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THE INFLUENCE OF PHYSICAL ACTIVITY ON BODY COMPOSITION AND THE LEVEL OF STUDENT'S FLEXIBILITY

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Abstract

Introduction. The purpose of the study was to assess the impact of physical activity on the body ingredients and the level of flexibility among students with various levels of physical activity.

Material and methods. The study involved 235 physical education students and 142 physiotherapy students (171 females and 206 males). The results provided information regarding their levels of physical activity. Their body ingredients were determined with the use of a Tanita BC 418 MA analyser. Their level of flexibility was assessed using the Modified Sit-and-Reach Test.

Results. The results of the study demonstrated a significantly lower body mass, lower fat content, lower value of the BMI index as well as a significantly higher level of flexibility ($p<0.001$) among students of physical education, compared to the students of physiotherapy.

Conclusions. The results indicate a positive impact of increased physical activity on the correct body mass as well as a very good level of flexibility.

***Key words**: body composition, flexibility, students*

Introduction

One of the factors that make it possible to maintain good health is physical activity. Low physical activity increases the risk of obesity, ischaemic heart disease, increased content of triacylglyceroles and low-density lipoproteins in the blood (LDL), arterial hypertension, cerebral stroke, post-meal postprandial hyperinsulinaemia and carbohydrate intolerance, type-two diabetes, osteoporosis, malignant neoplasms (colon, prostate, lung, breast), depression and others. What can also be observed is a negative impact on the immune system, resulting in lowered immunity and an increased vulnerability to contagious diseases. Insufficient physical activity may also lead to dysfunctions of the motor system and the spine, pains, and ultimately to the further limitation of motor activity.

The concept of physical fitness, so heavily promoted in our times, is aimed at health (Health–Related Fitness). It emphasises the components of fitness that positively affect human health (1).

One of the important elements of physical fitness is flexibility, the specific property which is closely connected with the structure and function of the motor system, determining the range of motion in a joint or group of joints possible to be achieved without injury (2-4). In dynamic exercises, e.g. in sport, a very important role has dynamic flexibility which is described as the ability to perform motion within a group of joints in the optimal range (4). A good level of flexibility determines the optimal motion technique and high economics of energetic transformations in the body as well as reduces the risk of strain and injury. It may be said, therefore, that flexibility has an important impact on the level of mastery in sport.

The range of motion within a joint depends on a number of factors: the anatomic construction of the joint, the strength and flexibility of ligaments, tendons and muscles, as well as the content and the stretching ability of the joint capsule. These features depend on the efficiency of the nervous system (muscle tonus, proprioception), hormones as well as genetically-conditioned type of collagen (5). In addition, flexibility depends on the gender, age and physical activity. It is emphasised that the correct level of flexibility makes it possible to maintain the optimal spatial structure of motion, which significantly affects the strength, speed and economics of the muscles (4,6)

The range of motion within joints as well as the so-called joint stiffness are lowered due to injuries, reduced physical activity or immobilisation as well as the effect of aging of the body. Reduced joint mobility results from numerous changes within the intra-articular, pariarticular and parosteal tissues, within the skin and the hypodermis, and others. The negative changes may also be brought about in the muscles, which lose their flexibility, become shorter and are subject to atrophy. Their muscle tone increases, thus increasing the risk of strain, tendon and muscle inflammations as well as torn ligaments (5,7,8). Shortened muscles may also result in an incorrect body posture and pains in the low back (9). Other factors that may contribute to limited mobility within joints include, for instance, systemic disease, infections, inflammation processes, degeneration changes, pain, etc. (5).

Serious dysfunction of the motor system may result from hipermobility within the joint and from destabilisation. A joint with hipermobility is always strained and the micro-injuries accumulate, thus leading to an untimely wear and degeneration changes (5,6).

Joint flexibility examinations are commonly used both in physiotherapy and in the other areas of physical education. In motor system ailments, measurements of the range of motion within joint serve as the basis for assessment of their functional condition and a yardstick for effective rehabilitation. Clinical studies usually involve measuring the range of motion within a joint using various types of protractors. In physical education and sport, assessment of flexibility comprise a part of numerous commonly used batteries of tests to assess physical fitness. The tests usually serve as the basis for a general assessment of flexibility in multiple joints. One of such tests is the Sit-and-Reach Test, developed by Wells and Dillon (10 cited from 2). The test consists in measuring the maximum reach of the fingers in a forward bend, with legs straight in knees in the sitting position. In most cases, the zero point, from which the reach of the bend is measured, is assumed on a arbitrary basis, which negatively affects the precision of the measurement of the level of flexibility. This is because it is common knowledge that specific individuals may have various proportions of limbs and the trunk, which may have a significant effect on the result of the measurement (e.g. individuals with relatively short lower limbs compared to the trunk and the upper limbs will achieve better results). For these reasons, in the recent years, a Modified Sit-and Reach Test is becoming more popular (11). In this test, the effect of length and proportion of the limbs and the truck has been eliminated by setting the zero point at the end of the outstretched fingers in the initial position, i.e. while seated straight (11,12). Numerous studies have proved the high accuracy and reliability of this flexibility test, especially with respect to hamstring muscle group (11,13,14).

The objective of the study was to assess the impact of physical activity on the body components as well as on the level of flexibility among male and female students of the Departments of Physiotherapy and Physical Education.

Material and methods

The study was conducted on 171 female and 206 male students, who declared that over the previous 12 months that they had not competitively practised any sport. They took part in obligatory physical activities under their course of study, in the average amount of 104 minutes (students of physiotherapy) and 228 minutes per week (students of physical education). Moreover, the students of physiotherapy declared additional physical activity in the amount of 12 (females) and 30 (males) minutes per week, and the students of physical education in the amount of 48 (females) and 114 (males) minutes per week. The total average number of hours of physical activity among the studied group of students amounted to, respectively: - students of physiotherapy – 116 (female) and 134 minutes per week (males); - students of physical education – 276 (female) and 342 minutes per week (males).

Prior to assessing of flexibility with the test groups, their basic somatic indices were recorded. The analysis of their body composition involved the use of a Tanita - BC 418 MA (Tanita Corporation, Japan) body composition analyser according to the Bioelectric Impedance Analysis method. Once their body composition were determined, and before the flexibility test, the studied groups performed a standard five-minute warm-up. Assessment of flexibility were taken using the Modified Sit-and-Reach Test according to the procedure described in literature (11,12). In this test subject sits on the floor with buttocks, shoulders, and head in contact with the wall; extends the knees; and places the soles of the feet against the box. A ruler is placed on top of the box with the zero end toward the subject. Keeping the head and shoulders in contact with the wall, the subject reaches forward with one hand on top of the other, and the ruler is positioned so that it touches the fingertips (Fig. 1). This procedure establishes the relative zero point for each subject. As you firmly hold the ruler in place, the subject reaches forward slowly, sliding the fingers along

Fig.1. *Modified Sit-and-Reach Test. Initial position.*

Fig.2. *Modified Sit-and-Reach Test. Final position.*

the top of the ruler. The score is the most distant point on the ruler contacted by the fingertips (Fig. 2).

The results of the study were analysed using the ANOVA statistic method, and the STATISTICA 7.0 software (Stat Soft Inc., USA).

Results

Table 1 shows the values of selected somatic indices as well as the results of the flexibility test.

The female students of physiotherapy demonstrated a significantly higher body mass ($p<0.05$), higher fat content ($p<0.001$), and consequently higher values of the body mass index - BMI ($p<0.05$), compared to the female students of physical education. According to the standards of World Health Organisation (WHO), both groups demonstrated a correct body mass.

Similar results were obtained among both male groups. The physiotherapy students proved to have significantly higher body mass values ($p< 0.001$) and higher fat content ($p< 0.001$), which led to higher values of the body mass index BMI ($p<0.001$), compared to the students of physical education. According to the standards of World Health Organisation (WHO), the students of physical education had correct body mass values, whereas the students of physiotherapy were overweight.

In the Modified Sit-and-Reach Test, the female students of physiotherapy achieved results that was poorer (by 6,3 cm) than that of the female students of physical education (Tab. 1). The difference was important statistically ($p< 0.001$). According to the centile ranking for this test (11), the result achieved by the female students of physiotherapy was approx. 30 centiles, whereas the female students of physical education achieved approx. 70 centiles.

Very similar differences were observed between the male groups. The students of physiotherapy achieved 6.4 cm less compared to the students of physical education. The difference was important statistically ($p< 0.001$). According to the centile ranking for this test (11), the result achieved by the students of physiotherapy was approx. 30 centiles, whereas the students of physical education achieved over 67 centiles.

The study proved a higher level of flexibility among the females. The difference between the female and male students of physiotherapy amounted to 1.4 cm, and between the female and male students of physical education amounted to 1.3 cm. In both cases, the differences were insignificant statistically as they indicated a marginal impact of gender-related conditions on the level of flexibility.

Discussion

The main objective of the present work was to attempt to determine the impact of physical activity on the level of flexibility. The study involved students with low and high levels of physical activity (physiotherapy and physical education, respectively). The results showed that greater physical activity among the female and male students of physical education was accompanied by more favourable proportions of body components and lower values of the BMI, as well as higher levels of flexibility, compared to the female and male students of physiotherapy. Numerous works have demonstrated the positive effect of increased physical activity on the reduction of the fat content (15,16).

The greater physical activity among the female and male students of physical education was also accompanied by a higher level of flexibility. It seems that the decisive factor with respect to the level of flexibility is the amount and type of physical activity. Flexibility may, and should be, developed by systematic stretching exercises. Here, it should be emphasised that both in everyday life and in sport it is advisable to aim at an optimal, not a maximal level of flexibility. In view of the literature, Thacker et al. (6) presented a logical model of mutual relations between stretching exercises, the muscle effort capability and the risk of injury.

Some works indicate a relation between an impro-

Table 1. *Somatic characteristics and level of flexibility (M ± SD) physical education (FE) and physiotherapy (Ph) students*

Group	n		Age (yrs)	Ht (cm)	BM (kg)	BF (%)	BMI (kg/m^2)	F (cm)
Female								
FE	71	M	22.2	164.7	57.7	23.0	21.1	41.1
		SD	3.3	5.1	6.8	4.6	2.2	6.8
Ph	100	M	24.6	164.4	59.7*	25.8***	22.1*	34.5***
		SD	2.3	5.7	10.5	6.3	3.7	6.3
Male								
FE	164	M	22.4	179.8	77.2	13.3	23.9	39.5
		SD	2.7	6.7	10.9	4.6	2.8	9.1
Ph	42	M	24.8	180.5	86.7***	17.7***	26.6***	33.1***
		SD	2.1	5.7	13.3	5.1	3.7	8.1

* $p<0.05$; *** $p<0.001$; Ht – body height; BM – body mass; BF – body fat content; BMI – body mass index; F - flexibility

ved level of flexibility and a reduced risk of injury (17-19). On the basis of numerous experimental studies related to the impact of various strategies on lowering the risk of injury in sport, Abernethy and Bleakley (20) recommend the use of a preventative training program, including, for instance, strength training and flexibility training.

According to Alter (21), females demonstrate definitely higher levels of flexibility than males. In the present study, this view was not confirmed. No significant gender-related differences were observed between male and female students of physical education and physiotherapy. This confirms the thesis that physical activity is a factor with a greater impact on the level of flexibility than gender (12).

The results of the flexibility test among the male and female students of physical education, with 67-70 centiles should be considered very good. The results among the male and female students of physiotherapy, with approx. 30 centiles, should be considered poor. Logically, it may be concluded that the level of physical activity was a decisive factor on the level of flexibility in the groups under study. High and systematic physical activity among the male and female students of physical education resulted in a very good level of flexibility. On the other hand, the low level of physical activity among the male and female students of physiotherapy significantly affected their level of flexibility, which was poor in this case.

Conclusions

1. The less favourable body proportions among the male and female students physiotherapy, compared to those of the male and female students of physical education, were probably a result of their very low level of physical activity.
2. The study indicates a significant effect of physical activity on the level of flexibility. The low physical activity among the male and female students of physiotherapy was accompanied by a low level of flexibility, whereas high physical activity among the male and female students of physical education was accompanied by a high level of flexibility.
3. No significant differences in the level of flexibility between the female and male students of the same line of study proves that physical activity is a factor of greater importance than gender.

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Authors' contribution
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection