Ph.D. Thesis

THE EFFECT OF REGULAR PHYSICAL ACTIVITY ON HEALTH AND HEALTH BEHAVIOUR

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THE APPLICANT'S RELEVANT PUBLICATIONS

I **Bóka F.**: 5-12 éves utánpótlás korú labdarúgók képzése. Magyar Sporttudományi Szemle 2007;8(4):36-38.

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III **Bóka F.**, Nagymajtényi L., Paulik E.: A rendszeres testedzés hatása az aerob állóképességre. In: Tudomány a sportoló nemzetért. Konferenciasorozat 2007. Előadás kivonatok CD melléklete, Magyar Sporttudományi Társaság, 2007

IV **Bóka F.**, Nagymajtényi L., Paulik E.: Utánpótláskorú labdarúgók testi fejlettsége és kondicionális jellemzői. VI. Országos Sporttudományi Kongresszus I. (Szerk.: Bendiner N. és Bognár J.), Budapest, 2008. pp. 94-97.

V **Bóka F.**, Varga Á.: A női vízilabdázás helyzete Szegeden. Magyar Edző 2008;11(2): 31-33.

VI **Bóka, F.**, Nagymajtényi, L., Paulik, E.: Anthropometric characteristics and physical performance in young athletes in Hungary. Fiziologia – Physiology, 2008;18.3(59):8-11.

VII Paulik E., Nagymajtényi L., **Bóka F.**: Különböző fizikai aktivitású fiatalok egészségmagatartása és az egészségi állapot szubjektív megítélése. Egészségfejlesztés 2008;49(5-6):2-7.

VIII Paulik E., **Bóka F.**: Psychosomatic and psychological predictors of self-rated health in Hungarian men of various ages and levels of fitness. Central European Journal of Occupational and Environmental Medicine 2008;14(4):369-377.

IX Paulik E., **Bóka F.**, Kertész A., Balogh S., Nagymajtényi L.: Determinants of health-promoting lifestyle behaviour in the rural areas of Hungary. Health Promotion International 2010;25(3):277-288. doi:10.1093/heapro/daq025 IF: 1.544

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LIST OF CITABLE ABSTRACTS RELATED TO THE THESIS

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2. **Bóka F.**, Paulik E., Nagymajtényi L.: Különböző korú és edzettségű férfi egyének antropometriai sajátosságai. Magyar Higiénikusok Társasága XXXVI. Vándorgyűlése, Előadás összefoglalók, Siófok, 2006. p. 32.

3. **Bóka F.**, Nagymajtényi L., Paulik E.: A rendszeres testedzés hatása az aerob állóképességre. In: Tudomány a sportoló nemzetért. Konferenciasorozat 2007. Előadás kivonatok, Magyar Sporttudományi Társaság, 2007 p. 88.

4. Vágó A., **Bóka F.**, Paulik E.: A kondicionálás képzés eredményessége éllabdarúgók körében. In: Tudomány a sportoló nemzetért. Konferenciasorozat 2007. Előadás kivonatok, Magyar Sporttudományi Társaság, 2007 p. 88.

5. **Bóka F.**, Nagymajtényi L., Paulik E.: Utánpótlás korú labdarúgók testi fejlettsége és kondicionális jellemzői. Magyar Sporttudományi Szemle 2007;8(3):15.

6. Paulik E., **Bóka F.**: Psychosomatic and psychological predictors of self-rated health in Hungarian men of various ages and levels of fitness. 11th Regional Conference on Environment and Health. 15/16 May 2009 Szeged, Hungary Absztrakt CD-n

7. **Bóka F.**, Nagymajtényi L., Paulik E., Hocza Á.: Fiatal labdarúgók szomatikus fejlődése. Magyar Sporttudományi Szemle 2009;10(38):18.

List of abbreviations

ANOVA	analysis of variance
ATP	adenosine triphosphate
BF%	body fat percent
BMI	body mass index
CI	confidence interval
ECG	electrocardiogram
HBSC	Health Behaviours in School-aged Children
HDL	high density lipoprotein
HPB index	health promoting behaviour index
LDL	low density lipoprotein
OR	odds ratio
PE	physical education
SC	sport club
SPSS	Statistical Package for the Social Sciences
SRH	self-rated health
U17	under 17
VLDL	very low density lipoprotein
WHO	World Health Organization

CONTENTS

1 INTRODUCTION

The Constitution of the World Health Organization (WHO, 1946) defined health as ’a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity’, and ’the enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition’ [17].

The development of health and well-being largely depend on lifestyle, thus on physical activity, aerobic physical condition, proper diet, the optimal choice of rates of work, burdening, and relaxation, the amount of time devoted to entertainment, recreation and hobbies, physical and clothing hygiene, the system of interpersonal relationships and the emotions attached to them, hierarchic relationships, beliefs, ideology, and religion. To achieve all these factors, sport is a good tool or method, which not only contributes to the education of motion structure, but educates the individual to be persistent, self-caring, and to be able to make sacrifices. The aim of sport through personality and capability development, and transmission of culture is to educate people to live a healthy lifestyle and to maintain their health.

As a consequence of modern civilization people do very little physical exercise. Life is much more comfortable, there is more and more work done by machinery, and the rate of physical exercise is continuously decreasing in our everyday life. Sport helps us to spend our free time in a useful way, contributes to our health, physical development, or to maintain our physical condition. If somebody pursues a sport seriously, then physical exercise, sport might become a goal of life.

The culture of physical exercise is the level of that operable knowledge, familiarity, capability of exercise, game, sport, which is the indispensable part of culture. Exercises can be started during the infant age, of course at the beginning in the form of little motions by the help of the parents. Later exercises with music, toys, balls, dance moves can be practiced, which are popular among children.

There are a lot of families who visit the swimming pool frequently, thus they manage to obtain a great family experience. During these occasions the muscles of the children are developed, the environment grabs the attention of children, gets used to the outside world and to doing exercises, furthermore this also creates the fundamentals of his/her attitude towards doing sports, and exercises.

The three basic aims of physical education provided in schools are the following: shaping the physical and sports culture of children, their healthy physical development has to be prepared, and the development of socially valuable attributes has to be facilitated.

There are athletes and professional athletes in many families, therefore their results and lifestyle can serve as an example for other members of the family. Professional athletes tend to have greater temper, their main desire is victory, and to reach self fulfilment in sports. Their desire to prove themselves and their self-esteem gains significance throughout the competition. To enhance their performance, they are willing to make a lot of sacrifices.

Concerning another lifestyle factor, nutrition, unfavourable tendencies can be revealed already during childhood. It is regrettable that children prefer to consume unhealthy foods (chocolate, sugar, chewing gum, chips, snacks), which can have harmful effects on their health if they do not do sufficient amount of physical exercise. These harmful substances attack their digestive system, and increase the chance of obesity, prevent the future physical development or shift it to a negative direction. The children not only have to get acquainted with the positive elements of sports, but with the proper eating habits, and with spending their free time in a right way. Serving with examples can be very useful and effective among children. The parents, the educators, the coaches have a huge role and responsibility concerning the fact whether the child follows an active or inactive lifestyle. Children generally like playing sports games and doing exercises; the participation in sports provides them with happiness, joy, good mood, game, recreation, health, company, steadiness, and higher capability to concentrate.

Numerous studies have already demonstrated that there is correlation between proper health behaviour, physical activity, and health condition among different demographic groups. That is why physical activity has such a significant role in the prevention and treatment of obesity, since with little physical exercise an efficient diet cannot be developed and maintained [89]. Physical exercise also provides protection against the development of psychosomatic diseases, since frequent physical exercise maintains health, shapes and develops personality, enhances performance in mental and physical work [25].

Besides the behaviour influencing role of sports, one of the main issues of sports science researches is the examination of body sizes, body structures, body composition and physiological performance [57,93,95]. Generally the competitors in stamina oriented sports have lower body fat index, have greater muscle volume, and the aerobic and anaerobic performance is outstandingly high. The athletes of different sports can have different physical attributes. This can be influenced by natural selection, inherited attributes, and the effects of

training sessions. There are some sports which can be particularly described as sports-specific.

The determining factor concerning body composition in the category of children who do not pursue any sports basically, is lifestyle, therefore in this case the role of innate attributes can be almost utterly excluded [14]. The data of heart and circulation system indicate that the selective aspects tend to prevail to a higher extent, adaptive possibilities are more limited in certain category of sports, and part of these can be originated in constitutional indicators.

The examinations based on sport, physical attributes and lifestyle are quite limited. Generally the successful, adult athletes are being examined, and the rising generation is rather out of the scope. All these factors support the completion of this examination, and during this examination not only the physical and fitness attributes were surveyed, but certain background information was revealed in the form of questionnaires.

The aims of the study were to describe and analyse the correlation of health, health behaviour, anthropometric attributes, and physical performance of 10-25 year-old male population with various levels of physical activity; and to measure the efficiency of the applied training methods and approach among rising generation (10-13 years old) football players by the comparison of physical and fitness development of Tisza Volán SC football players born in 1995 and the same age group that does not pursue any sports.

Our working hypotheses were that

- there are differences in health behaviour depending on sport and physical activity;, the more active people live the healthier way of life;
- the objective and subjective consideration of health shows correlation with physical activity: people with more physical activity are healthier – this can be measured on the base of the psychosomatic symptoms during young age of the child;
- the highly active athletes' anthropometric characteristics and level of physical performance are related to their age, the kind of sport, and the training volume;
- the differences between football players and the control group that does not pursue sports show the effectiveness of training.

2 LITERATURE REVIEW

2.1 Health and health influencing factors

The scientists and even lay people have been taking interest in the matter of defining health and disease, but even today we cannot talk about a commonly accepted standardized concept.

According to Hippocrates the main condition of health is the harmony between the human body and soul and its environment, meanwhile disease is the state of disharmony [19]. The word 'health' itself refers to completeness, and to the person who is in good physical condition, and means the completeness, soundness, impeccability of the personality [63].

According to the naturalist definition of health, answering the question of what is a disease or what is considered healthy, is an empirical question; therefore it can be easily concluded: the body which adapts to its environment in a bad way is ill, and the one which adapts well is healthy. According to the normativist theory that something is a disease or not, is not a question of fact, but it depends on the value system of the society, and the modification in our value norms consequently changes our perception of disease [41].

The traditional medical – biomedical – view attaches almost exclusive significance to biological processes among the reason factors of disease. According to the psychosomatic approach, if the body and soul factors are in harmony with each other, then we are talking about the condition of health [19].

In the beginning the term „status of well-being" in the definition of WHO was considered a biological fact and was regarded equal with the lack of disease [17]. It is a brand new recognized point of view in health science that health is influenced by one's behaviour, thus preventive and health development factors gain significance in health preservation [100].

The subjective perception of health and disease controls and defines our health behaviour, habits of medical visits, therefore it has no less significance from this point of view, than the objective health condition [72]. The self-evaluation of health condition is influenced by numerous factors, still it has been proved that from self-evaluation the physical and mental condition can be concluded [77].

The determinants of health have a profound effect on the health of individuals, and communities [31]. According to the data published by the WHO chronic diseases are the major cause of death in almost all countries. The causes of the main chronic disease epidemics are well established and well known. These risk factors – unhealthy diet, physical

inactivity, tobacco use – explain the vast majority of chronic disease deaths at all ages, in men and women, and in all parts of the world [103].

2.2 Health behaviour, as an influencing factor of health

The health determining role of non-smoking, healthy diet, and regular physical activity has been proved by many domestic and international examinations [55,99]. The protective effect of steady diet or riskful effects of regular smoking are well known in chronic diseases. The lack of physical exercise as a risk factor also has an important role in the etiology of those diseases (e.g. cardiovascular diseases), which – mainly in developed countries – leads the death and disease statistics.

The unfavourable health status of the Hungarian population is well-described on the base of the mortality data [36]. The reasons for this fact are related to the unhealthy nutrition habits characterized by excessive intakes of energy, fat, animal fat, cholesterol, added sugar and salt, and insufficient consumption of vegetables, fruits and whole-meal cereal, smoking and to the lack of physical exercise [86,92]. The occurrence of unhealthy lifestyle factors were described not only in the adult, but also in the youth population in Hungary [64].

The behavioural factors influencing different health conditions turn up not only in an isolated form, but also in combination with each other. The relationship between physical activity and other lifestyle (unhealthy diet, smoking etc.) and demographic factors was stated in several studies [6,47,69,82,85].

The protective role of physical activity and diet factors prevails concerning osteoporosis [5]. Physical exercise also provides protection against the development of psychosomatic diseases, since regular physical exercise or sport activity maintains the condition of the body, shapes and develops personality, enhances performance in mental and physical activity [25]. Health oriented behaviour results in a better health condition not only in an objective but in a subjective way [23,38,66].

Increasing evidence was found to suggest that risk behaviours are interrelated and for many, combine to a lifestyle that may further increase health risks [96]. The assessment of healthy lifestyle behaviours has been analyzed in several epidemiological studies. In these surveys, lifestyle and its relation with the social and economic situation and the health status has been studied by indexes based on 3 to 5 lifestyle factors [24,37,39,44,50]. It has demonstrated that clustering of multiple healthy lifestyle habits is strongly associated with better health-related quality of life in diabetic adults [50]. Only 2.1% of men and 1.1% of women have met the criteria for healthy lifestyle (score 4) in full-time employees [37], while

in adult residents the prevalence of the healthy lifestyle index (including 4 behaviours) was 5.4% [44]. An extraordinarily low prevalence of healthy lifestyles (3.0%) has been found in the US adult population [82].

The most prevalent chronic diseases are linked by common risk factors such as smoking or unhealthy nutrition, underlying socioeconomic, cultural, political and environmental determinants and opportunities for intervention. These determinants influence health opportunities, health-seeking and lifestyle behaviours as well as onset, expression and outcome of disease [104].

2.3 The attributes of physical activity and its effect on health condition

2.3.1 The attributes of physical activity and toughness

Physical activity means some form of physical exercise, that can be professional, amateur, free time activity and recreational exercise.

Many forms of physical activity are known but from a physiological point of view five different physical exercises can be distinguished: isometric, isotonic, isokinetic, anaerobic, and aerobic [20]. Isometric physical exercise that results in traction, but locomotion is not involved. Isotonic physical exercise involves muscle contraction and joint motion (e.g. in a push up position arm bending and stretching). Programs based on such physical exercise develop muscle strenght and the endurance of muscles. Concerning isokinetic physical exercise the lifting requires physical effort and further effort is needed to get back into starting position. This form of physical exercise requires special equipment. This method is better from the point of view of the development muscle power and muscle endurance [20].

Aerobic physical exercise requires increased oxygen consumption, and heart beat during a relatively long period. Following anaerobic physical exercise the body does not require higher oxygen input. The exercises require short term physical effort (e.g. sprints) [20].

According to a generally accepted view, the 30 minute, medium intensity, great muscle pack usage, aerobic physical exercises have preventive and therapeutic effects. In order to realize benefits of aerobic exercises the exercises (running, swimming, cycling, skating, and ball games) need to be practiced at least 3 times a week with 10 minutes warm-up period and 5 minutes relaxation period [27].

However many examinations refer to the fact that the anaerobic component in the performance of children’s stamina gains much greater significance than it was assumed [57].

The anaerobic exercises are significant in professional sports. The above mentioned sports can be done in an anaerobic way, but the two forms of exercises differ in intensity, extent and in the execution of the exercise quality.

During physical exercise our body needs energy, which can be aerobic and anaerobic according to the type of energy source.

Throughout the metabolistic procedures the lipids, carbo-hydrates, proteins, nuclein-acids degrade, and the main direction of the procedure will be the glucolysis, during which pyruvic acid and ATP molecule are produced. The reactions are catalyzed by different enzymes. The reaction path of pyruvic acid can proceed in two reduction paths [91].

During an anaerobic alactacid process in case of 2-10 second exercise with maximal intensity the body utilizes ATP and creatin-phospate for the energy. Lactic acid is yet not developed due to the short duration of the exercise. Sudden starts, jumps, sprints and short fights belong to this category.

During anaerobic lactacid – 10-50/60 second duration with high intensity – exercise throughout the glycolysis the muscles gain energy from glycogen, and glucose. Lactic acid is developed; the longer physical exercise is prevented by acidosis, which is the increase in the pH rate of the blood. Sequential sprints, swim sprints in water polo, and longer fights belong to this category.

Numerous examinations prove that as a result of frequent physical exercise an increase takes place in the amount of ATP, creatine-phosphate and glycogen in the muscle. The cardiac chamber and even the weight of the heart are greater in case of those children who pursue sports, than those who do not [91].

According to Gyetvai et al. motoric and physical capabilities can be divided into two major categories as coordination and conditional capabilities [29]. The elements of coordination capabilities are speed coordination, stamina coordination, motion sensoring, dimensional orientation capability, balancing capability and rythym capability.

The three elements of conditional capabilities are strength, speed, and stamina. Strength (maximal strength, fast strength, relative strength, strength-stamina, reactive strength) is a vector quantity. Strength is the basic condition of every motion status-change. The muscle tissue uses chemical energy for contraction and develops mechanical energy. Speed (speed of reaction, speed of motion, acyclical motions, cyclical motions), speed stamina is that motoric capability that is realized during the effective and short execution of reaction, movement and motion. Stamina is determined by endurance and level of capacity. The general physical stamina, which is necessary for being fit, is best characterized by aerobic

capacity. In cyclical sports short (45 s-2 min), medium (2-9 min.) and long term (9 min-) stamina can be distinguished. According to energy providing processes aerobic and anaerobic stamina can be distinguished. Depending on the quantity of muscle bundles, we can talk about local (less than one-third of our muscles), regional (between one- and two-thirds of our muscles) and global (more than two-thirds of our muscles) muscles [91].

2.3.2 The effects of physical activity on health condition

The effects of physical activity with respect to potential health consequences are complex. The benefits do not come without some risk (*Figure 1*). On one hand increased physical activity is associated with a substantial reduction in the risk of chronic diseases in industrialized societies; on the other hand physical activity and exercise training are accompanied by certain risks [55].

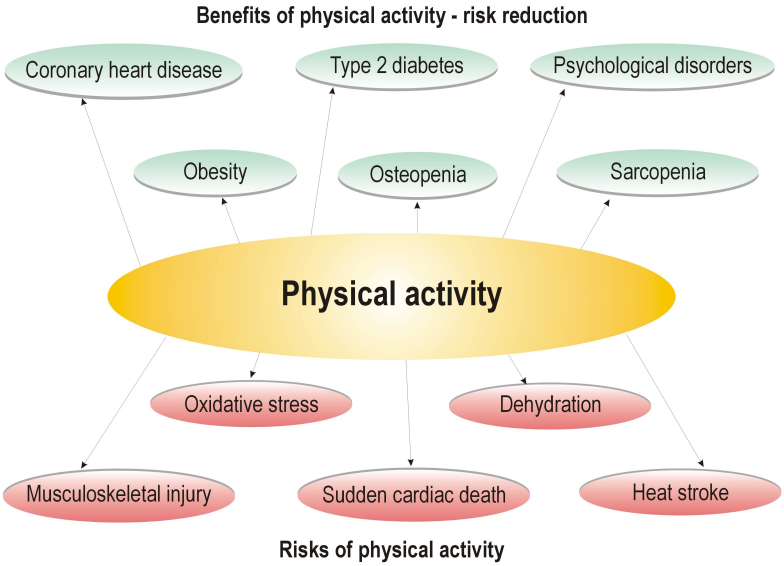

Figure 1. Benefits and risks of physical activity [55]

2.3.2.1 The relationship between physical activity and chronic non-infectious diseases

Despite the well-known positive effects of physical activity recently one of the most important risk factors of lifestyle is inactivity. Currently only the 22% of the American population does physical exercise regularly, 54% occasionally, meanwhile 24% can be considered inactive concerning cardiovascular prevention. In Hungary according to a survey from 2003 21% of the male and 13% of the female population does physical exercise regularly. The average daily physical exercise is 8-10 minutes in Hungary [27,67].

The positive effect of physical activity to health and well-being is well known, in spite of this in the civilized world inactivity, the increased amount of sitting are those major risk

factors of chronic diseases (cardiovascular diseases, type 2 diabetes mellitus, osteoporosis etc.) which occur frequently in the population [88]. Physical activity reduces high blood pressure, body weight, fat content, LDL cholesterol, VLDL cholesterol, platelet aggregation, etc. It is internationally admitted that there is a positive relationship between the so called protective cholesterol, or HDL cholesterol and physical activity. Higher HDL cholesterol level and thus the developed cholesterol transport protects the body from arteriosclerosis and the emergence of cardiovascular complications [80]. According to the accumulated information on the relationship between physical exercise and immune competence, physical activity modifies the distribution, and movement of periferic mononuclear cells, meanwhile through increasing natural immunity, enhances the protectiveness of the immune system [84].

Recreational and professional sports can have preventive effects concerning the emergence of many diseases and can increase the average age of population. Physical fittness improves mental condition, psychological resistence and physical endurance [43].

Positive relationships were found between status of physical fitness and self-rated health (SRH) among population subgroups divided by age, gender, income, and educational attainments; the level of fitness was significantly related to a better SRH in multivariate analysis [1]. Physical training level has also been shown to be closely associated with mortality and functional limitation in both middle aged and older people [33,58]. Among middle-aged male employees and in elderly population physical activity was a considerable predictor of SRH [66,71]. In epidemiological studies, SRH is generally used as a valid measure of health status. It is able to measure not only psychological well-being but also overall health [62]. In addition, it significantly foretells functional limitations [34,48,66].

Due to the lack of major physical illness, adolescents tend to use psychosocial health variables, e.g. psychological well-being or health behaviours, as a frame of reference for health perceptions. Most young people are free of serious diseases, nevertheless they experience and report considerable subjective health complaints that may have an influence on their health sensations [22,79].

2.3.2.2 The effect of physical activity on body composition

Body mass index (BMI) means the proportion of the components, and tissues. As a result the amount, and weight of the muscles, bones, fat, organs can be separated, and measured, furthermore the relative proportion of body parts can be determined compared to body weight.

The relative muscle and fat weight, body mass structure and age determine the individual's body weight expressed in kilograms. Based on these data the strengthening of the individual and the economical aspect of the strengthening can be determined. Too much muscle can reduce speed, too much fat reduces performance.

BMI is a good method for assessing nutritional status when compared with body fat percentage by whole-body bioimpedance as the reference method. Although skinfold thickness and leg-to-leg bioimpedance give similar results, the BMI is more proposed because this method is easier to use and reliable. There are circumstances in which bioimpedance measurements are useful. For example, patients who have been selected for lung transplantation often follow an extensive nutrition and training program to maximize their lean body mass. Repeated bioimpedance measurements can be used to monitor their body composition, but also to motivate the patients during this period [98].

In the complex biological process called growth, the alteration of body composition is an important feature [76]. Numerous studies were accomplished about effects of usual physical activity on fitness and anthropometric parameters in subjects of various age, physical activity, nutritional state etc. [21,45,46,60].

The relationship between physical activity and changes in body composition in children was described by Stevens et al. [90]. In a German study, made on persons aged between 17 and 26, body weight increased and fitness decreased in non-obese young adults [49]. Rowlands et al. have found a positive relationship between activity and fitness, and a negative relationship between fatness and activity [87].

Anthropometric studies on athletes engaged in various sports indicated a relationship between body composition and the type of sport. Body composition has a significant effect on athletic performance and, conversely, exercise has the potential to alter body composition [83], so that the evaluation of body composition in connection with exercise and sport has emerged as an important field of interest [2,35,51,53,54,81,94,98,102].

2.3.2.3 The negative effects of physical activity

The most prevalent complications are musculoskeletal in nature. A risk of injury is determined by a history of previous injury, as well as intensity, duration and frequency of exercise. The general principle that the volume of physical activity should be increased gradually over time is widely regarded as critical for reducing injury risk [55].

During prolonged performance, a significant amount of body water is lost via sweating. The fluid loss results in decreased circulatory blood volume, blood pressure and

sweat production. The dehydration predisposes physically active persons to heat exhaustion or to even more dangerous heat stroke [55].

Sport activity is not in itself the cause of enhanced mortality, but it triggers cardiac arrest in those physically active persons who already have inherited cardiovascular abnormalities [55].

Increased energy demand during physical activity imposes an increase in oxygen supply to active tissues. Vigorous physical activity may thus induce a state in which the antioxidant defenses of several tissues are overwhelmed by excessive production of reactive oxygen species [55].

The major contibutor to exercise-induced medical complications is the intensity of the exercise. Once the intensity and amount of exercise performed is increased, the risk for injury will indisputably be elevated [55].

Examining students of Harvard University born between 1860 and 1916 showed that the lifespan of that 275 „B" team was longer, than the 177 „A" team, and the 1638 students who did not pursue any sports [91].

The negative effects of sports are moderate compared to the potential benefits, it is obvious that these effects have to be faced, but as a whole the added value of sports need to be emphasized.

2.4 The effect of regular physical activity on the physiological characteristics of the youth

Recently the amount of children's regular and intensive physical activity obviously lags behind the requirements based on biological development.

The fall in the number of sport facilities, sports associations, sports schools, and sports classes results in significantly less children and adolescents who pursue sports. This indicates the expected sports activity of the adult population.

Development is an indicative procedure, with starting and ending point, in which the development procedure can be divided into separated phases. At age 11-12 the physical development of children is even, the movements are stronger and more structured. The physical abilities develop further, physical status is getting better and coordination abilities develop, this deviation compared to the children with average activity can be significant [42]. The development of physical abilities for experts working with adolescents requires just as thorough planning as the technical-tactical preparation. The development of physical abilities is age group specific.

Well developed bone structure, stability of the bones, and slow growing tendency is typical of this male age group (10-12 years). The growth intensity of the bones is not the same, at age 7-11 the vertical growth can be observed, meanwhile at post teen age rather the cross-section of the bones grow [56]. The growth phase can take place in a variety of extents in case of children, and strongly influences the coordinational abilities. In case of sudden growth the movements get destructured, get slower; later with the strengthening of the muscles the motion structure becomes synchronized again. Based on the type of sport, athletes with different height can find their place in the team with the help of the coach.

The share of the muscle system in the body mass is higher, than the children with the same age who are not pursuing any sports. The further increase of the muscles cannot be achieved or just in a minimal way in this age, since hormone system sets limitations to it. The structural and functional attributes of development are determined by dehidro-epiandrosteron level of plasma produced by the adrenal cortex, which in case of girls in this period, this level is twice as high as the boys' [56]. At age 12 the weight of the muscles is only 25-30% of the whole body weight, and the absolute strength of the girls is similar to the boys [59]

The development and capacity of the nervous system is still big, but it already does not reach the capacity of the 0-6 age group [32]. The development of coordinational abilities reaches the 90% level at teen age [52].

In this age group (10-12) it is already proven concerning aerobic and anaerobic performance that the boys can reach higher intensity and extent than the girls. The aerobic capacity of the boys improves evenly from school age until adult age [30]. The anaerobic capacity, which can be characterized by the fall of blood pH, or by the maximal level of lactic acid, is smaller in this age than in teen age or in adult age. Anaerobic performance can be better developed in these ages, than aerobic performance [56]. General stamina, physical fitness are best characterized by aerobic capacity; some observations however indicate, that in the stamina performance of children the anaerobic component has higher significance than it was earlier assumed [26].

2.5 The attributes of different sports

Sport specificity is highly typical of some sports (football, water polo, kayak-canoe). Natural selection, inherited attributes and consequences of training effects gain role. The amount of muscles to be put on until young adult age is with high probability genetically controlled and is in relationship with the bearing capacity of the developing bone system.

There is a positive fat accumulating tendency in case of athletes around the age of 12, which is the beginning of sexual maturing. The peak of the negative phase is around the age of 13-14 and intercepts with the intensive growth of limb and body size. The least fat tissues can be found in the body of kayak-canoeists. In those sports where the fat percentage of the athletes significantly exceeds the average, the subcutaneous fat is mainly concentrated around the rump (handball, water polo).

According to the survey of Sziva et al. during treadmill exercise from 11 sports, behind the fencers and wrestlers the worst performance on average was carried out by handball players [93]. The best performance was shown by kayak-canoe athletes after penthatlon athletes and athletes. Examining the average of maximum pulse the third best result was provided by kayak-canoeists, and the worst by handball players.

According to the survey of Mészáros kayak-canoeists have the highest relative bone mass and relative muscle mass; water polo players have the highest relative fat mass [57]. A research from 2003 concluded that the bone mass of water polo players is smaller than average athletes [70]. The upper arm bone of kayak-canoeists is wider than the standard value.

Good football players prove to be average concerning their stamina in aerobic capacity, muscle hypertrophy and muscle enzyme activity. They have to demonstrate very good performance in the sequential sprints (high, repeated speed stamina is necessary) and obviously they need to handle the ball well. They do not need outstandingly high lactacid capacity, but their alactacid anaerobic capacity is great in those exercises where the lower limbs are used [3].

Water polo is a popular and highly demanding sport [10]. Despite this fact, very few studies have been published concerning the physical and physiological attributes required to achieve world-class performance. An analysis of the physical characteristics of water polo players provided information about body size and body composition indicators [98]. However, the development of a comprehensive battery of tests that would include both anthropometric and physiological measurements would offer a more integrated profile of the elite water polo player.

According to domestic examinations: water-polo players have significantly less relative bone and muscle mass and fat content is higher. Both attributes are favourable concerning body density. Higher fat content has an important role in temperature control as well [57].

3 MATERIALS AND METHODS

3.1 Study design and participants

The cross sectional analysis, including questionnaire based surveys, anthropometric and physical fitness measures, was taken in 2006 among 10-25 year old male population with various levels of physical activity. In 2008, part of the examined sample (10-13 years old football players and their control group) the anthropometric and physical fitness have been measured again (follow up).

Age, physical activity, sports have been taken into consideration during the selection of participants. The selection of those participants, who do not pursue any sports, was done randomly from four elementary and four secondary schools, and from the students of University of Szeged, who besides physical education (PE) classes did not do any frequent physical exercise. Those people were selected to the recreational group who besides PE classes did some physical exercise in school, or in two fitness gyms in Szeged. The athletes were selected from the most promising registered players of the given age group in sport clubs of Szeged, and included several age group representative players, as well as European/World Championship and Olympic Game winners among the adults.

342 people participated in the survey: 64 participants who do not pursue any sports, 65 participants doing recreational activity and 213 participants who are professional athletes. The deviation from the original sample number during the presentation of the results derived from the fact that in the professional athlete category 12 of the questionnaires in the survey have been filled out deficiently, therefore from this part of the examination they were excluded, which resulted in the fact that the group of athletes had 201 members, and the total sample consisted of 330 members (96.5% of the original sample). But in the examination concerning anthropometric and toughness data among professional athletes, these 12 members also took part (n=213).

In the follow up examination (2006 and 2008) of rising generation football players the most promising players (16 people) were deliberately selected, meanwhile during the cross sectional analysis in 2006 among elementary school kids who do not pursue any sports, the selection was random.

3.2 Measurements

3.2.1 Questionnaire

The questionnaire based survey among the examined population dealt with the following subjects: personal attributes, sport habits, sport habits of parents, friends, other lifestyle factors (smoking, alcohol consumption, drugs, nutrition), habits concerning doctor's appointments, health condition (known chronic diseases, the subjective consideration of health, etc.).

The personal attributes wanted to reveal the interviewee's age, residence and parents' education level. The attributes of physical activity meant to reveal the sport activity of parents, friends, and the importance of doing exercise as well.

Among health damaging behaviours the habits of smoking, consuming drug and alcohol were measured. According to their self-reported smoking activity the subjects were divided into three groups as current smokers (daily and occasionally smoking), former smokers and never smokers. Concerning alcohol consumption, the life prevalence and the current alcohol consumption were examined, like frequency of alcohol consumption, the amount and type of occasionally consumed alcohol. Concerning drugs, the life prevalence of trying a drug and the type of the consumed drug were measured.

Concerning nutrition and eating habits, the frequency of eating, the frequency of consuming particular foods in the month preceding the examination, the consumption of liquid, vitamins, and food supplements were examined. Food intake was collected from all participants using a self-reported food frequency questionnaire consisted of 16 issues about the past month consumption of foods such as fruits and vegetables, snacks, sweets, etc. Response options were 'never', '1-3 times per month', '1-3 times per week', '4-7 times per week' and 'more than once a day'. The food frequency questionnaire was developed on the basis of the Hungarian nutritional guides [86], and the questionnaire used in the HBSC (Health Behaviours in School-aged Children) study [65]. In the evaluation altogether 11 questions were taken into consideration; the answers regarded as healthy were mineral water, milk and milk products, raw vegetable or salad, cooked vegetable, fresh fruit consuming more than once a day; fresh fruit juice, brown bread, consuming '4-7 times per week' or 'more than once a day'; poultry or fish having '1-3 times per week', '4-7 times per week' or more than once a day; sweets or/and chocolates, chips and/or snacks, preserved foods (e.g. packet soup) eating 'never' or '1-3 times per month'. In the data processing, the healthy habits were scored as "1", while the other answers regarded as unhealthy were scored as "0". These positive

dietary factors were summarized in a healthy eating score number, the range was 0-11 points; higher scores meant healthier eating habits [9].

The aggregate analysis of health factors – smoking, physical activity, nutrition – was based on the adaptation of health promoting behaviour (HPB) index [73], taking into consideration the following:

- Regarding cigarette smoking subjects were subdivided into two groups as non-smokers (including never smokers and ex-smokers) and current smokers.
- The recreational athletes and the professional athletes were considered to be physically active.
- Nutritional habits were evaluated on the basis of the above mentioned 11 questions about the frequency of various foods [9]; the top and bottom half of the score range was dichotomized into healthy and unhealthy diet on the base of the median value.

The HPB index was developed by summing the total number of positive activities – not smoking, healthy nutrition, physical activity – for each respondent; and the range was 0-3 points. Higher scores meant healthier lifestyle, and the score of 3 points was regarded as "healthy behaviour" [73]. The occurrence of the highest score (3 points) of HPB index comparing with the scores of less than 3 points were analysed by socio-demographic parameters (age of the respondents, parents' education level).

The participation in health service (general examination, heart examination, dental exam, etc.) was checked regarding the year preceding the examination.

Concerning health status chronic diseases were detected on the basis of the question "Are you suffering from any chronic disease?", answered by "yes" or "no", and if "yes" the disease had to be specified.

SRH was measured using the following question: "How would you rate your general health status?" with reply alternatives from one to five (very poor, poor, fair/acceptable, good, and very good). It was stated in several epidemiological studies that SRH can be used as a valid measure of health status both in adult and young populations [40,77].

The psychosomatic symptom scale included the following self-reported symptoms: headache, sleeping disorders, diarrhoea or vomiting, low-back pain, weakness, and pain in the joints. The measurement of the general psychological well-being of the respondents was based on their feelings (fatigue, nervousness, anxiety, peacefulness, happiness, energetic state) during the past 12 months [78]. The frequency of the symptoms and feelings during the last 12 months was reported. Responses were coded as nearly always (4), often (3), sometimes (2), seldom (1), and never (0), and nearly always (0), often (1), sometimes (2),

seldom (3), and never (4) in case of peacefulness, happiness and energetic state. The evaluation was based on the mean of the total scores and on the mean scores referred to each symptom.

3.2.2 Anthropometric and physical fitness measures

The anthropometric parameters and physical fitness were measured under standardized conditions in the fitness gym in Szeged, always on Sunday afternoon, at least 2 hours after the last meal.

The anthropometric measurements included body mass, body height, body fat percent (BF%), upper arm girth and shoulder width. Body mass was measured to the nearest 0.5 kg, and body height to the nearest 0.5 cm; with the subjects wearing gym shorts and T-shirts and no shoes. BMI was calculated from body mass and body height, and expressed in kg/m^2. BMI was grouped into four categories – underweight, normal weight, overweight and obese – according to the recommendation of the WHO among people aged 18 and over [101], and the Hungarian recommendation among younger ones [68]. BF% was determined by bioimpedance analyser; classes of BF% were set up, depending on age, as recommended in the manual of the instrument. Upper arm girth was measured at the mid-point of the arm; and shoulder width, between the two acromia.

Physical performance/fitness was determined by two simple sport tests: Cooper's 12 minute run test – run length in meters – was used for aerobic capacity [15,18], while anaerobic capacity was measured by the Burpee test performed in two minutes. The Burpee test involves the following practices: standing erect, arms by the side; placing the hands on the floor in front of the feet (squat position); thrusting the legs back to assume a push up position; squat position; returning to the starting position. In order to measure anaerobic capacity lying weight lifting exercises were involved (the push up of maximal weight once), and the calculated relative power was applied to assist the measuring, and sit ups were involved as well (4 minutes). The duration of the tests were determined in order to get a more credible picture about the differences between the groups. During the evaluation the study of Tompa was used which is the "Manual for measuring and qualifying the physical condition of students" [97].

Training volume was characterized by the weekly average time (frequency and length of training sessions).

3.3 Statistical analysis

The data were processed by the Statistical Package for the Social Sciences (SPSS), version 13.0. In all tests, $p<0.05$ was considered as statistically significant.

3.3.1 Evaluation of lifestyle characteristics and health status

Univariate analyses were done by chi-square test and one-way ANOVA (analysis of variance) followed by post hoc Scheffe test. Multiple logistic regression model with a forward stepwise procedure was performed in order to identify the factors associated with the occurrence of health promoting behaviour; odds ratios (OR) and 95% confidence intervals (95% CI) were calculated for each variable.

The association between the SRH and the frequency of symptoms was analysed on the basis of the Pearson's correlation coefficients. Forward multiple linear regression models were used to study the simultaneous relation between SRH as dependent variable, and age, chronic diseases, psychosomatic symptoms, and psychological well-being parameters as independent variables separately in the three groups of different level of physical training [75].

3.3.2 Anthropometric and physical performance measures

For each age group and sport, mean and standard deviation of the anthropometric and performance characteristics was calculated. Comparison of the means by age groups and sports was done by non-parametric Kruskal-Wallis test, because the Levene's test was significant. Spearman's rho correlations were used to determine the degree of association among selected variables.

Comparisons of anthropometric and physical performance measures of young athletes were done by one-way ANOVA. One-sample t-test was used to measure the changes between 2006 and 2008.

3.4 Ethical permission

The study protocol was approved by the Human Investigation Review Board of the Albert Szent-Györgyi Medical and Pharmaceutical Centre, University of Szeged (No. 11/2006). Informed written consent was obtained from the study population; in the group which was under 18 years old, permission was asked from the parents, too.

4 RESULTS

4.1 Characteristics of respondents

The main characteristics of the examined population are summarized in *Table 1*. Men of 10 to 25 years of age (n=330) were involved in the study. Of these, 98 (29.7%) were 10-13 years old, 104 (31.5%) were 14-17, and 128 (38.9%) were 18-25 years old. According to the level of their physical activity 64 (19.4%) were slightly (inactive), 65 (19.7%) were moderately active (recreational), and 201 (60.9%) represented the highly active (professional) athletes including football players, water poloists, kayak-canoeists, and handball players.

Table 1 Basic characteristics of the studied population

Physical activity/sport	Age groups						Total	
	10-13 years		14-17 years		18-25 years			
	n	%	n	%	n	%	n	%
Inactive	18	28.1	18	28.1	28	43.8	64	100.0
Moderately active	17	26.2	19	29.2	29	44.6	65	100.0
Highly active	63	31.3	67	33.3	71	35.3	201	100.0
Football players	15	30.0	17	34.0	18	36.0	50	100.0
Water poloists	15	31.3	13	27.1	20	41.7	48	100.0
Kayak-canoeists	17	34.0	19	38.0	14	28.0	50	100.0
Handball players	16	30.2	18	34.0	19	35.8	53	100.0
Total	98	29.7	104	31.5	128	38.8	330	100.0

4.2 The characteristics and correlations of health behaviour and health status

4.2.1 The characteristics of health behaviour – physical activity

The tendencies of educational level of parents are shown in *Table 2*, which indicate that there is significant difference in the educational level of mothers: in case of highly active athletes the education level of mothers was significantly higher; in case of fathers this correlation could not be observable.

The importance of sports did not show any difference concerning age groups (*Table 3*). According to physical activity 80% of highly active athletes consider that regular physical activity is important, 41% of recreational athletes hold the same opinion, 30% of the people who do not pursue any sports share this view.

The social environment – the sport activity of parents and friends – has shown significant difference in case of people with different physical activity (*Table 3*). 43% of the athletes had parents who were both athletes, 40% of the recreational athletes, and 54% of inactive people had parents who never did sports. Most part of athletes (97%) had friends who

did sports; this number was 89% in case of recreational athletes, while 70% of inactives had friends who did sports.

Table 2 The distribution of people with various levels of physical activity by the parents' education level

Characteristics	Physical activity						Total	
	Inactive		Moderately active		Highly active			
	n	%	n	%	n	%	n	%
Mothers' education level[a]								
Elementary school	2	3.3	4	6.5	3	1.5	9	2.8
Vocational school	16	26.2	6	9.7	16	8.1	38	11.8
Secondary school	24	39.3	26	41.9	86	43.4	136	42.4
College, university	19	31.1	26	41.9	93	47.0	138	43.0
Fathers' education level[b]								
Elementary school	2	3.4	0	0.0	5	2.5	7	2.2
Vocational school	20	33.9	15	24.2	38	19.3	73	23.0
Secondary school	19	32.2	17	27.4	80	40.6	116	36.5
College, university	18	30.5	30	48.4	74	37.6	122	38.4

[a]Chi-square test: *p=0.002*; [b]Chi-square test: *p=0.079*

Table 3 The importance of physical activity and sports habits of parents/friends according to age groups and physical activity

Characteristics	Age groups						Total	
	10-13 years		14-17 years		18-25 years			
	n	%	n	%	n	%	n	%
Importance of regular physical activity – very important	66	67.3	64	61.5	80	62.5	210	63.6
Professional athlete parent(s)								
Both of the parents	35	35.7	38	36.5	37	29.1	110	33.4
Father	26	26.5	31	29.8	45	35.4	102	31.0
Mother	14	14.3	9	8.7	5	3.9	28	8.5
Neither of the parents	23	23.5	26	25.0	40	31.5	89	27.1
Having professional athlete friends	84	86.6	95	93.1	118	92.2	297	90.8

Characteristics	Physical activity						Total	
	Inactive		Moderately active		Highly active			
	n	%	n	%	n	%	n	%
Importance of regular physical activity – very important[a]	19	29.7	27	41.5	164	81.6	210	63.6
Professional athlete parent(s)[a]								
Both of the parents	6	9.5	18	27.7	86	42.8	110	33.4
Father	17	27.0	19	29.2	66	32.8	102	31.0
Mother	6	9.5	4	6.2	18	9.0	28	8.5
Neither of the parents	34	54.0	24	36.9	31	15.4	89	27.1
Having professional athlete friends[a]	45	71.4	57	89.1	195	97.5	297	90.8

[a]Chi-square test: *p<0.001*

4.2.2 The characteristics of health behaviour – smoking, alcohol and drug consumption

12.4% of the interviewees (41 persons) claimed themselves regular or occasional smokers, 4.5% (15 persons) used to smoke. According to physical activity the frequency of smoking was significantly higher in case of the group of people who do not pursue sports (20.4%) comparing with moderately (15.4%) and highly active (9.0%) persons [74].

Two-thirds of the youth (221 persons) have already consumed alcohol, 10.5% (34 persons) have already tried some form of drugs. It can be concluded from the examination of alcohol consumption broken down by age groups that 20% of 10-13 year old children have already consumed alcohol, and until the age of seventeen 75% of them consumed alcohol. Athletes were asked how regularly they consumed alcohol and 42% of them replied that they have never consumed alcohol. The life-prevalence of alcohol and drug consumption was significantly less in the group of professional athletes (*Figure 2*). The proportion of drug triers was the highest in the group of recreational athletes. Drug consumption mainly meant trying out marijuana [74].

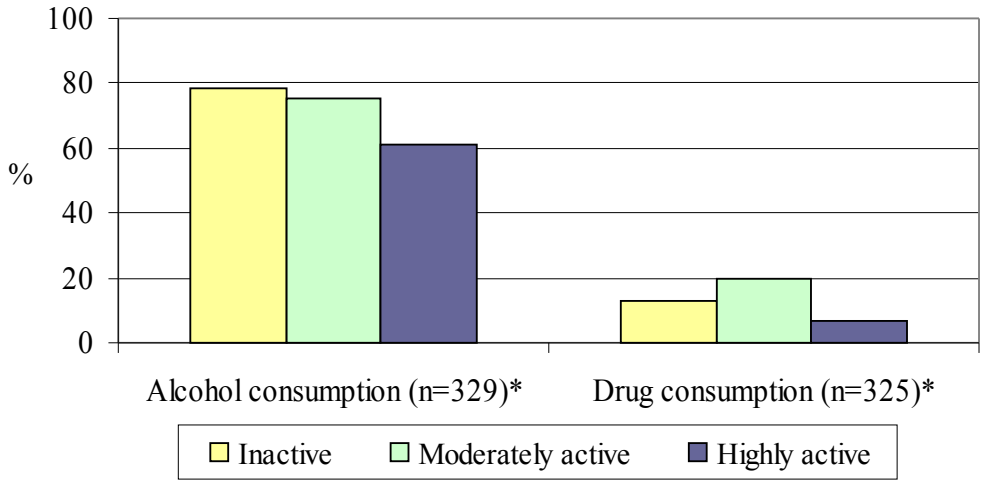

Figure 2 The life-prevalence of alcohol and drug consumption of the youth with various levels of physical activity (*Chi-square test: $p<0.05$)

4.2.3. Characteristics of health behaviour – nutritional habits

Figure 3 shows the main the characteristics of diet. Regarding the frequency of healthy eating items more than two third of the interviewed people stated that they have healthy eating habits considering consumption of poultry, fish or preserved food [9].

Examining the relationship between the consumption of some selected foods and demographic, behaviour or health related variables, the correlation with age, physical activity and smoking habits were shown to be significant according to the chi-square tests (*Table 4*).

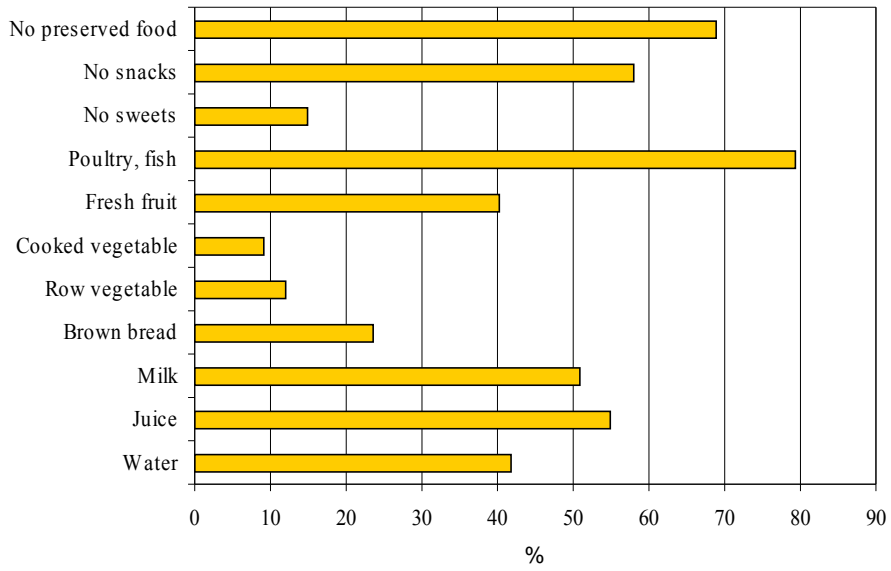

Figure 3 The frequency of healthy eating items in the studied population [9]

Generally, diet of young adults (aged 18-25) was proven to be worse in dependence of age; the frequency of milk, vegetable and fruit consumption of 18-25 years old was significantly lower comparing with younger groups, while mineral water consumption was lower in children aged 10-13 years (*Table 4*). On the base of physical activity, handball players and those of slight or moderate activity had worse results regarding the consumption of mineral water, juice ($p<0.01$), milk, brown bread, vegetables, fruits, poultry ($p<0.05$) and snacks ($p<0.05$), while better results were found in case of kayak-canoeists and in football players. In respect of smoking habits former smokers and non smokers ate notably healthier than current smokers, significant differences were found in case of milk and snack consumption. There was no significant relation found between diet and characteristics of state of health (BMI, SRH).

On the base of the distribution of healthy eating scores in the total population it can be stated that there was no person who had 0 or 11 scores, the median value was five [9]. Studying the relationship between the means of healthy eating scores and age, physical activity, smoking habits, BMI or SRH, the correlation with the first three of these factors were shown to be significant according to the one-way ANOVA tests (*Table 5*). Young adults (aged 18-25), those of slight physical activity besides handball players, and current smokers had the lowest mean of healthy eating scores (*Table 5*). The highest means were found in case of kayak-canoeists and former smokers. There was no correlation between diet and health variables [9].

Table 4 Consumption of some selected foods (%) in relation to demographic, lifestyle and health variables [9]

Characteristics	Mineral water[1]	Juice[2]	Milk[1]	Brown bread[2]	Row vege-table[1]	Cooked vege-table[1]	Fresh fruit[1]	Poultry, fish[3]	Sweets[4]	Snacks[4]	Pre-served food[4]
Total (n=330)	41.8	54.8	50.9	10.0	12.1	9.1	40.3	79.4	14.8	57.9	68.8
Age group	*	*n.s.*	**	*n.s.*	**	*	***	*n.s.*	*n.s.*	*n.s.*	*n.s.*
10-13 years	31.6	56.1	64.3	12.2	13.3	13.3	57.1	75.5	13.3	59.2	71.4
14-17 years	45.2	61.5	52.9	11.5	20.2	11.5	50.0	77.9	15.4	57.7	61.5
18-25 years	46.9	48.4	39.1	7.0	4.7	3.9	19.5	83.6	15.6	57.0	72.7
Physical activity	*n.s.*	**	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*	*n.s.*	*	*n.s.*
Inactive	39.1	39.1	39.1	9.4	12.5	9.4	39.1	71.9	20.3	43.8	67.2
Moderately active	40.0	50.8	53.8	9.2	7.7	6.2	43.1	72.3	21.5	60.0	63.1
Highly active											
Football players	42.0	74.0	62.0	12.0	16.0	14.0	48.0	74.0	8.0	58.0	76.0
Water poloists	45.8	66.7	56.3	10.4	12.5	12.5	37.5	85.4	10.4	58.3	70.8
Kayak-canoeists	46.0	62.0	58.0	18.0	16.0	14.0	46.0	92.0	8.0	74.0	76.0
Handball players	39.6	43.4	39.6	1.9	9.4	0.0	28.3	84.9	17.0	56.6	62.3
Smoking status	*n.s.*	*n.s.*	*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*	*n.s.*
Current smokers	39.0	51.2	31.7	9.8	9.8	9.8	24.4	80.5	12.2	39.0	70.7
Former smokers	60.0	46.7	60.0	20.0	20.0	6.7	46.7	80.0	20.0	53.3	80.0
Non smokers	41.2	55.8	53.3	9.5	12.0	9.1	42.3	79.2	15.0	60.9	67.9
Body mass index	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*
Underweight	37.5	50.0	25.0	0.0	25.0	0.0	37.5	87.5	12.5	62.5	87.5
Normal weight	40.2	54.9	50.0	9.8	9.2	8.7	36.4	79.3	13.6	56.0	70.7
Overweight	44.1	52.9	50.0	11.8	13.7	9.8	41.2	79.4	17.6	59.8	66.7
Obese	44.4	61.1	63.9	8.3	19.4	11.1	58.3	77.8	13.9	61.1	61.1
Self-rated health	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*
Good	41.4	54.3	51.8	9.7	11.5	8.6	39.6	80.2	14.0	58.6	70.1
Poor	44.2	57.7	46.2	11.5	15.4	11.5	44.2	75.0	19.2	53.8	61.5

[1]more than once a day; [2]4-7 times per week; [3]at least 1-3 times per week; [4]at least 1-3 times per month

Results of chi-square test: *p<0.05; **p<0.01; ***p<0.001; n.s.: p>0.05

Table 5 Means of healthy eating scores in relation to demographic, lifestyle and health variables [9]

Variables	Mean± SD	p-value*	Variables	Mean± SD	p-value*
Age group[a]		0.001	Smoking[c]		0.031
10-13 years	4.86±2.06		Current smokers	3.85±2.04	
14-17 years	4.82±1.89		Former smokers	5.00±1.73	
18-25 years	4.06±1.55		Non smokers	4.61±1.82	
Physical activity[b]		0.002	Body mass index		0.235
Inactive	4.06±2.02		Underweight	4.38±2.20	
Moderately active	4.45±1.62		Normal weight	4.40±1.81	
Highly active			Overweight	4.60±1.89	
Football players	4.94±1.75		Obese	5.08±1.87	
Water poloists	4.83±2.04		Self-rated health		0.801
Kayak-canoeists	5.16±1.72		Good	4.53±1.89	
Handball players	3.98±1.73		Poor	4.60±1.68	

*Results of one-way ANOVA

[a]Post hoc Scheffe test: significant difference at $p<0.05$ level between 10-13 and 18-25 years old, and between 14-17 and 18-25 years old.

[b]Post hoc Scheffe test: significant difference at $p<0.05$ level between lightly active persons and kayak-canoeists, and between kayak-canoeists and handball players.

[c]Post hoc Scheffe test: significant difference at $p<0.05$ level between current smokers and never smokers

Table 6 Consumption of vitamins and nutrient supplementers by age groups and levels of physical activity

Characteristics	Age-groups						Total	
	10-13 years		14-17 years		18-25 years			
	n	%	n	%	n	%	n	%
Regular vitamin consumption[a]	58	61.7	68	67.3	64	51.2	190	59.4
Consuming nutrient supplementers[b]	3	3.2	11	10.7	19	15.2	33	10.3
Characteristics	Physical activity						Total	
	Inactive		Moderately active		Highly active			
	n	%	n	%	n	%	n	%
Regular vitamin consumption[c]	27	44.3	38	60.3	125	63.8	190	59.4
Consuming nutrient supplementers[d]	2	3.3	11	16.9	20	10.3	33	10.3

[a]Chi-square test: $p=0.042$; [b]Chi-square test: $p=0.016$; [c]Chi-square test: $p=0.025$;

[d]Chi-square test: $p=0.042$

Vitamin and nutrition supplement consumption by age groups and physical activity, have shown significant difference (*Table 6*). Professional athletes consumed more vitamins, meanwhile recreation athletes consumed more nutrition supplements. The consumption of

vitamins was based firstly on parental (34%), secondly on medical (21%) recommendation, while the nutrition supplementers were mainly recommended by physicians and coaches.

4.2.4 The combination of health promoting behaviours

The relationship between various health-promoting behaviours – non-smoking, healthy nutrition and regular physical activity – is shown in *Table 7*.

Table 7 Spearman's rho correlations between health-promoting behaviours

	Non-smoking	Healthy nutrition	Physical activity
Non-smoking	1.000		
Healthy nutrition	0.142**	1.00	
Physical activity	0.117**	0.083	1.00

**Correlation is significant at the 0.01 level.

There were significant correlations between non-smoking and healthy nutrition, as well as physical activity, but no correlation was found between nutrition and physical activity (*Table 7*).

Table 8 Factors influencing the healthy behaviour – logistic regression model

Predictors	P value	ORs	CI 95%
Age-groups	<0.001		
10-13 years	0.001	3.31	1.83-5.98
14-17 years	0.001	3.31	1.84-5.94
18-25 years		1.00	
Education level of father	0.313		
8 years of schooling	0.943	1.06	0.19-5.83
Vocational school	0.523	1.29	0.59-2.81
Gimnasium	0.065	1.76	0.96-3.22
University		1.00	
Education level of mother	0.043		
8 years of schooling	0.633	1.45	0.32-6.58
Vocational school	0.041	0.35	0.13-0.96
Gimnasium	0.023	0.51	0.29-0.91
University		1.00	

OR=odds ratio; CI=confidence interval

Regarding the distribution of the studied population according to the number of the health-promoting behaviours altogether 40.0% of the participants had all the three positive lifestyle characteristics, and only 2.4% had none of them (16.4% had one of them, 41.2% had three of them). *Table 8* shows the associations of sociodemographic characteristics with the highest score of HPB index. In the multivariate logistic regression model, health-promoting

behaviour was significantly associated with age ($p<0.001$) and education level of mothers ($p=0.043$); the education level of father did not influenced significantly the behaviour of their children.

4.2.5 The characteristics and correlations of health status with health behaviour

4.2.5.1 The characteristics of health status

Health status was examined according to the frequency of chronic diseases and the subjective perception of health.

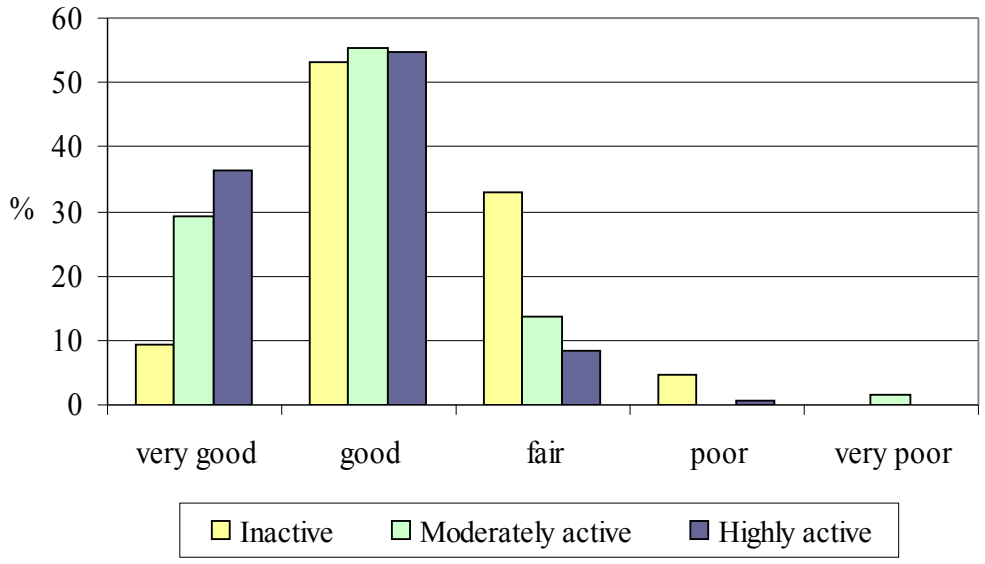

Figure 4 The self-assessment of health status of youth with various levels of physical activity (n=330) (Chi-square test: $p<0.05$) [74]

10% of the interviewees had some known chronic diseases; the frequency did not show any difference according to physical activity (*Table 9*). Based on the self-evaluation of health scale (very good, good, fair, poor, very poor) the lowest categories, poor and very poor, were just present to a very low extent, it was 4.6%, the majority (77%) of the interviewees claimed to be good or very good; broken down to physical activity, the best evaluation was given by professional athletes (*Figure 4*).

Health related characteristics of the studied population are summarized in *Table 9*. Chronic diseases (asthma, allergy, or joint problems) were marked largely in the inactive group; the difference between the groups was, however, not considerable. According to total scores, inactive people perceived the majority of psychosomatic complaints and moderately active people observed the least, although the difference was not significant. The most frequent psychosomatic symptom was headache in the inactive and moderately active group,

and pain in the joints in case of athletes. Summarized assessment of features of psychological well-being showed that inactive people seemed to feel significantly more unwell compared to the other two groups. Fatigue was the most regular complaint in all three groups; happiness and energetic state was noteworthy more infrequent among inactive people; while there was no important change in other symptoms in connection with physical fitness.

Table 9 Health related characteristics of the studied population by physical activity [75]

Variables	Inactive	Moderately active	Highly active	Total	p value
Chronic disease (yes) [n (%)][b]	10 (15.6)	4 (6.2)	19 (9.5)	33 (10.0)	0.184
Psychosomatic symptoms (all symptoms) (mean±SD) [a]	5.75±3.80	4.38±3.20	4.82±3.50	4.92±3.52	0.074
Headache	1.45±0.92	1.09±0.89	1.08±0.89	1.16±0.91	0.015[c]
Sleeping disorders	0.95±1.03	0.66±0.99	0.76±0.99	0.77±1.00	0.231
Diarrhoea or vomiting	0.26±0.54	0.34±0.73	0.19±0.50	0.24±0.56	0.177
Low-back pain	1.05±1.17	0.75±0.93	0.84±1.00	0.87±1.02	0.242
Weakness	0.98±1.03	0.71±0.76	0.83±0.87	0.83±0.89	0.206
Pain in the joints	1.05±1.16	0.83±0.93	1.12±1.07	1.05±1.06	0.165
Psychological well-being (all symptoms) (mean±SD) [a]	9.33±3.36	7.81±3.61	8.01±3.34	8.23±3.44	0.015[c,d]
Fatigue	1.92±0.99	1.89±1.12	1.91±1.01	1.91±1.03	0.984
Nervousness	1.45±1.21	1.31±1.17	1.55±1.03	1.48±1.09	0.285
Anxiety	1.39±1.16	1.23±1.11	1.16±0.88	1.22±0.99	0.298
Peacefulness	1.37±1.01	1.20±0.99	1.37±1.06	1.34±1.04	0.497
Happiness	1.45±1.08	1.11±0.92	0.98±0.84	1.10±0.92	0.002[c]
Energetic state	1.73±1.13	1.08±1.03	1.02±0.93	1.17±1.03	<0.001[c,d]

[a]One-way ANOVA test was used for comparison.
[b]Chi-square test was used for comparison.
[c]Significant difference was between inactive and highly active groups (Scheffe test)
[d]Significant difference was between inactive and moderately active groups (Scheffe test)

During the age group analysis of examinations only the body-fat measuring has shown significant difference, which indicates that such an examination did not take place at the 10-13 age group (*Table 10*). By physical activity there was significant difference concerning examinations, in ECG (electrocardiogram), body mass and weight measures, and body fat measures; the participation of professional athletes were higher in all, except the body fat measuring, while higher tendency was typical in the participation of body fat measuring from moderately active athletes (*Table 10*)

Table 10 The utilization of health related medical examinations 12 months preceding the survey according to age groups and physical activity

Characteristics	Age-groups						Total	
	10-13 years		14-17 years		18-25 years			
	n	%	n	%	n	%	n	%
Medical examination	78	81.3	86	82.7	96	76.2	260	79.8
Taking a blood sample	27	27.6	33	32.0	52	40.6	112	34.0
ECG examination	41	43.2	58	55.8	68	53.1	167	51.1
Measuring body mass and height	87	89.7	96	93.2	113	88.3	296	90.2
Body-fat measuring[a]	5	5.2	37	35.9	50	39.1	92	28.1
Orthopaedic examination (life-prevalence)	51	52.0	49	47.6	72	57.1	172	52.6

Characteristics	Physical activity						Total	
	Inactive		Moderately active		Highly active			
	n	%	n	%	n	%	n	%
Medical examination[a]	44	68.8	40	62.5	176	88.9	260	79.8
Taking a blood sample	17	26.6	20	30.8	75	37.5	112	34.0
ECG examination[a]	9	14.8	15	23.1	143	71.1	167	51.1
Measuring body mass and height[c]	51	81.0	58	90.6	187	93.0	296	90.2
Body-fat measuring[b]	16	25.4	31	47.7	45	22.6	92	28.1
Orthopaedic examinations (life-prevalence)	25	39.7	39	60.0	108	52.3	172	52.6

[a]Chi-square test: $p<0.001$; [b]Chi-square test: $p<0.01$; [c]Chi-square test: $p<0.05$
ECG=electrocardiogram

To the question what other doctors they visited, the most people indicated the ophthalmologist, but in this case the athletes represented low participation. 7% of the interviewees took medicine regularly, from this 7% of 10-13 age group, 9% of 14-17 age group, and 4% of 18-25 age group. 8% of the inactives, 5% of the moderately active athletes, 7% of the professional athletes took medicine regularly.

As the participants were older they visited the dentist less times. They visited the doctor due to control on the one hand, on the second hand when they experienced pain. 50% of the inactives only visited the dentist in case of pain or problem. 60% of the athletes visited the dentist regularly. This number is better than those people who did not do any sports, but not better than the recreational athletes. Recently in case of athletes dental examinations should be considered basic.

Half of the interviewees have never been at an orthopaedic examination. 60% of the inactives have not been to an orthopaedic examination, 45% of athletes, and 60% of recreational athletes have been.

One-quarter of the inactives and the recreational athletes visited the ophthalmologist, while only 5% of the athletes did.

4.2.5.2 The health behaviour of youth with various levels of physical activity and the self-rated health

The result of the one-way ANOVA concerning factors influencing the self-assessment of health status is shown in *Table 11*.

Table 11 Associations of health behaviour and chronic diseases with self-rated health [74]

Characteristics	Mean±SD	p value*	Characteristics	Mean±SD	p value*
Age-group		0.001	Row vegetable[b]		0.732
10-13 years	4.32±0.65		Yes	4.10±0.68	
14-17 years	4.09±0.72		No	4.13±0.73	
18-25 years	3.98±0.71				
Physical activity		<0.001	Cooked vegetable[b]		0.227
Inactive	3.25±1.09		Yes	4.04±0.68	
Moderately active	3.92±0.76		No	4.15±0.72	
Highly active	4.36±0.63				
Smoking		0.095	Fresh fruit		0.006
Smokers	3.90±0.62		Yes	4.18±0.68	
Former smokers	4.07±0.46		No	3.94±0.77	
Non smokers	4.16±0.73				
Alcohol consumption[a]		0.001	Chronic disease		0.002
Yes	4.02±0.72		Yes	3.76±0.87	
No	4.34±0.63		No	4.16±0.68	
Drug consumption[a]		0.063			
Yes	3.91±0.62				
No	4.15±0.72				

[a] life-prevalence; [b]at least once a day *Results of one-way ANOVA

Younger age, competitive physical activity, neglecting the consumption of alcohol, daily fruit consumption, and the lack of chronic diseases carried a significantly better subjective perception (*Table 11*). Taking into consideration the factors which proved to be significant, during the multivariate analysis the model proved to be robust. The 5 factors involved in the multivariate analysis explained the self-assessment of health status by 28.8% in total. Physical

activity was the strongest influencing factor (p=0.007); both recreational and athletes regarded their health status better, than the inactives [74].

4.2.5.3 Factors influencing self-rated health of youth with various levels of physical activity

SRH was considerably different dependently on physical activity (*Figure 4*). Own health was judged "very good" in the highest proportion (36.3%) in the highly active group, and the lowest (9.4%) in the inactive group, "good" was chosen in more than 50% in all groups. On the base of mean value of SRH scores highly active athletes had the highest (4.27±0.71) and inactives the lowest scores (3.67±0.71), while moderately active people were in between (4.11±0.75).

According to correlation analysis, age proved to be related negatively with SRH only in the highly active group, consequently older subjects considered SRH worse. The presence of chronic diseases showed significant connection with SRH only in case of highly active people. Total score of SRH, psychosomatic symptoms and parameters of general state of health had all negative correlation in each group: the lower was the score, the better was SRH perceived [75].

Detailed analysis of the psychosomatic symptoms revealed negative correlation of SRH with sleeping disorders, low-back pain, weakness and pain in the joints in the inactive people; headache and diarrhoea in the moderately active group; and headache, sleeping disorder, low-back pain, weakness and pain in the joints in the highly active athletes [75].

On examination of the psychological well-being symptoms, no correlation with SRH was found in the inactive group; in the moderately active people fatigue and energetic state, while among athletes all parameters showed relationship with SRH, although in the latter group the correlation was strong only in case of peacefulness, happiness and energetic state [75].

According to the multivariate linear regression model, age and chronic diseases had no strong influence in either groups (*Table 12*). In the inactive group, certain psychosomatic symptoms, viz. low-back pain and sleeping disorders, accounted for 22.2% of the variance in SRH. In the moderately active people diarrhoea and – from the parameters of psychological well-being – energetic state turned out to be in connection with SRH (26.6%). Among highly active athletes, headache, pain in the joints, energetic state and peacefulness were responsible for 19.8% of the variance in SRH. Inverse relationship was found in case of every factor, meaning that lower scores were associated with better self-assessment [75].

Table 12 Physical activity related predictors of self-rated health – forward linear regression models [75]

Model	Predictors	R Square	β	p value
	Inactive			
1	Low-back-pain	0.177	-0.436	<0.001
2	Low-back-pain	0.222	-0.289	0.031
	Sleeping disorders		-0.279	0.037
	Moderately active			
1	Diarrhoea or vomiting	0.201	-0.463	
2	Diarrhoea or vomiting	0.266	-0.427	<0.001
	Energetic state		-0.276	0.013
	Highly active			
1	Energetic state	0.095	-0.315	<0.001
2	Energetic state	0.152	-0.288	<0.001
	Headache		-0.248	<0.001
3	Energetic state	0.180	-0.247	<0.001
	Headache		-0.198	0.003
	Pain in the joints		-0.192	0.005
4	Energetic state	0.198	-0.211	0.002
	Headache		-0.204	0.002
	Pain in the joints		-0.184	0.007
	Peacefulness		-0.151	0.022

4.3 Anthropometric and physical fitness measures

4.3.1 The relationship between level of physical activity and anthropometric and physical fitness measures

Based on the measuring of BMI 41.8% of the examined people were either overweighted or obese. The development of nutrition status according to age groups, physical activity, and sports is summarized in *Table 13*. According to age groups, the best values were in the category of 18-25 year-old, 72.7% of them belonged to the normal category, and the proportion of obese people was the lowest in this group ($p<0.001$). According to physical activity there was no significant difference between the groups ($p=0.368$), but in the sports category there were considerable differences ($p<0.001$): among water poloists and handball players the proportion of obese people is quite high according to the calculations of BMI.

Table 13 The BMI based distribution of nutrition status according to age groups, and physical activity

Attributes	Nutrition status (BMI groups)			
	underweight	normal weight	overweight	obese
Age groups				
10-13 years	3 (3.1)	40 (40.8)	38 (38.8)	17 (17.3)
14-17 years	2 (1.9)	51 (49.0)	35 (33.7)	16 (15.4)
18-25 years	3 (2.3)	93 (72.7)	29 (22.7)	3 (2.3)
Physical activity/sport				
Inactive	2 (3.1)	36 (56.3)	20 (31.3)	6 (9.4)
Moderately active	3 (4.6)	41 (63.1)	13 (20.0)	8 (12.3)
Highly active (together)	3 (1.5)	107 (53.2)	69 (34.3)	22 (11.0)
Football players	2 (4.0)	43 (86.0)	4 (8.0)	1 (2.0)
Handball players	0 (0.0)	23 (43.4)	22 (41.5)	8 (15.1)
Water poloists	0 (0.0)	19 (39.6)	20 (41.7)	9 (18.8)
Kayak-canoeists	1 (2.0)	22 (44.0)	23 (46.0)	4 (8.0)
Total	8 (2.4)	184 (55.8)	102 (30.9)	36 (10.9)

According to body fat measuring (bio-impedance) examinations 82.7 % of the subjects belonged to the normal category, 12.1% had a moderate overweight and 4.8% was only obese. The attributes based on age and physical activity is shown in *Table 14*. There were no significant differences according to age-groups (p=0.673) and physical activity (p=0.139), but in the sports category there were also considerable differences (p=0.003).

Table 14 The bioimpedance based distribution of nutrition status according to age groups and physical activity

Attributes	Nutrition status based on bioimpedance			
	underweight	normal	moderate overweight	overweight
Age groups				
10-13 years	0 (0.0)	82 (83.7)	11 (11.2)	5 (5.1)
14-17 years	0 (0.0)	90 (86.5)	11 (10.6)	3 (2.9)
18-25 years	1 (0.8)	101 (78.9)	18 (14.1)	8 (6.3)
Physical activity/sport				
Inactive	1 (1.6)	48 (75.0)	9 (14.1)	6 (9.4)
Moderately active	0 (0.0)	57 (87.7)	5 (7.7)	3 (4.6)
Highly active (together)	0 (0.0)	168 (83.6)	26 (12.9)	7 (3.5)
Football players	0 (0.0)	46 (92.0)	4 (8.0)	0 (0.0)
Handball players	0 (0.0)	44 (83.0)	5 (9.4)	4 (7.5)
Water poloists	0 (0.0)	32 (66.7)	14 (29.2)	2 (4.2)
Kayak-canoeists	0 (0.0)	46 (92.0)	3 (6.0)	1 (2.0)
Total	1 (0.3)	273 (82.7)	40 (12.1)	16 (4.8)

Table 15 The results of Cooper's test by age groups and physical activity

Attributes	Results of Cooper test (n (%)						p value
	very weak	weak	medium	good	exceptional	extra	
Age groups							<0.001
10-13 years	0 (0.0)	0 (0.0)	19 (19.4)	40 (40.8)	25 (25.5)	14 (14.3)	
14-17 years	7 (6.7)	13 (12.5)	25 (24.0)	33 (31.7)	20 (19.2)	6 (5.8)	
18-25 years	26 (20.3)	24 (18.8)	23 (18.0)	29 (22.7)	15 (11.7)	11 (8.6)	
Total	33 (10.0)	37 (11.2)	67 (20.3)	102(30.9)	60 (18.2)	31 (9.4)	
Physical activity							<0.001
Inactive	17 (26.6)	15 (23.4)	20 (31.3)	12 (18.8)	0 (0.0)	0 (0.0)	
Moderately active	10 (15.4)	12 (18.5)	22 (33.8)	20 (30.8)	1 (1.5)	0 (0.0)	
Highly active	6 (3.0)	10 (5.0)	25 (12.4)	70 (34.8)	59 (29.4)	31 (15.4)	
Sports							<0.001
Football players	0 (0.0)	4 (8.0)	2 (4.0)	11 (22.0)	15 (30.0)	18 (36.0)	
Handball players	0 (0.0)	0 (0.0)	4 (7.5)	23 (43.4)	20 (37.7)	6 (11.3)	
Water poloists	5 (10.4)	6 (12.5)	17 (35.4)	14 (29.2)	5 (10.4)	1 (2.1)	
Kayak-canoeists	1 (2.0)	0 (0.0)	2 (4.0)	22 (44.0)	19 (38.0)	6 (12.0)	

Table 16 Result of the Burpee test according to age groups and physical activity

Attributes	very weak	weak	medium	good	exceptional	pro-sport
Age groups						
10-13 years	38 (38.8)	16 (16.3)	9 (9.2)	8 (8.2)	8 (8.2)	19 (19.4)
14-17 years	46 (44.2)	22 (21.2)	14 (13.5)	7 (6.7)	10 (9.6)	5 (4.8)
18-25 years	37 (28.9)	29 (22.7)	23 (18.0)	22 (17.2)	8 (6.3)	9 (7.0)
Total	121 (36.7)	67 (20.3)	46 (13.9)	37 (11.2)	26 (7.9)	33 (10.0)
Physical activity						
Inactive	42 (65.6)	15 (23.4)	5 (7.8)	2 (3.1)	0 (0)	0 (0)
Moderately active	27 (41.5)	15 (23.1)	6 (9.2)	7 (10.8)	6 (9.2)	4 (6.2)
Highly active	52 (25.9)	37 (18.4)	35 (17.4)	28 (13.9)	20 (10.0)	29 (14.4)
Sports						
Football players	7 (14.0)	5 (10.0)	4 (8.0)	11 (22.0)	9 (18.0)	14 (28.0)
Handball players	12 (22.6)	14 (26.4)	8 (15.1)	6 (11.3)	5 (9.4)	8 (15.1)
Water poloists	23 (47.9)	10 (20.8)	10 (20.8)	4 (8.3)	0 (0)	1 (2.1)
Kayak-canoeists	10 (20.0)	8 (16.0)	13 (26.0)	7 (14.0)	6 (12.0)	6 (12.0)

Physical performance was determined by two simple sport tests: Cooper's 12 minute run test and the Burpee test performed in two minutes. According to the Cooper test half of the subjects fell into the medium and good category, one fifth of them performed very weakly or weakly, and only one fourth of the subjects were exceptional or better. There was significant difference in performance according to age group, physical activity and sports

(*Table 15*): the best performance was shown by the 10-13 year-old age group, the pro-athletes and within that the football players [7].

Based on the results of the Burpee test (*Table 16*), it can be concluded that 89% of the inactive, 64.6% of the recreational, and 44.5% of the athletes performed weakly or very weakly. Nobody from the inactive category, 15.4% of the recreational, and only 24.4% of the athletes performed exceptional or better [7].

4.3.2 Anthropometric characteristics and physical performance by sport

The results of measurements by age-groups and sport are shown in *Table 17*. Significant age-group related differences were seen in anthropometric and physical performance parameters except the results of the Burpee test in football players and water poloists [12].

There were correlation between BMI and other anthropometric parameters (*Table 18*). BMI and BF% was in correlation except in 10-13 years old football players and 18-25 years old kayak-canoeists. BMI was in strong relationship with upper arm girth except 10-13 years old football players and 14-17 years old water poloists. A strong correlation between BMI and shoulder width values was in 10-13 years old water poloists, kayak-canoeists and 14-17 years old handball players (*Table 18*).

Correlation between anthropometric data and training volume was seen only in the age groups above 13 years. In the 14-17 years old football players' group, training volume was in strong relationship with BF% and with shoulder. In the 18-25 years old groups, the kayak-canoeists' upper arm girth, as well as the handball players' BF% and upper arm girth was in connection with training volume, while no correlation was found in the water poloists' group.

The performance in Cooper's test was not influenced by the training volume, while the Burpee test, among the 14-17 old football players and the 18-25 years old kayak-canoeists had a correlation with the training volume.

When testing the relationship between physical performance and anthropometric parameters it was found that results of the Cooper's test were correlated to BMI and BF%, beside Burpee test outcome with BMI, BF% and body measures. In the 10-13 years old group, there was no correlation between anthropometric data and physical performance.

Table 17 Anthropometric and physical performance parameters in highly trained young athletes [12]

Characteristics	Football players		Handball players		Water poloists		Kayak-canoeists	
10-13 years old	*(n=16)*		*(n=16)*		*(n=16)*		*(n=17)*	
	mean	*SD*	*mean*	*SD*	*mean*	*SD*	*mean*	*SD*
Body mass index (kg/m^2)*	17.06	2.07#	20.69	2.12#	21.51	2.69#	19.23	2.79#
Body fat (%)*	5.31	1.27#	7.13	3.70#	9.43	5.80#	7.21	3.63#
Upper arm girth (cm)*	21.87	1.99#	25.13	2.33#	23.80	3.01#	24.20	2.73#
Shoulder width (cm)*	42.09	2.05#	47.75	1.88#	47.80	2.48#	46.53	3.18#
Weekly training time (min)*	439.69	69.01#	378.75	78.13#	326.25	121.76#	340.29	111.25#
Cooper's run test (m)*	2106.51	176.89#	2090.23	222.27#	1862.50	257.88#	2017.65	312.72#
Burpee test (number)*	58.44	9.93	58.13	11.50#	36.13	8.15	44.06	9.49#
14-17 years old	*(n=19)*		*(n=18)*		*(n=15)*		*(n=21)*	
	mean	*SD*	*mean*	*SD*	*mean*	*SD*	*mean*	*SD*
Body mass index (kg/m^2)*	19.82	1.68	23.12	3.37	23.99	2.41	23.60	2.32
Body fat (%)*	8.20	3.77	13.93	6.25	16.90	4.07	13.69	5.77
Upper arm girth (cm)*	27.00	2.50	29.75	3.23	30.63	1.56	30.67	2.23
Shoulder width (cm)*	47.31	4.76	57.87	3.18	55.40	2.56	58.67	1.63
Weekly training time (min)*	706.84	357.89	465.28	88.12	451.67	68.34	638.57	219.44
Cooper's run test (m)*	2723.68	409.73	2655.56	178.96	2126.67	345.31	2666.67	03.86
Burpee test (number)*	52.37	11.75	42.05	5.22	44.00	15.75	49.00	6.79
18-25 years old	*(n=20)*		*(n=19)*		*(n=21)*		*(n=15)*	
	mean	*SD*	*mean*	*SD*	*mean*	*SD*	*mean*	*SD*
Body mass index (kg/m^2)*	22.11	2.07	24.14	2.21	24.03	1.55	24.58	1.40
Body fat (%)*	15.40	4.09	16.39	2.21	19.42	3.58	15.18	3.58
Upper arm girth (cm)*	29.07	2.68	32.63	2.22	32.86	2.61	33.60	2.03
Shoulder width (cm)*	56.30	2.81	61.26	2.64	59.86	5.59	62.67	8.03
Weekly training time (min)*	1074.00	395.48	610.79	183.83	803.09	377.51	780.00	247.38
Cooper's run test (m)*	3030.00	389.47	2963.16	208.73	2466.67	300.56	3157.33	253.08
Burpee test (number)*	58.50	11.70	52.21	11.87	42.62	8.65	60.60	8.09

*Significant differences between sports (Kruskall-Wallis test)

#Significant differences between age-groups within sports (Kruskall-Wallis test)

Table 18 Spearman's correlation coefficients between body mass index and other anthropometric parameters [12]

Age groups and kinds of sport	Body fat (%)	Upper arm girth (cm)	Shoulder width (cm)
10-13 years old			
Football players	0.420	0.494	0.163
Handball players	0.692**	0.745**	0.201
Water poloists	0.829***	0.726**	0.772***
Kayak-canoeists	0.849***	0.931***	0.776***
14-17 years old			
Football players	0.869***	0.829***	0.647**
Handball players	0.937***	0.857***	0.864***
Water poloists	0.913***	0.397	0.288
Kayak-canoeists	0.798***	0.638**	0.506*
18-25 years old			
Football players	0.986***	0.826***	0.101
Handball players	0.887***	0.711**	0.659**
Water poloists	0.905***	0.502*	0.390
Kayak-canoeists	0.151	0.755**	0.589*

*p<0.05, **p<0.01, ***p<0.001

Among the 18-25 years old water poloists, negative correlation was found between Cooper's test results and BMI, and between Burpee test performance and shoulder width Among the 14-17 years old football players, the results of the Burpee test were in connection with BMI, BF% and shoulder width. In the 18-25 year old kayak-canoeists' group, the Burpee test results were correlated with BMI, upper arm girth and shoulder width

4.4 The examination of training method efficiency among rising generation football players

The results of anthropometric and conditional measuring conducted in 2006 and 2008, among the football players of Tisza Volán SC Football School born in 1995 and inactive children of the same age are shown in Table 19 and 20 [8].

Throughout the anthropometric examination body weight, height (based on these body-mass index, BMI), shoulder width, upper arm girth measuring took place. The conditional measuring included the average of Burpee test (2 minutes), sit ups (4 minutes), Cooper test, and maximal strength.

Throughout the survey in 2006 the anthropometric attributes of the two groups did not show significant difference, except in case of the average of body-mass index and shoulder width (*Table 19*); the upper body muscle of the inactive proved to be more developed. The

conditional measuring (*Table 19*) proved to be significantly better in case of football players than the inactive, except the maximal strength [8].

Table 19 The physical and conditional development of young inactive and football players in 2006

Characteristics	Inactive (n=20)	Football player (n=16)	p value*
Anthropometric parameters (mean±SD)			
Body weight (kg)	39.55±7.01	36.49±6.51	0.189
Body height (cm)	144.70±8.37	145.94±8.39	0.662
BMI (kg/m2)	18.79±2.27	17.06±2.07	0.024
Upper arm girth (cm)	22.85±2.79	21.87±1.99	0.248
Shoulder width (cm)	44.70±4.37	42.09±2.05	0.035
Conditional measurements (mean±SD)			
Sit ups (number)	88.75±23.84	137.06±20.90	<0.001
4 beat push ups (number)	31.75±10.24	58.43±9.93	<0.001
Cooper test (m)	1633.50±136.97	2106.25±176.89	<0.001
Maximal strenght (kg)	23.25±5.45	23.43±4.21	0.911

*Results of one-way ANOVA

Table 20 The physical and conditional development of young inactive and football players in 2008-ban

Characteristics	Inactive (n=20)	Football player (n=16)	p value*
Anthropometric parameters (mean±SD)			
Body weight (kg)	51.25±10.43	46.93±9.61	0.211
Body height (cm)	155.95±9.42	158.93±9.49	0.353
BMI (kg/m^2)	21.05±3.75	18.39±2.14	0.016
Upper arm girth (cm)	25.15±2.81	24.06±2.11	0.209
Shoulder width (cm)	46.20±4.64	44.00±2.85	0.106
Conditional measurements (mean±SD)			
Sit ups (number)	78.15±17.39	153.18±21.79	<0.001
4 beat push ups (number)	39.80±10.82	63.93±11.73	<0.001
Cooper test (m)	1735.00±213.43	2687.50±206.16	<0.001
Maximal strength (kg)	26.50±6.20	35.87±6.28	<0.001

*Result of one-way ANOVA

There was no considerable difference between the groups concerning physical state of development throughout the survey in 2008; however the conditional measurements definitely showed better performance regarding football players (*Table 20*). The results of one-sample t-test of the 2006 and 2008 survey showed significant changes in both groups and concerning all examined parameters.

5 DISCUSSION

In our survey the life style, health behaviour, health status, anthropometric attributes and physical performance capability of young people with different physical activity were examined.

5.1 Health and health behaviour

Based on the results it could be concluded that there is correlation between physical activity and examined life style factors. In case of recreational and pro athletes, from the health damaging behaviours, the prevalence of alcohol consumption and smoking was definitely lower, than in case of inactives, however the prevalence concerning drug consumption was higher in case of recreational athletes. Fruit consumption increased with the number of subjects who increasingly did exercises. On the whole it could be concluded that the healthiest lifestyle was demonstrated by professional athletes [74].

Frequent physical exercise assumingly prevents and reduces the chance of health damaging effects, and enhances the functional balance of the body from a psychological and physical point of view as well. Sports maintain the condition of the body, forms, and develops the personality, enhances performance in mental and physical activity at the same time, eases the resolution of stress, besides free time can be spent as a joyful activity [61]. According to our results age, physical activity and smoking was proven to be in relationship with dietary habits, while health variables such as BMI and SRH not. It is important to emphasize that different types of sport showed different picture; while in case of kayak-canoeists there was the strongest connection between physical activity and eating habits, this relation was no longer seen at other sportsmen [9].

Regarding the results related to smoking behaviour – as former smokers had healthier nutrition habits than smokers – indicate that a positive change in lifestyle can be accompanied by other positive changes [9].

Based on the HPB index applied to the collective occurrence of health supporting behaviours – non smoking, healthy nutrition, physical activity – it could be concluded that among youngsters the proportion of those was considerably higher (40.0%), whereby all three of the favourable health behaviour occurred collectively, than in the general domestic resident sample (5.5%) [73]. However in this young age group it could be observed that the probability of the occurrence of these collective behaviours decreased by aging.

Physically active lifestyle, in case of this survey as well, affected the self-assessment of health positively; athletes subjectively perceived their health better, in spite of the fact that objectively – based on frequency of chronic diseases – no considerable deviation was found between the groups with different physical activity [74].

The most frequent psychosomatic symptoms were headache and pain in the joints. The frequency of the symptoms involved in our study had an influence on SRH; those who had fewer symptoms tended to evaluate their own health significantly higher. The psychological well-being parameters showed negative correlations with SRH, in case of fewer complaints the self-evaluation was better. Studying the relationship between psychosomatic symptoms, psychological well-being parameters and variations in SRH in three populations of different levels of physical activity, it was found that increased level of sports had positive relationship with SRH; physically active people considered their state of health much better. The worse SRH result of the inactive group was in connection with higher number of complaints, and with the lack of positive effect – energetic state, happiness – of exercise. The positive influence of physical exercise was manifested in the energetic state in the moderately active group; while at highly active athletes besides positive effects – energetic state, peacefulness – some negative effect is yet appeared (e.g. pain in the joints). The regression analysis revealed that the components of SRH in the inactive group were different from those in moderately and highly active groups. Our results indicated a relationship between the frequency of psychosomatic and psychological symptoms and SRH in three 10-25 years old male populations distinguished in different levels of physical activity [75].

The health status of the Hungarian population can be improved by the modification of numerous factors, and to achieve this the modification eating habits, non-smoking, more physical exercise are indispensable [4]. Our results indicated that exercises prove to have health preserving and developing function, therefore from the above factors – especially among youngsters – the acceptance of physical activity, spread of doing exercises are of vital importance, which would bring a considerable leap forward concerning the improvement of health status of the population [74].

Based on the measurements by age groups, it is obvious that the older the subjects, the worse results were received, which indicates some concerns, since the childhood accustomed habits, and lifestyle will have determining effects in adult age as well. The foundations of healthy physical and mental development should take place in childhood. To get accustomed to physical exercises, the lifestyle idols of the environment are of crucial importance. Parents, teachers have to participate in this, in case of athletes the coaches have to take this role as

well, since coaches not only are responsible for making the kids acquire the professional foundations of the sport, but training the kids mentally, and developing a healthy lifestyle, and protecting them from addictive diseases [11]. The role of environmental factors is supported by our results: athletes were the ones who proportionally had parents, who did sport or do sports frequently, and athletes generally make friends with athletes, therefore the family and friendship idols and examples are even important recently.

Athletes tend to pay more attention to their health condition, not only concerning the fewer frequency of health damaging factors, but doctor visits, the latter which is assisted by compulsory sports medical examinations.

5.2 Anthropometric characteristics and physical performance

The observed age-dependent increase of anthropometric parameters might be, in the 10-13 and 14-17 years group, equally due to growth and training. In the subjects above 18, the major factors were likely the training volume and the type of sport. The dissimilar effect of intensive training on the anthropometric characteristics in different sports has already been described by other authors [2,54,102].

The choice of sport can, however, itself is influenced by body constitution: those of thin figure have a preference to football while the overweighed children's choice is probably water polo.

The high BF% of the water poloists is a sport specific feature, where fat has probably a thermal insulator role in the water. Water polo requires much of stamina. Beyond being a heat insulator, fat tissues actively produce hormones influencing blood level of sugar and triglycerides, the latter being utilised by the muscles for energy production [98].

Kayak-canoeists had, determined by the characteristics of this sport, the largest muscle mass; but this was nearly free of fat (high BMI together with low BF%), which was due partly to the high physical load and partly to that any overweight would be unwanted ballast in the boat.

Handball players had a likely good physical state, but in this sport direct body-to-body fight is frequent so that body mass, represented to a lesser extent by fat and not muscles, is more crucial.

Compared to the above sports, football players had lower BMI and BF% data and weaker upper body musculature. Beyond the influence of physical constitution on the choice of sport, this might be due to the higher energy consumption during training work by feet,

compared to upper body training, but also to the low level of physical training of football players in Hungary. Coerver's method [16], athletic training of football players, has less weight in Hungary compared to countries with more successful football. In those, technical development is prioritized in the 5-13 years old, whereas condition development and physical training is done mostly in the age groups of 13-14 to 18-20. In all sports investigated in the present study, the 10-13 years olds' anthropometric data were sport specific without correlation to training intensity or physical performance (kind of sport chosen by physical constitution).

Among the older, kayak-canoeists had the best and water poloists the worst condition. The 18-25 years old kayak-canoeists' very good performance in the Burpee test was in correlation with their upper body composition, probably because this test requires short-term (2-4 min) high anaerobic capacity, a characteristic of this sport. In the same age group, the results of the water poloists' Cooper's test were in negative correlation with BMI: more corpulent players had lower aerobic performance.

The results described above indicated typical differences in the anthropometric data and physical performance of male kayak-canoeists, football, water polo and handball players. The differences arose partly from the influence of physical constitution on the choice of sport, but are later influenced by the physiological demands of the kind of sport and its specific training methods. In practice, the anthropometric examinations and ongoing performance measurements enable or help the suggestion and choice of a kind of sport in childhood.

5.3 Training and performance among rising generation football players

Considering the described data, the question can be raised that based on the conducted examinations what are those conclusions which can be applied in practice as well. Since I have been coaching young football players for a long time, my considerations will be summarized that can be conducted in domestic practice and are valid to this field of expertise.

Based on our results concerning physical development there was no significant difference between football player and inactive control groups, but the conditional measuring showed better performance of the football players in this age group. In the second phase of the follow-up examination the results showed even greater difference for the benefit of football players concerning conditional measuring [12].

The technical, physical capabilities and strength enhancement of the youngsters need to be solved in a way that it does not prevent, but helps developing the development of

technical-tactical capacitation, especially in that age, when the relevant organs, organ-systems are still in the massive quantitative changing period [11].

The development of physical capabilities of youngsters requires just as thorough planning from the coaches as the technical-tactical preparation [11].

To this male age group well developed bone mass, bone stability and slowly emerging growth tendency are typical. The growth phase turns out to be quite diverse in case of children, when sudden growth takes place the movement coordination falls apart, and slows down; with the enhancement of muscle mass later the movement coordination gets back into order. The state of development of coordination capabilities reaches 90% by teen age [52].

The share of muscle system in the whole body mass is higher, than the inactives of the same age. Hormonal conditioning does not make or just to a minimal extent the growth of muscle mass possible in this age. At age 12 the weight of muscles is only 25-30% of the total body mass [59]. The classical conditioning training and development can be started from age 13-14, before that natural, gymnastic exercises or exercises with own weight should be applied.

Aerobic performance depends on many innate, trainable attributes. In this age during endurance 210-220 beat/minute is totally normal; the sedation objective is not the 120-130, but the 130-150 pulse frequency zone [56]. In this age group (10-12) it is already proven of the aerobic and anaerobic capacity that males are able to reach higher intensity and spread. Anaerobe capacity is lower in this age, than in teen or adult age. It is important to apply the proper methods in the proper age, in order to ensure the optimal development of muscle and circulatory system (aerobe-anaerobe capacity, sports heart).

At age 5-7 getting football to be favoured is the main goal. It is important that every exercise is done with ball, and with many playful exercises; the training elements should be diverse and short. The ball handling capability should dominate. There are no fix positions, everyone should play everywhere. At age 8-9 they are able to cooperate in offense and defense. Age 10-12 is especially important concerning the development; goal is to develop technique and reaching game maturity phase. By age 12 it is expected that all the technical elements are known by the kids. Foundations of conditional training are integrated into practice. It is important to apply the new methods eg: small games, coordination exercises, running school, applied coordination basic games, etc.

An important element of the training is running school, which includes the coordination development without ball, improving rhythm, small jumps, start practices, special football movements. Children should swim once a week, applying standard swimming

technique, thus it has a positive effect on circulatory system, increases health capacity, and strengthens every muscle group. In winter season once a week movement coordination improving exercises: aerobic or spinning. Stretching is indispensable 3 times 10-15 minutes a week. It is proved that after stretching the number of muscle and tissue injuries decreased, and performance and movement coordination improved. This training method considerably contributed to the fact that more players of mine managed to achieve an international career.

Mental training is one of the crucial factors of football players, which has several elements. Social background plays a more important role than earlier. It can generate serious problems if the parents divorced and children grow up in a fragmented family, which does not only affect the financial issues, but also the social sensitivity and psychological condition of the child. The attitude of parents to sports has a determining role as well.

Genetic nature strongly determines the attitude and personality of the player. It is important that a socially accepted behaviour evolves which expects positive values from the individuals and the team and expects role modelling from parents and coaches. Development of team spirit, honesty, cooperation, cognitive thinking and healthy lifestyle is important.

The psychological and teaching tasks strongly coincide. It has to be emphasized that many time we are not only coaches in the eyes of the children but „father figures". Football is 70% brains, 30% technique which requires a lot of running [28]. It is very important that many intelligent players are raised. Important part of the mental training is the hygienic education. It is a great problem that at age 6-12 winning pressure determines the work of the coach. In my opinion, at first the technical and tactical elements need to be taught which are relevant to that age group, and result is only a secondary aspect. This does not mean that we should not enhance their spirit of victory.

Besides the positive effect of applied training method on physical performance, those results have to emphasize which are demonstrated in the sport success of football players. As the most successful team ever in the history of Tisza Volán Focisuli, they managed to reach first and second ranking in many international tournaments, and there are 7 players which are members of the national team in their age group (5-95', 1-96' and 1.94' female age group). Eight male players are the members of FC Fiorentina, Atalanta Calcio, Puskas Academy, Sandor Karoly Acadmey of Football, Miklós Fehér Academy, and Vasas Academy, and one girl is the member of U17 national team.

The football world can be compared to a pyramid. The pro line can only work if the foundations are strong, and this is the rising generation. The higher the top of the pyramid is, the wider the foundation is [12]. It can be definitely told that adult football in Hungary will only improve fundamentally, if the training and education of rising generation football players apply the modern methods and results of sports science. There are more and more football academies in Hungary where talented players are being gathered. The training system does not follow the principles of modern preparation in every element, thus it would be important to combine the nationally successful methods with Hungarian individuality, style, and capabilities. The renewal of the rising generation football players would mean a way to reform and ensure the long term improvement of domestic football. It would mean a great leap forward if there was one football centre in each county, in cooperation with the state, local government or with one of the significant football associations. Here should be gathered the most talented players of the county, and should be trained within the system and framework of the academy similarly to the English model. To achieve this proper circumstances and expertise is needed. The basis for this would be an organized school based football education, but currently this is very rudimentary in Hungary [6]. I tried to achieve this in the last couple of years, and outstanding results were produced on a national level. These results were proved by our researches. It would be recommended, if these methods were tried by others as well, and more players would emerge to international football platform from Hungarian workshops.

6 SUMMARY

Summarizing our data it can be stated that the results of this study verified the original hypotheses:

1. Our study revealed that single factors are not independent from each others in development of health behaviour, and these relationships can be observed already in young population. Our study stated that higher physical activity, healthier eating habits and non-smoker status are associated with each others, namely physically more active lifestyle more likely to contribute to other health promotional activities, thus encourage developing conscious health behaviour. It is essential to have attitudes toward healthier life, because, for this reason, it is expected that positive change of a lifestyle factor entail acquirement of further „healthy habits" into one's life. In order to encourage the whole population to behave more healthfully, there is a need for further improvements started in the youth population.
2. The protective effect and risk of sport can be measured in a young and healthy population on the base of psychosomatic symptoms and parameters of psychological well-being. Regular physical training provides a healthier life resulted in better general state health, which finally entails a better picture of SRH. In a young population, that is free from chronic diseases, psychosomatic symptoms and psychological well-being have important role in SRH; the latter has strong correlation with positive effects of physical training.
3. Our results indicated typical differences in the anthropometric data and physical performance of male kayak-canoeists, football, water polo and handball players. The differences arose partly from the influence of physical constitution on the choice of sport, but are later influenced by the physiological demands of the kind of sport and its specific training methods. The anthropometric examinations and ongoing performance measurements enable or help the suggestion and choice of a kind of sport in childhood.
4. The results of the follow up study between young football players and their inactive control group showed the positive effect of applied training method (running school, swimming, spinning, mental training etc.) on physical performance. Our results supported the fact that the modern methods and results of sports science have to be applied in the training and education of rising generation football players.

REFERENCES

1. Abu-Omar K., Rutten A., Robine J. M.: Self-rated health and physical activity in the European Union. Soz. Praventivmed. 2004;49:235-242.
2. Andreoli A., Melchiorri G., Brozzi M., Di Marco A., Volpe S. L., Garofano P., Di Daniele N.: Effect of different sports on body cell mass in highly trained athletes. Acta Diabetol. 2003;40:S122-S125.
3. Apor P., Nádori L.: Kondícióedzés a labdarúgásban. Budapest, 1988.
4. Barabás K.: Az egészségfejlesztés új módszereinek lehetőségei a tizenéves populációban. In: SZTE ÁOK Gyermek- és ifjúságpszichiátriai osztály posztgraduális tudományos továbbképzése 2004.
5. Bidoli E., Schinella D., Franceshi S.: Physical activity and bone mineral density in Italian middle-aged women. Eur. J. Epidemiol. 1998;14(29):153-157.
6. Bóka F., Majoros A.: Londoni szakmai út egy utánpótlás edző szemszögéből. Magyar Edző 2007;10(1):19-21.
7. Bóka F., Nagymajtényi L., Paulik E.: A rendszeres testedzés hatása az aerob állóképességre. Tudomány a sportoló nemzetért – Konferenciasorozat 2007. Testnevelés és sport az utánpótlás-nevelésben. Szeged, 2007. május 22. CD mellékleten megjelent teljes előadás
8. Bóka F., Nagymajtényi L., Paulik E.: Utánpótláskorú labdarúgók testi fejlettsége és kondicionális jellemzői. VI. Országos Sporttudományi Kongresszus. Eger 2007. október 28-30. (Szerk: Bendiner N. és Bognár J.), Budapest, 2008. pp. 94-97.
9. Bóka F., Nagymajtényi L., Paulik E.: Dietary behaviour in young men of various levels of physical activity. Acta Aliment. 2010 (Accepted for publication)
10. Bóka F., Varga Á.: A női vízilabdázás helyzete Szegeden. Magyar Edző 2008;11(2): 31-33.
11. Bóka F.: 5-12 éves utánpótlás korú labdarúgók képzése. Magyar Sporttudományi Szemle 2007;8(4):36-38.
12. Bóka, F., Nagymajtényi, L., Paulik, E.: Anthropometric characteristics and physical performance in young athletes in Hungary. Fiziologia – physiology, 2008;18.3(59): 8-11.
13. Both J.: A futball egy nagy játék. Both és társa Bt. Budapest, 1999. p. 381.
14. Bouchard C.: Genetic determinants of regional fat distribution. Hum Reprod. 1997;12(Suppl 1):1-5.
15. Bunc V.: A simple method for estimating aerobic fitness. Ergonomics 1994;1:159-165.
16. Coerver W., Collette R.: Soccer fundamentals for players and coaches. Englewood Cliffs, N.J.: Prentice Hall, 1986.
17. Constitution of the World Health Organization, 1946. http://apps.who.int/gb/bd/pdf/bd47/en/constitution-en.pdf
18. Cooper K. H.: Testing and developing cardiovascular fitness within the United States Air Force. J. Occup. Med. 1968;11:636-639.
19. Csabai M., Molnár P.: Egészség, betegség, gyógyítás. Springer, Budapest, 1999.

20. Detre Z.: A sport egészségmegőrző szerepe. Hadmérnök, 2006;1(1) http://hadmernok.hu/archivum/2006/1/2006_1_detre.html

21. Dittmar M.: Reliability and variability of bioimpedance measures in normal adults: effects of age, gender, and body mass. Am. J. Phys. Antropol. 2003;122:361-370.

22. Eger H. L., Costello E. J., Erkanli A., Angold A.: Somatic complaints and psychopathology in children and adolescents: stomach aches, musculoskeletal pains, and headaches. J. Am. Acad. Child Adolesc. Psychiatry 1999;38:852-860.

23. Ellis E., Grimsley M., Goyder E., Blank L., Peters J.: Physical activity and health: evidence from a study of deprived communities in England. J. Pub. Health 2007;29:27-34.

24. Fleming S., Kelleher C., O'connor M.: Eating patterns and factors influencing likely change in the workplace in Ireland. Health Promot. Int. 1997**.** 112, 187-196.

25. Fox K. R.: The influence of physical activity on mental well-being. Public Health Nutr. 1999;2(3a):411-418.

26. Frenkl R.: Gyermek-sportélettani ismeretek és alkalmazásuk. In: A gyermeksport biológiai alapjai (szerk. Mészáros J.) Budapest, 1990.

27. Gabler T., Kovács V.: A rendszeres testedzés egészségmegőrző szerepe. Családorvosi Fórum. 2005;1:46-49.

28. Gifford C. *Soccer*: The Ultimate Guide to the Beautiful Game. *Kingfisher* Publications, 2002.

29. Gyetvai Gy., Kecsekmétiné Petri A.: A testkultúra elméleti és kutatásmódszertani alapismeretek. Fõiskolai jegyzet. Szeged, 2000. p. 234.

30. Győri P.: Óvodások szomatikus nevelése. VEAB,Veszprém, 1988.

31. Healthy People 2010. Understanding and Improving Health. U.S. Department of Health and Human Services, November 2000. http://www.healthypeople.gov/document/pdf/uih/2010uih.pdf

32. Hirtz P.: Koordinative Fahigkeiten in Schulsport. Volk und Wissen Volkseigener Verlag. Berlin, 1985.

33. Huang Y., Macera C. A., Blair S. N., Brill P. A., Kohl H. W., Kronenfeld J. J.: Physical fitness, physical activity, and functional limitation in adults aged 40 and older. Med. Sci. Sports Exerc. 1998;30:1430-1435.

34. Idler E. L., Benyamini Y.: Self-rated health and mortality: a review of twenty-seven community studies. J. Health Soc. Behav. 1997;38:21-37.

35. Ihász F., Király T., Völgyi E.: A testalkati jellemzők és az izomtömeg kapcsolata 9-10 éves fiúknál IV. Országos Sporttudományi Kongresszus, Szombathely. 2003. 56-63 p.

36. Józan P.: Az ezredforduló népesedési viszonyai Magyarországon. (In: A magyar lakosság egészségi állapota az ezredfordulón. Ed.: Ádány R.) Medicina Könyvkiadó Zrt, Budapest, 2003. pp.11-25.

37. Kaleta D., Makowiec-Dabrowska T., Jegier A.: Lifestyle index and work ability. Int. J Occup. Med. Environ. Health. 2006;19:170-177.

38. Keresztes N., Pikó B.: Középiskolás fiatalok pszichoszociális egészsége és értékorientációja fizikai aktivitásuk tükrében. Egészségfejlesztés 2006;47(4):19-23.

39. King D. E., Mainous A. G., Carnemolla M., Everett C. J.: Adherence to healthy lifestyle habits in US adults. Am. J. Med. 2009;122:528-534.

40. Kökönyei Gy.: Szubjektív jóllét. (In: Iskoláskorú gyermekek egészségmagatartása. Ed.: Aszmann A.), Országos Gyermekegészségügyiintézet, 2003. pp. 93-108.

41. Kovács J. Az egyéni és társadalmi egészség fogalmáról I-II. LAM 1992;2:80-85; 286-289.

42. Kun I.: Labdarúgó korosztályos képzés 6-11 éves korig. Magyar Edző 2005;4:8-9.

43. Kuntzleman C. T.: Childhood fitness: What is happening? What needs to be done? Prev. Med. 1993;4:520-532.

44. Kwasniewska M., Bielecki W., Kaczmarczyk-Chalas K., Malgorzata P., Drygas W.: Prevalence of healthy lifestyle in adult residents of Lódż and Lublin voivodeships – project WOBASZ. Przegląd Lekarsk. 2007;64:61-64.

45. Kyle U. G., Gremion G., Genton L., Slosman D. O., Golay A., Pichard C.: Physical activity and fat-free and fat mass by bioelectrical impedance in 3853 adults. Med. Sci. Sports Exerc. 2001;33(4):576-584.

46. Kyle U. G., Morabia A., Schutz Y., Pichard C.: Sedentarism affects body fat mass index and fat-free mass index in adults aged 18 to 98 years. Nutrition 2004;20:255-260.

47. Laaksonen M., Prattala R., Karisto A.: Patterns of unhealthy behaviour in Finland. Eur. J. Public Health. 2001;11:294-300.

48. Lee Y.: The predictive value of self-assessed general, physical, and mental health on functional decline and mortality in older adults. J. Epidemiol. Community Health 2000;54:123-129.

49. Leyk D., Rohde U., Gorges W., Ridder D., Wumderlich M., Dinklage C., Sievert A., Ruther T., Essfeld D.: Physical performance, body weight and BMI of young adults in Germany 2000-2004: results of the physical-fitness-test study. Int. J. Sports Med. 2006;27(8):642-647.

50. Li D., Ford E. S., Mokdad A. H., Jiles R., Giles W. H.: Clustering of multiple healthy lifestyle habits and health-related quality of life among U.S. adults with diabetes. Diabetes Care, 2007;30:1770-1776.

51. Li L., Li K., Ushijima H.: Moderate-vigorous physical activity and body fatness is Chinese urban scool children. Pediatr. Int. 2007;49(2):280-285.

52. Matsudo V. K. R.: Motor fitness characteristics of Brazilian boys and girls from 7 to 18 years of age. Sports Science Review, 1987;55-61.

53. Mcintyre M. C.: A comparison of the physiological profiles of elite Gaelic footballers, hurlers, and soccer players. Br. J. Sports Med. 2005;39:437-439.

54. Melchiorri G, Andreoli A., Candeloro N., De Lorenzo A.: Changes in body composition caused by intense physical training. Clin. Ter. 2000;151:73-76.

55. Melzer K., Kayser B., Pichard C.: Physical activity: the health benefits outweigh the risks. Curr. Opin. Clin. Nutr. Metab. Care 2004;7:641-647.

56. Mészáros J.: Fejlődéstani alapismeretek 6-14 éves korig. (In: Labdarúgás lépésről lépésre. Ed.: Göltl B.) Budapest, 2002.

57. Mészáros J., Othman M., Mohácsi J., Farkas A.: Minősített sportolók testösszetétele: edzéshatás vagy szelekció? Magyar Sporttudományi Szemle 2001;1:4-6.

58. Miilunpalo S., Vuori I., Oja P., Pasanen M., Urponen H.:Self-rated health status as a health measure: the predictive value of self-reported health status on the use of physician services and on mortality in the working-age population. J. Clin. Epidemiol. 1997;50:517-528.

59. Mohácsi J., Mészáros J., Frenkl R., Farkas A.: A testi felépítés és az edzői szelekció összefüggései fiatal sportolóknál. ÁISH, Budapest, 1987.

60. Mohácsi J., Petrakonics M., Zsideg P., Ihász F., Mohácsi Á., Tatár A.: Gyermekek testzsírtartalma és aerob teljesítménye. Magyar Sporttudományi Szemle 2003;3:27 31.

61. Monspart S.: A testedzés szerepe az életminőség javításában. Egészségnevelés 2001;42:156-158.

62. Mossey J. M., Shapiro E.: Self-rated health: a predictor of mortality among the elderly. Am. J. Public Health 1982;72:800-808.

63. Naidoo J., Wills J.: Egészségmegőrzés. Gyakorlati alapok. Medicina Könyvkiadó Rt., Budapest; 1999.

64. Németh Á.: Serdülőkorúak táplálkozási szokásai, testképe és szubjektív jólléte. Új dieta, 2007;3-4, 01, http://www.uj-dieta.hu/index.php?content=630

65. Németh Á., Szabó M.: Táplálkozási és étkezési szokások. (In: Iskoláskorú gyermekek egészségmagatartása. Ed.: Aszmann A.), Országos Gyermekegészségügyi Intézet, 2003. pp. 25-33.

66. Okano G., Miyake H., Mori M.: Leisure time physical activity as a determinant of self-perceived health and fitness in middle-aged male employees. J. Occup. Health 2003;45:286-292.

67. Országos Epidemiológiai Központ: Országos Lkossági Egészségfelmérés. Kutatási jelentés. Budapest, 2005. http://www.oszmk.hu/index2.php

68. Országos Gyermekegészségügyi Intézet, Magyar Védőnők Egyesülete: Útmutató és táblázatok a gyermekkori tápláltság megítéléséhez. 3. sz. Módszertani levél. Budapest, 2004.

69. Panagiotakos D.B., Pitsavos C., Lentzas Y., Soumas Y., Papadimitriou I., Zrimbekis A., Stefanadis C.: Determinants of physical activity among men and women from Greece: a 5-year follow-up of the Attica Study. Ann. Epidemiol. 2008;18:387-394.

70. Pápai J., Szabó T.: Tornász gyermekek sportágválasztását befolyásoló tényezők. Kalokagathia, 2003;1:18-32.

71. Parkatti T., Deeg D. J., Bosscher R. J., Launer L. L.: Physical activity and self-rated health among 55- to 89-year-old Dutch people. J. Aging Health 1998;10:311-326.

72. Paulik E., Müller A, Pikó B., Pető É.: A saját egészség megítélése és az életmód. Népegészségügy 1997;78(3):28-33.

73. Paulik E., Bóka F., Kertész A., Balogh S., Nagymajtényi L.: Determinants of health-promoting lifestyle behaviour in the rural areas of Hungary. Health Prom. Int. 2010;25(3):277-288. doi:10.1093/heapro/daq025

74. Paulik E., Nagymajtényi L., Bóka F.: Különböző fizikai aktivitású fiatalok egészségmagatartása és az egészségi állapot szubjektív megítélése. Egészségfejlesztés 2008;49(5-6):2-7.

75. Paulik E., Bóka F.: Psychosomatic and psychological predictors of self-rated health in Hungarian men of various ages and levels of fitness. Centr. Eur. J. Occup. Environ. Med. 2008;14(4):369-377.

76. Pietrobelli A., Tato L.: Body composition measurements: from the past to the future. Acta Paediatr. Suppl. 2005. 94(448):8-13.

77. Pikó B.: Pszichoszomatikus tünetek és a szubjektív egészségértékelés epidemiológiája középiskolások körében. Orvosi Hetilap 1999;140:1297-1304.

78. Pikó B.: Health-related predictors of self-perceived health in a student population: the importance of physical activity. J. Commun. Health 2000;25:125-137.

79. Pikó B., Barabás K., Boda K.: Frequency of common psychosomatic symptoms and its influence on self-perceived health in Hungarian student population. Eur. J. Publ. Health, 1997;7:243-247.

80. Pucsok J.: Elhízás és fizikai aktivitás. Obesitológia Hungarica 2000;1(1):6-8.

81. Pucsok J.: Csökkent és fokozott fizikai aktivitás hatása a “body mass” indexre. Háziorvosi Továbbképző Szemle 2004,9(6):462-464.

82. Reeves M. J., Rafferty A. P.: Healthy lifestyle characteristics among adults in the United States, 2000. Arch. Int. Med. 2005;165:854-857.

83. Reilly T., Gilbourne D.: Science and football: a review of applied research in the football codes. J. Sports Sci. 2003;21(9):693-705.

84. Rigó J.: A korszerű, kiegyensúlyozott táplálkozás. Subrosa Kiadó Kft. 1996.

85. Rodler I., Bíró L., Greiner E., Zajkás G., Szórád I., Varga A., Domonkos A., Ágoston H., Balázs A., Vitrai J., Hermann D., Boros J.: Táplálkozási vizsgálat Magyarországon, 2003-2004 (I. Rész). Orv. Hetil. 2005;146(34):1781-1789.

86. Rodler I., Zajkás G.: Táplálkozási ajánlások. (In: Élelmezés- és táplálkozás-egészségtan. Ed.: Rodler I.) Medicina Könyvkiadó Rt., Budapest, 2005. pp. 202-211.

87. Rowlands A. V., Eston R. G., Ingledew D. K.: Relationship between activity levels, aerobic fitness, and body fat in 8- to 10-yr-old children. J. Appl. Physiol. 1999;86(4): 1428-1435.

88. Sokolov A., Grechkina L.: Physical development and the cardiovascular system in young people in relation to the level of motor activity. Gig. Sanit. 2004;4:63-65.

89. Somhegyi A., Varga P.P.: Fizikai aktivitás: több jelentős népbetegség kockázatának hatékony csökkentése. Egészségnevelés 2001;42:278-281.

90. Stevens J., Suchindran C., Ring K., Baggett Cd., Jobe Jb., Story M., Thompson J, Going Sb., Caballero B.: Physical activity as a predictor of body composition in American Indian children. Obes. Res. 2004;12(12):1974-1980.

91. Szatmári Z.: Sport, életmód, egészség. Akadémia Kiadó, Budapest, 2009.

92. Széles Gy.: Táplálkozás. (In: Országos Lakossági Egészségfelmérés OLEF2000. Eds.: Boros, J., Németh, R. & Vitrai, J), Országos Epidemiológiai Központ, Budapest, 2002. www.oszmk.hu/dokumentum/OLEF_2000/kutatasi_jelentes.pdf

93. Sziva Á., Szabó T.: Különböző sportágak élvonalbeli fiatal sportolóinak kardiorespiratorikus jellemzői. Magyar Sporttudományi Szemle 2003;3:37.

94. Takada K., Sugita S., Ikeuchi R., Okuda N., Fujinami T.: Body composition measurement by electrical bio-impedance method to establish the effect of daily physical training in adolescents. Med. Prog. Technol. 1993-94;19(4):187-192.

95. Tatár A., Zsidegh M., Prókai A., Vajda I., Völgyi E., Mészáros J.,: Sportoló és nem sportoló fiúk testi felépítése és fizikai teljesítménye. Magyar Sporttudományi Szemle 2003;3:38.

96. Tilson E. C., McBride C. M., Albright J. B., Sargent J., D.: Smoking, exercise and dietary behaviours among mothers of elementary school-aged children in a rural North Carolina County. J. Rural Health, 2002;18:547-555.

97. Tompa F. (szerk.): Útmutató a tanulók fizikai állapotának méréséhez, minősítéséhez. Oktatási minisztérium. Budapest, 2000.

98. Tsekouras Y. E., Kavoura S. A., Campagna A., Kotsis Y. P., Syntosi S. S., Papzoglou K., Sidossis L. S.: The antropometrical and physiological characteristics of elite water polo players. Eur. J. Appl. Physiol. 2005;95:35-41.

99. U.S. Department of Health and Human Services: The health consequences of smoking: a report of the surgeon general. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2004.

100. Vergeer F., Leeuwe J.: A "jól-lét" fogalma az egészségnevelésben. Egészségnevelés 2002;43:63-65.

101. WHO: Obesity: preventing and managing the global epidemic. Technical Report Series 894. Geneva, 2000

102. Wittich A., Oliveri M. B., Rotemberg E., Mautalen C.: Body composition of professional football (soccer) players determined by dual x-ray absorptiometry. J. Clin. Densitom. 2001;4(1):51-55.

103. World Health Organization: Preventing chronic diseases: a vital investment. 2005. Geneva. http://www.who.int/chp/chronic_disease_report/full_report.pdf

104. World Health Organization Regional Office for Europe: Gaining health. The European strategy for the prevention and control of noncommunicable diseases. 2006. http://www.euro.who.int/__data/assets/pdf_file/0008/76526/E89306.pdf

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APPENDIX

Magyar nyelvű összefoglaló

A RENDSZERES TESTEDZÉS HATÁSA AZ EGÉSZSÉGI ÁLLAPOTRA ÉS AZ EGÉSZSÉGMAGATARTÁSRA

Bóka Ferenc

BEVEZETÉS

Az egészség, a jó közérzet kialakulása függ az életmódtól, így a mozgásos aktivitástól, az aerob edzettségtől, a helyes étrendtől, a munka, terhelés, pihenés arányainak optimális megválasztásától, a szórakozásra, kikapcsolódásra, hobbikra szánt idő mennyiségétől, az öltözködési-, testápolási higiénétől, a társas viszonyok rendszerétől, az ezekhez kapcsolódó érzelmektől, a hierarchikus kapcsolatoktól, a meggyőződésektől, a világnézettől, a vallásos eszmétől.

A civilizáltság egyik következményeként a mai kor embere nagyon keveset mozog. Egyre kényelmesebb az élet, mind több a gépek által végzett munka, és egyre csökken a testmozgás aránya a mindennapjainkban. A sport segít szabadidőnket helyesen eltölteni, hozzájárul egészség fejlesztéséhez, támogatja az egészséges testi fejlődést, vagy a fejlettség megtartását. A személyiség- és a képességfejlesztés, valamint a kultúra átadása révén a sport célja végső soron az egészséges életmódra nevelés, az egészség megőrzése és fejlesztése.

A sport magatartásformáló szerepe mellett, a sporttudományi kutatások egyik kiemelt területe a nemzetközi szinten eredményes sportolók testméreteinek, testi felépítésének, testösszetételének és élettani teljesítőképességének vizsgálata. A sportágak vagy sportág csoportok versenyzői jellemző testi felépítéssel és kondicionális tulajdonságokkal rendelkezhetnek, melyben ebben egyformán szerepet kap a természetes szelekció, az öröklött tulajdonságok és az edzés hatásának következményei. Vannak sportágak, amelyekre különös mértékben jellemző a sportág-specifikusság.

A vizsgálat célja egyrészt különböző fizikai aktivitású 10-25 éves fiú/férfi népesség egészségi állapotának, egészségmagatartásának, antropometriai jellemzőinek és fizikai teljesítőképességének felmérése, és ezek összefüggéseinek elemzése, másrészt az utánpótlás korú (10-13 éves) labdarúgók körében alkalmazott edzési módszerek eredményességének bemutatása volt a fiatalok testi fejlettségének és kondicionális paramétereinek követéses vizsgálata alapján.

VIZSGÁLT SZEMÉLYEK ÉS MÓDSZER

Az önkitöltéses kérdőíves megkérdezésből, valamint antropometriai és kondicionális mérésekből álló keresztmetszeti vizsgálatban különböző fizikai aktivitású 10-25 éves férfiak (n=330) vettek részt, közülük 98 (29,7%) 10-13 éves, 104 (31,5%) 14-17, 128 (38,8%) pedig 18-25 éves volt. Sportaktivitásukat illetően nem sportolók (64 fő, 19,4%), rekreációs sportot

végzők (65 fő, 19,7%) és igazolt sportolók (201 fő, 60,9%) – labdarúgók, kézilabdások, vízilabdások és kajak-kenusok – voltak. 2008-ban a 10-13 éves labdarúgók (16 fő) és nem sportoló kontroll csoportjuk (20 fő) körében az antropometriai és kondicionális jellemzők ismételt felmérésére került sor.

A nem sportolók kiválasztása véletlenszerűen történt négy általános és négy középiskola, illetve a Szegedi Tudományegyetem azon tanulói/hallgatói közül, akik a testnevelés órákon kívül más rendszeres testmozgást nem végeztek. A rekreációs csoportba olyan személyek kerültek be, akik a testnevelés órákon túlmenően legalább heti 2 alkalommal sportolnak iskolai keretek között. A sportolók kiválasztása a Szegeden működő egyesületek versenyzői közül célzottan történt az egyes korosztályokban igazoltak köréből.

A kérdőíves felmérés a szociodemográfiai jellemzőkre, a sportolási szokásokra, a szülők, barátok sportolási szokásaira, az egészségmagatartásra és egyes egészségi állapot jellemzőkre (ismert krónikus betegségek, saját egészség megítélése) terjedt ki. Az antropometriai vizsgálatok során testtömeg, testmagasság és testzsír mérés történt, míg a kondicionális mérések (Cooper futás, fekvenyomás stb.) az állóképesség és az edzettség meghatározására irányultak.

EREDMÉNYEK, MEGBESZÉLÉS

Rendszeres, illetve alkalmi dohányosnak vallotta magát a megkérdezettek 12,4%-a, fizikai aktivitás szerint szignifikánsan magasabb volt a dohányzás gyakorisága a nem sportolók körében. A megkérdezettek 67,0%-a fogyasztott már alkoholt, 10,5%-uk pedig kipróbált már valamilyen drogot életében. Mind az alkohol, mind a drogfogyasztás életprevalenciája szignifikánsan alacsonyabb volt a versenysportoló csoportban. Napi rendszerességgel fogyasztott gyümölcsöt a megkérdezettek 74,8%-a, nyers zöldséget 35,3%, míg párolt zöldséget vagy főzeléket 23,3%. A gyümölcs- és a zöldségfogyasztás egyaránt a versenysportolóknál volt a leggyakoribb, de fizikai aktivitás szerint szignifikáns különbség csak a gyümölcs vonatkozásában volt megfigyelhető.

Ismert krónikus betegsége a megkérdezettek 10,0%-ának volt, a gyakoriság a fizikai aktivitás szerint nem mutatott különbséget. Az egészség önértékelése kapcsán a „nagyon rossz”, illetve „rossz” minősítés aránya igen alacsony (4,6%) volt, a többség (77,7%) azt „jó”-nak, vagy „kiváló”-nak minősítette; fizikai aktivitás szerint a legjobb minősítést a versenysportolók adták; többváltozós vizsgálat szerint a fiatalabb életkor, a versenyszerű

fizikai aktivitás, az alkohol mellőzése, a napi rendszerességgel történő gyümölcsfogyasztás, valamint a krónikus betegségek hiánya szignifikánsan jobb szubjektív megítéléssel járt együtt.

Az antropometriai mérések szerint az idősebbek és a kevésbé aktívak kedvezőtlenebb képet mutattak. A kondicionális mérések korcsoportonkénti vizsgálata is rosszabb eredményeket mutatott az idősebbek körében. Fizikai aktivitás szerint egyértelműen a versenysportolók nyújtották a legjobb teljesítményt. Sportágak szerint a legjobb eredményt a labdarúgók és a kajak-kenusok érték el, mivel az ő terhelési módszereik hasonlítanak a leginkább a mérési teszthez. A leggyengébb teljesítményt a vízilabdások nyújtották, amely összefüggésbe hozható robosztusabb alkatukkal és a vízi közeggel, amely más izomcsoportokat fejleszt.

Az utánpótláskorú labdarúgók és a nem sportoló kontrollcsoport között a testi fejlettséget illetően nem volt lényeges különbség sem a 2006-os, sem pedig a 2008-as felmérés alapján, a kondicionális mérések azonban mindkét vizsgálati évben a labdarúgók jobb teljesítményét mutatták.

KÖVETKEZTETÉSEK

Az eredmények alapján megállapítható volt, hogy a fizikai aktivitás és a vizsgált életmódi tényezők összefüggést mutattak egymással; a legegészségesebben a versenyszerűen sportolók éltek. A mozgásos életmód nagyobb valószínűséggel társul más egészségfejlesztési/megőrzési tevékenységekhez is, így elősegíti az egészségtudatos magatartás kialakulását.

A fizikailag aktív életmód pozitívan hatott az egészségi állapot önértékelésére is; a sportolók szubjektíve jobbnak ítélték az egészségüket, annak ellenére, hogy objektíve – a krónikus betegségek gyakorisága alapján – nem volt jelentős eltérés a különböző fizikai aktivitású csoportok között.

Az egészséges testi és lelki fejlődés megalapozására legfőképp gyermekkorban lenne szükség. A sportolás, a testedzés elterjedésében rendkívül fontosak a gyermek környezetéből származó életmódminták. Igen lényeges, hogy a gyermeket fiatal korától a testnevelés és a sport terén is rendszeres és egységes nevelő hatások érjék. Ebben szerepet kell vállalnia a szülőknek, a pedagógusoknak, a versenyszerűen sportolók esetén pedig az edzőknek is, az utóbbiak ugyanis nemcsak az adott sportág „professzionális” elsajátításáért felelősek, hanem a fiatalok mentális képzéséért, az egészséges életmód, a szenvedélybetegségektől való mentesség, védelem kialakításáért is.

Eredményeink rámutattak arra, hogy a testmozgás egészségmegőrző és -fejlesztő funkcióval is rendelkezik, éppen ezért a fenti tényezők közül, különösen a fiatalok körében kiemelt jelentőségűnek tartjuk a fizikai aktivitás fontosságának elfogadtatását, a rendszeres – még ha nem is versenyszintű – testedzés elterjesztését, amely változások jelentős előrelépést hoznának a lakosság egészségi állapota javulásában is.

Vizsgálataink alátámasztották az utánpótláskorú labdarúgók körében végzett edzés módszereknek a fejlődésre gyakorolt hatását: a 10-12 éves korban megtörténő fizikális képzés kellő alapot biztosít a 13-14 éves kor után előtérbe kerülő kondicionális képzéshez. Az alkalmazott edzés módszernek a fizikai teljesítményre gyakorolt pozitív hatása mellett, ki kell emelni azon eredményeket is, amelyek a labdarúgók sportsikereiben mutatkoznak meg. A Tisza Volán Focisuli történetének legeredményesebb csapataként az elmúlt években számos hazai és nemzetközi tornán első-második helyezést értek el, valamint 7 korosztályos válogatott labdarúgó került ki közülük (5-95', 1-96'os 1-94' leány korosztályban).

A futballvilág egy piramishoz hasonlítható. Az élvonal csak akkor működhet, ha az alap erős, és ez az utánpótlás. Minél magasabb a piramis csúcsa, annál szélesebb az alapja. Egyértelműen kijelenthetjük, hogy felnőtt labdarúgásunk csak akkor fog jelentős és tartós javuláson átmenni, ha az utánpótlás korú labdarúgók képzését a modern módszerek, a sporttudomány eredményeinek alkalmazásával végzik. A hazai labdarúgás hosszú távú és eredményes javulását az utánpótlás képzés megújításával lehetne elérni, melyhez megfelelő szakemberekre és tárgyi feltételekre lenne szükség, s amelynek egy szervezetten működő iskolai labdarúgás lehetne az alapja.

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