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Generation changes over the period of 1986-2006 in the physical fitness of boys aged 7-19 from eastern Poland at particular stages of education

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Summary

Study aim: To assess the size of secular trends in the physical fitness of boys from eastern Poland taking into consideration stages of education.
Material and methods: The physical fitness results of boys aged 7-19 years living in eastern regions of Poland were analyzed: 3188 students were examined in 1986 while in 2006 the research included 10 810 boys. In both examinations (1986 and 2006), the level of motor abilities was measured according to the guidelines of the International Physical Fitness Test. The individual results of children and youth examined in 2006, which took into account calendar age, were converted into points on a T scale, with means and standard deviations from 1986 accepted as norms. On the basis of the obtained point values and taking into account stages of education (7-9 – integrated teaching, 10-12 – primary school, 13-15 – lower-secondary school, 16-18 – upper-secondary school), arithmetic means and dispersion values concerning motor abilities in the groups were calculated. Individual results in motor abilities of every subject were used to define quantitative generation changes. Differences between the means obtained in 1986 and 2006, as well as between the fractions of boys qualified for respective fitness category in both examinations, were assessed.
Results: Over the 2-decade period the boys from eastern Poland slightly improved their results only as far as sit-ups are concerned (1.47 points), while the level of bent arm hang, handgrip, 50 m run, and shuttle run 4×10 m remained the same. In contrast, negative changes were observed in the long run (4.44 points), the sit-and-reach test (4.47 points), and the standing broad jump (3.74 points). The greatest decline in motor abilities was noted amongst schoolchildren from integrated education classes (2.69 points); whereas the smallest decline was noted in adolescents from lower secondary schools (0.60 points).
Conclusions: The changes noted in physical fitness indicate that in the context of health the revision of the Act on Physical Culture from 2002, which reduced the number of school's physical education classes, is a debatable issue.

Key words: Physical fitness – Boys – Generation changes – Eastern Poland

Introduction

At present, the acceleration of the maturation of children and adolescents, as well as the increase in their body height and body mass, has been observed globally [1,3–5, 11,14,20]. It is noteworthy that greater increases are observed in body mass compared to in body height, which affects the increase in the value of the BMI and, consequently leads to an increase in the numbers of girls and boys with overweight and obesity [2,9,23]. So tangible changes have not been observed in the physical fitness of children and adolescents. In Europe and beyond, declines have been reported in the level of selected motor abilities of children and youth, as documented by, inter alia, Malina *et al.* [10], Lewis *et al.* [8], Molinre-Urdiales *et al.* [12], Runhaar et al. [16], and Smopokos *et al.* [21]. These authors have claimed that the rate of generation changes in the basic somatic traits, maturation, and physical activity depended on the socioeconomic status of their country or region and on the living standards of their populations.

A similar tendency for change in the described developmental variables has been observed in Poland. An in-depth analysis of environmental factors made it possible to conclude that the environment itself is subject to transformations at a different rate in different regions of the country. Hence, the time variability of somatic traits and the variable rate of biological maturation in different regions and social environments has been confirmed in studies by Łaska-Mierzejewska and Olszewska [7], Przewęda and Dobosz [15], Saczuk and Wasiluk [19], and others.

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An overview of literature indicates that the course of changes in the physical fitness of children and adolescents is different in various regions of the country. After the observed positive trends, the earliest decrease in the results of motor tests was noted by authors who made their observations in economically developed regions. In turn, on the basis of the national research, the aforementioned changes were noted only in the last decade of the last century [15]. In view of the above, it would seem interesting to monitor trends and the rate of changes in the level of motor abilities of young inhabitants of regions with the lowest economic indices. Therefore, the objective of this study was to determine values of generation changes in physical fitness of boys from eastern Poland at different stages of their development and to establish the size of the population affected by generation changes in the level of motor abilities.

Material and Methods

In 1986, research was undertaken to assess the physical fitness of 3188 boys inhabiting eastern regions of Poland. In 2006, the same observations were conducted with 10 810 boys in the same regions, within statutory research of the University of Physical Education in Warsaw. The detailed information on the number of boys from different educational stages in particular observation periods is provided in Table 1.

Table 1. The number of boys examined in 1986 and 2006

Stage of education	1986	2006	Total
Integrated education (7-9 years)	513	1261	1774
Primary school (10-12 years)	912	3477	4389
Lower-secondary school (13-15 years)	939	3000	3939
Upper-secondary school (16-19 years)	824	3072	3896
Total	3188	10 810	13 998

In both surveys (1986 and 2006), motor abilities were evaluated according to the guidelines of the International Physical Fitness Test [6] through the following tests: 50 m run, shuttle run 4×10 m (SHR), long run (LOR) at a distance of 600 m (up to 12 years of age) or 1000 m (over 12 years of age), standing broad jump (SBJ), bent arm hang (BAH), sit-ups (SUP), handgrip (HGR), and the sit-and-reach test (SAR). In order to determine generation changes in physical fitness, all individual results of children and adolescents evaluated in 2006 were converted into points on a T scale, with means and standard deviations from 1986 accepted as norms. In these calculations, the calendar age of study participants was taken into consideration. On the basis of the obtained point values, the arithmetic means and dispersion values concerning motor abilities in the groups took into account stages of education (7-9 – integrated education, 10-12 – primary school, 13-15 – lower-secondary school, and 16-19 – upper-secondary school). In turn, individual results in motor abilities of every subject were used to define quantitative generation changes. Taking the values of mean±1SD from 1986 as the norm, the individual physical fitness results of each participant from both observation periods were classified into the following groups:

- group I (below the norm) – boys who achieved results below the standard score (up to 39.99 points);
- group II (norm) – boys who achieved results within the range of standard score (from 40.0 to 60.0 points);
- group III (above the norm) – boys who achieved results above the standard score (over 60.0 points).

The above criteria was established assuming that on the T point scale the mean of reference group accounted for 50 points; standard deviation, for 10 points. The percentage of boys within a given age category for particular motor abilities and for overall fitness were calculated. Differences between the results in each group indicate in how many boys from 2006 the level of the described motor abilities changed as compared to the results of 1986.

The significance of differences between mean values from 1986 and 2006 was verified with the Student's t-test for independent variables. In turn, the significance of differences between the number of boys assessed in 2006 and classified to groups resulting from standard scores of the population evaluated in 1986 was determined with the chi-square test [22]. In all analyses, the level of significance was set at $\alpha = 0.05$.

Results

From 1986 to 2006, the level of physical fitness in boys attending schools in the eastern regions of Poland declined, which can be seen in both the physical fitness results and in the calculations of overall fitness (Fig. 1). The greatest negative changes were found in the students of integrated education. A statistically significant decrease was observed in the long run – by 6.72 points; handgrip – by 4.37 points; sit-and-reach – by 4.10 points; bent arm hang – by 3.70 points; and standing broad jump – by 3.77 points. In contrast, a similar level of results in both study periods analyzed was noted in the 50 m run, the 4×10 m shuttle run, and sit-ups.

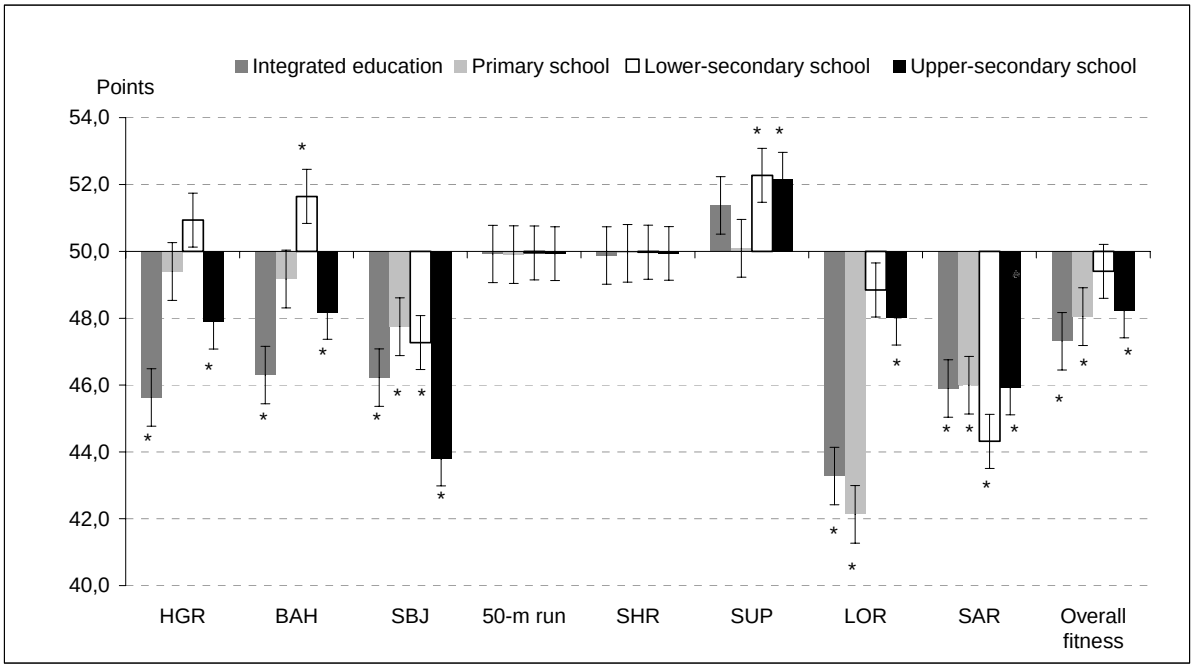

Fig.1. Results of motor abilities of boys examined in 2006, standardized against the results from 1986 (means±SD expressed in T-scale points)

Legend: HGR – Handgrip; BAH – Bent-arm hang; SBJ – Standing broad jump; SHR – 4×10m shuttle run; SUP – Sit-ups; LOR – Long run; SAR – Sit-and-reach; * Significantly ($p<0.05$) different from the results obtained in 1986

Over the 2 decades analyzed in the study, a smaller decrease in the level of physical fitness was observed in the boys from primary schools. Statistically significant differences were noted in long run (7.87 points), sit-and-reach test (4.00 points), and standing broad jump (2.25 points). In the other motor abilities, results from 1986 and 2006 were at similar levels, and the differences observed were not statistically significant. In turn, in the case of boys attending lower-secondary schools in eastern Poland and evaluated in 2006, the level of physical fitness was similar to that of the boys examined in 1986. It should be emphasized that this was not a uniform picture of changes in all motor abilities. The investigated schoolboys achieved better results in sit-ups (2.27 points) and bent arm hang (1.65 point), and worse results in sit-and-reach test (5.68 points) and standing broad jump (2.73 points).

In turn, in the oldest group of boys, results that were higher than in 1986 were only noted in sit-ups (2.16 points). In the case of the 50 m run and the shuttle run 4×10 m, small, insignificant differences were observed between the results. In the case of the other motor abilities, worse results were recorded in: standing broad jump – by 6.22 points; stand-and-test – by 4.09 points; handgrip – by 2.12 points; long run – by 2.00 points; and bent arm hang – by 1.83 points.

Results concerning the overall level of physical fitness make it possible to conclude that in 2006, the number of boys who achieved results above the standard score decreased by 1.8%; the number of boys achieving results within the standard score range, – by 9.2%. In contrast, the number of boys who achieved results lower than the standard score increased by 11.1%. The above differences were statistically significant. The analysis of particular motor abilities demonstrated the most beneficial changes occurred with sit-ups, where the percentage of boys achieving results above the standard score increased by 5.5%; the percentage of boys with results within the standard score decreased by 4.9%; the percentage of boys with results lower than the standard score decreased by 0.6%. In contrast, the greatest negative changes were observed in the sit-and-reach test. In the first 2 groups analyzed, a decrease in the number of boys examined in 2006 by 6.2% and 15.4%, respectively, was noted, whereas the number of boys achieving the worst results increased by 21.6%. In the case of the other motor abilities, analyses demonstrated fewer and not always significant differences (Table 2).

Discussion

Economic development observed in many European countries and around the world contributes to the lifestyle changes of entire societies, since the development of civilization influences human lifestyles. Apart from the positive aspects, it also has a negative impact on the human body. Driving children and adolescents to schools located

Table 2. Difference between fractions of boys examined in 2006 and in 1986, classified according to fitness result

Variable	Below SS (<39.9 pts)	Within SS (40.0-60.0 pts)	Above SS (> 60.0 pts)
HGR	1.83*	-2.42*	0.60
BAH	19.18*	-17.01*	-2.15*
SBJ	16.85*	-15.04*	-1.79*
50-m run	16.32*	-9.44*	-6.87*
SHR	3.52*	-2.73*	-0.77
SUP	-0.55	-4.92*	5.50*
LOR	9.77*	-6.78*	-2.97*
SAR	21.56*	-15.38*	-6.17*
OF	11.06*	-9.21*	-1.83*

Legend: SS – Standard score; HGR – Handgrip; BAH – Bent-arm hang; SBJ – Standing broad jump; SHR – 4×10m shuttle run; SUP – Sit-ups; LOR – Long run; SAR – Sit-and-reach; OF – Overall fitness; * Significant difference ($p<0.05$)

near their residences, allowing young people to devote too much time to watching television and DVDs, or to using computers and other inventions of contemporary technology reduces their physical activity [9,21,24]. Hence, nowadays, a decrease in the level of some motor abilities of both girls and boys is being observed in Poland and other countries [15,18]. Reasons behind the decreasing physical fitness of children and adolescents are being sought in, among other things, reduced physical activity and preferences for more and more sedentary lifestyles. It affects a growing number of children and adolescents with excessive body mass, which in turn is reflected in their physical fitness. It is common knowledge that boys with overweight and obesity achieve worse results in motor ability tests [17]. These processes do not proceed at a constant rate, but are modified by the environment in which the subjects live [13,15]. The problem of the decline in physical fitness observed globally in children and youth has been noted in the areas of eastern Poland as well [17]. The negative generation changes in the level of motor abilities did not proceed with equal intensity in all age categories. In the case of boys attending lower-secondary schools in eastern Poland and examined in 2006, no decrease was noted in physical fitness compared to the results reported 20 years earlier, but only changes in its structure were observed. However, at the other educational stages a significant decline was reported in the test results. It is alarming that the greatest decrease in physical fitness results was observed in boys in the youngest age category. Hence, the introduction of physical education classes led by teachers of integrated education and not by graduates of the University of Physical Education, as is observed in many schools, is disputable.

It is noteworthy that the negative generation changes did not affect all tests of the International Physical Fitness Test. In some motor abilities, the boys examined in 2006 achieved better results than the boys evaluated 20 years earlier (trunk muscle strength), and in the case of some tests the results noted in the 2 examinations were alike (50 m run, shuttle run 4×10 m, and in 2 age categories – handgrip strength). The generation changes in the motor abilities of boys from eastern Poland may reflect their adaptation to the changing environment. Analysis of the overall physical fitness proves that the described differences were observed in 11.1% of the boys. The highest percentage of the boys showed negative changes in sit-and-reach test, whereas the greatest positive changes were observed in trunk muscle strength.

On the basis of the study results, the following conclusions and observations may be formulated: 1) The changes noted in physical fitness indicate that in the context of health the revision of the Act on physical culture from 2002, which reduced the number of a school's physical education classes, is a debatable issue, 2) In the first 3 years of primary school, physical education classes should be taught by graduates of the University of Physical Education and not by integrated knowledge teachers, since the biggest negative changes in motor abilities were observed in this age group, 3) The content of physical education classes at all education levels should be verified in order to increase the level of these motor abilities that underwent the biggest negative generation changes.

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