended to use with exercise.
- Doing aerobics and anaerobic exercises together (such as football, cycling, running) may require taking extra carbohydrate before and after the activity.
- The risk of hypoglycemia at night after exercise is high. Basal insulin dose should be reducedif blood glucose level is less than 125 mg/dL.
- Exercise should absolutely be started with a warming period of 5-10 minutes and 5-10minute cooling period should be involved.
- Aerobic exercises should be done at moderate and intense level, at least 3 days a week and 30-45minutes a day. Suggested aerobic exercises; such as swimming, walking, running, cycling.
- Plenty of water and plain soda should be consumed during exercise.
- Appropriate clothing should be preferred for the heat of the environment to be exercised.
- Appropriate footwear should be worn for exercise.

Situations Where Exercise Is Inappropriate

1- Immediately after eating (within 1 hour)

2- Immediately after insulin is made

3- If the blood glucose level is less than 100 mg/dL

4- If the blood glucose level is above 250 mg/dl and there is ketone in the urine

5- In the event of an additional disease

6- In extremely hot and cold environments

7- Patients with proliferative retinopathy and nephropathy should avoid resistive exercises andanaerobic exercises that would probably result in high blood pressure.

Actions to be taken in Planned Exercises

If blood glucose is normal or close to low:

- Pre-exercise bolus insulin dose is reduced by 10-20%.
- If necessary, the after-exercise dose is reduced by 10-20%.
- Additional carbohydrates may be given.
- If exercise lasts for a long time, blood sugar is measured every 30 minutes.
- After the exercise is over; blood sugar is frequently measured in case of risk of blood sugar decline throughout the day.After intense movement, body uses insulin more effectively. As result of active use of muscles, insulin in these parts will get into circulation, as well. For this reason, blood sugar reduction can be seen; even the hours pass after exercise (Increased insulin sensitivity). Long-acting insulin doses can also be reduced before and after intensive exercise.
- Long-acting insulin dose is reduced by 10-30% at night before the scheduled exercise.

If the blood sugar is high:

- Ketone is measured. If negative (if not), plenty of water is drunk. If blood sugar is extremely high (250 mg/dl and over) andketone is positive, exercise should not be done.
- Dose is increased by 10-20% at insulin hours.
- If it is not insulin time and exercise is necessary, 5% of the daily total insulin dose is administered as an additional dose.
- Blood sugar should be followed hourly. Especially in competitive sports, blood sugar may increase due to stress. So frequent blood sugar control is recommended before and after exercise.

Unplanned Exercise

If blood glucose is normal or close to low

- Its dose should be reduced if it is insulin time.
- Otherwise, extra snacks should be taken absolutely.
- Sugar may drop after exercise. So blood sugar control should be done frequently.
- If necessary after exercise, insulin dose should be reduced.

If blood sugar is high

- The dose should be increased by 10-30% if it is insulin hour.

- If it is not insulin hour, an additional dose should be intervened (5% of the daily dose).
- Ketone should be controlled in the urine, and if it is negative, the exercise can be continued.
- Plenty of water should be consumed.
- If the sugar level is still high after exercise, the next insulin dose should be increased by 10%.
- If sugar is still high (>250mg/dl) and ketone is positive, exercise should not be done.

Physical Training Course

There is no inconvenience for diabetic children to attend physical training classes; on the contrary, their active participation in physical training and sports courses is recommended. It is recommended to do physical training at the first two hours in the morning or first two hours afternoon. Since these hours correspond to post-meal exercise hours, there will be less blood sugar reduction effect and there will be no need for additional meals. For this, it is recommended to get support from school administrators or course teachers. It is also important to keep high-glycemic-indexed snacks (fruit juice, sandwiches, and cube sugar) and hypoglycemic drugs (glucagon) available at the school at all times. The diabetic nature of the child is not an obstacle to involve in sports with training or competition; however, it is necessary to take necessary measures in cooperation with the diabetic child/adolescent and his/her family. Special training should be given by the diabetes team for these athletes (if necessary for trainers).

EXERCISE PRESCRIPTION

Aerobic and anaerobic exercises in diabetic children may have different effects on blood sugar levels. In aerobic activities, blood glucose tends to fall both during and after exercise. Anaerobic activities are for short term, but they may produce transient sudden changes in blood sugar levels.

Exercise Severity

It is required to measure the maximum amount of oxygen (VO_2 max) consumed in determining exercise intensity. In cases where it cannot be determined, exercise intensity can be determined according to the maximal cardiac rate, MET (metabolic equivalent) values and perceived fatigue level. Accordingly:

Moderate Exercise: They are theactivities performed by consuming 3-6 times more energy than the rest. Accordingly, on a scale of 0-10, exercises done between 5 and 6 can be considered as moderate activities. It is a moderate activity if the child or adolescent is in a tempo that he/she is able to talk but not sing a song during exercise.

Vigorous-Intense Exercise: Activities performed by consuming 7 times more energy than the rest for children and adolescents. Accordingly, on a scale of 0-10, exercises done between 7 and 8 can be considered as severe activities. If the child or adolescent is having trouble in communicating with the person next to him/her during the exercise, he/she is doing a very severe activity.

Which Exercises Should Be Performed

- Exercise should absolutely be started with a warming period of 5-10 minutes and 5-10minute cooling period should be involved.
- Aerobic exercises should be done at moderate and intense level, at least 3-7 days a week and 30-60 minutes a day.Children are recommended to perform moderate and vigorous exercises on a regular and daily basis. The exercise program could consist of aerobic exercises such as swimming, walking, running, cycling. Details are shown in Table 17.

Table 17. Examples of Moderate and Vigorous Exercises for Children and Adolescents

Type of exercise	Child	Adolescent
Moderate aerobic exercise	• Skateboarding • Roller skating • Bicycle • Brisk Walking	• Skateboarding, roller skating • Bicycle • Brisk Walking • Home and garden works • Games that require grabbing and throwing, such as basketball
Vigorous aerobic exercise	• Activities containing • Running and chasing such as hide and seek • Bicycle • Running • Defense sports • Jumping rope • Skiing • Basketball • Football • Swimming • Tennis	• Bicycle • Running • Defense sports • Jumping rope • Skiing • Basketball • Football • Swimming • Tennis • Dance

OBESITY AND TYPE-2 DIABETES

Definition

Obesity is a metabolic disease characterized by excessive fat accumulation in the body and with high morbidity and mortality. In children, a body mass index above 95 percentile (+ 2 SD) is defined as obesity and between 85 and 95 percentile as overweight. One of the most important risks of obesity is Type-2 diabetes. Type-2 diabetes considered as adult's disease in the past yearsbegun to be seen in childhood ages as well with the increase of obesity incidence. Type-2 diabetes is a polygenic, chronic disease caused by insulin deficiency or ineffectiveness. Type-2 diabetes is described as a circumstance that fasting blood sugar level is above 126 mg/dl, second hour blood glucose level in OGTT is above 200 mg/dl or blood sugar is above200 mg/dl and HbA1c is above 6% with diabetes symptoms. The matters that should be taken into consideration in differential diagnosis of Type-2 diabetes are being a fat child/adolescent, having a strong family history of diabetes, clinical and laboratory findings of insulin resistance and comorbidities associated with diabetes (insulin resistance, hypertension, dyslipidemia, Polycystic Ovary Syndrome...).

Prevalence

As in adults, the incidence of obesity is also increasing in childhood. According to Turkey Nutrition and Health Survey 2010, obesity prevalence is found to be 8.5% between the ages of 0 and 5 and 8.2% between the ages of 6 and 18. Rate of overweight is found to be 17.9% between the ages of 0 and 5 and 14.3% between the ages of 6 and 18. According to these results, 26.4% of children in the 0-5 age group and 22.5% of the children in the 6-18 age group are above the normal weight.

There is no study in Turkey regarding the prevalence of childhood Type-2 diabetes, which is the most important disease accompanied by obesity. However, in a limited number of studies conducted on obese children and adolescents in Turkey, glucose intolerance was detected and this was considered as a leading finding of Type-2 diabetes. Given the national data base established by the Pediatric Endocrinology and Diabetes Association, it is estimated that there are up to 300 children and adolescents with Type-2 diabetes in Turkey.

Causes and Risks

The most important cause of obesity in childhood is inactive lifestyle. The increase in urbanization, changing of nutrition habits, too much technology in the center of lives and sedentary lifestyle have become threat to the increase of obesity and Type-2 diabetes. Rate of obesity increases as children consume high-calorie fast-food and

fizzy drinks with high content of sugar instead of healthy nutrition, make excessive consumption of the foods containing carbohydrates and refined sugar. Another reason is the growth of portions. The widespread use of advanced technological tools (such as mobile phones, tablets, and computers) and longtime screen activities contributed to the increase in obesity by reducing the length of time children spend on the move. Other risks associated with development of obesity in children are having obese parents, unhealthy nutritional habits of families, low or high birth weight (>4000 gr or <2500 gr).

Prognosis

Studies suggest that 40-50% of those who are obese during childhood and70-80% of those who are obese during adolescence will be obese in adulthood too. It is reported that disease risks and mortality by obesity increase as the time spent with obesity increases. Comorbid seen in obese children are hypertension, cardiovascular diseases**,** dyslipidemia, hepatosteatosis, insulin resistance, disorders of glucose metabolism and Type-2 diabetes, sleep apnea, PCOS, musculoskeletal disorders, psychological problems such as depression and anxiety.

Prevention and Treatment

Obesity and Type-2 diabetes are preventable public health problems. Healthy nutrition habits and active lifestyle could reduce the risk of development of obesity and Type-2 diabetes. For this purpose, healthy nutrition and physical activity habits should be tried to be acquired from early childhood period. In case of obesity, healthy nutrition and physical activity training should be repeated, wrong nutrition habits of family should be changed and medical treatment should be applied if necessary. There is no approved drug treatment for obesity in childhood. However, if insulin resistance and glucose metabolism disorders are present, metformin therapy may be started in children over 10 years of age. Oral antidiabetics and/or insulin could be used in Type-2 diabetes other than healthy nutrition and active lifestyle.

BENEFITS OF PHYSICAL ACTIVITY

Prevention and Treatment

Itis reported that physical activity reduces fat tissue and abdominal fat and prevents muscle mass loss caused by dieting. Weight gain of children and adolescents could be prevented by healthy nutrition together with exercise therapy. Recommended exercise program

must be individual, entertaining, practical and sustainable in accordance with the individual's daily life habits.

Exercise Intensity: It should be 50-80% (moderate and vigorous intensity) of maximum cardiac rate. In cases where maximal cardiac rate cannot be determined, exercise intensity could be determined according to the level of perceived fatigue. Accordingly:

Moderate Exercise: It is the activity performed by consuming 3-6 times more energy than the rest. Accordingly, on a scale of 0-10, exercises done between 5 and 6 can be considered as moderate activities. It is a moderate activity if the child or adolescent is in a tempo that he/she is able to talk but not sing a song during exercise.

VigorousExercise: It is the activity performed by consuming 7 times more energy than the rest for children and adolescents. Accordingly, on a scale of 0-10, exercises done between 7 and 8 can be considered as severe activities. If the child or adolescent is having trouble in communicating with the person next to him/her during the exercise, he/she is doing a very severe activity.

Exercise Period: It should be 30-60 min per day. Initially and at the end, low-tempo activities should be performed for 5 minutes for warming and cooling. Exercise period should be kept low in the first weeks and then prolonged to the targeted level over time.

Exercise Fluency: It should be 5 - 7 days a week.

Exercise Content: There are three basic components of the exercise program to be applied in children and adolescents. First of those is anaerobic exercises. The second one is strength exercises applied to increase lean body mass. In this way, the mass of the muscles increases, dropping fat amount and increasing the metabolic rate. Third one is the activities that stimulate bone growth**.** Ensure that the given daily exercise program covers these three exercise components. Exemplary exercises are given in Tables 18-20.

Table 18. Physical Activity and Exercise Recommendations for Children and Adolescents

AEROBIC EXERCISES		
	CHILD	**ADOLESCENT**
Moderate aerobic exercise	• Roller skating • Bicycle • Brisk Walking • Games involving running, chasing: playing tag, catching, etc. • Bicycle • Jumping rope	• Roller skating • Bicycle • Brisk Walking • Bicycle (constant or outdoor) • Home and garden works • Ball Games • Jumping rope
Vigorous aerobic exercise	• Defense Sports • Running • Football • Basketball • Swimming • Tennis	• Games that include running, chasing and ball grabbing: • dodgeball, colorful stopping (a ball game), volleyball, etc. • Defense Sports • Running • Football • Basketball • Swimming • Tennis

Table 19. Muscle Strengthening Exercise Programs in Children and Adolescents

MUSCLE STRENGTHENING EXERCISES	
CHILD	**ADOLESCENT**
• Pull rope • Modified push-ups (Knees • on the ground) • Resistance exercises using body weight or elastic bands • Rope, tree, wall climbing • Shuttle pull (full or half) • Swinging with handsgames	• Pull rope • Push-up • Resistive exercises where body weight or elastic bandsare used • Rope, wall climbing • Shuttle pull (full or half)

Table 20. Muscle Strengthening Exercise Programs in Children and Adolescents

EXERCISE STIMULATING BONE DEVELOPMENT	
CHILD	**ADOLESCENT**
• Games involving hopscotch, jumping, • Trampoline • Jumping rope • Running • Gymnastics • Basketball • Volleyball • Tennis	• Games involving jumping • Trampoline • Jumping rope • Running • Gymnastics • Basketball • Volleyball • Tennis

EXAMPLE OF DAILY PROGRAM

- **Walking** (20 min)-going to-returning from the school
- **Ball game** (30 min)-football, basketball, dodgeball
- **Push up - Pull up** (5 min)
- **Jumping rope** (5 min)
- **Total = 60 min.**
  - **Aerobic exercise:** Ball game-walking
  - **Bone strengthening exercise:** Ball game - jumping rope
  - **Muscle strengthening exercise:** Push up - Pull up

For performing the exercises properly, Physical Activity Comformity Report Training video is available on the web site of the General Directorate of Public Health, Healthy Nutrition and Mobile Life Department.

It is advisable to do appropriate physical activities more efficiently for elementary and secondary school students in schools as part of game and physicalactivities course.

(http://tegm.meb.gov.tr/www/oyun-ve-fiziki-etkinlikler-dersi-ogretim-programi/icerik/62).

REFERENCES

1. *American College of Sports Medicine (2013). ACSM's guidelines for exercise testing and prescription. Lippincott Williams &Wilkins.*
2. *http://tegm.meb.gov.tr/www/oyun-ve-fiziki-etkinlikler-dersi-ogretim-programi/icerik/62.*
3. *Robertson K, Riddell MC, Guinhouya BC, et al. Exercise in children and adolescents with diabetes. ISPAD Clinical Practice Consensus Guidelines 2014 Compendium. Pediatric Diabetes 2014: 15 (Suppl. 20): 203–223. doi: 10.1111/pedi.12176.*
4. *Swedish National Institute of Public Health, Physical Activity in the Prevention and Treatment of Disease, 2010.*
5. *T.C. Sağlık Bakanlığı Türkiye Halk Sağlığı Kurumu Çocukluk Çağı Diyabeti Eğitici Rehberi. Ankara 2014.*
6. *Türkiye Halk Sağlığı Kurumu Obezite, Diyabet ve Metabolik Hastalıklar Daire Başkanlığı http://fizikselaktivite.gov.tr/tr/fiziksel-aktivite-uygunluk-karnesi-egitimi-ve-fiziksel-aktivite-recetesi-liderlik-programi/.*
7. *Türkiye Halk Sağlığı Kurumu, Türkiye Fiziksel Aktivite Rehberi-Çocuk ve Ergenlerde Fiziksel Aktivite, Ankara 2014.*
8. *U.S. Department of Health and Human ServicesCenters for Disease Control and Prevention Division of Adolescent and School Health-2013.*
9. *U.S. Department of Healthand Human Services, Physical Activity GuidelinesforAmericans, 2008.*
10. *Yeşilkaya E, Cinaz P, Andıran N, et al. First report on thenationwideincidenceandprevalence of Type-1 diabetes among children in Turkey. Diabet Med. 2016 Jan 27. doi: 10.1111/dme.13063.*

SECTION 8

PHYSICAL ACTIVITY AND EXERCISE IN PSYCHIATRICDISEASES

AUTHORS:

Esra AKI, PhD Prof.	*Hacettepe University, Faculty of Health Sciences, Department of Ergotherapy,*
Birim Günay KILIÇ, MD Prof.	*Ankara University, Faculty of Medicine, Department ofChild and Adolescent Psychiatry and Mental Health*
Hülya KAYIHAN, PhD Prof.(President)	*Hacettepe University, Faculty of Health Sciences, Department of Ergotherapy,*
Esra GÜNEY, MD Assoc. Prof.	*Gazi University, Faculty of Medicine, Department ofChild and Adolescent Psychiatry and Mental Health*
Yasemin TAŞ TORUN, MD Spec.	*Health Sciences University, Gulhane Education and Research Hospital, Child and Adolescent Psychiatry and Mental Health Clinic*
Selen ŞİMŞEK, Spec. Nurse	*T.R. Ministry of Health, General Directorate of Public Health*
Neslihan TAŞ, PT	*Hacettepe University, Faculty of Health Sciences*
Sema YILMAZ AHİ	*T.R. Ministry of Health, General Directorate of Public Health*

ABSTRACT

Autism spectrum disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD) neurodevelopmental disorders which starts in early childhood and negatively affects functionality in many ways.

ASD is a disorder identified with marked shortcomings in social interaction and communication, limited, repetitive behavioral patterns and related with interests and actions. ASD is chronic. Its treatment is multidimensional and has to be multidisciplinary. Aiming at improving the child's independent life skills, advancing life quality and recovering social skills and communication, the treatment should be planned individual-based. In children with ASD, the inadequacies of the ability to process the senses from their environments and bodies lead to motor coordination problems. Scientific research shows that programs involving sports, exercise and other physical activities can reduce symptoms, improve behavior and increase quality of life for autistic individuals. Studies in this area show that sport and physical activity could create opportunities for social interaction, contributing to the development of motor performance and physical fitness development and self-management skills. Regular participation in physical activity reduces depression in individuals with ASD, contributes to life quality by improving psychological health.

The main feature of ADHD is the presence of significant and heavy hyperactivity-impulsivity and/or inattention symptoms incompatible with the individual's developmental level. There are cognitive, behavioral and physiological effects of physical activity participation in children with ADHD. It appears that cognitive functions of children with ADHD and physical activity involvement are at a better level. Physical activity propelling functions develop attention, memory, cerebellar functions, behavioral control, neurocognitive functions and academic performance, helping to reduce abnormal sensory behaviors such as attention deficit/impairment. Physical activity is recommended for children with ADHD in order to provide positive change in social interaction and communication, improvement in behaviors and life quality.

AUTISM SPECTRUM DISORDER

Definition

Autism spectrum disorder (ASD) is a neurodevelopmental disorder that starts in early childhood and continues throughout life. It is a disorder identified with marked shortcomings in social interaction and communication, limited, repetitive behavioral patterns and related with interests and actions.

Autism is generally diagnosed at 24 - 36 months although the symptoms can be detected by caregivers at 12-18 months. Sometimes it is explained by families that some skills are lost (regressive autism) and this is usually between 12 and 24 months. On the other hand, it is sometimes seen that children with ASD are not able to be diagnosed in clinics or the application is too late.

Findings of ASD in the field of social interaction/communication are lack of social emotional reciprocity, abnormal social communication, inability to initiate and sustain speech, limited verbal and nonverbal communication, abnormal eye contact, inability to recognize and use body language/gestures and mimics, insufficiency to feel joy and emotions of others, inability to exhibit different behaviors suited to the social situation, disability in making friends and imaginary play and narrowness of interest fields. It's symptoms in the areas of behaviors, information and activities are concerning himself/herself with one or more limited recurrent interest area (intensity and/or weird as content) in an excessive manner, commitment to routine or rituals that are invariable, passionate and nonfunctional, insistence on uniformity, repetitive, stereotypic hand, finger, motor behaviorisms involving the entire body, dealing with certain part of objects, echolalia, excessive or inadequate response to sensory stimuli and unusual forms of attention with sensory stimuli.

Indications start in early development stage, however, may not be fully realized until social expectations go beyond the capacity of the individual may be masked with strategies learned afterwards by experience. Those with sound mental functions may have some extraordinary abilities especially memory, arithmetic, music and picture skills. However, they cannot form a whole and remain as separate abilities.

Prevalence/Incidence

Researches in recent years report a marked increase in the frequency of the disorder. The prevalence of ASD in the US (United States of America) in 2008 was found to be 11.3/1000 (1/88), which is 78% higher than in 2002 and 23% higher than in 2006. According to the latest data from the Disease Control Centers in 2014, 1 out of every 68 children has autism. In a study conducted in South Korea, ASD prevalence was reported as 2.64%. This study was then repeated according to DSM-5 criteria and the prevalence was calculated as 2.20%.

Even the causes of the increase in ASD prevalence are not able to be largely explained, it is thought to be related with changes in diagnostic criteria, social effects, increased parental age and geographical factors. OSB is seen about 5 times more frequently in males compared to females.

Causes/Risks

Since behavioral symptoms and functional impairment degree are variable, ASD is defined as a heterogeneous cluster of symptoms with different etiologies and pathologies. It is considered as a multifactorial disorder caused by the interaction of neurological, immunological, biochemical, environmental and genetic factors. In many cases etiology could not be detected and these cases are diagnosed as idiopathic autism or non-syndromic autism. Diagnosis of autism in
5-25% of the cases are associated with other syndromes such as autism diagnosis, Fragile X syndrome, Down syndrome, tuberous sclerosis.

There are pretty strong evidences indicating that hereditary factors play a role in ASD. It is estimated that the average inheritability of autism is 90% as part of twin studies. Based on these findings, autism is thought to be among the highest psychiatric disorders in terms of inheritance. It is believed that many genetic interactions play a role in genetic susceptibility to impairment.

Many neuroanatomical, neurophysiological and neurochemical disorders are observed in studies on patients with ASD. It is also reported that prenatal, natal and postnatal factors may also be effective on autism. However, it is thought that birth complications may not be cause of autism but a heritable risk associated with autism or a consequence of impaired fetal development.

Advanced father age is the most consistent data among the environmental factors associated with ASD. In the studieson exposure to mercury and vaccination, none of them arerelated to ASD.

Prognosis

ASD is chronic. Some positive developments may arise in some areas such increase in social interest of school age children and adolescents. Behaviors get worsens in some adolescents, whereas some positive changes may be observed in others. Language development and general mental level are the most important determinants of prognosis. The high level of intelligence, talking before the age of six and low social dysfunction in childhood are indicators of upturn. Professional/social functionality and life quality are low in those even without mental retardation.

Treatment

Early diagnosis and treatment are vital for ASD. Treatment must be multidimensional and multidisciplinary and age of the child, the severity of the disorder, additional diagnoses and the psychosocial environment should be taken into consideration. Aiming at improving the child's independent life skills, advancing life quality and recovering social skills and communication, the treatment should be planned individual-based. It is also important to achieve develop in the areas where children are strong. In general, the treatment adopted is special training methods. These children should involve in individual and group treatment programs and their parents should be monitored by consultation. Although ASD is biologically based, the most effective treatment methods are behavioral and educational. Drug treatments generally target behavioral problems and additional diagnoses. It would have a supportive role in the treatment to involve the children at young ages in play groups or pre-school education. During the school period, they should be carefully evaluated for starting primary education.

Effects of Physical Activity

Behavioral intervention programs commonly used in ASD focus on developing communication, social and cognitive skills. However, in children with ASD, the inadequacies of the ability to process the senses from their environments and bodies lead to motor coordination problems. Scientific research shows that programs involving sports, exercise and other physical activities can reduce symptoms, improve behavior and increase quality of life for autistic individuals.

Some of the children with OSB respond to audio, tactual and visual warnings. Being hypersensitiveto, even, light warnings affect behavioral responses in a negative way. Some children with ASD do not response to warnings. They do not want to move and their activity involvement is very low. The activities given by considering perception thresholds of sensory warnings of children will increase their motor coordination and coping skills.

Hypersonic children are recommended to do individual and non-contact activities instead of group activities in noisy and crowded environments. Proprioceptive and deep pressure-inducing resistant activities are recommended to normalize hypersensitivities.

In hyposensitive children, the activities are done repeatedly. Team sports, swimming with many stimulants are allowed to perform under ample lighting. The irregular nutritional habits of hyposensitive children who require excessive stimulation lead to irregular weight gain. Improper nutritional habits and use of antipsychotic medications may lead to weight gain.

Overweight is a common problem among children with ASD and causes diabetes,cardiovascular diseases, bone and joint problems and even depression. If anxiety,

gastrointestinal problems and depression are combined with autism findings; this turns out to be a much greater problem for these children. Activities such as walking, running and swimming reduce the body mass index of the autistic individuals, improve physical fitness levels and overall motor activity levels.

Research shows that physical activity can also reduce the frequency of negative self-stimulation behaviors that are common among autistic individuals. There are researches suggesting that swimming and 60-minute in-water exercise programs reduce stereotypical movements, improve positive social behavior and advance learning capacity. Increasing self-esteem and levels of happiness and leading to positive social involvement may be indicated among the positive effects of physical activity on children with ASD. For children with ASD who are able to involve in team sports, these activities provide useful opportunities to enhance social relationships among team members and to improve skills such as decision making and communication.

It is suggested that the activity should be separated into small pieces and organized directive should be reinforced with repetitions for a successful physical activity in children with ASD.

Children with ASD tend to be inactive due to problems in handling sensory stimuli and social anxiety. Psychopharmacological treatment, sleep disturbances and atypical eating patterns also reinforce this tendency. Lately acquired or weak motor skills; cause some disabilities in motor skill components such as physical fitness and hand-eye coordination, perception and balance disorders. Children with OSB have posture, movement and strength weaknesses. This motor coordination disorders may lead to delay in involvement of children with ASD in physical activities and group activities compared to their peers. As a result, these children constitute a high risk group in terms of social isolation, depression and sudden anger outbursts. Properly planned physical activity, sports and games help the child with ASD to increase their participation in activities, as well as to communicate more effectively with their peers.

In children with ASD, physical activity has biological and behavioral effects.

Physical activity is closely related to cognitive functions. Physical activity increases the attention and duration of the child with ASD, motor coordination develops. These effects are also proved by functional MRI studies.

The planned physical activity in children with ASD reduces incompatible, unwanted and repetitive behaviors, improving health and well-being. It is demonstrated that an aerobic exercise such as running for about 45 minutes prolongs attention period, provides impulse control and improves social behaviors and learning. These improvements also contribute to the development of appropriate behaviors in activities such as school skills, staying in the room and playing outside the child with ASD. Activities such as swimming, horse riding and cycling also provide effective changes in children with ASD.

Prevention and Treatment

It is a well-known fact that physical activity has a really important role for all individuals with autism, which is under ASD umbrella and described as a neurological disorder affecting the structure or functioning of the brain. For example, autistic individuals suffer difficulties in organizing social relations and behaviors and establishing relations with their peers and also have stereotypical behaviors and flaws in linguistic skills. Participation in physical activity contributes to social development of autistic individuals and reduction of stereotyped movements in a way positive way. Research findings on the involvement of children with ASD in physical activity and sporting activities suggest that sports and physical activities may offer opportunity for social interaction and contribute to the development of motor performance and physical fitness and self-management skills. In addition, there are adverse behaviors such as aggression, self-harm, anger attacks, stress and these behaviors may leave the autistic individuals against the stress vulnerable. Regular participation in physical activity reduces depression in individuals with ASD, contributes to life quality by improving psychological health. Being overweight is yet one of the main issues for some individuals with ASD. Regular physical activity plays an important role in addressing this problem.

It was observed that children with ASD generally enjoyed in-water activities, that the water relieves them and that they participated better in the activities in water or immediately after water. Furthermore, children with ASD may maintain their soundness and well-being mood by gaining skills that they can use lifelong through an in-water activity program that is well-planned and carefully implemented. It is stated that the game skills in pool can offer potential learning opportunities to a large number of children with ASD. However, despite the beneficial effects of sports and physical activities revealed by the results of the research on children with ASD, it seems that this issue was not adequately addressed.

Indications

Physical activity is recommended for children with ASD, who have no other health problems that may pose an obstacle for doing exercise, in order for they have positive changes in social interaction and communication, improvement in behaviors and life quality.

ATTENTION DEFICIT HYPERACTIVITY DISORDER

Definition

Attention Deficit Hyperactivity Disorder (ADHD) is a neurobehavioral disorder that begins in early childhood and negatively affects the functioning in many aspects.

The main feature of ADHD is the presence of significant and heavy hyperactivity-impulsivity and/or inattention symptoms incompatible with the individual's developmental level. It is difficult to distinguish excessive motor activity of a child that is observed in childhood or before the age of 4, in particular. ADHD is usually diagnosed in primary school years. For diagnosis, symptoms must come out in at least two environments (such as home, school or workplace), cause dysfunction and at least some of the symptoms must start before the age of 12. In ADHD, 3 sub-groups are defined on two dimensions, one is attention deficit and the other is impulsivity/hyperactivity. These subgroups are defined as the type in which attention deficit is in the foreground, the type in which hyperactivity/impulsivity is in the foreground and finally the compound type. Hyperactivity component includes hyperactivity, having a more disruptive and aimless nature, and appears as dysphoria, logorrhea and discomfort. In the case of the attention deficit component, symptoms come out as concentration problems, mess, dysmnesia, imaginariness, difficulty in completing tasks and losing items. Children with ADHD often leave work unfinished and leave tasks early. The impulsivity component can appear in different forms. Also an impulsive cognitive manner may appear that may negatively affect the performances of learning and school other than the behaviors such as speaking in the class, attempting to physically dangerous activities, not waiting his/her turn, interrupting others' speech or intervening in other's games and arguing frequently.

Symptoms of attention deficit could appear in adolescence and adulthood as difficulty in organizing activities, easily distraction by stimuli, tendency to delay, difficulty in starting or completing tasks, not paying attention, not being able to use time. Hyperactivity indications are increase in adaptive behaviors such as impatience, feelings of internal restlessness, choice of job requiring activity and avoidance from idle/silent environments and frequent job change. Symptoms are often felt by the individual rather than being manifested obviously. Impulsivity emerges as low obstruction threshold, quick decision making, fast car driving and frequent motor vehicle accidents, difficulties in relationships and frequent partner changes, interrupting and anger control difficulties. If attention deficit is a more dominant symptom than hyperactivity, ADHD may not be identified until puberty. Individuals may be negatively affected in their school successes and their academic skills may be impaired due to inattention and cognitive problems in adolescence.

Prevalence/Incidence

ADHD affects 5-8% of school age children. The incidence in males is 2-5 times morethan females.

Causes/Risks

ADHD is a multifactorial disorder in which many factors play a role in etiology. Researches for identifying the etiology of ADHD focused on genetic, neurochemical, neuroimaging and environmental causes. The data show that the etiology of ADHD with a heritability of approximately 76% is of genetic origin to a large extent. It is believed that many genes (especially DAT1, DRD4, DRD5, 5HTT, HTR1B, SNAP25) with small effects are responsible for genetic susceptibility to impairment. Dopamine (DA), norepinephrine (NE), and serotonin are the neurotransmitters most associated with pathophysiology of ADHD. According to neuroimaging studies, the dorsolateral prefrontal cortex, ventrolateral prefrontal cortex, dorsal anterior cingulate cortex (dACC), striatum and cerebellum, which are brain regions associated with attention/cognition, executive functions, functioning memory, motor control, response inhibition and/or award/motivation, are brain regions that are examined by far the most and associated with the disorder. Data reaching today have a nature of supporting fronto-striatal dysfunction in ADHD. Complications during pregnancy and delivery, alcohol intake or smoking during pregnancy and environmental risk factors such as exposure to various toxins are also associated with ADHD. It was recently proved that prematurity, intra-uterine nicotine exposure and low birth weight are the major environmental risk factors associated with ADHD.

Prognosis

Increasing evidence confirm that ADHD is a chronic disorder that generally continues in adulthood as well. While studies on the persistence of impairment show varying proportions in a wide spectrum, 60-85% of children with ADHD diagnosed in childhood generally continue to meet impairment criteria in adolescence and up to 60% exhibit the symptoms in adulthood. In the remaining 40% of the cases, symptoms may improve in adolescence or early adulthood. In some cases, mobility may be lost, however, reduced attention period and impulse control problems continue. While hyperactivity is usually the first symptom to improve, attention deficit is the last to improve. Hereditary clinical picture, interfamilial issues, high severity of childhood symptoms, mental retardation of child and simultaneity between ADHD and conduct disorder, mood and anxiety disorders are among the factors for ADHD to continue in adolescence and adulthood as well. Untreated ADHD is associated with antisocial conducts in children and adolescents such as smoking and alcohol-substance abuse, aggression, unlawful acts, depression, anxiety

disorders and increased internet risk of addiction. The problems in adults that may emerge due to chronic ADHD are accidents and injuries, suicide attempts, alcohol and substance abuse, marital problems, work related problems and socialrelationship problems.

Treatment

Effectiveness of pharmacological treatments and behavioral interventions in the treatment of the main symptoms of ADHD is generally proved. Psychoeducation and behavioral interventions involving patient and family education may be applied as first-step interventions for many children, as well as pharmacological treatments, depending on the nature of target symptoms, accompanying disorders and environmental factors. Methylphenidate and non-stimulant atomoxetine among the pharmacological treatment options of ADHD are the primary treatment options in Turkey. Their efficacy and reliability in the short and long term are proven. A meta-analytic study, which is conducted with the aim of eliciting anxiety that the stimulants used in the treatment of ADHD lead to drug dependence, showed that stimulant therapy in childhood reduces substance and alcohol abuse/addiction risk.

Secondary and tertiary healthcare service options include the α2 agonists (clonidine and guanphazine), modafinil, tricyclic antidepressants (especially imipramine) and bupropion and are recommended only in cases in which response to treatment with stimulant therapy and atomoxetine treatment is not possible.

Benefits of Physical Activity

Increased physical fitness: Physical activity leads to a decrease in maximum cardiac rate in individuals and facilitates cardiac rate to return to its normal limits easily.

Neurotransmitter Mechanism: Dopamine, serotonin, noradrenaline and gamma-aminobutyric acid (GABA) levels are affected by regular exercise. The release of beta endorphins enhances coping skills.

Thermogenic Effects: Thirty minutes of physical exercise increases overall body relaxationwith a 1-2 degree increase in body temperature so that the ability to cope with stress increases.

There are cognitive, behavioral and physiological effects of physical activity participation in children with ADHD. It appears that cognitive functions of children with ADHD and physical activity involvement are at a better level. Physical activity propelling functions develop attention, memory, cerebellar functions, behavioral control, neurocognitive functions and academic performance, reduce abnormal sensory behaviors such as attention deficit/impairment.

Physical activity regulates emotional states such as impulsivity, inattention, hyperactivity, social skills, anxiety and depressive mood, somatic complaints and problematic behavioral responses.

Physical activity regulates the catecholamine response and physiological response such as cardiac rate and motor skills of the child with ADHD. Children with ADHD have a higher resting cardiac rate. Increase in cardiac rate with exercise is similar to their peers.

Prevention and Treatment

Being important at every period of life, physical activity is more critical especially for children, adolescents and young adults, to reinforce the health, prevent from diseases and provide psychosocial well-being. This is especially important nowadays where sedentary lifestyle, obesity and similar problems are frequently seen in youth. Another issue that strengthens the relationship between obesity and impulsivity is obesity in children with ADHD. It is observed that a majority (58%) of children taking obesity therapy have ADHD. Scientists agree that the level of physical activity should be monitored in childhood, adolescence and adulthood. In a study, a comparison was made between 65 children and/or adolescents with the diagnosis of ADHD at the ages of 6 - 14 and 32 children and/or adolescents with learning disorder at similar ages in terms of connection between anxiety and physical activity involvement. It is detected that involvement of the group with ADHD in physical activity prominently increased the level of depression and anxiety compared to the group not involving in physical activity**.**

Indications

Physical activity is recommended for children with ADHD, who have no other health problems that may pose an obstacle for doing exercise, in order for they have positive changes in social interaction and communication, improvement in behaviors and life quality.

Physical Activity Prescription for ASD and ADHD

Children should be active from the first year of life. They should be kept as active as possible in the first year and their activities should be supported. Children between the ages of 1 and 4 should have a total of 180 minutes of physical activity at different intensities during the day.
These activities should include at least 60 minutes of energetic gaming activities in different indoor and outdoor environments.

As in healthy children at the age group of 5 - 11, moderate to vigorous intensity physical activities should be preferred every day for children with ADHD as well. High intense activities are recommended at least 3 times a week.

Healthy adolescents and ADHD children at the ages of 12-18 should do 60-minute activity every day and these activities are advised to progress to vigorous intensity from moderate intensity. Activity preferences should include vigorous intensity activities at least 3 times a week and strength activities for muscles and bones at least 3 times a week.

Well-planned activity programs should include four main types of activity; aerobics, muscle – bonestrengthening, balance and stretching activities.

Aerobic exercises (swimming, cycling, jogging, etc.) are recommended three times a week for 30 minutes and 60% -80% of the maximum oxygen consumption rate (at the speed of speech).

Physical Activity Recommendations for ASD and ADHD

- In-water exercises
- Outdoor sports
- Stretching and strengthening exercises
- Balance and bilateral coordination exercises
- Group exercises/team sports
- Yoga
- Pilates
- Horse riding
- Trampoline/bounding-jumping
- Jumping rope
- Bowling

Points to be Considered

Children with ADHD should not be limited in their activities, on the contrary these children should be are encouraged to do physicalactivity.

As children with ADHD suffer concentration problems, exercises should be done in a calm and quiet environment, with time periods where the child's concentration is best.

There are some studies examining the effects of stimulant drugs used in treatment of children with ADHD on exercise. Mahon et al. (2008) reported that stimulant drugs increased cardiac rate below the maximum level, however, did not affect other cardiorespiratory measurements (oxygen uptake and respiratory change rate) or perceived effort. Familial and individual cardiovascular risk factors should be researched before starting drug treatment in children with ADHD, blood pressure and cardiac rate should be measured at each examination and guidance should be made for cardiologic assessment in case of risk factor or levels above normal limits (≥95. percentile according to age, sex and height). Such measures are of greater importance for ADHD diagnosed children who undergo a treatment and do physical activity.

Contraindications for ASD and ADHD

Uncontrolled high blood pressure

Cardiac insufficiency

Unstable arrhythmias

Pulmonary hypertension (severe, > 55mmHg),

Systemic disease with multiple organ involvement,

Acute myocarditis, endocarditis or pericarditis.

ANXIETY DISORDERS IN CHILDREN AND ADOLESCENTS

Definition

Anxiety is a normal reaction that is experienced throughout life in healthy individuals and has protective and adaptive function during the development of individuals. Conversely, anxiety disorders are characterized by fear or anxiety that causes significant distress and loss of function. Intense anxiety, physical symptoms caused by anxiety, cognitive distortions and avoidance behaviors are among the common clinical features of anxiety disorders.

There are separation anxiety disorder, selective mutism, panic disorder, specific phobia, social phobia and generalized anxiety disorder under the title of anxiety disorders in DSM-5, which is the current diagnostic classification system.

Separation Anxiety Disorder

Separation anxiety is a normal developmental process that begins with the development of selective attachment in infant and continues for years. Normal separation anxiety usually increases in early childhood, gradually declines at the age of 3-5 years and then ends. Separation anxiety disorder is a psychopathology characterized by unrealistic and extreme anxiety due to separation of child from the persons that he/she is attached most. Children and adolescents suffering separation anxiety disorder feel extreme anxiety that he/she or attachment figures such as his/her parents may be harmed. A number of emotional, cognitive, behavioral and somatic symptoms emerge in the face of separation of attachment figures or such anticipation and negatively affect one enjoying life, social life, family relations and functions in school and other fields. As consequence of such basic fear, some behavioral symptoms such as inability to leave the parent, anxiety and avoidance in play at friend's house and multiple somatic symptoms such as nightmares with themes of separation, being lost, abduction, death etc., stomach, headache, nausea and vomiting may emerge. The school refusal is one of the situations observed in the separation anxiety disorder and significantly affecting the functioning of children.

Selective Mutism

Selective Mutism is defined as a situation where a person can/does not speak in an environment or case that person(s) is/are expected to talk, despite having ability to speak. Although the frequency of selective mutism varies in different populations (0.11-2.2%), it is a chronic disorder leading to significant dysfunction in academic and social areas. It was shown to be 1.5-2 times more common in females than males. Children with selective mutism speak normally while in their home or with their parents. However, they may not speak in school, environment outside their home or near people that they do not know. The severity of selective mutism can be variable; there may be children who do not speak at school almost at all, as well as the case of not speaking with a single person (teacher only). Other symptoms associated with selective mutism include excessive shyness, withdrawal, overdependence and opposition to parents.

Panic Disorder

As a recurrent disorder, panic disorder emerges in unexpected times and is followed by panic attacks. So the patient feels fear of subsequent attacks and exhibits avoidance behavior. Panic attacks, which form the basis of the disorder, are symptoms such as dyspnea, palpitations, chest pain, dizziness, de-realization, paresthesia, hot or cold pressure, sweating, feeling of fainting, trembling or shaking and anxiety attacks that occur in unexpected moments. Panic disorder for children and adolescents is a psychopathology that causes chronic and psychosocial challenges and difficulties in academic field as well as family and friend relations.

The way of meeting the diagnosis criterion of panic disorders is to undergo unexpected and recurrent panic attacksby child and adolescent. Panic attack is an anxiety attack that occurs without any real threat or danger and leads to a group of emotional, somatic, and cognitive symptoms for child or adolescent. The indications reach a peak within a couple of minutes in these sudden attacks and cause apparent fear and disturbance in the person. Generally, these attacks gradually lose their intensity in 15-20 minutes and then disappear. Adolescents may suffer emotional and somatic symptoms such as palpitations, trembling, shaking, nausea, abdomen discomfort and sweating during panic attacks. Chest pain that may occur during panic attack is one of the most frightening symptoms for a child and his/her family. In a study on 27 children between the ages of 8 and 17 who applied to cardiology due to non-organic chest pain, 9 out of these patients were found to have panic disorder.

Children and adolescents with panic attack may have the fears of going mad, losing control, contracting a serious disease, fainting or even dying. However, it is known that in child and adolescent age group, cognitive symptoms are expressed less than somatic symptoms. A child having a panic attack thinks that something is going wrong or to happen; however, he/she could

not make sense that what is happening and how. Although there may be panic reactions in small children, there is not exact data on the presence of unexpected typical panic attacks in this age group without stimulus. It is suggested that small children will not have panic attack since their cognitive development is insufficient to interpret somatic experiences in a catastrophic way.

Specific Phobia

Specific phobia is excessive or nonsignificant, apparent and constant fear that arises in case of a particular object or condition or an expectation in this regard. As result of such fear, the person exhibits avoidance behavior, experiences intense anxiety and such case affects functionality of the individual or severe problems occur related to fear.

In normal development, fear is a common emotional reaction in children. Children typically exhibit fear reactions to foreigners, separation, loud noise, darkness, water, imaginary creatures, spiders and snakes. These fears are generally short-lived, declines with age and do not lead to significant deterioration in functionality. Fears that are defined as phobic are fears that cause significant distress and disrupt functionality. Specific phobia is divided into five sub-types; animal type, natural-environment type, blood-injection-wound type, situational type and other type. Animal-type and natural-environment type phobia generally occur during childhood.

Expectation anxiety is observed in specific phobia caused by the possibility of confrontation with phobic stimulus. The phobic stimulus may lead to cognitive indications such as fear, inability to cope and thought to be damaged and physical indications such as sweating, desert mouth, difficulty in breathing and stomach discomfort. The person exhibits avoidance behaviors to reduce anxiety due to basic fear. If it is not possible to avoid, reactions such as irritability, being petrified, thumb sucking, clinging to parent or crying can be seen in children. Adults are aware that these fears are exaggerated and nonsense unlike children.

Social Phobia

Social phobia is a significant and permanent fear that one experiences in situations where the person come up against unfamiliar persons or in social situations where other may keep an eye on. A person may feel a significant anxiety if encounters with frightening social situations and the person may exhibit the behavior of avoidance from the situations which cause such anxiety. The social anxiety or avoidance behavior by a person hasalso a negative impact on his/her functionality or a significant distress is experienced associated with fear.

Individuals with social phobia are often afraid that others may find mistakes in themselves and think they can or will do or say something stupid or embarrassing. Somatic complaints such as flushing, sweating, fast heartbeat, trembling, desert mouth and dizziness are frequent. Individuals with social phobia are afraid that these somatic symptoms may be perceived by other people and this fear makes them feel more anxiety.

Clinical features of social phobia seen in children and adolescents may differ from those in adults in addition to some similarities. These children may cry, throw a temper tantrum, hide behind their mothers or resist going to school if they confront with a frightening social situation. Children and adolescents with social phobia may refrain from involving in class activities and fail in examinations or presentations. Adolescents and young adults with social phobia may avoid close contact and communication with opposite sex.

Generalized Anxiety Disorder

Generalized anxiety disorder is an anxiety disorder in which people feel extreme distress, anxiety and concern with regard to many events or activities, have difficulty in subduing their concerns and functionality of people is significantly affected by anxiety and concern. In generalized anxiety disorder, clinical indications usually begin in early childhood and peak in the middle of adolescence. Its frequency is reported as 2-6% in children and adolescents. The symptom that is the basic appearance of generalized anxiety is the concern had by children and adolescents in many areas and events such as school and social functioning for at least 6 months. These children and adolescents have a sustained, persistent and uncontrollable anxiety about their future, health, safety and performance. These concerns are accompanied by somatic symptoms such as discomfort, fatigue, muscle strain, sleep disturbances, stomachache and headache; cognitive symptoms such as difficulty in collecting attention and behavioral symptoms such as avoidance of behaviors that are not believed to display a perfect performance by them and are irregular/socially disapproved behaviors.

Children and adolescents with generalized anxiety disorder are often perfectionists. They are disposed to interpret a small mistake as a real flop. They tend to avoid activities they do not believe that their performances will be perfect. Self-criticism is frequent in these children and adolescents. Furthermore, they need to be approved frequently and to a large extend. They may not be able to make progress in their works unless they are approved that they do well and correct.

Prevalence/Incidence

Anxiety disorders are one of the most common psychopathologies of childhood. Studies suggest thatthe incidence of any life-long anxiety disorder in children and adolescents varies between15% and 20%. According to data from community studies, the incidence of any anxiety disorder was found to be 31.9% in the age range of 13-18. Considering the incidence of anxiety disorders in children and adolescents, it is known to us that there are significant changes with age. During adolescence; the incidence of panic disorder, agoraphobia and obsessive compulsive disorder was shown to increase, while the separation anxiety incidence is reduced in both girls and boys. It is also known that there is an increase in the frequency of social phobia and generalized anxiety disorder for girls with age. According to current data on anxiety disorders, anxiety disorders in children and adolescents are chronic, lead to significant impairment in functionality and are a significant risk factor in terms of anxiety disorders, depression, substance abuse and destructive behavior disorders observed in adulthood.

Causes/Risks

It is believed that both genetic and environmental factors play a role in the etiology of anxiety disorders. Familial transmission, genetic factors, temperament related factors and environmental causes are the fields being studied most. Anxiety disorders have familial transmission. There are a significantly increased risk of anxiety and mood disorder for the first-degree relatives of the individuals with anxiety disorder. This is also applicable for anxiety in children and adolescents. Anxiety disorder is more common in parents of the children with anxiety and also possibility of having child with anxiety increases for adults with anxiety. There are twin studies indicating that genetic factors in anxiety etiology are effective by 30-40%.

Prognosis

Studies on the course of anxiety disorders make us think that the continuity may be both as homotypic (continuity/recurrence of the same disorder in advanced ages) and heterotypic (transforming into a different disorder in advanced ages). Investigations in both clinical and community samples show that the heterotypic persistence of anxiety disorders in children and adolescents is in the forefront. Anxiety disorders may predict future mood and substance use disorders, other anxiety disorders, self-harming behaviors.

Treatment

A multimodal therapy is recommended for children and adolescents with anxiety disorder which includes psychoeducation of children and their parents, cognitive behavioral therapy (CBT), family therapy and pharmacotherapy together. Besides, some information should be conveyed to child and family on importance of activity involvement. While determining the option of therapy, the psychosocial stressors of the child and adolescent, risk factors, degree of anxiety disorder and its effect on functionality, comorbid situations, age and developmental level of child, expressive skills and general behaviors, level of awareness and cooperation of the environment, support and physical condition of the caregiver, attitude of child and his/her family to the therapy to be applied, child's participation in the family, school and games and evidence level of therapy should be considered. All of the factors listed above are of great importance. However, the severity of anxiety disorder and its effect on functionality play a great role in determining treatment options because pharmacotherapy should be used in cases which are moderate and severe, impair the functioning significantly and in which adequate response is not available, while CBT is the treatment option for the anxiety disorder which is mild and does not significantly impair functioning. Along with selective serotonin reuptake inhibitor drugs (SSRIs) as the first choice in the pharmacological treatment of anxiety disorders in children and adolescents; many drugs such as serotonin and norepinephrine reuptake inhibitors (SNRIS), tricyclic antidepressants (TCA) and benzodiazepines could be used in therapy. Safety and confidence are so important in treatment. The child should be allowed to express his/her positive and negative emotions. Child should know that he/she can express his/her feelings explicitly. In the treatment, child should be encouraged to proceed to independence from dependency. Opportunities for problem solving and selection should be given. Child should be given the opportunity to select again and again, however, this should be done within the needs and in a regular manner. Game is the basis for the activity-based intervention program of the child. Game provides the child's motor development, socialization, abstract concept development, emotional integration and development of autonomy. Game activities should be well structured and age-appropriate, short-term and attractive. It should include a wide range of motor activities and be encouraging.

Benefits of Physical Activity

Exercise and physical activity are important for mental health since they reduce stress and anxiety of individual. Researches indicate that physical activity is very effective in reducing fatigue, improving mental alertness and concentration and improving general cognitive function. While stress and anxiety affect the brain, the rest of the body feels negative effect through many neural connections. Exercise and physical activity produce endorphins that act as natural painkillers in the brain and also provide sleep patterns and thus reduce stress. Regular aerobics exercise

reduces general tension levels, improves and stabilizes mood, regulates sleeping and advances self-esteem. Approximately five minutes of aerobic exercise could start to alert anti-anxiety effects. Physical activity and exercise improve the ability to cope with stress, helping improvement of mental health.

DEPRESSION IN CHILDREN AND ADOLESCENTS

Definition

Depression is a disorder characterized by unhappiness, hopelessness, loss of interest in willingly performed activities, feelings of worthlessness, irritability, loss of concentration, sleep and appetite problems and accompanied by certain negative thoughts. Although daily symptoms are not necessary for diagnosis in clinical depression, depressive symptoms are expected to be seen most days of the week throughout two weeks at least.

Causes, symptoms and treatment of depression in childhood and adolescence have differences pertaining to developmental period. Depression in infancy occurs in the event of loss of mother or caregiver or apparent corrosion of relation between this person and infant by a reason whatsoever. This clinical condition that emerges in the second half of the first year of life is characterized by developmental retardation, apathy and unhappiness in infants.

It is difficult to make a diagnosis in children during play age since they are not able to utter their complaints due to inability of linguistic performance. In this period, depression may show up with clinical findings such as not showing expected development, withdrawal, decrease in motions or peevishness, moodiness, behavior disorder, change and impairment in sleep, eating and defecation habits.

Depression symptoms in school-age children may occur either as introversion and decrease in interests and involvement or discomfort, irritability and behavioral disorders on the contrary. Also, failure to thrive and appetite disorders such as eating attitude disorders may be observed as well as sleep disorders such as inability to sleep alone and night fears. Disorders such as enuresis and encopresis and somatic complaints such as head and abdominal pain may be seen among the depressive symptoms in this period. Depression, especially in school-age children, affects children's cognitive functions and school achievement negatively and disrupts their functioning.

Adolescents experience marked and sudden changes in their emotions, thoughts and relationships as a characteristic of the period they are in. Adolescents in depression may sometimes experience these changes more rapidly and violently, as well as social withdrawal, decrease in interest and activities, friendship breakdowns, poor school success, escaping from school and home, substance-alcohol

use tendency and suicidal thoughts and attempts may be seen. Depressive affection, guilt feelings, excessive anger, difficulty in maintaining relationships or hypersensitivity to rejection or criticism may be observed. Depression in adolescents is closer to adults in terms of symptoms and treatments. Adolescents with symptoms of mild and moderate depression may conceal their symptoms by showing reactive variability in affection and making additional efforts.

Depression and suicide, which is an important health problem related with depression, take place the most important place among the mental disorders of children and adolescents. It is a fact that the suicide thoughts and plans in school age depression are less common than in the adolescence. However, it must be taken seriously, if seen. Also suicide attempt ending up with death increases by age.

Prevalence/Incidence

Point prevalence of depression is reported as 1-2% in pre-school and school age children, while it is3-8% in adolescents. The life-long prevalence of depression until the end of adolescence is approximately20%. Studies conducted in this field support that depression rate increases with age. The increase in the risk of depression during early adolescence continues throughout adolescence. While depression is similar in girls and boys in the pre-adolescence period, the incidence in girls increases in adolescence.

Causes/Risks

In play age, major depression is caused by stress factors. However, situations that are cause of stress for child in this period may not be a source of stress for other periods. The most important stresses of this period are the changes in the life of child. During the developmental periods, children will be more or less affected by negative stress factors, depending on structural characteristics. Now the genetic and biochemical factors have started to play a role in the etiology of depression, even though dynamic factors and stress factors maintain its efficiency that are discussed in infancy and play age childhood as causes of depression in school age child. Both genetic and environmental factors were shown to be effective in the development of depression. The presence of depression in family in the etiology of childhood depression is effective through genetics, identification and social learning.

In addition, several findings were detected in researches which support the connection between depression and various neuroendocrine, neuroanatomic and neurochemical factors.

Prognosis

Factors such as the disease onset age, severity, presence of accompanying disorders and depression history in parents are related to the duration and prognosis of depression. It is reported that the depressive episode lasts for an average of 7-9 months in patients in the clinical sample, while it is approximately 3-6 months in community sample. The depressive episode may spontaneously recover with 40% of relapse within two years. The presence of negative family factors or the presence of chronic environmental stressfactors is associated with unfavorable outcome.

Treatment

Treatment for children younger than the age of six is mainly play therapy. Cooperation with family is also important other than play therapy in play age. It is important to take measures against environmental stress factors and to develop protective mechanisms. Child should be provided and encouraged to be directed to the areas of activity and friendships that he/she can enjoy. Antidepressant drug treatments may also be added to these interventions during the school age. Communication and cooperation with the school may also be necessary. In adolescents, psychotherapy has an important place in treatment. It is reported that drug treatments applied with psychotherapies are more effective in depressed children and adolescents. Selective serotonin reuptake inhibitors are preferred, with priority, in pharmacotherapies of child and adolescent depression. There is also different pharmacological treatment methods applied as secondary and tertiary treatment.

Indications for Children with Anxiety Disorder and Depression

Physical activity is recommended for children with anxiety disorder and depression, who have no other health problems that may pose an obstacle for doing exercise, in order for they have positive changes in social interaction and communication, improvement in behaviors and life quality.

Physical Activity Prescription for Anxiety Disorder and Depression

- 30 minutes between 3 and 5 days a week
- Daily targets should be identified and regular physical activity should be done.
- Recreational individual and group activities should be preferred.
- According to changes in child's emotional state, the duration and frequency of physical activity should be adjusted.

Physical Activity Recommendations for Anxiety Disorder and Depression

Activities should be done accompanied by child's favorite music genre and in child's favorite environments.

- Swimming
- Bicycle riding
- Nature walks/sports
- Stretching and strengthening exercises (light intensity, not increasing anxiety)
- Group exercises/games
- Pilates
- Horse riding
- Trampoline/bounding-jumping, jumping rope accompanied music or rhythm

Points to be Considered

Games and physical activities that require competition in children with anxiety may lead to an increase of anxiety. Such activities should be planned in a controlled way according to the situation of child. It also should not be forgotten that activities, which are composed of repeats, uninteresting and automated, will not support the child's motivation to involve in physical activities. This may be more obvious for children with depression in particular. The activities that will keep child's attention, increase self-confidence of child, support his/her awareness about him/her and are enjoyable should be preferred.

EATING DISORDERS IN CHILDREN AND ADOLESCENTS

Definition

Eating disorders are a group of psychiatric disorders characterized by severe disorders in eating behavior that may result in death. In DSM 5, it is classified as pica, rumination disorder, avoidant/restricted food intake disorder, anorexia nervosa, bulimia nervosa and binge eating disorder. While pica, rumination disorder and avoidant/restricted food intake disorder among eating disorders are observed during early childhood and infancy; anorexia nervosa, bulimia nervosa and binge eating disorder are often observed during adolescence.

Pica

It is defined as constantly eating the foods, which are not nutritious and do not carry nutritional properties, for at least one month. Pica occurs frequently between 12 and 24 months in children with normal development. However, healthy children, too, may eat not edible substances in this period. In order to be able to diagnose pica in this period, eating behavior must be continuous, clinically significant at a severe level and incompatible with the level of development. Children with pica eat hair, paint, fabric, plaster, sand, insect, leaf, soil. In the clinic for these children, thumbsucking and nail biting accompany with the aim of alleviating internal tension and relieving himself/herself. Complications such as anemia, infection, constipation, diarrhea, iron and zinc deficiency, lead poisoning and bowel obstruction due to bezoar formation can occur in children with Pica.

Rumination Disorder

After at least one month of ingesting and partially digesting food, it is defined as voluntary re-feeding and re-chewing of food without a cause such as disgust or nausea. This should not be explained by another health problem (e.g. gastroesophageal reflux, pyloric stenosis). Indications of rumination disorder are usually observed when child is alone. The child often tries to get stomach contents into mouth through various body movements such as putting hand on mouth, squeezing, effort, straining, taking his head back and sucking his/her tongue. Once the stomach contents come to mouth, inactivity, empty gaze, pleasure and relaxation are observed in child. In this way, the child is both relaxed and attracts attention of his/her mother. Thus the behavior is strengthened by the pragmatic conditioning in child. Rumination disorder may emerge as a behavior of child to stimulate and relax himself/herself.

Avoidant/Restricted Food Intake Disorder

Although there is no problem in reaching food, persistent insufficient eating is a disorder followed by a failure to thrive and significant weight loss. In this disorder, there is no problem with perception of body weight or body shape. The disorder starts before the age of six. Reluctance to food and meal is characterized by lack of expected weight gain and weight loss in children. Children with avoidant/restricted food intake disorder apply to the clinic with complaints of refusal to eat, conflict during feeding and growth retardation.

Anorexia Nervosa

Anorexia nervosa is an eating disorder status in which the desire to be slim and fear of being overweight push a patient into some typical behaviors in order for him/her to lose weight. Its basic feature is that the individual refuses to have minimum body weight that is considered normal and exhibits apparent impairment in perception of body shape or size. Anorexia nervosa is the eating disorder status, which has the highest mortality rate among psychiatric disorders.

Bulimia Nervosa

Bulimianervosa is a status where a patient exhibits the pattern of behaviors that aim to control body weight just as anorexia nervosa. However body weight of the patient is normal or above normal in contradistinction to anorexia nervosa. The patient with bulimia nervosa has eating attacks that he/she cannot avoid and resorts to the methods such as regurgitation and use of laxative-diuretic-appetite suppressant and similar medications in order to reduce the fattening effects of foods taken during these attacks. The eating attacks that cannot be prevented, the guilt and depressed mood due to these attacks and vicious circle of eating attacks-vomiting due to such a mood are typical.

Binge Eating Disorder

In the case of binge eating disorder, the patient eats too much in an uncontrolled way within a short span of time. It is accompanied by the indications such as eating fast, eating when not hungry, eating alone, eating until being physically uncomfortable and disgust. Diagnosis as made if this status is observed at least one time a week throughout three months.

Obesity is increasing worldwide as an epidemic problem in adolescents and children. Obese patients are usually divided into two subgroups in the study, obese with binge eating disorder and obese without binge eating disorder. Weight of obese persons with binge eating disorder is related to eating a lot and their psychopathology is also higher than the other group. The rates of depression are especially high in those who have a binge eating disorder. Impulsiveness, aggression and anger; are among the important psychopathological features observed in patients with eating disorders. Impulsive properties were found to be high especially in those with binge eating disorder. It is known that impulsive children are more prone to tasty foods and therefore more attention should be paid to dietary programs.

Prevalence/Incidence

It is estimated that 25-50% of infants and small children have nutritional problems (rejection of eating, eating too little, choosing food, avoiding food, difficulty in transition to feeding himself/herself). It is reported that 1-2% of children have severe nutritional problems such as refuse to eat, weightloss or failure to gain weight. It is reported that 70% of those who refuse to eat in infancy and childhood still have nutrition problems at the age of 4. However, it is detected that selective eating behavior during childhood is associated with anorexia nervosa development in early adulthood.

Incidence of anorexia nervosa is reported to be 8/100,000 per year in women and 0.5/100,000 in men, although it varies according to the methods of the studies. Frequency is reported as 12-13/100.000 for bulimia nervosa.

Causes/Risks

Although the etiology of eating disorders is not completely understood, many theories such as developmental, genetic, neurobiological and psychosocial structure are emphasized. According to current researches, it is accepted that eating disorders is based on multifactorial etiology. In some cases of eating disorders, environmental reasons such as psychosocial reasons, low stimulus, emotional and physical neglection, maternal and paternal psychological pathology are reported, while organic orientation of eating disorder is emphasized in some others. Eating disorders, especially in early childhood and infancy, were found to be closely related to the impaired family structure, inadequate mother-child interaction, maternal deprivation, neglect and abuse.

Prognosis

Although co-morbidity with other psychiatric disorders is common, eating disorders tend to lead to higher chronicity and adverse results compared to other psychiatric disorders.

Treatment

It is important to make a comprehensive mental examination for eating disorder cases and to start a treatment if there are problems leading to predisposition to eating disorder. Recognition and prevention of eating disorders before or during the onset phase of them is the most important step in treatment and follow-up. Multidimensional therapy is the most commonly used approach as a treatment approach for eating disorder or impaired eating behavior. Multidimensional treatment approach includes intervention to physical, psychological, psychosocial and individual-family interactions. During the evaluation, mother-child interaction and communication, family functioning should be necessarily emphasized. Primary treatment strategies are behavioral methods and pharmacological agents (SSGI, etc.) are used in some cases. It is suggested that some anorexia nervosa cases should be monitored in services with bed due to the high mortality risk.

Benefits of Physical Activity

Planning the current physical activity is very important for patients with eating disorder. In general, patients are taken to bed rest to reduce their calorie expenditure. Individuals may be involved in a safe physical activity program even in such a situation.

Controlled physical activity and exercise prescription have a positive effect on weight gain or menstrual cycle in eating disorders. With supervised exercise, increased treatment compliance, balanced therapeutic relationship, reduced nutritional priority, reduced bulimic symptoms and reduced negative exercise behaviors could be achieved.

Controlled physical activity and exercise in eating disorders were shown to be effective on self-confidence, self-esteem, right body image and increased mood perception and reduced depression.

Exercise Prescription and Appropriate Physical Activities for Eating Disorders

Patients with severe eating disorders are expected to decrease rest and activity. Physical activity should be light intensity and for short duration. Reaching, sitting, standing in crawling position, normal joint movements, stretching exercises and yoga are appropriate activities.

Appropriate exercises for patients with moderate eating disorders may be joint movements while standing, stretching exercises and yoga. The risk of fracture should be kept in mind, considering that the increase in bone mineral density is later than the weight restoration.

Contraindications

Intensive physical activities (e.g. gymnastics, jumping) with blow and resistiveexercises are contraindicated.

Points to be Considered

The following factors should be taken into account when creating a physical activity and exercise program:

- Irregularities in vital signs,
- Low percentage of ideal body weight,
- Presence of negative exercise behaviors,
- Low bone mineral density / fracture risk
- Menstrual dysfunction.

REFERENCES

1. *Adler LA, Newcorn JH, Faraone SV.The impact, identification and management of attention-deficit/hyperactivity disorder in adults. CNS Spectrums 12 (12 supp 23) 2007; 1-19.*
2. *Agranat Meged AN, Deitcher C, Goldzweig G, et al. Childhood obesity and attention deficit/hyperactivity disorder: a newly described comorbidity in obese hospitalized children. Int J Eat Disord 2005; 37(4):357-9.*
3. *APA, American Psychiatric Association: Diagnostic and Statistical Manual of Mental Disorders: DSM 5. Fifth ed. Arlington, VA: American Psychiatric Association. 2013*
4. *Ashwood P, Wills S, Water JV. The immune response in autism: a new frontier for autism research. Journal of Leukocyte Biology 2006; 80: 1-15.*
5. *AutismSpeaks.org. http://blog.autismspeaks.org/2011/02/03/s-evaluating-change/. 2014. Bozukluk, O. Gösteren Çocuklarda Bir Müdahale Yaklaşımı: Su İçi Etkinlikler. International Journal of Early Childhood 2012; 4(1): 32-45.*
6. *Aydın İ, Sarol H. Otizmli Bireylerin Fiziksel Aktivite Programlarına Katılımını Engelleyen Faktörlerin İncelenmesi. International Journal of Science Culture and Sport SI 2014; (1): 870-880.*
7. *Banerjee TD, Middleton F, Faraone SV. Environmental risk factors for attention-deficit hyperactivity disorder. Acta Pediatrica 2007; 96: 1269-1274.*
8. *Barkley RA. History. Attention-Deficit Hyperactivity Disorder. 3rd ed. New York: Guilford Pres, 2006; 3-75.*
9. *Beesdo K, Knappe S, Pine DS. Anxiety and anxiety disorders in children and adolescents: developmental issues and implications for DSM-V. The Psychiatric clinics of North America. 2009; 32(3):483-524.*
10. *Bennett K, Manassis K, Duda S, et al. Preventing Child and Adolescent Anxiety Disorders: Overview of Systematic Reviews. Depression and anxiety. 2015; 32(12):909-18.*
11. *Berkman ND, Lohr KN, Bulik CM. Outcomes of eating disorders: a systematic review of the literature. Int J Eat Disord, 2007; 40:293-309*
12. *Biederman J. Attention-Deficit/Hyperactivity Disorder: A Selective Overview. Biol Psychiatry 2005; 57: 1215-1220.*
13. *Birmaher B, Williamson DE, Dahl RE, et al. Clinical presentation and course of depression in youth: does onset in childhood differ from onset in adolescence? J Am Acad Child Adolesc Psychiatry 2004; 43:63-70.*
14. *Brent D, Maalouf F. Depressive Disorders in Childhood and Adolescence. Rutter's Child and Adolescent Psychiatry, (eds, Thapar A, Pine DS, Leckman JF, Scott S, Snowling MJ, Taylor E), 6.Baskı, Wiley Blackwell, 2015:874-892.*
15. *Brent DA, Weersing VR. Depressive Disorders. Lewis's Child and Adolescent Psychiatry A Comprehensive Textbook, (eds Martin A, Volkmar FR), Wolters Kluver Lippincott Williams &Wilkins, 4. Baskı, Philadelphia, 2007: 503-513*
16. *Boddaert N, Zilbovicius M, Philipe A, et al. MRI findings in 77 children with non-sendromic autistic disorder. PLos One, 2009; 4: e4415.*
17. *Brand S, Jossen S, Holsboer-Trachsler E, et al. Impact of aerobic exercise on sleep and motor skills in children with autism spectrum disorders- a pilot study. Neuropsychiatric Disease and Treatment 2015; 11:1911-20.*
18. *Burklund LJ, Craske MG, Taylor SE, et al. Altered emotion regulation capacity in social phobia as a function of comorbidity. Social cognitive and affective neuroscience.2015; 10(2):199-208.*
19. *Bush G, Valera EM, Seidman LJ. Functional Neuroimaging of Attention-Deficit/Hyperactivity disorder: a review and suggested future directions. Biol Psychiatry 2005; 57: 1273-1284.*
20. *Button E, Aldridge S. Season of birth and eating disorders: patterns across diagnoses in a specialized eating disorders service. Int J Eat Disord, 2007; 40:468-471.*
21. *Carruth, B.R. Prevalence of picky eaters among infants and toddlers and their caregivers' decisions about offering a new food. Journal of the American Dietetic Association. 2004; 104: p. 57-64.*
22. *CDC. Prevalence of autism spectrum disorders--Autism and Developmental Disabilities Monitoring Network, 14 sites, United States, 2008. MMWR Surveill Summ,2012; 61(3): 1-19.*
23. *Chauhan A, Chauhan V. Oxidative stres in autism. Pathophysiology 2006; 13: 171-181.*
24. *Çetin FH, Güney E. Dikkat Eksikliği / Hiperaktivite Bozukluğu. Kaplan & Sadock Psikiyatri Davranış Bili mleri/Klinik Psikiyatri (çeviri) içinde, Editörler: Sadock BJ, Sadock VA, Ruiz P [Bozkurt A (Çev. Ed.)], Ankara: Güneş Tıp Kitapevleri, 2016: 1169-1180*
25. *Dahl, M. ,Sundelin C. Feeding problems in an affluent society. Follow-up at four years of age in children with early refusal to eat. Acta Paediatrica, 1992; 81(8): p. 575-579.*
26. *Davis TE, Ollendick TH . Empirically supported treatments for specific phobia in children: Do efficacious treatments address the components of a phobic response? Clinical Psychology: Science and Practice. 2005; 12(2):144-60.*
27. *de la Barra F, Vicente B, Saldivia S, et al . Separation anxiety, social phobia and generalized anxiety disorders in the chilean epidemiological study of children and adolescents. J Child Adolesc Behav.2014; 2(133):2.*

28. *Diler RS . Panic disorder in children and adolescents. Yonsei Medical Journal. 2003; 44(1):174-9.*
29. *Dobson ET, Strawn JR. Pharmacotherapy for Pediatric Generalized Anxiety Disorder: A Systematic Evaluation of Efficacy, Safety and Tolerability. Paediatric drugs. 2016; 18(1):45-53.*
30. *Fairburn CG, Harrison PJ. Eating disorders. Lancet, 2003; 361: 407-16.*
31. *Field AE, Sonneville KR, Micali N, et al. Prospective association of common eating disorders and adverse outcomes. Pediatrics, 2012; 130(2):e289-295.*
32. *Freitag CM. The genetics of autistic disorders and its clinical relevance: a review of the literature. Mol Psychiatry 2007; 12: 2-22.*
33. *Freitag CM. Genetics of autism. J Intellect Disabil Res 2008;52: 817.*
34. *Fuentes J, Bakare M, Munir K, et al. Autism spectrum disorder. IACAPAP e-Textbook of Child and Adolescent Mental Health, Section C Developmental Disorders içinde Editor: Rey JM, 2014: 1-35. Geneva: International Association for Child and Adolescent Psychiatry and Allied Professions, 2015/ Alıntılanma Tarihi: 17.10.2016.*
35. *Gillberg C, Billstedt E Autism and Asperger syndrome: coexistence with other clinical disorders. Acta Psychiatr Scand. 2000; 102(5):321-30.*
36. *Greene AL, Eaton NR. Panic disorder and agoraphobia: A direct comparison of their multivariate comorbidity patterns. Journal of affective disorders. 2016; 190:75-83.*
37. *Güveli, GM; İşeri, E. Anksiyete Bozukluklarının Etiyolojisi Turkiye Klinikleri Journal of Child Psychiatry-Special Topics, 2016; 2.3: 7-13.*
38. *Hay P, Chinn D, Forbes D, et al. Royal Australian and New Zealand College of Psychiatrists clinical practice guidelines for the treatment of eating disorders. Austr N Z JPsychiatry, 2014; 48:977-1008.*
39. *Hechtman L. Predictors of long-term outcome in children with attention-deficit/hyperactivity disorder. Pediatr Clin North Am. 1999; 46(5): 1039-52.*
40. *Hua A, Major N. Selective mutism. Current opinion in pediatrics. 2016; 28(1):114-20.*
41. *Hurtig T, Ebeling H, Taanila A, et al. ADHD symptoms and subtypes: Relationship between childhood and adolescent symptoms. J Am Acad Child Adolesc Psychiatry. 2007; 46(12):1605-1613.*
42. *Işık E, Taner Y. Çocuk ve Ergenlerde Anksiyete Bozuklukları. In: Erdal Işık, editor. Çocuk, Ergen ve Erişkinlerde Anksiyete Bozuklukları. İstanbul: golden print; 2006; 367-491.*
43. *Kılıç BG, Gürkan CK, Kerimoğlu E. Çocukluk ve Ergenlik Döneminde Görülen Ruhsal Bozukluklar. Ruh Sağlığı ve Bozuklukları içinde. Editörler: Öztürk MO, Uluşahin NA, 2015; 572-626. Tuna matbaacılık, Ankara.*
44. *Kerkez Fİ. Sağlıklı Büyüme İçin Okulöncesi Dönemdeki Çocuklarda Hareket Ve Fiziksel Aktivite. Spor Bilimleri Dergisi 2012; 23(1): 34-42.*
45. *Kieling C, Goncalves RR, Tannock R, et al. Neurobiology of attention deficit hyperactivity disorder. Child and Adolescent Psychiatry Clinics of North America. 2008;17: 285-307.*
46. *Kim YS, Leventhal BL, Koh YJ, et al. Prevalence of autism spectrum disorders in a total population sample. Am J Psychiatry. 2011; 168(9): 904-12.*
47. *Kiluk BD, Weden S, Culotta VP. Sport participation and anxiety in children with ADHD. J Atten Disord. 2009; 12: 499–506.*
48. *King NJ, Muris P, Ollendick TH. Childhood fears and phobias: Assessment and treatment. Child and Adolescent Mental Health. 2005;10(2):50-6.*
49. *Kristensen H. Selective mutism and comorbidity with developmental disorder/delay, anxiety disorder, and elimination disorder. Journal of the American Academy of Child & Adolescent Psychiatry. 2000;39(2):249-56.*
50. *Lai MC, Lombardo MV, Baron-Cohen S. Autism Lancet. 2014; 383 (9920): 896-910.*
51. *Lichtenstein P, Carlström E, Rastam M, et al. The genetics of autism spectrum disorders and related neuropsychiatric disorders in childhood. Am J Psychiatry, 2010; 167(11):1357-63.*
52. *Lipsitz JD, Masia C, Apfel H, et al. Noncardiac chest pain and psychopathology in children and adolescents. Journal of psychosomatic research. 2005; 59(3):185-8.*
53. *Mahon AD, Stephens BR, Cole AS Exercise Responses in Boys With Attention Deficit/Hyperactivity Disorder: Effects of Stimulant Medication. Journal of Attention Disorders 2008; 12(2): 170-6.*
54. *March J, Silva S, Petrycki S et al. Fluoxetine, cognitive-behavioral therapy, and their combination for adolescents with depression: Treatment for adolescents with depression study (TADS) randomized control trial. JAMA. 2004; 292:807-820.*
55. *Marchi, M. and P. Cohen, Early childhood eating behaviors and adolescent eating disorders. Journal of the American Academy of Child & Adolescent Psychiatry, 1990; 29(1): p. 112-117.*

56. *Merikangas KR, He J-p, Burstein M, et al. Lifetime prevalence of mental disorders in US adolescents: results from the National Comorbidity Survey Replication–Adolescent Supplement (NCS-A). Journal of the American Academy of Child & Adolescent Psychiatry. 2010; 49(10):980-9.*
57. *Mohatt J, Bennett SM, Walkup JT. Treatment of separation, generalized, and social anxiety disorders in youths. AmericanJournal of Psychiatry. 2014.*
58. *Moriyama TS, Cho AJM, Verin RE, et al (2012) Attention Deficit Hyperactivity Disorder. IACAPAP e-Textbook of Child and Adolescent Mental Health, Section D Externalizing Disorders. Editor: Rey JM, s:1-23. Geneva: International Association for Child and Adolescent Psychiatry and Allied Professions, 2015/ Citation Date: 17.10.2016.*
59. *Motavalli-Mukaddes N. Otizm Spektrum Bozuklukları-Tanı ve Takip, İstanbul: Nobel Tıp Kitabevleri, 2014.*
60. *Muris P. Treatment of childhood anxiety disorders: what is the place for antidepressants?Expert Opin Pharmacother. 2012; 13(1):43-64.*
61. *Nagata T, Suzuki F, Teo AR. Generalized social anxiety disorder: A still-neglected anxiety disorder 3 decades since Liebowitz's review. Psychiatry and clinical neurosciences. 2015; 69(12):724-729.*
62. *Odent M. Attention deficit hyperactivity disorder (ADHD) and obesity: Two facets of the same disease? Med Hypotheses. 2010; 74:139-141.*
63. *Ollendick TH, Birmaher B, Mattis SG Panic disorder. Anxiety disorders in children and adolescents Guilford, New York.. 2004: 189-211.*
64. *Öztürk MA. Engellenen Bireylerin Gözünden Otizm Spektrumu Çeşitli İşlevlerin Gelişimi İçin Beden Eğitimi Önerileri. Engellilerde Beden Eğitim ve Spor Kongresi, 2011; 63.*
65. *Öztürk, M; Karaçetin, G. Çocuk ve Ergenlerde Anksiyete Bozukluklarında Farmakolojik Tedavi Yaklaşımları. Turkiye Klinikleri Journal of Child Psychiatry-Special Topics, 2016, 2.3: 47-53.*
66. *Pinheiro AP, Bulik CM, Thornton LM, et al. Association study of 182 candidate genes in anorexia nervosa. Am J Med Genet B Neuropsychiatr Genet, 2010; 153:1070-1080*
67. *Rey JM, Bella-Awusah TT, Liu J. Depression in children and adolescents. IACAPAP e-Textbook of Child and Adolescent Mental Health, Section E. Mood Disorders (Ed: Rey JM), International Association for Child and Adolescent Psychiatry and Allied Professions, Geneva, 2015*
68. *Rogers L, Hemmeter ML, Wolery M. Using a constant time delay procedure to teach foundational swimming skills to children with autism. Topics in Early Childhood Special Education 2010; 30: 102-111*
69. *Savcı, U, Tufan, AE. Anksiyete Bozuklukları, Obsesif Kompulsif Bozukluklar ve Travma Sonrası Stres Bozukluğunda Prognoz. Turkiye Klinikleri Journal of Child Psychiatry-Special Topics, 2016; 2.3: 64-67.*
70. *Schag,K., J. Schönleber, M. Teufel, et al., Food-related impulsivity in obesity and binge eating disorder--a systematic review. Obes Rev, 2013; 14(6):477-95.*
71. *Shaffer D, Çocuk ve Ergende Depresif Bozukluk ve Özkıyım. Kaplan&Sadock's Comprehensive Textbook of Psychiatry. (eds. Saddock BJ, Saddock VA) (çev eds. Aydın H, Bozkurt A) USA: Lippincott Williams& Wilkins, Ankara: Güneş Kitabevi, Öncü Basımevi,2007; 3262-3274*
72. *Silverman WK, Dick-Niederhauser A. Separation anxiety disorder. Anxiety disorders in children and adolescents 2004;2:164-88.*
73. *Sorensen MJ, Nissen JB, Mors O, et al. Age and gender differences in depressive symptomatology and comorbidity: an incident sample of psychiatrically admitted children. J Affect Disord, 2005; 84:85-91.*
74. *Şenol S, İşeri E, Şener Ş, et al Çocuklarda ve Ergenlerde Depresyon. "Ben Hasta Değilim: Çocuk Sağlığı ve Hastalıklarının Psikososyal Yönü" (Editör: Ekşi A) içinde. Nobel Tıp Kitabevleri, İstanbul 2011:238-251*
75. *Torun, YT; Taner, YI. Anksiyete Bozukluklarının ve Obsesif Kompulsif Bozukluğun Klinik Özellikleri, Ayırıcı Tanıları ve Komorbid Durumlar. Turkiye Klinikleri Journal of Child Psychiatry-Special Topics. 2016; 2.3: 26-33.*
76. *Waite P, Creswell C. Children and adolescents referred for treatment of anxiety disorders: differences in clinical characteristics. Journal of affective disorders. 2014; 167:326-32.*
77. *Weissman MM. Recent advances in depression across the generations. Epidemiol Psichiatr Soc, 2006; 15:16-19.*
78. *Wilens T, Faraone S, Biederman J, et al Does stimulant therapy of ADHD beget later substance abuse: A metanalitic review of the literature. Pediatrics 2003; 11:179-185.*
79. *Yanardağ M, Yılmaz İ An intervention approach for children with Autism: Aquatherapy. International Journal of Early Childhood Special Education, 2012; 4(1), 32-45.*
80. *Zahn-Waxler C, Klimes-Dougan B, Slattery MJ. Internalizing problems of childhood and adolescence: Prospects, pitfalls and progress in understanding the development of anxiety and depression. Dev Psychopathol 2000; 12: 443-4668.*

SECTION 9

PHYSICAL ACTIVITY AND EXERCISE IN RHEUMATIC DISEASES

AUTHORS:

Yelda BİLGİNER, MD Prof. (President)	*Hacettepe University, Faculty of Medicine, Department of Child Health and Diseases*
Ece ÜNLÜ AKYÜZ, MD Assoc. Prof.	*Turkish Association of Physiotherapy Rehabilitation*
Cenk AYPAK, MD Assoc. Prof.	*Diskapi Yildirim Beyazit Training and Research Hospital, Family Medicine Clinic*
Ela TARAKCI, PT PhD Assoc. Prof.	*İstanbul University, Faculty of Health Sciences, Departmentof Physiotherapy and Rehabilitation*

ABSTRACT

Childhood rheumatic diseases are a group of diseases of which causes are not fully known and which may develop due toproblems such as pain, joint stiffness, muscle atrophy, weakness, etc. that may affect manyorgan and system. The majority of children have lower levels of physical activity compared to their peers and their participation in sportive activities is low. It is extremely important to direct the children with rheumatologic diagnosis to physical activity in following periods due to stress, fatigue, risk of osteoporosis, cardiovascular disease risks. Physical activity can be defined as activities that occur with energy consumption by using our muscles and joints in daily life, which increase cardiac and respiratory rate and result in fatigue at different intensities. Physiotherapy approaches to these problems should be determined by evaluating factors such as pain, fear of injury, joint stiffness and fatigue which prevent regular physical activity and patients should be directed to active life by being removed from sedentary lifestyle. The primary goal is to improve physical fitness while creating structured exercise prescription as well as physical activity. While light intensity activities (slow walking, aquatic exercises, etc.) are reliably advisable to arthritis patients at all functional levels, moderate activities (rapid walking, low tempo running, dancing, jumping, swimming, table tennis, slow tempo cycling etc.) and high intense activities (jogging, tennis, fast dancing, etc.) should be planned individually. It is also important to inform the child and his/her parents of the disease and treatment process. It should be noted that activity and exercise are an important part of treatment. The patients and their families should be given training in order for patients to consume less energy while performing their daily works and do their activities safely with fewer loads on their joints.

INTRODUCTION

Rheumatologic diseases are among chronic diseases group due to reasons such as presence of chronic inflammation, generallyunknown cause, no influence in musculoskeletal system, bloodvessels and many other tissues. In childhood, rheumatic diseases occur not only in one part of the body but also with involvement of many organs and systems. In the majority of these patients, physical activity levels are reduced and participation in sportive activities is low. The presence of disease-induced acute and chronic pain, joint stiffness, muscular atrophy, weakness and systemic problems such as anemia lead to a reduction in physical fitness of these patients. Disease severity, treatment-related adverse effects or concerns about the exercise that it may aggravate the course of disease drew the patient away from physical activity. It may also lead them to live a life that is socially isolated from their peers. Multiple problems, often encountered, adversely affect children and their families in growth and development age.

Our objective in the treatment is to make children maintain their daily living activities without pain and limitation in joint movements and to help them achieve expected involvement as their peers. For this purpose, it is important to know the characteristics of the diseases in the spectrum of pediatric rheumatologic diseases and to take a holistic approach for indications.

JUVENILE IDIOPATHIC ARTHRITIS

Definition

Arthritis is an inflammatory condition in which one of the joint swelling, redness, temperature increase or loss of function is observed. If arthritis in a joint lasts more than 6 weeks, it is called as chronic arthritis.

Juvenile idiopathic arthritis (JIA) is a childhood, chronic, inflammatory disease. The disease manifests itself with particularly prominent peripheral arthritis. If the disease occurs before the age of 16 and lasts more than 6 weeks and all other causes, which may lead to arthritis, are excluded, the patients are diagnosed with JIA.

JIA is a term that replaces Juvenile Rheumatoid Arthritis (JRA) and Juvenile Chronic Arthritis (JKA) and covers both the former definitions. It was named as JIA and International League Against Rheumatism (ILAR) classification was established in 1995 in order to generate an international classification. According to this classification, systemic arthritis is divided into subtypes of oligoarthritis, RF-polyarthritis, RF + polyarthritis, prolonged oligoarthritis, enthesitis related arthritis, juvenile psoriatic arthritis.

Prevalence/Incidence

The frequency of JIA incidence varies from country to country. As part of the researches, the mean incidence values determined in various countries were 9.2-25/100,000 and the mean prevalence values were 12-113/100,000. In a study in Turkey, JIA prevalence was to be found as 64/100,000.

Ethiopathogenesis

Although JIA etiopathogenesis is not fully understood, genetic susceptibility, immunological factors and environmental factors are emphasized. While infections are the most accused ones among the environmental causes, it plays an important role in stress and trauma in the etiology. Mediators released from stimulated T lymphocytes for various reasons stimulate macrophages leading to the release of inflammatory cytokines and precursors. As result of inflammatory interference, synovitis and intra-articular fluid volumeincrease.

Clinic

In JIA, joint swelling, erythema, increased temperature, pain, loss of function and stiffness are observed. While pain is less in rest, it aggravates in active and passive motion. In JIA all joints can be involved but major joints are more affected than small joints. Cervical, thoracic and lumbar spinal involvements are also seen. Constitutional signs and symptoms are anorexia, weight loss, fatigue and growth

retardation. Extraarticular involvement includes ocular, cardiac, pulmonary and hematopoietic system. JIAstill continues in approximately 55% of patients in adulthood.

SYSTEMIC CONNECTIVE TISSUE DISEASES

Systemic Lupus Erythematosus (SLE)

SLE is a chronic autoimmune disease affecting many systems. The disease may affect almost all organs; skin, joint, kidney, hematopoietic system, veins and central nervous system are affected most. SLE typically occurs in adolescent girls; however, it may also be seen at earlier ages. The ratio of girl/boy is reported as 5/1. According to classification criteria of American College of Rheumatology (ACR), 4 out of following 11 classification criteria have high susceptibility to SLE diagnosis: malar rash, discoid rash, photosensitivity, mouth ulcers, arthritis, cerositis, renal failure, neurological disorder, hematologic disorder, immunological disorder, antinuclear antibody (ANA). It is observed in 90% of patients at any time during arthritis disease. Unlike arthritis seen in JIA, joints are less edematous but more painful. While it does not cause erosive disease, ligament tensions can lead to deformities. Arthralgia and myalgia are frequent. SLE therapy is adjusted according to the patient, depending on the findings of the patient and organ involvement.

Juvenile Dermatomyositis (JDM)

JDM is a multisystemic disease characterized by striated muscle and chronic inflammation on skin. JDM is the most common idiopathic inflammatory myositis in children. It is 2-5 times more in females than males and onset age is between the ages of 4 and 10. It has an appearance unique to characteristic skin and muscle pathology. Criteria used in diagnosis of JDM are typical skin rashes such as heliotrope rash, Gottron's papules on the extender faces, calcinosis in soft tissues, symmetrical proximal muscle weakness, elevations in serum skeletal muscle enzymes, degenerations in muscle biopsy, presence of myositis specific antibody. In patients, proximal skeletal muscle weakness and joint contractures due to pain and muscle shortness are observed in neck, abdomen and hip flexors. In more severe cases, swallowing muscles and respiratory muscles can also be affected.

Juvenile Scleroderma

As a rare disease in childhood, juvenile scleroderma is an aggregation of diseases including different subgroups. The most prominent feature of the disease is keratosis and sclerosis on/in the skin. The disease is examined in two main groups as localized and systemic scleroderma. There may be excessive collagen and extracellular matrix production not only on the skin but also in the vital organs and around the blood vessels by the fibroblasts. Musculoskeletal involvement is common in patients.

VASCULITIS

Systemic vasculitis is a heterogeneous group of diseases characterized by blood vessel wall inflammation, which could cause tissue ischemia and damage due to systemic vasculitis, vascular obstruction, occlusion, aneurysm or tear. The classification of vasculitis is based on the vessel diameter and type of lesion involved. The most common vasculitis in children is IgA vasculitis (Henoch-Schonlein purpura) and Kawasaki's disease.

OTOINFLAMATIC DISEASES

Auto-inflammatory diseases are diseases of the natural immune system and are not associated with autoantibodies or antigen-specific T cells as autoimmune diseases. Other than hereditary periodic fever syndromes, many monogenic and polygenic diseases are included in this group.

Familial Mediterranean Fever (FMF)

As an autosomal recessive, ethnic origin and self-healing disease with a lifespan from 12 to 96 hours, FMF is a disease, in which peritoneum with fever, synovium, pleura, and occasionally pericardium are involved,occurs with acute inflammation attacks. Arthritis in FMF is a usually non-sequela, non-wandering, non-erosive acute monoarthritis, locating in the lower extremity in general. Ankles and knees are mostly affected by joint involvement. The involved joint is typically swollen and reddish.

In rheumatologic diseases mentioned above, chronic inflammatory disorders in the joints markedly restrict the mobility and productivity of the patient in dailylife. In addition, the chronic nature of these diseases affects daily living activities and social life involvement. For this reason, these diseases should be treated rapidly and effectively. Medical professionals such as pediatric rheumatologist, physical medicine specialist, physiotherapist, ophthalmologist, orthopedist, social worker, child psychiatrist and patient's family should actively participate in the treatment. Aim of the treatment from medical aspect is to reduce the pain, to suppress disease activity and to recover the restricted range of motion.

EVALUATIONS

Detailed evaluation making plan of physical activity and exercise in pediatric rheumatology is important to take the right clinical decision. Demographic data, CV, family history, treatments applied, expectation of child and family should be analyzed in the anamnesis.

Subjective Evaluations

1. Pain: It is among the most common complaints in pediatric rheumatologic diseases. Characteristic, intensity, localization and course of pain, factors aggravating and relieving pain and accompanied features should be examined. Pain is assessed according to the child's age and co-operation using personal expression, behavioral observations or physiological measures. In the face system, the most commonly used method, the child expresses his/her pain through scales in which different expression schemes exist (Figure 4). Face expression is considered the most reliable objective finding. Visual analogue scale (VAS) is considered to be the most reliable method, although methods such as pain thermometers, color analog scales can be used in children aged 5 years and older (Figure 5).

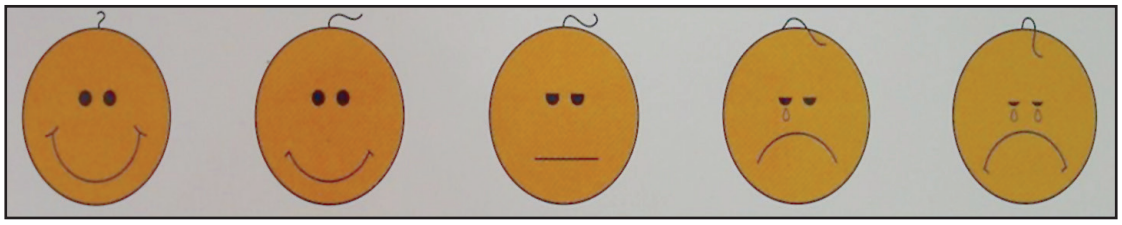


Figure 4. Face Scale

Figure 5. Visual Analog Scale

2. Morning stiffness: Morning stiffness, which is among the characteristic symptoms of pediatric rheumatic diseases, indicates disease activity. Stiffness should be assessed since localization, severity and duration of stiffness affect the functions of the patient.

3. Daily living activities and functional abilities: The activities of children with arthritis in daily life should be assessed in detail. Impediments that patients have during self-care activities such as washing, dressing, eating; mobility activities such as walking, climbing stairs, running; school conditions, play and leisure time activities should be examined and trainings should be provided as part of treatment, if they need support for these activities. In addition to the scales developed for children to assess daily living activities, there are also standardized assessment scales assessing the level of functional ability.

Pediatric Evaluation of Disability Inventory (PEDI):PEDI is a comprehensive clinical assessment tool that evaluates the functional ability and performance of children with disabilities. PEDI evaluates both talent and performance. Thus PEDI allows us to measure the functional skill restriction and disability levels.

Functional Independence Measure for Children (WeeFIM): It is a measure developed in 1993 by utilizing the Functional Independence Measure (FIM) developed for adults. It is a useful, brief and comprehensive method for measuring the functional disability of children in development, educational and social aspects. WeeFIM includes 18 items in 6 areas as self-care, sphincter control, transfers, locomotion, and communication, social and cognitive.

Childhood Health Assessment Questionnaire (CHAQ): It is a measure used to assess functional abilities in rheumatologically affected children. It consists of 8 sub-sections (dressing and personal care, standing up, eating, walking, body care, reaching, holding, activities) and 30 questions. In addition, ancillary equipment, device use, pain and well-being are questioned.

4. Quality of life: Health Related Quality of Life (HRQOL) refers to the subjective perception of a person on satisfaction from his/her own health and is based on assessment of quality of life in children, self-report of the child or knowledge given by the parent. There are few scales on quality of life for children with arthritis. The most commonly used scales:

Pediatric Quality of Life Inventory (PedsQL) 3.0 Arthritis Module for Children: It is specifically designed to measure HRQOL dimensions adapted for pediatric rheumatology. PedsQL 3.0 Arthritis Module includes a total of 22 articles, with sub-sections of Pain and Ache (4 Articles), Daily living activities (5
Articles), Treatment (7 Articles), Anxiety (3 Articles) and Communication (3 Articles). The inventory includes two forms, one is child form and the other family form.

Juvenile Arthritis Quality of Life Questionnaire (JAQQ): It is a 74-article scale designed to assess quality of life in children with arthritis. It includes areas of gross motor functions (17 articles), fine motor functions (16 articles), psychosocial functions (22 articles) and general symptoms (19 articles).

Pediatric Rheumatology Quality of Life Scale (PRQL): It is HRQOL scale developed for pediatric rheumatology patients. There are two sub-divisions: physical health and psychosocial health. Each subscale includes 5 articles, accounting for 10 articles in total.

Childhood Arthritis Health Profile (CAHP): It is a scale developed for comprehensive assessment of health status in children with arthritis. It measures physical functions, psychosocial functions and the effects of disease on family.

5. Depression and anxiety: Psychiatric disorders are more common in children with arthritis. The intensity and prevalence of depressive symptoms varies according to the severity of the medical diagnosis, the stage of disease where psychiatric assessment has been made, degree of inability, pain level and personality characteristics.

6. Fatigue: Fatigue is a common problem in children with arthritis when compared to healthy children. Fatigue is thought to be affected by many underlying factors such as reduction in aerobic capacity, limitations in GYA, weakness, etc.

PedsQL Multidimensional Fatigue Scale: PedsQL Multidimensional Fatigue Module is a valid and credible scale and consists of sub-sections of "General fatigue", "Fatigue during Sleep-Rest" and "Cognitive Fatigue", which contain 18 articles.

Visual Analog Scale (VAS): VAS is a commonly used method in the literature to evaluate fatigue severity. 0-10 cm or 0-100 mm VAS is used. High scores indicate high degree of fatigue.

Objective Evaluations:

1. Posture: Posture should be evaluated statically and dynamically. Asymmetry in the lower extremities, leg length inequality, genu varum, genu valgum, tibial torsion, pes plano valgus, hallux valgus, hammer finger, shoulder protrusion, tilt of the head, kyphosis and scoliosis are frequently seen in lower extremities, while postural problems seen in children with arthritis are often associated with affected joints (Figure 6-7).

Figure 6.Leg Length Inequality Caused by Arthritis and Secondary Scoliosis

Figure 7. Pes Planovalgus

2. Joint range of motion (JRM): Painful motion, fluidity of motion, last feeling of motion, contractures and deformities, especially hypermobile joints should be included in the JRM assessment.

3. Anthropometric measurements: The length measurements used for comparing affected joints with counter extremity and evaluating length difference in extremity are the most commonly used anthropometric measurements (Figure 8).

Figure 8. Anthropometric Measurements-Leg Length and Environmental Measurements

4. Muscle strength: Muscle weakness and muscular atrophy in children with chronic arthritis affect functions in a negative way. Muscle strength is measured by manual muscle testing or dynamometers (Figure 9). Pain, deformity and fatigue should be considered when assessing muscle strength. Muscular strength in children younger than the age of 5 should be observed during the activities mostly because it is hard to measure it objectively.

Figure 9. Muscle Force Measurement with Dynamometer

5. Walking: Gait disturbances are frequently observed in children with arthritis due to JRM limitations, pain, leg length inequality and problems in the lower extremities such as deformities. There may be seen changes in walking distance, walking speed, cadence (number of steps per minute), step length, step width and kinetic and kinematic parameters during stance and swing phases. Walking analysis could be done by both observational methods in clinic and detailed analysis in laboratory environment.

PATIENT EDUCATION

Rehabilitation approaches begin with training. It is important to inform child and his/her parents of disease and treatment process. It should be noted that activity and exercise are an important part of treatment. Patients and their families should be provided training in order for the patients to do their daily works safely by consuming less energy and imposing fewer loads on their joints.

Joint Protection Principles

- Pain should be respected. Pain should be used as a signal to organize activities.
- Load should be distributed to joints equally.

- Alternative methods should be used in the activities requiring effort to reduce strain. For example; measures such as reducing the weight of the objects using an assistant tool or reducing the load of the joints using walking aids will reduce the strains. It is important to use the joints as appropriate -balanced anatomical or at functional plans.
- Compelling positions that may lead to deformity should be avoided.
- It should be avoided to stay in the same position for a long time.
- Extremely hard grasps should be avoided (such as opening a hard doorhandle).
- Muscular strength and range of motion should be maintained.

Energy Saving Techniques

- Easy and difficult activities should be planned alternatively to follow each other.
- Activities should be done more slowly.
- The environment should be organized with appropriate ergonomic approaches.

As result of comprehensive evaluations of children with rheumatological complaints, joint activities could be preferred for children with JIA diagnosis, who have minor and major joint involvements; axial joint involvement exercises for enthesitis-related arthritis group; strengthening exercises for hypermobility cases and aerobic exercises in order to protect and support affected muscles for situations such as dermatomyositis. In vasculitis, protection of affected neuromuscular structures comes into prominence. In cases of enthesitis-related arthritis, appropriate orthosis and footwear selection or assistive devices (walker, armchair, walking stick, etc.) could be benefited. It should not be forgotten that electrotherapy methods are part of the treatment while the treatment schedule is planned. Knee braces or orthoses for protective purposes in the periods when the disease is active may be preferred in a way that they will not constrain the activity.

Physical activity

Acute Effects: In children with arthritis, fear and avoidance behaviors emerge and their movements are limited in acute stage due to pain and joint swelling.

Long Term Effects: In the following periods, there may develop disability of physical activities and difficulties in social activities involvement due to postural disorders, muscle and joint alignment disorders, atrophies, contractures and deformities, as demonstrated in Figure 10.

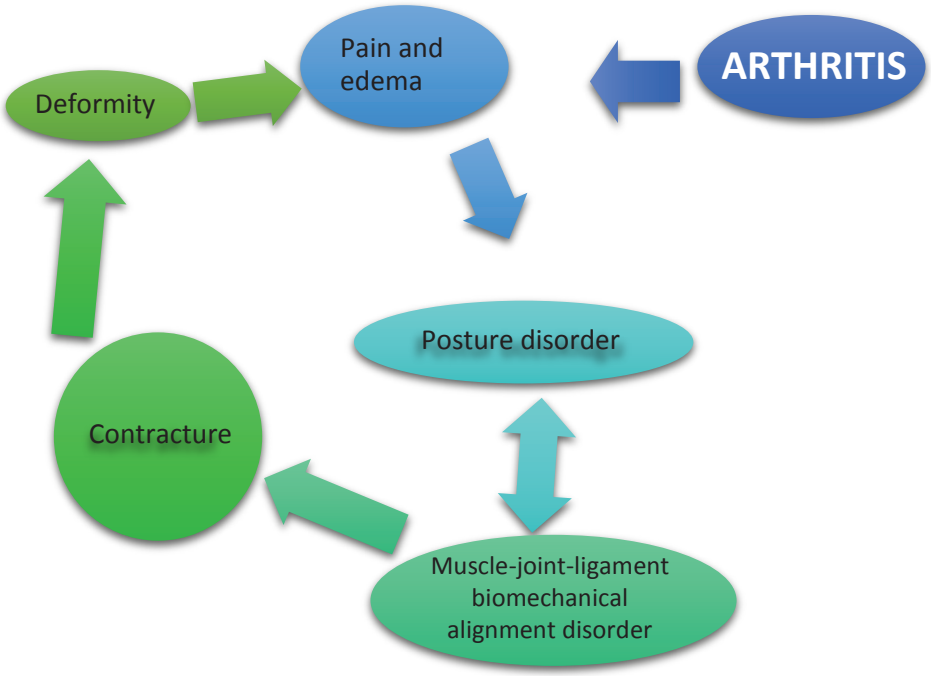


Figure 10. Connection among the Problems of Children with Arthritis

Indications of Physical Activity: It is extremely important to direct the children with rheumatologic diagnosis to physical activity in the future due to stress, fatigue, risk of osteoporosis, risks of cardiovascular disease and affected life span. Physical activity can be defined as activities that occur with energy consumption by using our muscles and joints in daily life, increasing cardiac and respiration rate and resulting in fatigue at different levels. These children do less activity than their healthy peers. Decondition, reduction in aerobic capacity, limitation of joint movements and muscle weakness problems compel children to be more inactive. Physiotherapy approaches should be determined for the factors such as pain, fear of injury, joint stiffness, fatigue, which prevent regular physical activity, by evaluating these problems and the patients should be conducted away from sedentary lifestyle and directed to an active life. Children with arthritis can involve in light intensity fitness programs or the activities that are suitable for their own situations and will not strain joints without any side effects.

The main indications of physical activity:

- Prevention of movement limitations in joints before they occur
- Protection and development of muscle strength
- Providing flexibility
- Development of endurance
- Prevention of getting quickly tired

- Preservation of body uniformity and posture
- Development of proprioceptive sensation of affected joints
- Prevention of osteoporosis risk
- Preservation of respiratory capacity
- Prevention of anxiety and depression

EXERCISE

Exercise Prescription

Exercise, which takes part in the sub-category of physical activity, includes planned, structured and recurring body movements that are designed to protect or improve one or more components of physical fitness. Therapeutic exercises are often recommended for children with arthritis for functional disabilities such as pain, limitation of joint motion, decrease in flexibility and loss of strength or in order to maintain or improve participation in activities such as daily living activities, work, spare time activities. This process and accompanying chronic pain may pave the way for a mood disorder, which may lead to anxiety and depression, to be experienced by child or adolescent. Therefore, the child/adolescent with arthritide can exhibit a more reluctant and tired behavioral pattern toward participation in vital activities, as well as physical disabilities.

The severity, intensity and duration of the exercises depend on the following factors:

- Involvement level and activity of the disease
- Level of physical activity of the child
- Pain level
- Exercise-symptom relation

The primary goal is to improve physical fitness while creating an exercise prescription. Cardiac rate, blood pressure, ECG (electrocardiography) and functional capacity should be considered. While light intensity activities (slow walks, aquatic exercises, etc.) are reliably advisable to arthritis patients at all functional levels, moderate activities (rapid walking, low tempo running, dancing, jumping, swimming, table tennis, slow tempo cycling etc.) and high intense activities (jogging, tennis, fast dancing, etc.) should be planned individually. If the pain after the exercises lasts longer than 24 hours, level of the exercise should be reviewed. Intensity of exercise in rheumatic diseases should be individually planned by considering health status, risk factors profile, behavioral characteristics, personal factors and exercise preference. Patients should concurrently start the exercise with medical therapy. Exercise should regularly be done every day with a tempo low at the start.

The child should follow the recommended number of repeats and also involve in the physical exercises that are suitable for his/her age apart from the recommended therapeutic exercises in order to maintain health.

The exercise models in the literature are listed below:

Active stretching exercises for joint limitations

Arthritis, non-use, habits and protective positions negatively affect the flexibility of contractile structures such as muscle and tendon and non-contractile structures such as capsule and ligament. Joint stiffness and soft tissue limitations can be treated with active stretching exercises. In arthritis children, exercises that require active involvement during play with music should be preferred (Figure 11).

Figure 11. Active Stretch

Strengthening exercises

The reduction in muscle strength and endurance may be caused by inflammation, non-use, reflex inhibition due to pain, loss of proprioception and impaired mechanical integrity around the joint. Strengthening exercise examples:

Isometric exercises: They provide awareness of muscular contraction and prepare adjacent joints for more compelling activities (Figure 12).

Dynamic (isotonic) exercises: They include concentric and eccentric contractions. Strength and endurance of muscles can be changed by changing the amount of resistance,contractions rate, coefficient and frequency, rest time. Resistance during exercises could be provided with some materials such as resistive bands, medical sandbags (Figure 13).

Figure 12. Isometric Exercise

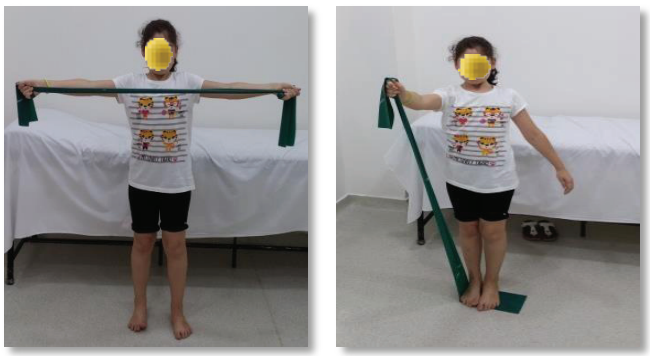


Figure 13. Exercises with Resistive Band

Aerobic (Cardiovascular) Exercises

Decrease in the level of physical activity in children and adolescents with rheumatologic diseases are associated with a reduction in cardiovascular capacities. These children get tired faster. Moderate aerobic exercises such as walking, cycling, and aerobic dance should be absolutely recommended, at least three days a week (Figure 14).

Figure 14. Stationary Bicycle

Balance and Proprioceptive Exercises

Proprioception can be described as being able to sense joint movements and position in the space and is part of the somatosensorial input. Proprioception and balance can reduce depending on the reasons such as injuries, inactivity, arthritis or motor unit reorganization, however, can be improved by retraining.

The possible association between arthritic joint involvement and proprioceptive sensory deficit is mainly based on neuromuscular control disorder and pathological changes in the joint. Ligament and capsule support are not provided sufficiently with the protective muscle activity which provides joint stabilization in the proprioceptive sensory deficit. As a result, the amount of the burden on the joint cartilage increases and distribution of burden is disturbed. This affects periarticular structures.

Children with arthritis have difficulties in activities such as running, jumping, climbing and playing games as their healthy peers if their proprioceptive senses are lost, even if they get sufficient physical gains with other exercises. For this reason, while exercise programs are being developed, balance and proprioceptive studies should be performed as well as strengthening exercises. Following exercises can be done in order to improve balance and proprietorship: walking backwards and tandem walks, standing on one leg and knee flexion-extension exercises on one leg, exercises of leaning forward, sides and back on an extremity (eyes open-eyes closed), exercises with balance board and exercises with minitrompolin (Figure 15).

Figure 15. Balance and Proprioceptive Exercises

Aquatic Exercises

It is a rehabilitation method based on in-water exercises using physical properties of water. Exercises are performed using various techniques.

These exercises have some advantages since they are entertaining, facilitate the movements if done with the help of lifting force of water or increase the strengthening effect if done against lifting force of water and also reduce the overall fatigue if done in tempo.

Clinical Pilates Exercises

Clinical Pilates exercises such as yoga and Tai Chi, which deal mind and body together, due to the reasons such as the biopsychosocial nature of pain and impairment of the body image of child, are also used in children with arthritis.

Clinical Pilates exercises describe human body as a system originating from a centralcolumn. This column is formed by the muscles, which most basically represent body. First of all, training of these muscles is provided. So the exercises start gently enough but also have a nature that requires attention. Provided that the child achieves stabilization of these minor movements, more difficult activities are done. Thus body awareness develops. Breath control and visual imagination are important in properly performance of the movement. Since the clinical Pilates exercises offer a holistic approach due to the principles of its philosophy, the children are under a continuous training during the exercises.

Technology Assisted Exercises

Virtual reality therapy, unlike classical exercises, is a different rehabilitation method applied in virtual environment. Some video-based games are often used in virtual rehabilitation practices because of interest and motivation of children. Nintendo Wii and Xbox game consoles are the most used devices for this purpose. Video games are used in various disease groups to improve balance, coordination, aerobic capacity and upper extremity functions (Figure 16).

Figure 16. The Use of Game Consoles to Improve Upper Extremity Functions

Contraindications and Risks of Exercise

Although not definite, there are relative contraindications. Pericarditis, congestive cardiac failure, pleuritis, pulmonary fibrosis, vasculitis and nephritis are relative contraindications. Patients with this type of complication require special treatment. While applying medical therapies, attention should be paid for the risk of fracture in children with osteoporosis associated

with physical inactivity and course of disease. C1-C2 instability should be considered when planning exercise in children affected by the cervical region. Jaw attachments could be used to protect teeth during exercise for children with jaw involvement. For children with ocular involvement, it is important to protect the eyes from traumas in the exercise plan.

Sportive Activities

It would be motivating in terms of sportive activities to start with play activities when directing the children to exercise.

- Swimming,
- Low-tempo walking,
- Jogging,
- Aerobic dance,
- Cycling
- and jumping rope are recommended activities.
- Contact sports are not recommended due to the risk of trauma to the joint.

Orthosis

Orthosis can be used to rest joints, tendons, ligaments and muscles in a functional position, to reduce local pain and swelling and prevent deformities by reducing activity and burden in/on the joints, to increase range of motion by gradual stretching, to improve functions, to reduce the need for analgesics, to preserve functions gained after operation and to prevent disability.

Children and adolescents frequently have flexion contractures in elbows, wrists and fingers. For this reason, wrist rest splints are rarely preferred to reduce pain and inflammation, prevent contractures and maintain function.

Lower extremity often requires orthosis due to flexion contractures in knee, hip and fingers, pesplanovalgus, hallux valgus and leg size inequality. For this purpose; dynamic splints, rocker soles, medial longitudinal arc reinforcements, hallux valgus rolls, wedges, made to measure soft-semi flexible or hard soles and thumb shields. Proper orthosis selection and footwear modification should be made in company with current findings of the patient (Figure17-18).

Figure 17. Progressive Knee Orthosis

Figure 18. Personal Insole

ERGOTHERAPY

Ergotherapy is a person-centered treatment that improves health with significant and purposeful activities. The main objective is to ensure the persons with JIA involve in daily living activities. This is achieved by improving the ability of the people to perform the activities he/she needs or expected from him/her or by arranging the activity or environment so that the involvement of the people can be achieved better.

The ergotherapy program includes:

- Teaching special methods to help the children with arthritis improve their independence in their daily living activities by using the special skills such as dressing, self-care, mobility and eating with their current capacities.
- Self-help tools and training for the use of these tools for the same purpose (for example, a cutlery with modified handle for people who have difficulty in grasping, a long handle for a person who does not have body balance and stretching ability, etc.)
- House rehabilitation and arrangements (for example, resettlement of safe and independent life-enhancing items, architectural adjustments in bathrooms, toilets and other rooms in accordance with the principles of joint protection).
- Joint protection training; teaching ergonomic arrangements in home, school and social life and independentmovement techniques.

Figure 19. Self Help Tools

Pediatric Rheumatologic Patient Approach Algorithm

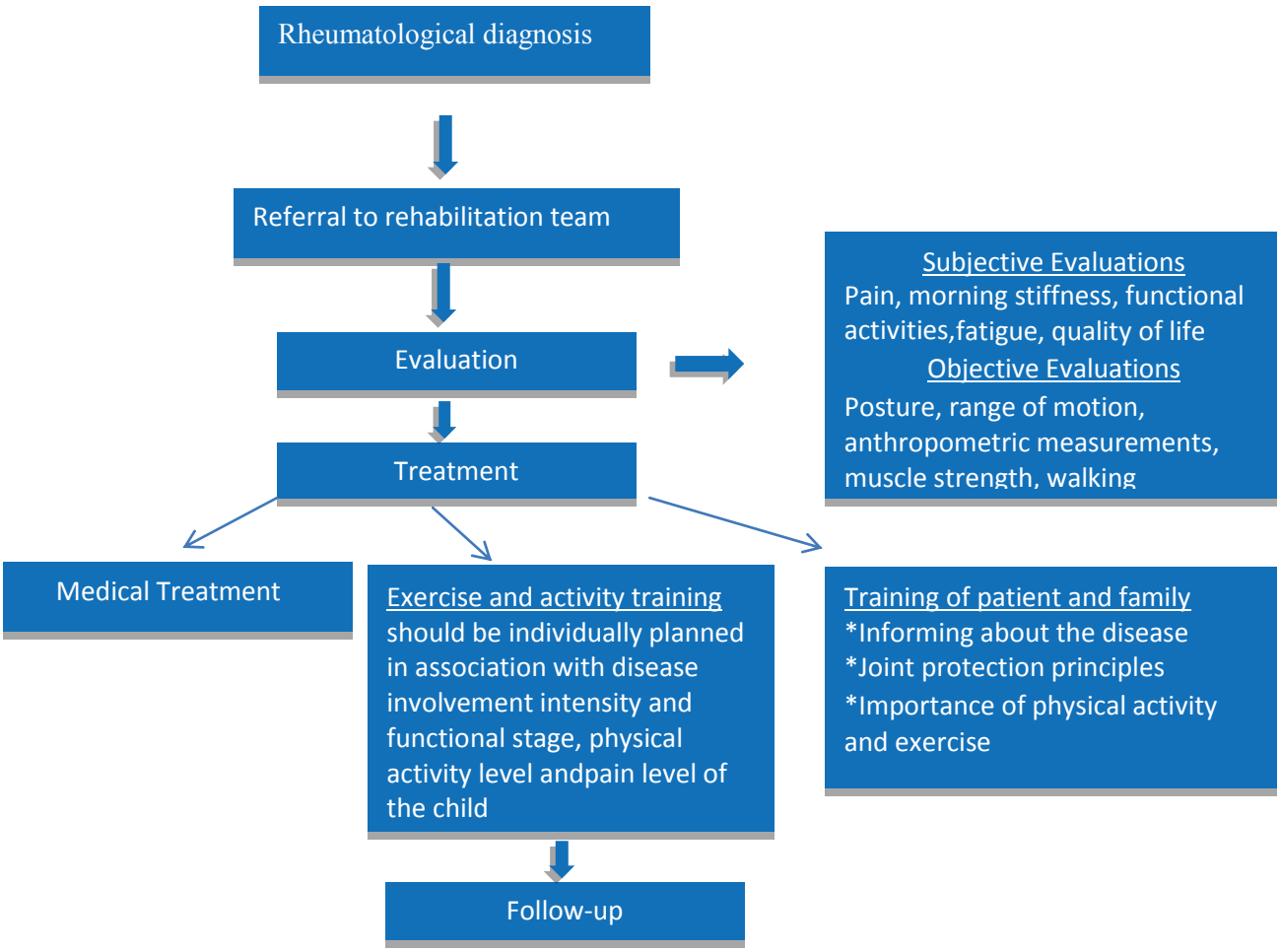


Figure 20. Pediatric Rheumatologic Patient Approach Algorithm

Table 21. Examples of Exercise and Activity in Pediatric Rheumatology by Disease Types

Disease Type	Exercise Recommendations	Activity and Sports Recommendations
Juvenile Idiopathic Arthritis	☐ Flexibility exercises ☐ Strengthening exercises ☐ Aerobic exercises ☐ Balance and proprioceptive exercises ☐ Aquatic exercises	☐ Swimming ☐ Walking ☐ Jogging ☐ Aerobic dance ☐ Cycling ☐ Jumping rope
Systemic Lupus Erythematosus	☐ Aerobic exercises ☐ Strengthening exercises ☐ Aquatic exercises	☐ Swimming ☐ Low-tempo walking ☐ Jogging ☐ Aerobic dance ☐ Cycling ☐ Jumping rope
Dermatomyositis	☐ Strengthening exercises ☐ Aerobic exercises ☐ Aquatic exercises	☐ Brisk walking ☐ Swimming
Scleroderma	☐ Flexibility exercises ☐ Strengthening exercises	☐ Brisk walking ☐ Swimming ☐ Aerobic dance
Vasculitis	☐ Strengthening exercises ☐ Aerobic exercises	☐ Swimming ☐ Brisk walking
Familial Mediterranean Fire	☐ Flexibility exercises ☐ Strengthening exercises ☐ Aerobic exercises ☐ Aquatic exercises	☐ Swimming ☐ Brisk walking ☐ Jogging ☐ Aerobic dance ☐ Cycling ☐ Jumping rope

Key Recommendations

1. After rheumatologic diagnosis, physiotherapy approaches should also start concurrently with medical treatmentin the early period.

2. Importance of exercise and sportive activities should be explained to child and family in order to prevent the complications due to inactivity that may develop depending on chronic disease.

3. The exercise prescription planned for child should be planned individually according to the intensity and activity of child.

4. Children should be motivated by applying the exercises recommended for children together with play activities.

5. Contact sports are not recommended for children with rheumatologic diagnosis since they may cause trauma.

In Conclusion

It is important not to forget that family is the most important part of the team in holistic treatment of children who are living with chronic disease. The policies that promote involvement of child in social life by increasing awareness of physical activity should be developed.

REFERENCES

1. *Exercise as a mean to control low-grade systemic inflammation. Mathur, N. and B.K. Pedersen, Mediators of inflammation, 2008. 2008: p. 109502.*
2. *Gokce I, Demirkaya E. New Treatment Strategies in the Treatment of Juvenile Idiopathic Arthritis.Turk J Rheumatol 2011; 26: 71-85.*
3. *Gualano B, Pinto AL, Perondi MB, et al. Therapeutic effects of exercise training in patients with pediatric rheumaticdiseases. Rev Bras Reumatol. 2011 Sep-Oct; 51(5):490-6.*
4. *Holden M. Virtual environments for motor rehabilitation: review. Cyberpsychol Behav 2005; 8(3): 187-211.*
5. *Jebsen RH, et al. An objective and standardized test of hand function. Arch Phys Med Rehabil, 1969. 50(6): p. 311-9.*
6. *Klepper SE. Exercises in Pediatric Rheumatic Diseases. Curr Opin Rheumatol 2008; 20: 619-24.*
7. *Lelieveld OT, Armbrust W, de Graaf I, et al. Promoting physical activity in children with juvenile idiopathicarthritis through an internet-based program: results of a pilot randomized controlled trial.Arthritis Care Res (Hoboken).*
   2010 May;62(5):697-703.
8. *Lelieveld OT, Armbrust W, van Leeuwen MA, et al. Physical activity in adolescents with juvenile idiopathic arthritis.. Arthritis Rheum. 2008 Oct 15;59(10):1379-84.*
9. *Long AR, Rouster-Stevens KA. The role of exercise therapy in themanagement of juvenile idiopathic arthritis Curr Opin Rheumatol. 2010; 22: 213-7.*
10. *Matijevic V, Secić A, Masic V, et al. Virtual reality in rehabilitation and therapy. Acta Clin Croat 2013; 52(4): 453-7.*
11. *Mendonça TM, Terreri MT, Silva CH, et al. Effects of Pilates Exercises on Health-Related Quality of Life in Individuals With Juvenile Idiopathic Arthritis. Arch Phys Med Rehabil 2013;94(11):2093-102*
12. *Özdoğan H, Ruperto N, Kasapçopur Ö, et al. The Turkish version of childhood health assesment questionnariaes (CHAQ) and the child health questionnarie. Clin Exp Rheumatol 2001; 19: 158-62.*
13. *Petty RE, Cassidy JT. In: Cassidy JT, Petty RE Juvenile idiopathic arthritis, editor. Textbook of Pediatric Rheumatology. WB Saunders Company; 2004. pp. 217-70.*
14. *Philpott J, Houghton K, Luke A. Physical activity recommendations for children with specific chronic healthconditions: Juvenile idiopathic arthritis, hemophilia, asthma and cystic fibrosis.Paediatr Child Health. 2010*
    Apr;15(4):213-25.
15. *Singh-Grewal D, Schneiderman-Walker J, Wright V, et al. The effects of vigorous exercise training on physical function in children with arthritis: a randomized, controlled, single-blinded trial. Arthritis Rheum 2007; 57: 1202-10.*
16. *Takken T, Van Der Net J, Kuis W, et al. Aquatic fitness training for children with juvenile idiopathic arthritis Rheumatology (Oxford) 2003; 42: 1408–14.*
17. *Tarakci D. Pediatrik Rehabilitasyonda Oyun Konsolları ile Sanal Gerçeklik Uygulamaları. Turkiye Klinikleri Journal of Physiotherapy and Rehabilitation-Special Topics, 2015; 1.1: 30-34.*
18. *Ünal E, Atasavun Uysal S, Kısacık(Dizmek) P, et al. Does effect clinical Pilates therapy on daily living activities and motor function in children with juvenile idiopathic arthritis in two weeks? A pilot study. Ann Rheum Dis 2012;71(3):757*
19. *Ünal E, Ünal E, ed. Romatizmal Hastalıklarda Biyopsikososyal Model: Bilişsel Egzersiz Terapi Yaklaşımı(BETY). 1st ed. Ankara: Pelikan Yayıncılık; 2014*

SECTION 10

PHYSICAL ACTIVITY AND EXERCISE IN DIGESTIVE SYSTEM AND LIVER DISEASES

AUTHORS:

Hasan ÖZEN, MD Prof. (President)	*Hacettepe University, Faculty of Medicine, Department of Child Health and Diseases, Gastroenterology Unit*
İrfan ŞENCAN, MD Spec	*Ankara Numune Training and Research Hospital, Family Medicine Department*
Emine ACAR, MD	*T.R. Ministry of Health, General Directorate of Public Health*
Numan DEMİR, PT PhD	*Hacettepe University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation*

ABSTRACT

Physical activity may have beneficial effects on the digestive system as well as harmful effects. Choice of physical activity is important in this group of diseases. While vigorous physical activities may be harmful, light to moderate individual-specific activities may be beneficial. Physical activity can be used as a good treatment option for relieving or reducing the effect of disease-related complications. There are many diseases related to the digestive system. These diseases cause decrease in physical activity level and deterioration in general health status due to the effects on different organs. Therefore special and appropriate exercise recommendations may provide effective and uncomplicated approaches for patients with digestive system disorders. Firstly, it will be more appropriate to evaluate the effects on the basis of diseases and to make appropriate recommendations by relevant experts in this frame.

Even prevention and/or treatment of obesity prevents occurrence of many digestive system problems or helps treat them. Furthermore, regular exercise in children with a chronic digestive system disease provides treatment for later complications and, if necessary, better surgical outcome (e.g. liver transplant).

Vigorous exercise may cause symptoms such as heartburn and pain, abdominal cramps, side pain andfitness. Even the marathon runners were reported to have digestive system hemorrhage.

GASTROOZOFAGEAL REFLUX

Gastroesophageal reflux (GER) is defined as the escape of stomach contents to esophagus. The most important complaints of adults and adolescents are retrosternal pain and burning sensation radiating from the upper part of the abdomen/lower part of the xyphoid toward neck, although symptoms in children are related with many systems. In the first two or three months of life, severe cyanosis attacks and sometimes convulsions, apnea and life-threatening events and even death can occur. In older children, GER may cause recurrent wheezing attacks, chronic cough or asthma. The presence of certain symptoms should suggest reflux in children with pulmonary disease. These are increased symptoms in supine position, coughing in the nights, recurrent bronchopneumonia, typically occurring one to three hours after going to bed and not seasonally. Again, the age-related symptoms of ear-nose-throat begin to become evident. GER should be considered and studied in children with chronic sinusitis, otitis, voice anxiety and laryngitis complaints.

Reflux observed in 2/3 of infants in the first three months is seen in the frequency of 4-5% when considering the whole childhood group. The prevalence in infancy is reported to be 10-18%.

History and physical examination are sufficient for diagnosis in children as old as they can tell their complaints. In young children, barium studies may be required if the response to treatment is inadequate or if long-term esophageal pH monitoring, esophageal intraluminal impedance analysis, reflux scintigraphy, anatomical abnormality or complications in atypical cases are considered.

The main cause of GER is the spontaneous relaxation of the lower esophagus fuscenter, which occurs naturally in healthy persons after meals. This is called as physiological GER. If the escape is more than normal and caused complications, it is called as GER disease (GERD). Also overweight, asthma, chronic lung diseases, certain medicines used in the treatment of diseases, caffeine-containing drinks, citrus fruits, ketchup, tomato sauce and fatty foods increase the risk of reflux.

Besides the negative effect on the quality of life, it is the most important complication to lead to Barretto's ophagus (precancerous) and stenosis.

In the treatment of GERD, position changes and food arrangements (for exampleaddition of 2-3 grams of corn starch to every 100 ml) for infants. There are also ready-made commercial products, which contain stabilizers and are manufactured for this purpose. Those reduce vomiting and are not effective on reflux parameters). The methods used are antacids (sodium alginate), prokinetics (such as metoclopramide, domperidone), drugs that inhibit gastric acid secretion (H_{2nd}receptor antagonists, proton pump inhibitors) and surgery (fundoplication) in the patients required. Today, the most common proton pump inhibitors are used.

Benefits of physical activity

Adequate physical activity will prevent obesity, one of the major causes of GERD. In addition, physical activity in obese children will help weight loss and thus reduce GER.

Vigorous exercise program may provoke reflux since it may affect the abdominal andthoracic pressure.

Indications

Exercises recommended by the World Health Organization for children should be done regularly. In those with obesity, exercise should be arranged so as to help weight loss.

Physical activity prescription:

Foods and beverages (citrus fruits, juices, tomato products, alcohol, cola, coffee - including caffeine free - chocolate, mint, onion, garlic, sour and bitter foods, carbonated drinks) that may increase reflux before physical activity should be avoided.

Intense physical activity may increase reflux episodes in people with erosive esophagitis. Light intensity or short-term exercises have no effect on reflux, regardless of body mass index. Activities such as swimming, cycling and walking are recommended. Weight loss for those who are fat will improve symptoms.

Contraindications

Vigorous exercise programs over a 30-minute period may increase GERD. Activities immediately after meals may increase the risk of GERD.

INFLAMMATORY INTESTINAL DISEASES

Inflammatory bowel diseases (IBD), Crohn's disease (CD), ulcerative colitis (UC) and indeterminate colitis (IC) are immunomodulatory disorders triggered by incompatible immunological responses to gastrointestinal flora resulting from the combination of genetic predisposition and environmental and immunological factors. They cause chronic and recurrent inflammation in the gastrointestinalsystem.

Epidemiological studies indicate that the frequency of IBD in children and adults is increasing.Their incidence varies from country to country. The incidence of CD in children is 0.6-7/100,000, and the incidence of UC ishas been reported between 0.5-4.9/100,000.

Abdominal pain, bloody/bloodless diarrhea, weight loss, failure to gain weight, fever, growth retardation, malnutrition, nausea and/or vomiting, arthropathy, erythematosus and secondary amenorrhea in girls are the main symptoms and signs.

Although the causes are not fully known, it is thought that they occur in individuals with genetic predisposition with the contribution of some environmental factors. These factors include smoking, factors of infection, appendectomy (decreases UC risk), breastfeeding, nutrition-related factors (refined sugars, ready-made products are increasing), drugs, socioeconomic factors and stress. It has been determined that oral contraceptive medications and non-steroidal anti-inflammatory drugs may increase the risk of IBD, while their effect in childhood is insignificant. In recent years, intestinal microbiota imbalances have also been shown to play a role in the pathogenesis. Studies show that lifelong IBD development risk increases in first-degree relatives of individuals with IBD and also the risk increases for children whose parents or siblings have IBD.

Diagnosis is made endoscopically and histologically. IBD's are chronic diseases which course with remissions and exacerbations. In the treatment, nutrition, corticosteroids, aminosalicylate derivatives such as mesalazine, immunosuppressive drugs (azathioprine, 6-mercaptopurine), methotrexate, biological agents (infliximab, adalimumab, etc.), antibiotics and, if necessary, surgical treatment are used.

Benefits of physical activity

Exercise can help reduce stress and symptoms. It is helpful for improvement of bone mineral density and increase of the immunological response in particular.

Indications

All IBD patients should exercise at the frequency and intensity recommended for healthy persons.

Physical activity prescription

Light to moderate intensity exercise is recommended. Intensive exercise is not recommended. 20-60 per day.

Contraindications

Exacerbation periods should be cared. It should not be done in post-operative periods.

CONSTIPATION

It is difficult to make a definition of constipation and it varies from person to person. For some, it may be a decrease in fecal incidence; for some, it means very hard and difficult defecation; for some others, it may be feeling pain while defecation. In the simplest case, it can be defined as difficulty or delay in defecation. In children, the frequency of defecation decreases from an average of 4 per day in the first weeks after birth, to 2 up to 2 years old and to 1 up to 4 years old. In 95% of patients, the reason is functional, organic causes are only found in very few parts. According to the Rome IV criteria, functional defecation is defined as defecation 2 times or less a week for a child with a developmental age of at least 4, the presence of fecal soiling and/or fecal continence and/or presence of painful-stiff stools and/or presence of big mass of stool in rectum and/or thick stool to clog the toilet.

Approximately 3% of pre-school children and 1-2% of school-age children complain of constipation. The reported incidence ranges from 0.3% to 8%. In addition, patients with constipation account for 3-5% of general pediatric outpatient clinics and up to 25% of pediatric gastroenterology clinics.

History and physical examination (including rectum tushe) is enough for diagnosis. Direct or contrastedgraphs are rarely required. Manometric work may be required when motility problems are suspected.

The basis of the treatment is initially the complete evacuation of the large intestine (oral polyethylene glycol, liquid paraffin, bicacodil, oral phosphate solutions, phosphate enemas, sodium citrate or docusate). Once the intestines were emptied, they should be kept empty until the order is established. For this purpose, lactulose, polyethylene glycol, liquid paraffin, sennaalkaloids, magnesium hydroxide may be used. The safest ones are lactulose and polyethylene glycol, the latter is more effective. Daily enough fluid and fiber intake should be provided. In the same time period, the regular habit of toilet should be provided to the child.

Benefits of physical activity

Moderate exercise and fiber intake with the diet may reduce symptoms of constipation. The incidence of constipation in obese children is higher and this is directly proportional to the level of obesity. The physical activity suggestion to prevent obesity indirectly reduces the risk of developing constipation. While there is not plenty of study on children, regular sport is a protective factor for children in terms of constipation. As the reason, it is thought that exercise shortens the gastrointestinal system transition time. The effect of light exercise on constipation was not shown.

Indications

In order to prevent constipation and assist in the treatment of those with constipation, every child should do the daily activities recommended by the authorities.

Physical activity prescription

More than 1 hour of physical activity per day with nutritional advice will be helpful to prevent constipation in children. It is also recommended by the World Health Organization that at least 1 hour physical activity per day recommended for healthy children will be beneficial to prevent constipation. Examples of these activities are brisk walking, swimming, and cycling.

Contraindications

There is no known contraindication.

CHRONIC LIVER DISEASES AND CIRRHOSIS

Chronic (persistent) injuries in the liver are called as chronic liver disease. The time it takes to be called chronic varies according to the reason. It is considered chronic for viral hepatitis after 6 months, while it is chronic at the time of diagnosis in hereditary metabolic diseases such as Wilson's disease and in autoimmune hepatitis. Whatever the cause, chronic liver diseases can progress to cirrhosis and liver failure over time. Cirrhosis is characterized by the formation of fibrous tissues and nodules in the liver at an advanced level and the liver fails to function. Over time, the patient may have consequences such as jaundice, ascites (fluid accumulation in the abdomen), bleeding from varicose veins (enlarged vessels) formed in esophagus.

It is not possible to give definite information about chronic liver diseases and cirrhosis frequency. The reasons change from country to country, region to region in the same country and time to time in the same country/region.

There are a number of reasons leading to chronic liver disease/cirrhosis and we can summarize them under a few main headings;

- Infections: hepatitis B, hepatitis C, cytomegalovirus, etc.
- Congenital metabolic diseases: The most common in our country are Wilson's disease, cystic fibrosis, tyrosinemia Type-1, galactosemia, progressive familial intrahepatic cholestasis, glycogen and lipid storage diseases.
- Congenital anatomic/structural abnormalities: biliary atresia (obstruction of the extrahepatic bile ducts), biliary cysts, congenital hepatic fibrosis, etc.
- Autoimmune causes: autoimmune hepatitis, primary biliary cirrhosis, primary sclerosing cholangitis
- Toxic causes, nutritional disorders (obesity and fatty liver disease), circulatory and vascular diseases

Prognosis of chronic liver diseases and cirrhosis depends on its cause, whether there is a specific treatment for that cause (eg, there are specific treatments for the causes as Wilson's disease, galactosemia and the disease progression may be halted), stage of the disease.

Patients with cirrhosis may have jaundice and ascites (accumulation of fluid in the abdomen), behavior and personality disorders, digestion and absorption disorders in the intestines and resulting malnutrition (poor nutrition), susceptibility to infections, hyperlipidemia and coronary cardiac disease, liver cancer, difficulty in breathing due to lungs affected, renal insufficiency due to kidneys affected.

The treatment is to treat the cause, if any, (such as treatments for viral hepatitis B and C, Wilson's disease, galactosemia) or to apply supportive treatment (organizing nutrition, prevention/treatment of acid development, treatment of pruritus, if any, and prevention/treatment of varicose vein).

Benefits of physical activity

Non-alcoholic fatty liver disease can be prevented by regular physical activity. In other diseases, there is no effect of physical activity in preventing liver damage.

Sarcopenia (a decrease in muscle mass) is a condition that develops gradually in chronic liver patients. Inflammatory (inflammatory) state of nutritional deficiency and liver disease causes sarcopenia. Sarcopenia reduces life quality, decreases activity, increases morbidity and reduces transplant success in liver transplant recipients. A regular exercise program with diet regimens, macro (carbohydrate, protein, fat) and micro (vitamin C, D, E, A, zinc, selenium) nutritional supplement support can reduce and even reverse the effects of sarcopenia. Exercise can increase oxygen use 200 times in skeletal muscle mitochondria. With a 1-month exercise program for patient with cirrhosis, oxygen consumption, thus physical capacity and endurance, increases.

Indications

As soon as chronic liver disease is diagnosed, the patient should be informed of regularexercise.

Prior to exercise programs, muscle mass can be assessed by anthropometric measurements, dual-energy X-ray absorptiometry, bioelectrical impedance, ultrasonography, tomography (preferable for showing muscle quality) or magnetic resonance imaging. Hand grip strength may also give information about muscle strength.

Physical activity prescription

The most appropriate exercise form is unknown. In older children and adolescents, 5000 steps per day may be recommended with adequate nutrition by age and sex. 1 hour walking-pedaling could be recommended 3 days a week so as to reach 60-70% of maximum heart rate. Ten-twelve-week aerobic exercise programs increase oxygen consumption. Exercise programs should be carefully customized.

Resistance exercises increase muscle mass while endurance exercises increase functional massbut does not affect sarcopenia. For this reason, both exercises should be programmed together.

Contraindications

The moderate exercise is thought to increase portal pressure and consequently the risk of acid and bleeding risk. If this thought is accompanied by poor nutrition, it causes more skeletal muscle loss. This condition worsened the prognosis and the course after the transplant. For this reason, a comprehensive functional status and nutritional status should be assessed prior to exercise program. Vigorous exercise can cause lactic acid accumulation. This is why light to moderate exercise should be recommended.

NON-ALCOHOLIC FATTY LIVER DISEASE

Non-alcoholic fatty liver disease (NAFLD) is a clinicopathologic condition with a wide spectrum ranging from simple lipoidosis to steatohepatitis-cirrhosis and end-stage liver disease. Histopathologically, it is defined as the presence of micro- or macrovascular oil infiltration in at least 5% of liver cells.

The incidence is increasing with increasing prevalence of obesity. According to autopsies of accidental deaths, it is reported that NAFLD is seen at the rate of 9-10% in normal weight and 38% in obese patients. It is the most common cause of chronic liver disease in children and it's prevalence is thoughtto be 9-10%.

The most important risk factor is obesity. In overweight (BMI>85.percentile) and obese (BMI> 95.persentile) children, it is more frequent than those with normal weight. Fast weight gain also increases the risk. It is more frequent in men than girls who have the same VKI. However, male sex does not increase the risk of steatohepatitis. It increases after ten years of age. It should be suspicious for diagnosis if obese persons in the family have insulin resistance and/or NAFLD history. Low birth weight and fast catch-up growth, excessive consumption of drinks and of food with fructose are also risk factors.

Diagnosis is made by clinical signs and symptoms, laboratory and imaging methods. Clinical indications are not specific to the disease; it could be asthenia, abdominal pain. It is present in about 50% of patients with hepatomegaly. Acanthosis nigricans could be seen as a finding of insulin resistance. Although liver enzymes can be used as screening tests, they are not sensitive enough to be at normal limits, nor do they correlate with the severity of the disease. Ultrasonography is the most widely used imaging method in diagnosis. Computerized tomography and MRI may be helpful in showing the degree of fattening. Reference diagnosis method is liver biopsy. It should distinguish from other diseases that may cause fattening in the liver (cystic fibrosis, rapid weight loss, Wilson's disease, glycogen storage diseases, fatty acid oxidation disorders, various syndromes, etc.).

Its prognosis depends on early diagnosis and treatment. There is not an effective medical treatment. A multidisciplinary approach involving dieting and exercise programs is needed. Initial weight loss should bearound 10%. Rapid and dramatic weight losses compromise steato hepatitis. High calorie beverages should be restricted, calories from fat in daily diets should be reduced below 30% and high fiber diets should be preferred. Even preservation of weight of children who are within rapid growth period will also cause a decrease in BMI.

Benefits of physical activity

In children with more moderate to vigorous exercise, obesity and eventually NAFLD developmentrisk is less. Physical activity increases insulin sensitivity. Aerobic exercises are more effective.

Indications

Once NAFLD diagnosis is made, the patient should be clarified on the necessity of regular exercise.

Physical activity prescription

For all children, 1 hour of moderate intensity exercise per day is recommended and additionally 1 hour of vigorous exercise 3 days a week is recommended. Also the time spent in front of television should be limited to 2 hours a day. For children with NAFLD, there is no evidence-based data. According to a limited number of study and data from adult studies, aerobic and resistance exercises are able to reduce the rate of liver cell lipoidosis. Transaminase levels were not affected.

The most successful results are obtained with synergy of dieting/weight loss and exercise.

Contraindications

No contraindication.

REFERENCES

1. *Anderson EL, Fraser A, Howe LD, et al. Physical Activity Is Prospectively Associated With Adolescent Nonalcoholic Fatty Liver Disease. JPGN 2016;62: 110–117*
2. *Dasarathy S, Merli M. Sarcopenia from mechanism to diagnosis and treatment in liver disease. Journal of Hepatology 2016, in print.*
3. *De Oliveiraa EP, Burinia RC. The impact of physical exercise on the gastrointestinal tract Curr Opin Clin Nutr Metab Care 2009;12:533–538.*
4. *Djärv T, Wikman A, Nordenstedt H, et al. Physical activity, obesity and gastroesophageal reflux disease in the general population. World J Gastroenterol 2012;18:3710-4.*
5. *Driessen LM, Kiefte-de Jong JC, Wijtzes A, et al. Preschool Physical Activity and Functional Constipation: The Generation R Study Journal of Paediatric Gastroenterology and Nutrition 2013;57:768-74.*
6. *Federico A, Trappoliere M, Loguercio C. Treatment of patients with non-alcoholic fatty liver disease: Current views and perspectives. Digestive and Liver Disease 38 (2006) 789–801.*
7. *Fell JM, Muhammed R, Spray C, et al; BSPGHAN IBD working group. Management of ulcerativecolitis. Arch Dis Child 2016;101:469-74.*
8. *Hyams JS, DiLorenzo C, Saps M, et al. Functional Disorders: Children and Adolescents. Gastroenterology 2016;150:1456-1468*
9. *Inan M, Aydiner CY, Tokuc B, et al. 'Factors Associated with Childhood Constipation', Journal of Paediatrics and Child Health 2007;4310:700–6.*
10. *Jones JC, Coombes JS, Macdonald GA. Exercise capacity and muscle strength in patients with cirrhosis. Liver Transpl 2012;18:146-51.*
11. *Kammermeier J, Morris MA, Garrick V, et al; BSPGHAN IBD Working Group. Management of Crohn's Disease. Arch Dis Child 2016;101:475-80.*
12. *Kappus MR, Mendoza MS, Nguyen D, et al. Sarcopenia in Patients with Chronic Liver Disease: Can It Be Altered by Diet and Exercise? Curr Gastroenterol Rep 2016;18:43.*
13. *Kranz S, Brauchla M, Slavin JL, et al. What do we know about dietary fiber intake in children and health? The effects of fiber intake on constipation, obesity, and diabetes in children. AdvNutr 2012;(3):47–53.*
14. *Mendes-Filho AM, Moraes-Filho JP, Nasi A, et al. Influence of exercise testing in gastroesophagealreflux in patients with gastroesophagealreflux disease. Arq Bras Cir Dig 2014;27(1):3-8.*
15. *Narula N, Fedorak RN. Exercise and inflammatory bowel disease. Can J Gastroenterol 2008;22:497-504.*
16. *Neuman MG, Nanau RM, Cohen LB. Nonmedicinal interventions in nonalcoholic fatty liver disease. Can J GastroenterolHepatol 2015;29(5):241-252.*
17. *Simre M. Physical activity and the gastrointestinal tract. EuropeanJournal of Gastroenterology&Hepatology 2002;14:1053–1056*
18. *Vajro P, Lenta S, Socha P, et al. Diagnosis of Nonalcoholic Fatty Liver Disease in Children and Adolescents: PositionPaper of the ESPGHAN HepatologyCommittee. JPGN 2012;54: 700–713*
19. *Wu LJ, Wu MS, Lien GS, et al. Fatigue and physical activity levels in patients with liver cirrhosis. J Clin Nurs 2012;21:129-38.*

SECTION 11

PHYSICAL ACTIVITY AND EXERCISE IN INFECTIOUS DISEASES

AUTHORS:

Ergin ÇİFTÇİ, MD Prof. (President)	*Pediatric Infectious Diseases Society*
Orçin TELLİ ATALAY, PhD Asst. Prof.	*Pamukkale University, School of Physiotherapy and Rehabilitation*
Demet BÖREKÇİ, MD	*T.R. Ministry of Health, General Directorate of Public Health*
Nalan TEPE GÖKÇE	*National Education Foundation Gokkusagi Secondary School*

ABSTRACT

Infectious diseases are a major cause of mortality and morbidity throughout the world. Infections may involve certain organs of body, as well as they may be common. Most of the infectionsdevelop as acute and may restrict normal physical activity during active period. The clinical course and treatment process of some infections is long. In this section, suggestions were made about the diseases characterized by physical activity and physical activity during important chronic infections.

INFECTIOUS MONONUCLEOUS

Infectious mononucleosis is an acute, lymphoproliferative disorder that is caused by Epstein-Barr virus (EBV) and most commonly seen in children and young adults. EBV is responsible for more than 90% of infectious pseudo mononucleosis tables. Infectious mononucleosis with an incubation period of 10-14 days in children is seen with complaints of fatigue, malaise, fever, sore throat and lymph gland growth. The main clinical findings are pharyngitis, diffuse lymphadenopathies, spleen and liver size.

Prevalence/Incidence

EBV affects more than 95% of the world's population. In developing countries, the disease usually develops in infancy and early childhood. In developed countries the disease is seen at later ages; half of children up to age of 6-8 get sick, about 30% of infections occur in adolescents and young adults.

Causes/Risks

The virus remains silent after the infection was transmitted and transmission to the other person is mostly through saliva.

Prognosis

The disease usually heals spontaneously. The symptoms usually last for two to four weeks and heal completely within two months. Complications may be seen in those with immune system problems. Viruswas also associated with some types of cancer.

Treatment

There is no specific treatment for the disease. Rest, adequate fluid intake, nutrition and febrifugals constitute symptomatic treatment of the disease. Corticosteroids are used in some complications of the disease.

Effects of Physical Activity

There is no preventive effect.

However, intensive physical activity should be avoided during the disease period.

Treatment

There is no positive effect of physical activity on the treatment of the disease.

Indication

Physical activity is not indicated in the case of infectious mononucleosis disease.

Physical activity prescription

Following criteria should be taken into account while returning to physical activity or performancesports in children who want to maintain physical activity.

1. Light activity should be performed so that the heart rate does not exceed 120/min. It should be paid attention that breathing difficulties should not be felt.
2. Duration of activity should not exceed 20-30 minutes at first. Light strengthening and endurance exercises could be done. The time can be increased by five minutes every day over time.
3. Physical activities and sportive practices should be done every other day.
4. Activities should be done to a tolerable extent. The person should be fully rested before the activity.
5. If the symptoms of the disease reappear, they should be discontinued for 2-3 days and the relevant doctor should be discussed with.
6. If the first 3-4 activities are completed without problems, the number of repetitions and the duration of the activity couldbe increased.
7. In order to return to the previous activity amount and intensity, the warning of the body should be taken into account and it should be ensured that the healing process is complete. The doctor should be consulted if necessary.

Contraindications/Risks

- Active period of the disease (first 10-14 days)
- The presence of signs of fever, malaise, respiratory distress
- Patients with splenomegaly: They should avoid challenging activities such as performance sports due to the risk of spleen rupture in the first 21 days and as long as splenomegaly progresses.

Human Immunodeficiency Virus (HIV) Infection

HIV infection is an infectious disease caused by the Human Immunodeficiency Virus (HIV), which causes opportunistic infections that cause major damage to immune system

Prevalence/Incidence

According to the World Health Organization, 3.2 million children under the age of 15 are infected with HIV. The number of HIV-infected people in our country is about 8 thousand. However, children make up a very small part of this figure.

Causes/Risks

HIV infection is caused by infection of a RNA virus from the retrovirus family. Transmission of the disease is by sexual contact, blood contact or vertical transmission from mother to baby.

Prognosis

Untreated patients have poor prognosis. The prognosis of the disease is significantly cured withthe antiretroviral drugs.

Treatment

It is treated with anti-retroviral drugs. Treatment of mother with these medications is effective in prevention of HIV infection in infants.

Benefits of physical activity

Developments in antiretroviral therapy have turned HIV infection into a chronic disease, resulting in the presence of various comorbidities in patients. These changes are loss in fat tissue (lipoatrophy) in the face, arms and legs, fat accumulation in the abdominal region, neck and breasts (lipohiptrophy) and also increase in total cholesterol, serum triglycerides and peripheral insulin resistance. In addition, HIV can cause decreased exercise capacity and deterioration in the daily activities of the patients. It is reported that the level of physical activity is low among adolescents with HIV/AIDS, in particular girls, there is a relation between physical inactivity and CD4 cells as well and most of the cases with CD4 level above 350/mm^3 are physically inactive individuals. Regular physical activity in patients increases aerobic capacity, muscle strength, flexibility and functional capacity. Other positive effects of physical activity are strengthening the immune system, reducing depression, and preventing or reducing side effects of anti-retroviral therapy. It was reported that an increase in the level of physical activity slows the progression of the disease. Long-term endurance exercises can increase CD4 levels and functional capacity and quality of life. Moderate intensity exercise allows weight loss without causing deterioration of the immunological profile or increased viral load. In addition, regular physical activity prevents excessive fatigue, which is the most important barrier for activity among the children with HIV.

Indication

It is indicated in asymptomatic HIV-infected individuals due to its positive effects on life quality.

Physical activity prescription

When determining the physical activity prescription, the individual's physical function, health status, responses to the activity and health status should be considered.

Strength training and aerobic activities are associated with body composition, muscle strength andcardiopulmonary relevance. Preference of the patient, stage of the disease and safety measures related to the symptoms is important in determining the activity prescription. Minimal activity intensity should allow beneficial effects. Excessive intensity varies from person to person. In patients with HIV, moderate intensity activities should be recommended for beneficial effects since high intense activities suppress immune system.

Strengthening activities should target large muscle groups such as trunk muscles, hamstring, quadriceps, biceps and should be moderate and be gradually increased. If it is intended to increase the muscle-related endurance, number of repeats could be increased at lower weights. Strengthening activities improve body composition, increase muscle strength and bone density.

Aerobic activities reduce body weight, improve body composition and increase aerobic capacity. Aerobic activities should be planned at moderate intensity (11-14 at Borg's scale, 50-85% of maximal cardiac rate, 45-85% of maximal oxygen consumption) and activities should be 3-5 days per week according to the patient's tolerance.

A total of 30-60 minutes is recommended per day, 20 minutes per day could be useful for those with poor physicalfitness.

Activities should be continued for at least 4 weeks in order for positive effects to appear.

Contraindications/Risks

- The presence of severe symptomatic infection,
- Excessive fatigue and weakness,
- Attention should be paid in exercises with traumatic events where blood contamination may occur.

Tuberculosis

Tuberculosis is a contagious disease that afflicts all organs, primarily and typically the lungs, of human caused by *Mycobacterium tuberculosis* complex bacillus.

Prevalence/Incidence

With a high morbidity rate, according to WHO (World Health Organization) Global Tuberculosis 2014 Report, the prevalence is 100/100000 and the incidence is 9 million new cases in 2013. Turkey incidence is 20/100000.

Causes/Risks

Cause of tuberculosis diseases is *Mycobacterium tuberculosis* complex bacillus. The main risk factors for disease development in infected cases are HIV (26-31 times), immunodeficiency, malnutrition, diabetes and poor living conditions.

Prognosis

Tuberculosis is a preventable and treatable disease. Disease develops in 10% of the patients with the disease infected by*Mycobacterium tuberculosis*. Improvement is achieved through regular use of essential drugs and taking necessary measures. In case treatment is not complied with, resistance develops against the medications and thus the duration of treatment is prolonged and the prognosis deteriorates.

The smaller the age of the patient in childhood, the greater the risk of spread of disease both in the lungand whole body is.

Treatment

Tuberculosis is a disease that can be prevented with vaccine to a major extent. The disease-specific vaccine is BCG vaccine.

Principles of Drug Treatment:

1. Short-term standard treatment regimens should be selected.
2. Drugs should be used regularly with direct supervised treatment (DOT).
3. Drugs should be used for a sufficient period of time.

Appropriate treatment is achieved by combining several anti-tuberculosis drugs. Children have the risk of developing extrapulmonary common disease, such as meningitis, more often than adults. Drug treatment regimes in children differ compared to adults. With a regular treatment, it could be healed up to 95-99%, the contagiousness is eliminated 15-20 days after the treatment. A preventive treatment regimen should be applied for the ones contacted with the patient.

Benefits of physical activity

In patients with tuberculosis, a decrease in physical fitness, muscle atrophy, impaired lung function and gas exchange occur. Exercise tolerance and daily physical activities decrease and life quality deteriorates as a result of changes in the musculoskeletal system.

Regular physical activity strengthens the immune system, increases cardiopulmonary fitness and prevents adverse changes in the musculoskeletal system. As a result, the quality of life of the patient increases.

There is no proven preventive effect.

Contraindications/Risks

- Physical activity is contraindicated; in the early period of fracture risk and limited joint movements in bone-joint tuberculosis,
- in case of symptoms of respiration difficulty in pulmonary tuberculosis.

Key Recommendations on Physical Activity in Infection Diseases

- People with a temperature of 38°C or more should definitely rest.
- The persons, who are aware of their normal body temperature, should rest, if their body temperature rises by 0.5-1°C and at the same time the number of resting heart beats increases by 10 beats/min. (accompanied by malaise, muscle ache, muscle stiffness, common joint aches and headache)
- Resting is recommended until the symptoms disappear in case of general ailment itself or accompanied by symptoms such as muscle pain, muscle stiffness, common joint aches and headache.
- Even if the body temperature is normal in all infections, the first 3 days of the disease is crucial for the body to cope with the infectionand to prevent the further progression of the infection.
- Attention is paid in the first three days in case of nasal discharge without the symptoms of sore throat, cough and general symptoms and then the activities could be continued if the symptoms do not worsen.
- If there are other symptoms accompanying the nasal discharge (sore throat, hoarseness or cough), we should be more restrictive depending on the severity and progression of the symptoms.
- Cautions should be taken before the symptoms progress in children with sore throat without othersymptoms.
- Since bacterial toxins can affect the heart in beta-hemolytic streptococcal tonsillopharyngitis, resting is recommended.
- Severe physical activity should be avoided in the case of afebrile cystitis/urinary tract infection.
- Severe physical activity should not be done in gastroenteritis.

REFERENCES

1. *Becker, Jonathan A., Julie Anne Smith. "Return to play after infectious mononucleosis." Sports Health: A Multidisciplinary Approach 6.3 (2014): 232-238.*
2. *De Grass D, Manie S, Amosun SL. Effectiveness of a home-based pulmonary rehabilitation programme in pulmonary function and health related quality of life for patients with pulmonary tuberculosis: a pilot study. Afr Health Sci. 2014;14:866-872.*
3. *Frantz JM, Murenzi A. The physical activity levels among people living with human immune deficiencyvirus/acquired immunodeficiency syndrome receiving high active antiretroviral therapy in Rwanda. Sahara J 2013;10:113-118.*
4. *Gomes-Neto M, Conceição CS, Oliveira Carvalho V, et al. A systematic review of the effects of different types of therapeutic exercise on physiologic and functional measurements in patients with HIV/AIDS. Clinics (Sao Paulo) 2013;68:1157-1167.*
5. *Gomes Neto M, Conceição CS, Oliveira Carvalho V, et al. Effects of combined aerobic and resistance exercise on exercise capacity, muscle strength and quality of life in HIV-infected patients: a systematic review and meta-analysis. PLoS One 2015;10: e0138066.*
6. *Guessogo WR, Mandengue SH, Assomo Ndemba PB, et al. Physical and functional follow-up of tuberculosis patients in initial intensive phase of treatment in Cameroon using the 6-min walk test. J Exerc Rehabil 2016;12:333-339.*
7. *Physical Activity in the Prevention and Treatment of Disease. Professional Associations for Physical Activity, Sweden, 2010.*
8. *Nelson Textbook of Pediatrics, 20th edition, 2016.*
9. *Rehm KE, Konkle-Parker D. Physical activity levels and perceived benefits and barriers to physical activity in HIV-infected women living in the deep south of the United States AIDS Care. 2016;28:1205-1010.*
10. *Akarsu S, Demirol M, Erensoy A, ve ark. Enfeksiyöz mononükleozda klinik ve laboratuar bulguları. Çocuk Enf Derg 2008; 2: 55-7.*
11. *Tanaka LF, Latorre Mdo R, Silva AM, et al. High prevalence of physical inactivity among adolescents living with HIV/AIDS. Rev Paul Pediatr 2015;33:326-331.*
12. *Yoshida N, Yoshiyama T, Asai E, et al. Exercise training for the improvement of exercise performance of patients with pulmonary tuberculosis sequelae. Intern Med 2006;45:399-403.*
13. *Webel AR, Moore SM, Hanson JE, et al. The rationale, design, and initial efficacy of SystemCHANGE™ -HIV: A systems-based intervention to improve physical activity in people living with HIV. J AIDS Clin Res 2013;4(3). pii: 1000200.*
14. *Webel AR, Perazzo J, Decker M, et al. Physical activity is associated with reduced fatigue in adults living with HIV/AIDS.J Adv Nurs. 2016*
15. *World Health Organization. Global Tuberculosis Report, 2014. Geneva, Switzerland: World Health Organization; 2014.*

SECTION 12

PHYSICAL ACTIVITY AND EXERCISE IN MUSCULOSKELETAL DISEASES

AUTHORS:

Güney YILMAZ, MD Assoc. Prof.	*Hacettepe University, Faculty of Medicine, Department of Orthopedics and Traumatology*
Gürsoy COŞKUN, PT PhD Assoc. Prof. (President)	*Hacettepe University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation*
Gizem İrem KINIKLI, PT PhD Assoc. Prof.	*Hacettepe University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation*
Fatma Gülçin UĞURLU, MD Asst. Prof.	*Yildirim Beyazit University, Faculty of Medicine, Department of Physical Medicine and Rehabilitation*
Gözde GÜR, PT PhD	*Hacettepe University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation*
İsmail KASIM, MD Spec.	*Ankara Numune Training and Research Hospital, Family Medicine Clinic*
Şenay BİLİMLİER	*Ankara Provincial Directorate of Health*

ABSTRACT

One of the most important problems of modern life is the decrease in physical activity. Transportation by means of vehicles, inadequacy of playgrounds, reducedphysical activity habits have a key role in the development of health-related life quality for children with chronic musculoskeletal system problems. Physical activity refers to any spontaneous, planned or organized movements made by skeletal muscles that increase energy consumption. Physical activity is effective in protection of health and prevention of the diseases that may be caused by physical inactivity, as well as improvement of life quality and functions for children with chronic musculoskeletal system diseases. Gaining attitudes and behaviors that are required to transform physical activity into lifestyle as part of daily living activities in children with chronic musculoskeletal system disorders also significantly contribute to the development of physical and mental health.

INTRODUCTION

It is known that regular physical activity in childhood and adolescence has positive effects on the development of the musculoskeletal system.Moderate to high level of physical activity in this perioddecreases secondary health problems in children with both normal and chronic musculoskeletal system problems. Children with regular physical activity have stronger muscles, stronger bones and lower body fat than their peers not doing regular physical activity.

Unlike adults in the pediatric group, growth and development are the case that causes dynamic forces on the musculoskeletal system. While growth means an increase in physical measurements; development includes the acquisition of skills and the increase in quality. Although growth and development take place in a certain period of time, they vary to a considerable extent person to person.

When children are involved in social and sportive activities involving exercise components, it is necessary to address some of the problems of childhood as well as problems that are related to orthopedic or musculoskeletal system and restrict or prevent involvement of child in social and sportive activities with his/her peers. Chronic musculoskeletal system problems can impair the general health of a person during childhood and adolescence, as well as impair the patient's daily life function and social relations. These problems may be inherent or deformities acquired during the growth period. For example, although flat foot that we call pes planus, shape and size of foot are genetically encoded, it is affected by many factors such as bone development, strengthening of the ligaments and transfer of burden during development period. In case of changes in these factors, irregularities may occur in foot arch development. Age, gender, race, body weight and age of starting to wear shoes are among the factors affecting foot development. It is called as pes planus if medial longitudinal arch (MLA) is lower than its normal value. Pes planus may cause changes in the ability of the foot to support, incompetence in movements, fatigue, different walking patterns and balance changes. It also affects the entire lower extremity; causes pain and problems in ankles, knees, hips and even spine especially. When all these facts are taken into consideration, it becomes necessary to provide the necessary support for ensuring normal weight distribution of the foot in the early period. The most appropriate approach is to recommend appropriate shoes and, if necessary, apply insoles (MLA supports) or similar shoe supports.

Apart from foot problems, knee, hip and spine problems are also frequently encountered problems during childhood. Lower extremities include pelvis, hip, femur, leg, knee, ankle and foot regions and their basic functions are to carry body loads, meet the forces affecting the lower extremity

and move the body. Lower extremities, on the one hand, provide stability with the body against loads applied externally and their torques, while on the other hand they have to withstand ground reaction forces, of which size may vary about one and five times the body weight. Therefore, it is important to maintain the normal alignment of the lower extremity and the body, to preserve their functions and to reduce musculoskeletal problems. In this section, we will examine the spinal and lower extremity problems and their treatments which are frequently confronted during childhood.

Spine Problems

Scoliosis

One of the main headings of chronic musculoskeletal system problems is spinal problems in children and adolescents. Among the deformities that may occur on the spine are mainly scoliosis and kyphosis. Also the mechanical back pain caused by various reasons could be examined under this heading.

Idiopathic scoliosis is a three-dimensional deformity in which the normal vertical alignment of the spinal cord is impaired, the spine is inclined to lateral and rotates around its long axis (Figure21.a-b). The scoliosis definition is used for lateral deviations exceeding 10 degrees on the coronal plan in the vertebrae. For smaller deformities, the definition of spinal asymmetry can be used. The incidence of idiopathic scoliosis ranges between 1.5 and 3%. Although the etiology of scoliosis is not yet fully elucidated, genetic factors, connective tissue pathologies and neurological problems were accused in the formation of deformity. Severity of scoliosis directs the treatment. While curves up to 20 degrees are followed by observation and exercise, curves between 20 and 40 degrees are treated with exercise in addition to the corset. Surgical treatment is generally recommended for curvatures, of which severity is above 50 degrees, if bone growth is complete. Because scoliosis is a deformity with a risk of progression; it leads to problems such as imbalances of body structure and stance, back deformities, limited physical activity, reduced physical skills, muscle skeletal pain and impaired lung functions. Together with these problems, young individuals with scoliosis may have cosmetic concerns about their appearances and negative psychological feelings. Negative psychological effects include effects on body image, diminished interest in life, feeling of worthless and problems in personal relationships. Conservative treatment is suggested for scoliosis to cope with all these negativities. It is also emphasized that if the scoliosis is not treated with the cause of being progressive, the curvature will get worse over time.

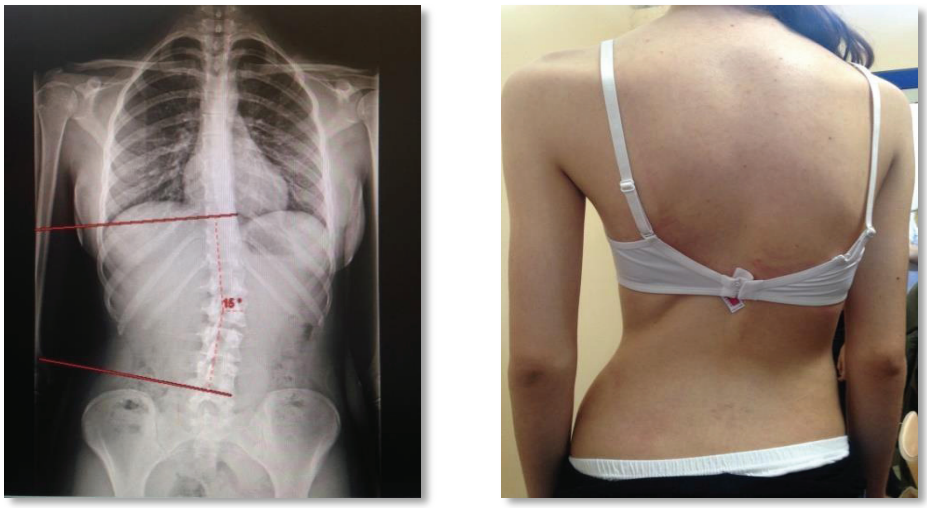


Figure 21. a) Left lumbar scoliosis, 15 degrees; **b)** Right thoracolumbar scoliosis 38 degrees

When scoliosis develops between the age of 10 and the age where bone growth is completed, this is called as *Adolescent Idiopathic Scoliosis* (AIS). The incidence of idiopathic scoliosis in adolescents between the ages of 10 and 16 is reported to be 2-4%, while girls have 7-8 times more risk than males in terms of incidence and progression. While "idiopathic" means that the cause is unknown, many related factors are described in the literature. Genetic factors associated with family history, endocrine factors associated with melatonin secretion, tissue factors involving changes in muscle structure and biomechanical factors including deformation of the vertebrae with early and rapid growth are the most important.

The aim of scoliosis treatment is to prevent progression of the disease, if possible, reduce the severity,minimize the problems caused by scoliosis and specified above, expand and raise awareness of the scoliosis person and his/her family about the subject and increase the self-satisfaction and improve the life quality.

There are many methods defined including orthosis practices and physical exercises in conservativetreatment of scoliosis. However, there is still no complete conclusion about the effectiveness, the superiority, the characteristics, the timing and the long term results of these methods and varieties. In the literature, exercises include active self-correction, postural exercises, strengthening, flexibility exercises, device-assisted exercises, Pilates exercises, three-dimensional exercises, respiratory exercises and aerobic exercises aimed at increasing cardiovascular endurance.

Within the scope of current treatments of scoliosis, there are general exercises such as Pilates and yoga which enhance the stability of the muscles around the spine. In addition, exercises such as Schroth (three-dimensional asymmetric exercises), SEAS (scientific exercises approach to scoliosis) and FITS (functional individual therapy of scoliosis), which were popular and scientifically proved in recent years, have gained importance. Individuals with scoliosis need to exercise regularly to keep both in the spinal periphery muscles in optimal length-strain relationship and strength. These exercises aim to increase strength, endurance and flexibility. Similar principles are considered when scoliotic individuals are recommended sports. The sport to be done by the individual should include symmetrical activities and continuous asymmetric loading should be avoided. The types of sports and physical activity that we can recommend to children with schizophrenia are shown in Table 22.

Table 22. Sports and Physical Activity Recommendations for Scoliosis Individuals

Moderate Severe Activities	High Severe Activities
Brisk Walking	Tempo running
Cycling	Tempo cycling
Skating	Jumping rope
Sports involving catching and throwing	Basketball
Couple dances, tempo dances	Volleyball, football, horse riding

Orthosis practices also involve many different methods which have different principles but the same purpose. Rigid plastic orthosis is usually used in moderate curves (20° - 40°), if progression is in question and the patient is still in development period (skeletal development is incomplete). Spinal orthoses commonly used in recent years include orthosis systems (Cheneau Concept, Sport concept, and Boston), each consisting of rigid, semi-rigid or elastic bands, each with different external corrective force and application techniques. It is important to use corset 23 hours a day and corset should reduce the curvature level by at least 30%. This ratio is calculated by measuring over corset X-ray.

An individual with scoliosis should be directed to physical activity by considering him/her as a whole and addressing the existing problems schematically (Figure 22). For example, existing problems of a 14-year-old girl with scoliosis should be, first of all, determined according to clinical and radiological evaluations. Then, it should be determined that these problems lead to difficulties in which activities and in which areas persons have involvement restrictions in daily life. For example, this girl with this scoliosis may experience pain due to curvature and may have difficulty while sitting. This will lead to limited participation in everyday life when this situation hinders her study. By addressing the existing problems that scoliosis causes in such a way, environmental and personal factors that cause these difficulties and limitations can also be identified and regulated. With work desk and chair arrangement, painless sitting posture can be provided, back-pack weight can be reduced and the person can be directed to appropriate physical activity, reducing the symptoms caused by scoliosis. In this way, the restriction of participation of the person in daily life will be eliminated.

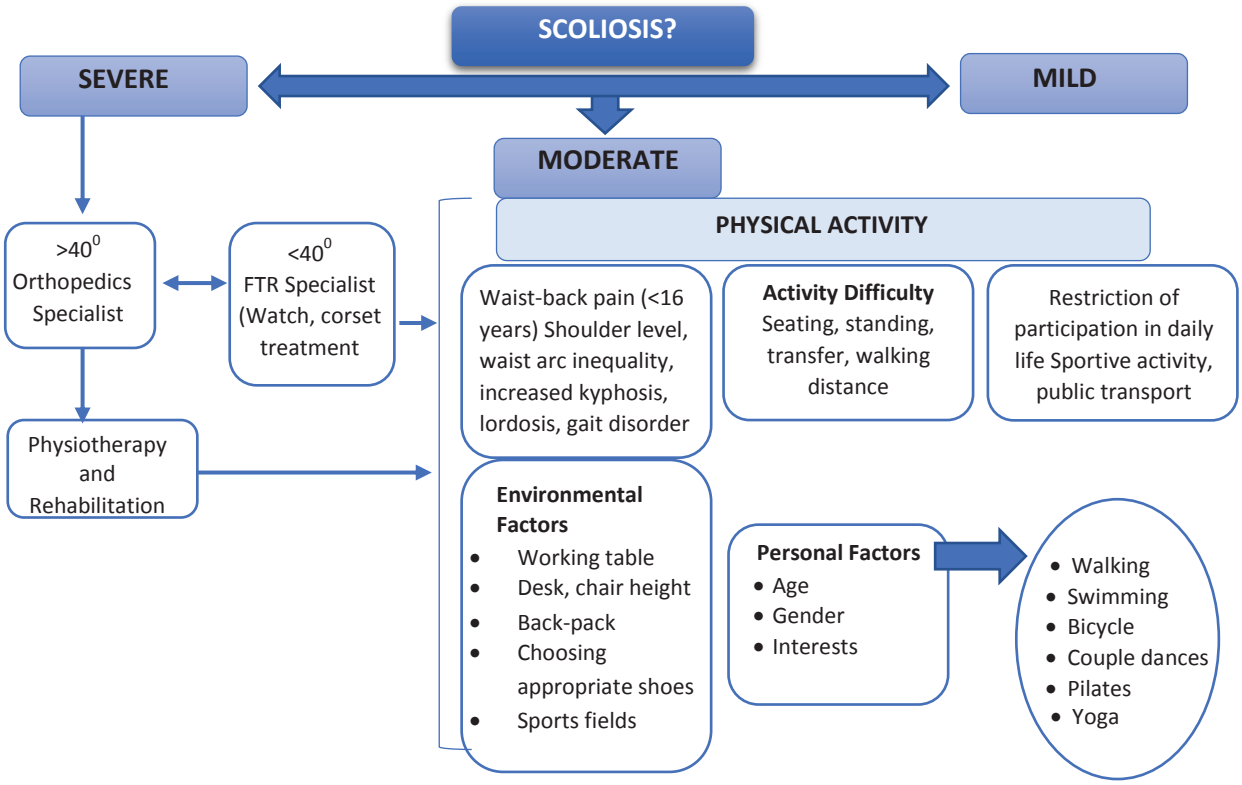


Figure 22. Algorithm of Family Physicians for Referring the Children with Chronic Musculoskeletal Problem to Physical Activity

Kyphosis

Kyphosis is a physiologically existing hump in the chest and back region (Figure 23. a). There is a physiological kyphosis between 20-45 degrees in rib cage (thoracic region) normally. Kyphosis/hump above the physiological limit can cause aesthetic and functional problems in the child. The kyphotic deformity may be functional (can be corrected by passive and active forces) or it may occur structurally due to various metabolic diseases, congenital developmental abnormalities, trauma, infection and neoplastic diseases.

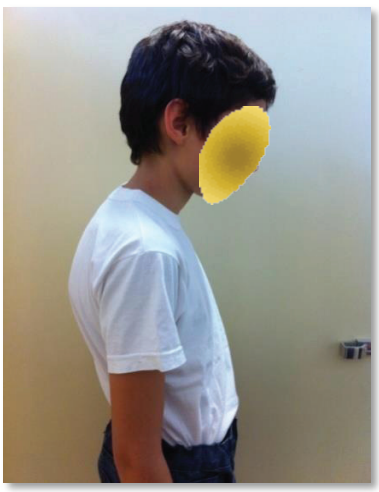


Figure 23. a) Thoracic Kyphosis

b) Kyphosis Corset

Being an aesthetic problem, progressive kyphosis is also a problem that can threaten general health because of problems that can cause heart and lung function. The incidence of kyphosis is around 1%, and the number of children brought to the physician's office due to postural disturbance by parents is higher. In the treatment of postural kyphosis, physiotherapy and rehabilitation approaches and exercise and physical activity recommendations aiming at improving body awareness are frequently used. In the kyphosis deformity due to underlying organic causes, orthosis treatment (Figure 23.b) and surgical methods are on the agenda. The use of corsets in deformities measured below seventy degrees may be recommended by the orthopedist. Corset therapy and follow-up are performed by physical treatment physicians and physiotherapists, and children and their families are educatedin terms of exercise and physical activity.

In the presence of kyphosis, posture exercises, back muscles strengthening and scapular retraction exercises are recommended. First of all, proper posture should be studied, then the exercises should be followed in correcting the kyphosis.

Lumbar pain

Another problem with frequent referrals to family physicians in spinal problems is lumbar pain which is especially seen in the adolescent period. Lumbar pain, which is considered to be a problem in adulthood due to decreased physical activity, heavy school bags, increased incidence of obesity in recent years, has become a frequent problem during childhood and adulthood as well. Studies showed that 50% of children complain of back pain at least once until the age of 15. Mechanical problems (muscular rupture, herniated disk, spinal injuries), developmental problems (kyphosis, scoliosis, waist slipping, spinal pathologies), infections, spinal tumors, abdominopelvic pathologies and psychological problems can be counted as reasons for childhood lumbar pain. Secondary acquisition due to pain in childhood is very rare. For this reason, every child consulting the 1st level health services for the complaint of low back pain should be referred to the relevant specialist according to the result of the evaluation by making the necessary physical examination by the family physician. Physiotherapy and rehabilitation approaches were successfully used in patients with no definite etiological cause.

Preventive Key Recommendations in Spinal Problems: Gaining physical activity habits from early ages can help prevent the development of children's chronic musculoskeletal problems as well as other problems that can occur.

1. Normal motor development of children should be followed up annually during the performance of primary health care services. Musculoskeletal system anomalies detected during screening should be directed to the relevant area of expertise. Children's physical activity levels can also be monitored with pedometer and accelerometer devices available in primary health care services.

2. Along with the beginning of the school year, protective education programs for gaining the right postural habits to children should be given bothteachers and students in the schools and the families in the Primary Health Care Services.

3. It is necessary to adjust the ergonomic conditions of the classes in the schools, to prevent carrying heavy school bags by providing proper lockers for stationery equipment such as books and notebooks asked for the students, to use the bags ergonomically, to listen the lessons within the class and to arrange the height of desk and chairs for the functions such as writing.

4. The Ministry of Health should manage on annual basis the screening programs for spine health and physical development of school children.

5. Required conditions should be provided in the schools for referring the students to sportive activities thatsupport spine health (e.g. swimming).

6. All family physicians should be trained in the basic examination methods used in diagnosis of scoliosis (e.g. forward bending test, measurement with scoliometer) in the training programs. This method of measurement is based on measuring the rotating intensity of the most protruding vertebrae with the help of a scoliometer placed on the dorsa while the person is leaning forward with knees straight. The severity of the vertebrae in the most intense zone of the curve is assessed by recording the result of the measurement.

Effectiveness of Physical Activity in Spinal Problems:

Physical activities should be determined in children with spinal problems in accordance with the chronological and biological age of the child. Tailor-made differences such as gender and the type of the spinal problem should be taken into account in the choice of physical activities.

Aerobic Fitness: For children with spinal problems, activities aiming at maximal oxygen consumption for improving the aerobic fitness (eg; football, volleyball...) should be progressed from moderate to high severity and applied at least 3 times a week for 30 to 60 minutes.

Increasing the Muscle Strength: In children with spinal problems, symmetrical plays and sportive activities are recommended, especially for strengthening the back and abdominal muscles. Because, in the case of spinal deformities or waist pain, the loads on the spine are distributed improperly, leading to asymmetry. And thus, strengthening the muscles and especially ensuring the abdominal-back muscular balance in case of waist pain makes it easier to deal with problems with the spine.

Improvement of Postural Uniformity: Physical activities and plays that increase body awareness also contribute to the development of cognitive functions such as motivation, communication, and social skills of children by increasing postural uniformity. While Pilates and Yoga increase postural uniformity, spine provides a balance between flexibility and strength.

Preservation of mental health: Regular physical activity improves self-confidence in children with spinal problems, enabling them to cope with depression and anxiety caused by aesthetic distress.

Preservation of skeletal health: Bone mineral density could be increased with sportive activities (e.g. running, tennis, volleyball, basketball) to be performed in adolescence. Studies showed that when girls are directed to physical activity for 5 days a week, their bone mineral densities increase.

Lower Extremity Problems

Childhood lower extremity problems can affect one's physical activity capacity and daily life functions. Problems of knee and foot are the main problems that parents take medical opinion in this regard. In childhood and young adulthood, many congenital or acquired knee and foot problems may arise. The most common problems among congenital deformities are flexible flat-foot and clubfoot (equinovarus foot). Acquired problems include deformities (cavus) that are more rarely seen due to various neurological diseases. Os-Good Schlatter's disease, one of the most common knee pain problems in the adolescent period, should not be ignored in children who complained of knee pain and applied to primary health care services. It is not right to completely limit physical activity for these children. At the onset of the disease, patients are directed to physical activity and it is suggested to limit the activities of extreme bending, tilting and squatting of the knee rather than strictly restricting the sportive activities. Furthermore, the patella band that alleviates the burden of the patellar tendon by creating a leverage line could be used (Figure 24).

Figure 24. Patellar Band

Flatfoot (pes planus)

The pes planus is characterized by reduced height of the medial longitudinal arch (MLA) relative to normal (Figure 25). Flexible flatfoot is the most common deformity in childhood. All infants born as flexible pes planus and almost all of them are pes planus in the first three years of life, normal foot arc develops during the first 10 years of life.

Figure 25. Pes Planus

It is generally recommended that children with pes planus walk on bare feet on different grounds to stimulate foot arch development. When the child starts to walk, he/she should walk with the bare feet, if possible, and the feet should not be restrained in shoes. When shoes are preferred, the use of sports shoes is recommended. It is stated that the choice of bootie and snoozies style soft shoes is the basis for the formation of pes planus.

Flexible flatfoot patients, who have often no pain, do not need a special treatment (special shoes, insoles). Although these children often say that they are tired earlier than their peers, there is no need to go to any restrictions in daily life and sportive activities. Children with painful flatfoot and progressive deformity should be evaluated by a qualified physician with appropriate imaging methods; they should be directed to physiotherapy and rehabilitation for appropriate footwear selection, foot-specific exercise approaches, insoles and similar applications. Strengthening exercises for muscles such as tibialis posterior, peroneus longus, flexor halluces, which support MLA, should be added to the treatment program for the individuals with pes planus.

Clubfoot (Pes Equinovarus)

Equinovarus foot is a problem of childhood. The foot is congenitally curved downward and inward (Figure 26). The treatment of congenital equinovarus foot deformity, which can be seen with multiple joint involvement and at very different intensities, mainly includes a set of orthopedic surgical approaches including serial plastering, soft tissue and bony interventions and physical therapies, home exercise programs, orthosis approaches and footwear proposals with or after such approaches.

Figure 26. Equinovarus Foot

Pes Cavus (High foot long arch)

Pes cavus is characterized by increased height of the medial longitudinal arch (MLA) compared to normal (Figure 27). Frequency is 10% in population. It is expressed that 60% of the individuals with pes cavus have pain.

Figure 27. Cavus Foot

According to the researches, it is also stated that there is a relationship between foot type and lower extremity injuries. While individuals with pes planus have a higher incidence of soft tissue and medial foot injuries, the incidence of lateral region, ankle and bone injuries is higher in case of foot with pes cavus. Therefore, it is necessary to treat in the presence of these problems. The purpose of the treatment in pes cavus is to improve weight distribution, comfort and stability, to maintain functioning, to protect joints and to normalize energy consumption. Orthosis is the main conservative treatment for pes cavus foot. Lateral heel wedge, transverse arch supports, tailor-made insoles, medial arch support for rigid conditions and footwear modifications are the orthoses commonly used to improve claw toes, hind leg and fore left ankles. Orthosis used in pes cavus should be made of soft and flexible material in order to increase shock absorption. In pes cavus, stretching the tibialis posterior and gastro-soleus complex, strengthening the peroneal muscles will improve foot-supporting surface balance and biomechanical alignment.

Genu varum and valgum

Knee problems that we call as genu varum/valgum are the deformities resulting from differences in foot pressure distribution during development, the flexibility of the ligaments or inability of muscles to carry the loads on the body. In-toeing and out-toeing problems may also cause valgum and varum deformities. Genu varum refers to outwardly bent knee, while genu valgum refers to outwardly bent knee (Figure 28). Childhood rheumatic diseases also cause these problems in the knee. Genu varum and valgum deformities seen in children are usually treated with wedge-shaped insoles under the feet. In more serious cases, orthosis stretching out above the knee are used.

Figure 28. Genu Valgum

Developmental dysplasia of the hip

It is a defect of hip development that occurs in different forms at different ages due to the developmental problems that occur congenitally or after postpartum period. The common etiologic cause is excessively loose hip capsule that fails to maintain the femur head in the acetabulum. The incidence of newborn hip instability varies between 0.1% and 1.5%.

The problem within the definition of hip dysplasia is assessed in three groups: 1. Dislocation; there is no relationship between the femur head and the acetabulum; 2. Subluxation; the relationship between the femur head and acetabulum is not completely eliminated but decreased and 3. Dysplasia; refers the failure of the acetabulum development. Developmental dysplasia of the hip is 4-6 times more common in girls than in boys. If the family history is positive; this rate increases by 20-30% in girls.

Developmental dysplasia of the hip is classified into two groups as "typical" and "teratological - atypical" types. Typical form hip joint consists of instability where the femur head can be partially (subluxed) or fully (dislocated) displaced from the acetabulum by the examiner in the newborn or where the hip can be reduced by the physician in the dislocated position. The disease is more prominent in the advanced childhood or adolescent period (e.g. Dislocated) or weak acetabular coverage may develop and it is called as dysplasia of the hip. The teratological form is usually associated with neuromuscular disorders such as myelodysplasia and arthrogryposis. These hips are dislocated in the prenatal period, the range of motion is limited and cannot be reduced during examination. These cases, which are resistant to treatment, constitute a small percentage.

It is necessary to keep the hip in proper position with some devices from the age of the very first detection of developmental dysplasia of the hip. Thick underpad (frejka pillow), pavlik harness, hip abduction orthosis are frequently used orthosis.

In addition, since excessive hip adduction leads to hip dislocation, swaddle should be avoided during the treatment process of both healthy infants and children with developmental dysplasia of the hip. According to the researches, incidence of developmental dysplasia of the hip in Turkey was reported as 0.58%. Compared to many countries, this rate is higher and its reason is associated with consanguineous marriage and frequency of swaddling use.

Since adductor muscular short stature is also a preliminary factor for dislocation, adductor hip muscles should be stretched with exercise and the abductor hip muscles should be strengthened.

In conclusion;

To sum up, in children with specific health problems such as pathologies described above, exercise, play or sportive activities, most of the time, depending on gaining muscular, cardiovascular, pulmonary, social and spiritual outputs, contribute to slowing down the course and symptoms of existing musculoskeletal problems, forming a protection against progression and secondary problems, increasing general health parameters such as balance, muscle strength and respiratory capacity, strengthening the responses from medical treatments in a positive way, increasing the power of the patient and family to cope with the problems and finally the child, family and other health professionals in terms of ensuring the social involvement of child with his/her healthy peers and even the ones having the same disease.

It is of vital importance for children if the physicians and physiotherapists, professionals providing recreational training, exercise and sportive training in various branches and health professionals working with children having such health problems are aware of the general effects, long-term progressions and potential risks of musculoskeletal problems listed above. In all cases, however, physical activity is beneficial to children in many aspects. It would be important if children are directed to physical activity appropriate to their age and existing problem in order to improve their health, increase physical fitness, develop posture and balance, increase self-esteem, provide weight control, strengthen muscles and bones and support independent life.

REFERENCES

1. *Asher M, Green P, Orrick J: A six-year report: Spinal deformity screening in Kansas school children. J Kans Med Soc 1980; 81:568*
2. *Bassani E, Candaotti CT, Pasini M, et al. Assessment of neuromuscular activation in individuals with scoliosis using surface electromyography. Revista Brasileira de Fisioterapia, 2008;12 (1): 13-19.*
3. *Bradford EG: Treatment of club-foot. J Bone Joint Surg Am 1889; s1-1:89-115*
4. *Burton AK, Clarke RD, McClune TD, et al: The natural history of low back pain in adolescents. Spine 1996; 21:2323*
5. *Everett CR, Patel RK. A systematic literature review of nonsurgical treatment in adult scoliosis. Spine 2007; 32 (19 Suppl):130-134.*
6. *Fowler EG, Kolobe TH, Damiano DL, et al. Promotion of physical fitness and prevention of secondary conditions for children with cerebral palsy: section on pediatrics research summit proceedings. Phys Ther (2007) 87(11):1495–510.*
7. *Harris R, Beath T: Hypermobile flatfoot with short Achilles tendon. J Bone Joint Surg Am 1948; 30:116.*
8. *Lee CH, Jeong YT, Kim HC, et al. Comparison of physique, physical fitness and mental health between spinal scoliotic and normal students. The Korean Journal of Growth and Development, 2006;14 (2): 87-94.*
9. *Mackenzie WG, Sampath JS, Kruse RW, et al: Backpacks in children. Clin Orthop Relat Res 2003; 409:78.*
10. *Ponseti IV, Zhivkov M, Davis M, et al. Treatment of the complex idiopathic clubfoot. Clin Orthop Relat Res. 2006; 451:171-176.*
11. *Sheir-Neiss GI, Kruse RW, Rahman T, et al: The association of backpack use and back pain in adolescents. Spine 2003; 28:922*
12. *Shneerson JM, Madgwick R. The effect of physical training on exercise ability in adolescent idiopathic scoliosis. Acta Orthop Scand, 1979;50 (3): 303-306.*
13. *Stuart L, Weinstein MD, Scott J, et al. Developmental Hip Dysplasia and Dislocation Part II. J Bone Joint Surg Am, 2003; 85 (10): 2024 -2035.*
14. *Uygur F, Yakut Y, Bek N. Çocuklarda Ortez Uygulamaları ve Rehabilitasyonu Orthotic Applications and Rehabilitation in Children Turkiye Klinikleri J PM&R-Special Topics 2010;3(3):70-8.*
15. *Van Brussel M, van der Net J, Hulzebos E, et al. 2011 Spring;23(1):2-14. doi: 10.1097/PEP.0b013e318208cb22. The Utrecht approach to exercise in chronic childhood conditions: the decade in review.*

SECTION 13

SUDDEN DEATH AND INJURIES IN SPORTS

AUTHORS:

Erdem KAŞIKÇIOĞLU, MD Prof. (President)	*İstanbul University, Faculty of Medicine, Department of Sports Medicine*
İrem DÜZGÜN, PT PhD Assoc. Prof.	*Hacettepe University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation*
Senem ÖZGÜR, PhD Assoc. Prof.	*Turkish Pediatric Cardiology and Heart Surgery Society*
Göktuğ ERTETİK, Research Assistant	*Ankara University, Faculty of Sport Sciences*
Ayşe GÜLMEZ VURAL	*T.R. Ministry of Health, General Directorate of Public Health*

ABSTRACT

Due to the increasing number of cardiovascular mortality and obesity, sporting activities are suggested to every individual whatever the age group. While it is known that regular exercisereduces mortality, trauma and sudden deaths, even rare, due to sporting activities have a broad repercussion in press, leading to serious anxiety in the family and society. In addition, policlinic applications are frequently made to obtain sports reports. For such applications, there is not a standard approach in Turkey in accordance with the laws and/or general decisions. For this reason, each clinic tries to respond this need with different combinations of examinations in accordance with their own practice and experience. However, it is obvious that the issue should be addressed not only from the medical aspect but also ethical and legal aspects. The best way to reduce unexpected deaths in sport fields is to detect the potential sudden cardiac arrest candidates through the prevention and screening before the event occurs and to prohibit from competitive sports. Considering the severity of the disease, functional stage and risk factors, individuals with a definite diagnosis of cardiovascular problems should be recommended tailor-made exercise and sportive activity.

INTRODUCTION

According to the World Health Organization (WHO) 2004 Report, sedentary lifestyle is among the major risk factors for deaths from non-communicable diseases across the world and it causes about 3.2 million deaths per year. WHO's 2008 Report states that 31% of adults at the age of 15 and above worldwide are not sufficiently active. According to the Chronic Disease Risk Factor Survey conducted by the Ministry of Health in 2011, it is determined that 87% of women and 77% of men do not perform sufficient physical activity across Turkey. These ratios suggest that sedentary lifestyle is serious for Turkey.

Despite the fact that it has not been published yet, it was revealed by Active Life Association that the adolescence age group is the most inactive group in terms of physical activity as part of a study carried out on 2,750 people in different occupational and age group. For this reason, we think that making children and adolescent age group more active is very important for community health. For this reason, exercise should be increasingly used and recommended as an important drug in the prevention of obesity, diabetes and early-age cardiovascular disease, which are increasing in this age group. In spite of all these, the inability to make appropriate and standardized health assessments and, if necessary, the proper planning of the person-specific exercise can sometimes lead to serious health problems.

The most important of these health problems that can be seen related to sports are sudden death events that can occur in sport fields or other living spaces. Although sudden death events are rarely seen, this tragic event can create serious negativity and sensitivity in society. Therefore, although encouragement of participation in sport and regular exercise is required particularly in these age groups, it is also a requirement to establish clinical screening and standards to prevent sudden death.

Defining Sudden Death

Sudden death, according to the definition of the WHO, is the death cases developing within six hours after the start of the symptoms, while the international society of forensic medicine defines this period as 1 hour. In these definitions, the symptom may be any cardiac complaint and/or finding, the first and only symptom may be sudden cardiac arrest in many cases. Some of the sudden deaths due to sports and exercise can develop in the sporting area, and a significant part of them occur in non-sports habitats, even in resting conditions.

Sudden Death Frequency and Etiology

According to the experience of the United States of America and Italy, which have researches much more than any country, sudden death is reported as 0.8-1 in 100.000 cases. It is also a known fact that the frequency of sudden death events increases as the age progresses. It is accepted that males are under more risk for sudden death due to the frequency of sports involvement and the phenotypic influence of some cardiovascular problems. In sudden death etiology, cardiovascular problems are suggested as a cause over 90% according to some sources. Apart from cardiovascular causes, physical conditions for sports and exercise and neurological, hematological and respiratory problems that are silent in cases are reported to possibly be both a facilitating and a primer cause. Knowing these etiologic causes is critical when recommending appropriate sports for individuals. Table 23 indicates the causes of trauma-related or nontrauma-related sudden death that can occur during sports.

Table 23. Cases that May Result in Sudden Death in Sports and Physical Activity

- Catastrophic brain injuries
- Cervical spinal cord injuries
- Diabetes-related complications
- Heat stroke associated with effort
- Dehydration and hyponatremia during exercise
- Effort-related sickling crisis
- Deadly contracts in contact sports
- Stroke of lightning
- Sudden cardiac arrest

Causes of Non-cardiac Traumatic Sudden Death

Catastrophic brain injuries

Mild traumatic brain injury (cerebral concussion) is often seen in athletes who use both helmets and not. Even rarely, subdural and epidural hematomas and malignant cerebral edema (such as secondary impingement syndrome) resulting from direct trauma give rise to more death than cerebral concussion. When these injuries occur, brain edema or blood accumulation (or both) increases the intracranial pressure. If this condition is not treated quickly, brainstem herniation and cardiorespiratory arrest may occur. Catastrophic brain injury in American football players results in death in the second place after the cardiac injuries. Apart from American football, deaths due to brain trauma could be seen in almost every sports branch. While mortality rate reaches up to 50% especially in catastrophic brain injuries such as secondary impingement syndrome, morbidity is close to 100%.

Protection and Recommendations

Protection from catastrophic brain injuries, skull fractures, intracranial hemorrhages andwidespread cerebral edema (secondary impingement syndrome) in sports includes;

1. In order to protect the athlete suffering trauma from sudden death, to follow-up consciousness, keep the airway open and follow vital signs as part of the first intervention, to apply stabilizing equipment for both head and neck by following Glasgow coma score
2. To transfer required cases to health institutions in a controlled manner where further intervention and evaluation could be performed after the first intervention
3. To provide athletes, coaches and parents with education on traumatic brain injuries and prevention
4. To ensure the use of sports-specific, standardized and certified equipment
5. To use comprehensive, objective assessment methods after injury
6. To monitorize and follow the symptoms.

Cervical spine injuries

Catastrophic cervical spinal cord injuries occur when the region is exposed to vigorous intensity trauma, resulting in distortion of the tissue. Sudden death is encountered especially in injuries on C5. Sudden deaths occur due to cardiorespiratory functions being affected by trauma in this region. Supporting the respiratory and circulatory functions is what should be firstly done in these injuries. Complex biochemical events occur in the first 24-72 hours and the risk of death is very high.

Protection and Recommendations

1. In order to protect the athlete suffering trauma from sudden death, to follow-up consciousness, keep the airway open and follow vital signs as part of the first intervention, to use stabilizing collar (neck protector) for both head and neck by following Glasgow coma score
2. To avoid moving the cervical region during transfer
3. To transfer required cases to health institutions in a controlled manner where further intervention and evaluation could be performed after the first intervention
4. To provide athletes, coaches and parents with education on traumatic brain injuries and prevention
5. To ensure the use of sports-specific, standardized and certified equipment
6. To use comprehensive, objective assessment methods after injury

Cardiovascular Problems That Could Cause Sudden Death

While hypertrophic cardiomyopathy is the most common cardiovascular disease that may cause sudden death among the child and adolescent age group, it is followed by coronary artery anomalies, canalopathies, other organic causes and other unidentified arrhythmias. Briefly describing these problems and classifying them is crucial in preventing sudden deaths. Cardiovascular diseases that can cause sudden death for the child and adolescent age group during sports are shown in Table 24.

Table 24. Cardiological Causes of Sudden Cardiac Death

Cardiomyopathies	• Hypertrophic cardiomyopathy (most common) • Dilated cardiomyopathy • Restrictive cardiomyopathy • ARVD* (most common in Italy)
Coronary Artery Anomalies	• ALCAPA** • ARCAPA*** • Rooted in other sinus • Kawasaki disease • Premature atherosclerosis (<35 years of age rare)
Canalopathies	• Long QT syndrome • Brugada syndrome • CPVT**** • Short QT syndrome
Transmission Disorders	• High-grade 2. degree block • Full AV block
Preexcitation Syndromes	Wolf Parkinson White syndrome
Outflow Obstruction	• Aortic stenosis • Aortic coarctation
Inflammation in the heart tissue	• Myocarditis • Endocarditis • Pericarditis
Trauma	Commotio cordis
Other	• Aortic dissection (Marfan syndrome) • Ehlers Danlos Syndrome • Post-Heart Transplantation • Mitral Valve Prolapse • Pulmonary Hypertension • Postoperative congenital cardiac disease • Use of cocaine and stimulants

* ARVD Arrhythmogenic right ventricular dysplasia,

**ALCAPA: Abnormal left coronary artery originating from pulmonary artery,

***ARCAPA: Anomalous right coronary artery originating from the pulmonary artery

****CPVT: Catecholaminergic polymorphic ventricular tachycardia

Hypertrophic Cardiomyopathy

Hypertrophic Cardiomyopathy (HCM) is accepted as the most common cause of sudden death in young age group performing sports. The importance of HCM in the frequency of sudden death is due to being the most common genetic transmission disease. As the number of individuals participating in the sports is increasing day by day, this table poses a higher risk. It is sometimes very difficult to distinguish physiologic hypertrophy resulting from cardiac adaptation from this pathological hypertrophy. It could be asymptomatic in the individuals with HCM just like the individuals carrying physiological hypertrophy of the heart of athlete and it manifest itself with a sudden death at first. However, some individuals may also experience symptoms such as dizziness, palpitations, shortness of breath, chest pain and syncope during exercise. HCM differential diagnosis should absolutely be considered for the athletes who describe these symptoms, have death at a young age in their own families and HCM history and have a suspicion of systolic murmur on physical examination.

Protection and Recommendations

Patient with HCM diagnosis at the young age group, cardiac arrest, continuous ventricular tachycardia or syncope attacks recurrent with exercise, short duration recurrent ventricular tachycardia attacks in Holter monitoring, advanced left ventricular hypertrophy (>30 mm), hypotensive blood pressure response to exercise and sudden death in the family and death history associated with HCM are high risk criteria for sudden death. Individuals with these criteria should be closely monitored, excluded from contested sports and directed to appropriate cardiology centers for implantation of an automatic intra-cardiac defibrillator. It should be aimed not to increase the work load on the heart during the given exercises to the cases other than patients with advanced clinical stage with poor prognostic criteria and with low functional capacity. Isometric exercises, high weighted strengthening exercises, vigorous intensity and severity aerobic exercises should not be preferred for upper extremity muscles. It should be remembered that light aerobic exercises may be safer for these patients.

Coronary artery anomalies

Although it is a rare congenital disease that affects approximately 1% of the population, it takes the second place among sports-related sudden death causes in the young age group. Although it is claimed to be responsible for 1.2% of sudden deaths due to reasons out of sports in the normal population, it is responsible for 12-19% of sudden deaths in the group of athletes. The malformation that is the most common and causes sudden death most frequently is coronary arteries originating from the abnormal sinus valsalva. The one among these anomalies that most causes sudden death of the athletes is the left main coronary artery rooted in the right sinus valsalva. The right coronary artery, rooted in the left sinus valsalva, is also an anomaly that may cause sudden death. Furthermore, if either right or left coronary artery is rooted in pulmonary artery instead of aorta, sudden death and thus relative ischemia may occur. Since this patient group does not have symptoms frequently or have atypical symptoms, it is hard to make the right diagnosis. Another critical problem is that the changes,which may be seen, even rare, in the results of resting electrocardiography (ECG)

and exercise test, are not diagnostic. A monitoring physician should be alerted by difficulty in breathing, chest pain, pressure, burning and syncope attack recurrent by unexplained exercise for a young athlete and this physician should suspect that the underlying cause could be a coronary artery anomaly.

Protection and Recommendations

The most important stage of diagnosis is the suspicion of the disease. Transthoracic or transesophageal echocardiography or electron beam computerized tomography may help detect coronary arteries rooted in the abnormal origin or suspect malformation. However, with the standard screening tests applied, most malformations of athletescannot be safely identified. Definitive diagnosis is made by coronary arteriography in suspected cases. Athletes with coronary anomalies should be prohibited from exercising competitive sports that require intense exercise in order to reduce the risk of cardiac events. The most common approach to restore distal coronary flow in patients with abnormal coronary arteries is by-pass grafting. As a result of clinical evaluation and examination, the cases found with significant myocardial ischemia should be excluded competitive sports and should avoid from vigorous intensity sportive activities.

Myocarditis

Myocarditis is one of the causes of sudden death associated with exercise in young athletes. However, in most cases, definitive diagnosis may not be possible even with myocardial biopsy/autopsy. As a result of the autopsy studies, about 6% of the athletes of competitive sports demonstrated acute inflammatory changes in the myocardium or idiopathic scar areas thought to be due to healed myocarditis. Myocarditis is an inflammatory disease caused mainly by enteroviruses and adenoviruses. In addition, it should be remembered that pancarditis cases, which may occur during acute rheumatic fever, may encounter with sudden death due to severe valve problems and heart failure during exercise. Sudden cardiac death may occur in patients with active myocarditis or recovering myocarditis due to deterioration of the electrical stability of the left ventricle. If an athlete had experienced fully healed myocarditis, he/she does not have to leave active sports life.

Protection and Recommendations

Athletes should be followed closely for 6 months from the onset of clinical findings. When cardiac measures and functions return to normal, competitive sports and vigorous intensity exercises should not be allowed again until arrhythmias in stress testing and ambulatory monitorization disappear.

Coronary artery disease

Although regular exercise is known to play an important role in preventing the development of atherosclerotic coronary artery disease, sudden deaths due to this disease during physical exercise were also reported in young age groups of athletes. In a study by Corrado et al. in the Veneto region

of Italy, atherosclerotic coronary artery disease is found to be one of the leading causes of sudden death among young athletes. In these cases, the disease was frequently shown to occur in the left anterior descending coronary artery. Maron et al. suggest in a study that premature coronary artery disease is responsible for 10% of sudden deaths among athletes of young age group. This disease is usually caused by familial dyslipidemias and causes myocardial ischemia or infarctions in the second or third decade. Athletes with tendon xanthomas and family history of sudden death or cardiac disease at early ages should be carefully evaluated for coronary artery disease.

Protection and Recommendations

Adolescents and young patients with familial hyperlipidemia and having ischemic cardiac event should be directed to regular exercise to protect against sudden death. During this guidance, recommended exercise should be safe and performed at appropriate pulse range, considering the severity and involvement of the disease, functional capacity and the medications used. Moderate aerobic exercises are recommended in this patient group.

Intramural coronary artery

The complete flexion of the left anterior descending coronary artery by the myocardium is an anatomic variation that can cause sudden death during exercise in young healthy individuals. While the myocardial fibers surrounding the coronary cause stenosis in the diastole, this stenosis reaches critical dimensions during systole and causes myocardial ischemia. Beta blockers may reduce stenosis in coronaries and increase blood flow, reducing ischemia and anginal symptoms.

Protection and Recommendations

As a result of clinical evaluation and examination, the cases found with significant myocardial ischemia should be excluded competitive sports and should avoid from vigorous intensity sportive activities.

Marfan syndrome and aortic rupture

Marfan syndrome is responsible for 7% of sudden deaths in young athletes due to rupture of the aortic aneurysm resulting from a decrease in elastic fibers in the aortic media layer. Athletes with physical findings such as arachnodactyly, scoliosis, pectus excavatum, highly arched palate, joints with increased flexibility and lens dislocation should be evaluated in terms of Marfan syndrome. However, it should not be forgotten that cardiovascular findings may also occur without evidence of skeletal system.

Protection and Recommendations

The primary determinant factor for allowing athletes with diagnosis of Marfan syndrome to perform competitive sports is the presence and degree of aortic dilatation. In the presence of aortic dilatation, the athlete must expose to a detailed medical evaluation before being allowed to participate in the competitions.

Valvular heart disease

Aortic valvular stenosis is a cause of sudden death in children and young asymptomatic individuals in the normal population. Since the typical murmur could be recognized easily as part of evaluations before participation in competitive sports, diagnosis of the disease could be made at early ages compared to other pathologies and involvement of the athlete in competitive sports is hindered, preventing disappointing results. Although mitral valve prolapses is common in the general population, it is a rare cause for sudden death in young athletes.

Protection and Recommendations

In the case of moderate and advanced Aortic stenosis, if there is effort-related syncope, chest pain, severe arrhythmia, spontaneous ischemia finding in ECG, competitive sports and moderate-severe aerobic and isometric exercises should be avoided. If patients with mitral valve prolapse have cardiomegaly due to chest pain, syncope, complex ventricular arrhythmias and mitral regurgitation or they have sudden death history in their families, a limitation in physical activities is recommended.

Arrhythmogenic right ventricular dysplasia

Although reported that it is among the rare causes of sudden deaths among young athletes according to previous studies, it is the most common cause in North Italy. Sometimes it is difficult to make the diagnosis of the disease. In the ECG, abnormal T waves may be seen in precordial derivations. Although seen rare, Epsilon waves are disease-specific finding. If echocardiography cannot help with the diagnosis, magnetic resonance imaging can sometimes be diagnostic, showing infiltration with myocardial fat tissue.

Protection and Recommendations

Arrhythmogenic right ventricular dysplasia is an important risk factor for sudden death development during exercise. The presence of severe ventricular arrhythmias previously documented on this table, the presence of syncope, the presence of sudden death in the early ages in the family, and the presence of radiologically extensive degeneration are accepted as important risk factors. It is necessary to avoid moderate and vigorous intensity exercises in individuals with a definite disease diagnosis and in high risk group.

Canalopathies

Genetically most common channelopathy is long QT syndrome. Abnormal extension of repolarization time in long QT syndrome paves the way for a ventricular arrhythmia called*Torsade de Pointes* . There are 13 different ion channel and structural protein mutations associated with this syndrome. Values over 450 in males and 460 msn in females are considered long QTc ("QT corrected" by heart rate). However, in approximately 40% of individuals with genetically positive Long QT, the QTc values are within normal limits. In addition, 5-10% of normal individualshave QTc values above 460 msn. For these reasons, making the long QT diagnosis by only evaluating the ECG may lead to some problems. ECG findings become meaningful with certain symptoms, positive family history and genetic testing or with very high QTc values. It covers approximately 75% of types 1, 2 and 3 cases. Treatment and precautions should be specific to the type. General approach is avoidance of stimulants and exercise and beta blockers. Left cardiac sympathetic denervation or implante cardioverter defibrillator (ICD) is the treatment options that should be selected according to the condition.

Brugada syndrome is another ion channel defect in which re-enteral-type tachycardiais observed in the right ventricular epicardium and between epicardium and endocardium as a result of the timing difference. Although symptom is observed in characteristic ST elevation in derivations seeing the right ventricular in electrocardiography, ECG findings may be subtle in most cases. Provocation tests with top-level ECG or sodium channel blockers can make characteristic ST elevation apparent. ICD treatment is needed in symptomatic cases.

Short QT syndrome is a relatively newly defined channelopathy. Up to now, 6 gene mutations were defined. As a result of these mutations, the period of repolarization in some regions of the atrium and ventricle is shortened abnormally, thus establishing a ground for the formation of serious arrhythmias both at the atrium and the ventricle. QT time under 360 msn in ECG should be stimulant. However, final diagnosis could be made by combining ECG findings with various recurrent symptoms and positive family history.

Catecholaminergic Polymorphic Ventricular Tachycardia (CPVT) is an ion channel defect characterized by exercise/stress induced syncope and sudden death. The defect is in the intracellular calcium channels. The major obstacle to recognition of the disease is the absence of pathologic findings other than moderate bradycardia and non-specific T-wave changes on ECG during rest. ECG findings and symptoms can be detected during the exercise test. Even during the exercise test, typical changes may not occur until the target cardiac rate is reached. One or two-way ventricular tachycardia monitoring is typical for CPVT following ever-increasing ventricular extrasystoles with increasing heart rate.

Protection and Recommendations

Since Catecholaminergic Polymorphic Ventricular Tachycardia and Long QT Type-1 are directly associated with exercise, absolute exercise restriction should be made. Patients with Long QT Type-1 should especially avoid swimming. Exercise restriction suggestions should be personalized according to the genetic and phenotypical characteristics of channelopathy.

However, the individuals with definite diagnosis of disease and at the high risk groupshould avoid moderate and vigorous intensity exercises.

Cardiac conduction system abnormalities

In the absence of other structural cardiac causes, congenital or subsequent abnormalities in the cardiac conduction system can lead to sudden death in athletes and other young individuals by forming cardiac blobs and bradyarrhythmias. Wolff-Parkinson-White Syndrome (WPW) is a disease that causes sudden death in less than 0.1%. Death often occurs as result of occurrence of rapid ventricular response by conducting the atrial fibrillation, which is often caused by increased sympathetic activity during exercise, through accessory path and degeneration of ventricular fibrillation.

Protection and Recommendations

Athletes with WPW syndrome should be evaluated for the development of atrial fibrillation and development of other arrhythmias with exercise test and 24-hour Holter monitoring and intensive exercise should be restricted until the end of the electrophysiological study and treatment.

Congenital Cardiac Tables

Major vessel transposition, Fallot tetralogy, pulmonary vascular disease and left ventricular outflow tract obstruction are the groups with the highest risk of sudden death. Patients who underwent Fallot tetralogy, atrial switch and Fontan operation in the post-operative long term are at risk for serious arrhythmia and sudden death.

Protection and Recommendations

The exercise program, which may be suitable for the severity of the disease, patient's functional capacity, planned treatment type and follow-up, should be planned.

Sudden Death after Blunt Chest Trauma

Acute heart arrests accompanied by severe arrhythmias following severe blunt traumas corresponding to the area in the locus region of heart, coinciding with the period where the electrical sensitivity of heart is high, may be seen. Nowadays, since children are directed to contact and defense sports more and more, its importance comes into prominence.

Protection and Recommendations

It is a frequently confronted problem, since children, who engage in contact sports or sports with possibility of blunt blows, are not sufficiently taught the rules related to these sports, protective equipment could not be used. It is vital to bring the rules education and the necessity of using equipment to protect from sudden death.

Other reasons

Causes, such as Kawasaki disease, are much less common cause of sudden death and account for about 6% of all cases. In 2% of athletes who died of sudden death due to exercise, no evidence of structural cardiac disease was found although heart was carefully examined in autopsies. It is suggested that some part of these cases are related to cocaine and ergogenic aids (Table 24).

Protection and Recommendations

Child and adolescent age group athletes should be reminded that recommendation and use of illegal ergogenic aids in order for increasing the performance may threaten their health. The use of these products should be banned on behalf of healthy sport, especially from these ages.

General Approach to Prevention of Sudden Death and Screening

The most effective method to prevent sudden death in children to do sports and exercise is pre-sports screen tests. Both the American and the Italian experience emphasize the importance of investigating the cardiac system and complaints, particularly after recording whether or not the individuals have a complaint. In addition, it is an unchanging approach in terms of diagnosis to make a physical examination involving assessment of all systems to be performed in a rigorous manner. However, there is no international consensus on what to do after these two important assessments. The American Heart Association does not accept any other method of screening other than history and physical examination. Despite this approach, some sports federations in the United States use ECG and echocardiography as part of routine examinations for athletes. Another important experience related to the subject is Italian data. Although the Italian approach routinely used echocardiographic evaluation in addition to ECG until the early 2000s, then they removed the echocardiographic evaluation from routine examination as they found this approach not cost-effective. In relation to the articles after Italian experience, the European Society of Cardiology published an important guide in relation to the subject in 2005. In addition to the history and physical examination, this guide suggested only routine ECG evaluation. Although there are not enough studies related to this topic in Turkey, there are some publications related to clinical proposals. In these publications, an evaluation flow chart is proposed in the pre-sport evaluation based on whether or not the physical activities to be done by children are competitive. According to these suggestions, an evaluation should be made in accordance with proposal of European Society of Cardiology for children not involved in competitive sports, while stress test and echocardiographic evaluation should be included for the group of competitive and symptomatic athletes. American Heart Academy (AHA) 2007 Recommendations:

1. Detailed personal and familial medical history
2. Physical examination is recommended to be structured so as to identify or suspect cardiovascular diseases that can cause sudden death especially.

3. American Heart Academy did not recommend the routine use of ECG because of concerns such as low prevalence of diseases, low sensitivity, high false positive rate, poor cost and concern about the need to evaluate the results by a competent person. This assumption was not considered pertinent by the European Society of Cardiology (ESC) and whether ECG is necessary for screening athletes is still contested.

Personal History Questions

1. Have you ever fainted or been about to faint during or after exercise?
2. Did you feel any discomfort, pain, tension and pressure in your chest during exercise?
3. Did you feel excessive fatigue, difficult breathing or shortness of breath during exercise (respiratory disorder)?
4. Did your doctor mention high blood pressure, high cholesterol?
5. Did your doctor mention that you have a murmur or other cardiac problem?

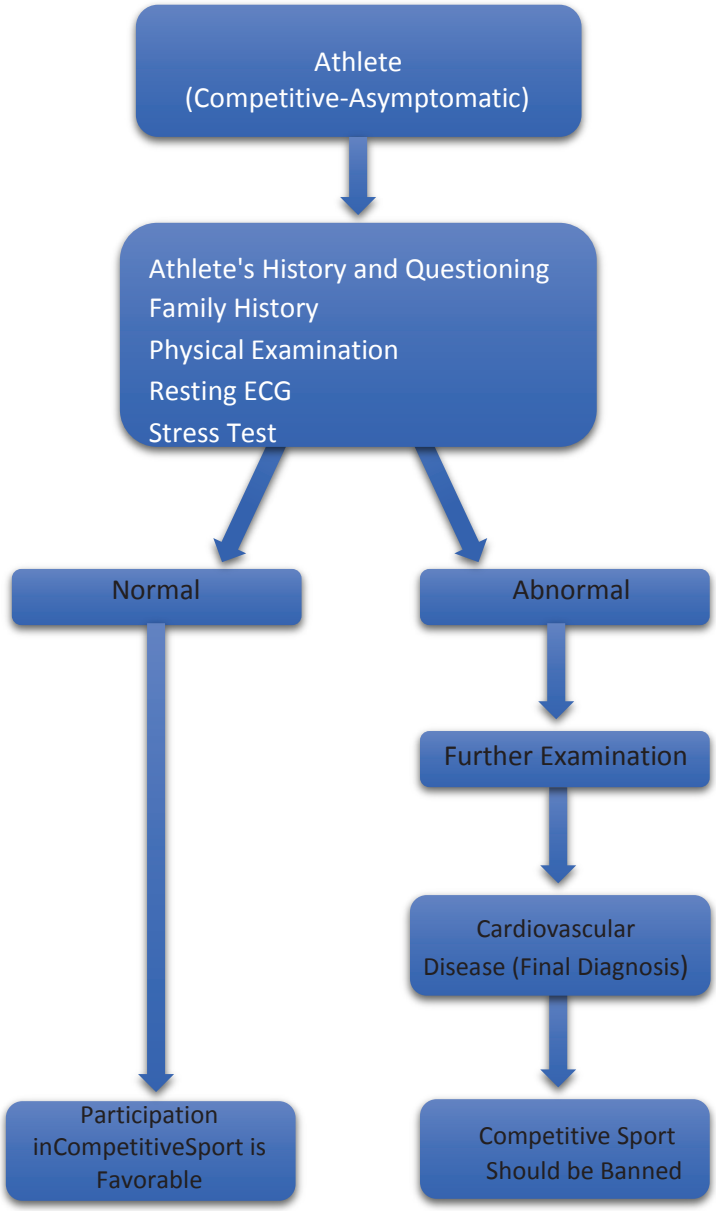
Family History Questions

1. Is there any person in your family having a history of unexpected or unexplained sudden deat under the age of 50, drowning, unexpected traffic accident or death due to cardiac problem c sudden infant death syndrome?
2. Do your close relatives have a disability due to cardiac disease under the age of 50?
3. Is there any person in your family having hypertrophic cardiomyopathy, Marfan syndrome, arrhythmogenic right ventricular dysplasia, long QT, short QT, Brugada syndrome or catecholaminergic polymorphic ventricular tachycardia, cardiac pacemaker or defibrillator?

Cardiovascular Physical Examination

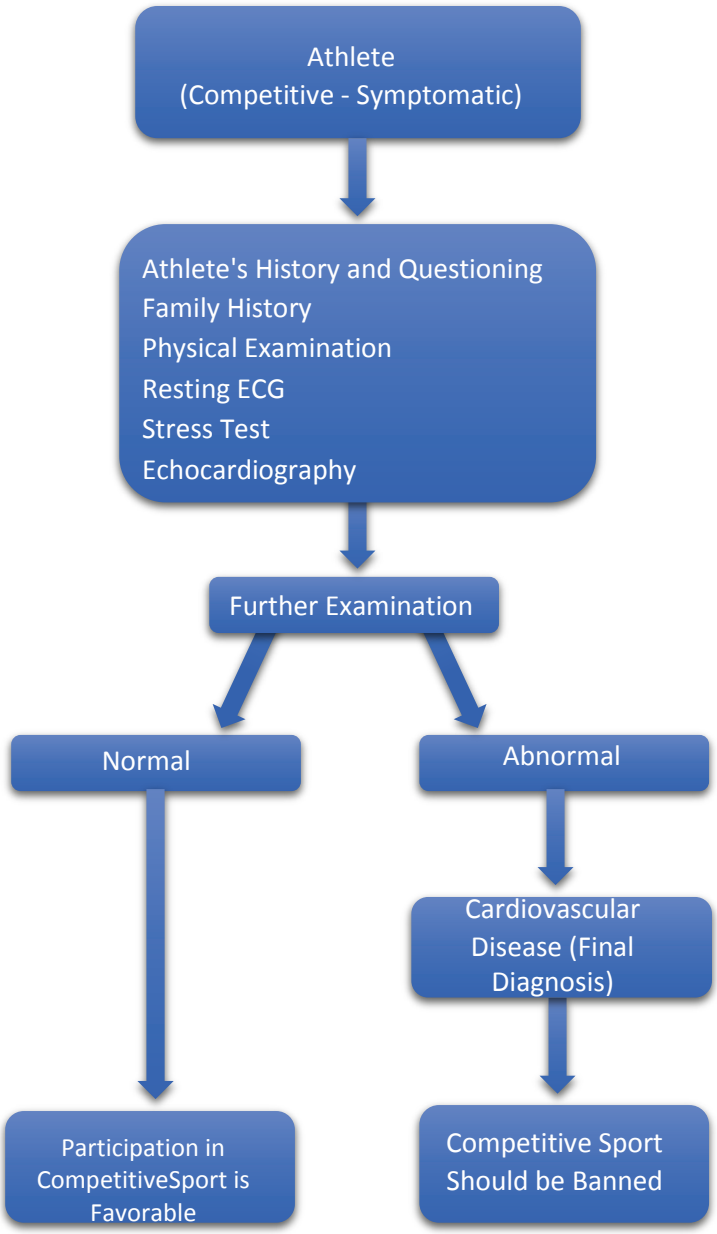
1. Dynamic auscultation (with both standing and in bed or with a Valsalva maneuver)
2. Radial and femoral pulse palpation to exclude aortic coarctation
3. Marfan physical stigmas; kyphoscoliosis, highly arched palate, pectus excavatum, arachnodactyly, total length of upper extremity longer than height, increased laxity in joints, myopia, mitral valve prolapses, aortic insufficiency
4. Bracial arterial blood pressure (sitting position)

Despite all these approaches, there is not yet a golden test or parameter other than the approaches already mentioned. For these reasons, especially those with symptoms and signs should be evaluated with advanced examination methods. The suggestion algorithm, previously published in terms of our Turkey's evaluation standards, is shown in Figures 29 and 30.



Source: Used with the permission of Anatolian Journal of Cardiology, from Anatolian Journal of Cardiology 2011; 11: 351-9.

Figure 29. Cardiovascular Risk Assessment for Competitive Athletes withoutCardiovascular Symptom



Source: Used with the permission of Anatolian Journal of Cardiology, from Anatolian Journal of Cardiology 2011; 11: 351-9.

Figure 30. Cardiovascular Risk Assessment for Athletes with Cardiovascular Symptom

Key Recommendations

- Health of every child and adolescent should be systematically assessed before starting sports and it should be periodically repeated.
- Children and adolescents who are or will be doing sports and exercises should be repeatedly instructed the rules that can avoid the health problems that may occur associated with sportive activities.
- The unquestionable use of protective garment and equipment conforming to the standards associated with sports and physical activity should be made obligatory.
- The complaints of individuals doing sports during and after the sports should be paid attention and evaluated.
- The places for competitive sports should be equipped with team and equipment that can respond to the sudden cardiac arrest and injuries that may occur during the competition.
- Automatic defibrillators should be available at appropriate places in the sporting areas and social areas outside, trainers and professionals should be able to use it.
- Children and adolescents engaged in sports should be warned that they should not use a substrate or substance other than natural and healthy nutritionand they should be prevented from using.
- Evaluations before sport should be made precisely and in accordance with guidelines, certificate of compliance with sports should be given after such evaluation.
- Before suggesting a sport to the individuals with a definitive diagnosis of cardiovascular problem, the diagnosis should be reviewed whether or not it poses a contraindication to the exercise.
- Exercises to be recommended for individuals with a definitive diagnosis of cardiovascular problems should be planned according to the individual's stage of disease pattern, level of functional capacity and if high risk factors are available.

REFERENCES

1. *Antzelevitch C, Burashnikov A, Mechanisms of Cardiac Arrhythmia, Electrical Diseases Of The Heart, Gussak I, Antzelevitch C, Volume I Second Edition, Springer London, 2013 s:93-128.*
2. *Asif IM, Rao AL, Drezner JA. Sudden cardiac death in young athletes: what is the role of screening? Curr Opin Cardiol. 2013; 28:55-62*
3. *Casa DJ, Guskiewicz MK, Anderson SA, et al. National Athletic Trainers' Association Position Statement: Preventing Sudden Death in Sports. J Athl Train 2012;47(1):96-118.*
4. *Corrado D, Pelliccia A, Bjornstad HH, et al. Cardiovascular preparticipation screening of young competitive athletes for prevention of sudden death: proposal for acommon European protocol. Consensus Statement of the Study Group of Sport Cardiology of the Working Group of Cardiac Rehabilitation and Exercise Physiology and the Working Group of Myocardial and Pericardial Diseases of the European Society of Cardiology. Eur Heart J 2005; 26: 516-24.*
5. *Corrado D, Migliore F, Bevilacque M, et al. Sudden cardiac death in athletes. Herz. 2009; 34:259-66*
6. *Kaşıkcıoğlu E. Sudden cardiac death during sportive activity. Ital J Pediatr 2006; 32: 8-11.*
7. *Kaşıkcıoğlu E. How could sudden cardiac deaths on the athleticfields be prevented? Anadolu Kardiyoloji Dergisi 2006; 6: 392-3.*
8. *Kasikcioglu E. Sporcularda kardiyovasküler nedenli ani ölümler. Klinik gelisim derg 2009;22:50-54*
9. *Kasikcioglu E. The incognita of the known: the athlete's heart syndrome. Anadolu Kardiyol Derg 2011; 11: 351-9.*
10. *Koester MC. A Review of Sudden Cardiac Death in Young Athletes and Strategies for Preparticipation Cardiovascular Screening. J Athl Train 2001;36(2):197-204.*
11. *Maron BJ, Pelliccia A. The heart of trained athletes: cardiacremodeling and risk of sports, including sudden death. Circulation 2006; 114: 1633-44.*
12. *Maron BJ, Thompson PD, Ackerman MJ, et al. Recommendations and considerations related to preparticipation screening for cardiovascular abnormalities in competitve athletes: 2007 update: a scientific statement from the American Heart Association Council on Nutrition. Physical Activity, and Metabolism: endorsed by the American College of Cardiology Foundation. Circulation. 2007; 115:1643-55*
13. *Maron BJ, Distinguishing hypertrophic cardiomyopathy from athlete's heart physiological remodelling: clinical significance, diagnostic strategies and implications for preparticipation screening. Br J Sports Med. 2009; 43:649-56*
14. *Özgür S, Karademir S, Sporcuların Kardiyak Açıdan Taranması, Cardiac Screening for Athletes, Arşiv kaynak tarama dergisi, 2013;22(4):575-590.*

Halk Sağlığı Genel Müdürlüğü
Sağlıklı Beslenme ve Hareketli Hayat
Daire Başkanlığı
Adnan Saygun Caddesi No:55 Sıhhiye,
Çankaya ANKARA

9 789755 907086