

**THE EFFECT OF REGULAR PHYSICAL ACTIVITY ON HEALTH  
AND HEALTH BEHAVIOUR**

**Summary of Ph.D Thesis**

**Ferenc Bóka**

Department of Public Health  
Faculty of Medicine  
University of Szeged

**Szeged**

**2010**





## Introduction

The Constitution of the World Health Organization 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'.

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.

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. 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.

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. 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.

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 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.

## Materials and methods

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).

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. 12 of the questionnaires in the survey were 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). Age, physical activity, sports were taken into consideration during the selection of participants. 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.

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 anthropometric measurements included body mass, body height, body fat percent (BF%), upper arm girth and shoulder width. 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, while anaerobic capacity was measured by the Burpee test performed in two minutes. 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). Training volume was characterized by the weekly average time (frequency and length of training sessions).

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.

Univariate analyses were done by chi-square test and one-way ANOVA (analysis of variance) followed by post hoc Scheffé 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 and 95% confidence intervals were calculated for each variable. The association between the self-rated health and the frequency of symptoms was analysed on the basis of the Pearson's correlation coefficients.

For each age group and sport, mean and standard deviation of the anthropometric and performance characteristics was calculated. Comparisons of anthropometric and physical performance measures were done by one-way ANOVA or non-parametric Kruskal-Wallis test.

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.

## **Results**

There was significant difference in the educational level of mothers: in case of highly active athletes the education level of mothers was significantly higher; meanwhile in case of fathers this correlation could not be observable.

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

The social environment – the sport activity of parents, friends – has shown significant difference in case of people with different physical activity.

12.4% of the interviewees claimed themselves regular or occasional smokers, 4.5% 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.

Two-thirds of the respondents have already consumed alcohol, 10.5% have already tried some form of drugs. The life-prevalence of

alcohol and drug consumption was significantly less in the group of professional athletes. The proportion of drug triers was the highest in the group of recreational athletes. Drug consumption mainly meant trying out marijuana.

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.

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.

Generally, diet of young adults (aged 18-25) was proven to be worse in dependence of age. 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, milk, brown bread, vegetables, fruits, poultry and snacks, 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 health status (body mass index, self-rated health).

Vitamin and nutrition supplement consumption by age groups and physical activity, have shown significant difference. Professional athletes consumed more vitamins; while recreation athletes consumed more nutrition supplements.

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 (non smoking, healthy diet and physical activity), and only 2.4% had none of them. In the multivariate logistic regression model, health promoting behaviour was significantly associated with age ( $p < 0.001$ ) and education level of mothers ( $p = 0.043$ ); while the education level of father did not influenced significantly the behaviour of their children.

10% of the interviewees had some known chronic diseases; the frequency did not show any difference according to physical activity. Based on the 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; by physical activity the best evaluation was given by professional athletes.

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.

Based on the measuring of body mass index (BMI) 41.8% of the examined people were either overweighted or obese. 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, 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.

According to body fat (BF%) measuring examinations 82.7% of the subjects belonged to the normal category, 12.1% had a moderate overweight and 4.8% was only obese. There were no significant differences according to age-groups and physical activity, but in the sports category there were also considerable differences ( $p = 0.003$ ).

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: the best performance was shown by the 10-13 year-old age group, the pro-athletes and within that the football players.

Based on the results of the Burpee test 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.

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.

There were correlation between BMI and other anthropometric parameters. 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.

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.

Throughout the survey in 2006 the anthropometric attributes of the two groups did not show significant difference, except in case of the average of BMI and shoulder width; the upper body muscle of the inactive proved to be more developed. The physical performance proved to be significantly better in case of football players than the inactive, except the maximal strength.

There was no considerable difference between the groups concerning anthropometric parameters throughout the survey in 2008; however the measuring of physical condition definitely showed better performance regarding football players. The results of one-sample t-test of the 2006 and 2008 survey showed significant changes in both groups and concerning all examined parameters.

## Discussion

Based on the results it could be concluded that there is correlation between physical activity and examined life style factors: the healthiest lifestyle was demonstrated by professional athletes. 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. 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.

Based on the health promoting behaviour index applied to the collective occurrence of health supporting behaviours – non smoking status, healthy nutrition, physical activity – it could be concluded that among youngsters the proportion of these was considerably higher, whereby all three of the favourable health behaviour occurred collectively, than in the general national sample.

Physically active life, in case of this survey as well, positively affected the self-assessment of health; 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.

The frequency of the symptoms involved in our study had an influence on self-rated health; those who had fewer symptoms tended to evaluate their own health significantly higher. The psychological well-being parameters showed negative correlations with self-rated health, in case of fewer complaints the self-evaluation was better. Increased level of sports had positive relationship with self-rated health; physically active people considered their state of health much better.

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 choice of sport can, however, itself be 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. 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.

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 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.

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

The technical, physical capabilities and strength enhancement of the youngsters need to be solved in a way that it does not prevent, but helps improving the development of technical-tactical capacitation, especially in that age, when the relevant organs, organ-systems are still in the massive quantitative changing period.

Besides the positive effect of applied training method on physical performance, the sport successes of football players have to be emphasized, too. As this team was the most successful in the history of Tisza Volán Focisuli, they managed to reach first and second ranking in many international tournaments, and there are seven players who 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.

## **Conclusions**

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

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.

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. In a young population, that is free from chronic diseases, psychosomatic symptoms and psychological well-being have important role in self-rated health; the latter has strong correlation with positive effects of physical training.

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 results of the follow up study between young football player and their inactive control group showed the positive effect of applied training method 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 player.

## LIST OF PUBLICATIONS RELATED TO THE THESIS

1. **Bóka F.**: 5-12 éves utánpótlás korú labdarúgók képzése. Magyar Sporttudományi Szemle 2007;8(4):36-38.
2. **Bóka F.**, Majoros A.: Londoni szakmai út egy utánpótlás edző szemszögéből. Magyar Edző 2007;10(1):19-21.
3. **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
4. **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.
5. **Bóka F.**, Varga Á.: A női vízilabdázás helyzete Szegeden. Magyar Edző 2008;11(2):31-33
6. **Bóka F.**, Nagymajtényi L., Paulik E.: Anthropometric characteristics and physical performance in young athletes in Hungary. Fiziologia – Physiology, 2008;18.3(59):8-11.
7. Paulik E., Nagymajtényi L., **Bóka F.**: Különböző fizikai aktivitású fiatalok egészségmagatartása és az egészségi állapot szubjektív megítélése. Egészségfejlesztés 2008;49(5-6):2-7.
8. 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.
9. 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
10. **Bóka F.**, Nagymajtényi L., Paulik E.: Dietary behaviour in young men of various levels of physical activity. Acta Alimentaria 2010 (Accepted for publications) IF:0.505

## LIST OF CITABLE ABSTRACTS RELATED TO THE THESIS

1. Paulik E., Nagymajtényi L., **Bóka F.**: A fizikai aktivitás szerepe a fiatalok egészségmagatartásának alakításában. Népegészségügyi Tudományos Társaság XV. Nagygyűlése, Előadás összefoglalók, Siófok, 2006. p. 105.
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 éllabdárúgók 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.

## **Acknowledgements**

I would like to thank to Prof. Dr. László Nagymajtényi, Head of the Department of Public Health, that I have been accepted as Ph.D. student for an unconventionally short period and gave the opportunity to perform research work.

I would like to express my grateful thanks to Dr. Edit Paulik, Associate Professor of the Department of Public Health for her scientific guidance and consultative support throughout the elaboration of this thesis.