ORIGINAL ARTICLE

National physical education curriculum: motor and cardiovascular health related fitness in Greek adolescents

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Br J Sports Med 2003;**37**:311–314

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Accepted 23 August 2002

Background: State school physical education (PE) programmes are common throughout Greece. However, it is not known if the main objectives of the Greek PE curriculum are achieved.

Objective: To assess the current national PE curriculum in relation to selected motor and cardiovascular health related fitness parameters.

Methods: A sample of 84 Greek schoolboys (mean (SD) age 13.6 (0.3) years, height 160.7 (8.6) cm, weight 50 (10.8) kg) volunteered. Forty three indicated participation only in school PE classes and habitual free play (PE group). The remaining 41 were involved in extracurricular organised physical activities in addition to school PE and habitual free play (PE+ group). The subjects underwent anthropometric, motor (flexibility, balance, standing broad jump, hand grip, sit ups, and plate tapping), and cardiovascular health related (percentage body fat, aerobic fitness, and physical activity) fitness assessments.

Results: Children in the PE group had inferior motor and cardiovascular health related fitness profiles compared with those in the PE+ group. Body fat (20.3 (8.8) *v* 13.9 (3.5); p<0.001), aerobic fitness (34.7 (3.7) *v* 43.9 (4.2); p<0.001), and time spent in intensive physical activity (0.2 (0.2) *v* 0.7 (0.3); p<0.001) showed the greatest differences between the two groups. In the pupils in the PE group, these were lower than the levels proposed to be necessary to combat future health risks. Adjustments for confounding variables showed a decrease in the significance of motor fitness, but not in cardiovascular health related parameters.

Conclusions: The national PE curriculum for Greek secondary schools does not achieve the required levels of motor and cardiovascular health related fitness and should be reconsidered.

Physical fitness has motor and health related components.[1] Participation in physical activity during childhood can aid the development of motor abilities[2] and lay the foundation for good health,[3] especially cardiovascular health.[4] However, studies have shown that the physical activity levels of children, in general, are not sufficient to promote optimal health.[5] This has also been confirmed in Greek children, in whom low physical activity levels[6] have been linked to cardiovascular health risk factors, such as obesity[7] and low aerobic fitness.[8]

School physical education (PE) classes provide the best opportunity to fulfil the motor and health related fitness needs of virtually all children.[9] PE teachers, in particular, have the potential to influence public health by promoting pupil participation in physical activity and assisting students to establish a lifetime habit of regular involvement in physical activity. However, it has been reported that school PE provides pupils with limited opportunities to engage in activities to fulfil these needs.[10]

Irrespective of size and location, PE programmes for state secondary schools are common and compulsory throughout Greece, aiming, among other things, to attain motor skills and improve cardiovascular health related fitness. However, there is little published information on the influence of such national curricula on aspects of motor and cardiovascular health related fitness in children of different grades. Therefore, the aim of this study was to examine the current national Greek PE programme in relation to selected parameters of motor and cardiovascular health related fitness in 13 year old schoolboys.

METHODS

Subjects

A total of 84 healthy boys volunteered. This sample represented 32.4% of all 13 year old boys living in the town of Katerini (population 50 000), Greece. Forty three of the subjects (mean (SD) age 13.5 (0.3) years, height 159.9 (8.2) cm, and body mass 47.7 (10.3) kg) indicated participation only in school PE classes (40 minutes, three times a week) and habitual free play (PE group). The main aims of the Greek PE curriculum are to promote motor ability and cardiovascular endurance.

The remaining 41 subjects (mean (SD) age 13.6 (0.3) years, height 161.6 (9.1) cm, and body mass 52.5 (10.9) kg) were involved, as members of sport clubs, in extracurricular organised physical activities at least three times a week (about 45 minutes a session), in addition to their school PE classes and habitual free play (PE+ group). These activities included football, basketball, swimming, athletics, tennis, and handball. Participation was self reported and confirmed by the school PE teacher.

The research ethics committee of the University of Wolverhampton, UK, approved the investigation, and permission was granted from the Greek Ministry of Education. Written informed consent was obtained from the subjects and their parents.

Data collection

The data collected included anthropometric measurements and motor and cardiovascular health related fitness parameters,

Abbreviations: PE, physical education; MET, metabolic equivalent

Table 1 Motor and cardiovascular health related fitness parameters

Parameters	PE group (n=43)	PE+ group (n=41)	*t*-Tests	Adjusted (n=84)
Motor fitness				
SAR (cm)	19.9 (7.4)	22 (5)	NS	NS
FLB (s)	13.5 (5.9)	14.2 (5.1)	NS	NS
SBJ (cm)	179.7 (17.1)	190.4 (19.1)	p<0.01	p<0.05
HGR (kg)	30.5 (6.2)	34.5 (8.4)	p<0.05	NS
SUP (reps in 30 s)	22.8 (2.1)	24.2 (2.7)	p<0.01	p<0.05
PLT (s)	12.7 (1.7)	11.9 (1.5)	p<0.05	NS
Cardiovascular health related fitness				
Body fat (%)	20.3 (8.8)	13.9 (3.5)	p<0.001	p<0.001
$\dot{V}O_2MAX$ (ml/kg/min)	34.7 (3.7)	43.9 (4.2)	p<0.001	p<0.001
Physical activity (≥6 METs – hours/day)	0.2 (0.2)	0.7 (0.3)	p<0.001	p<0.001

Values are mean (SD).
SAR, sit and reach; FLB, flamingo balance; SBJ, standing broad jump; HGR, hand grip; SUP, = sit ups; PLT, plate tapping; Adjusted, adjusted for age, height, body mass, and participation in organised extracurricular physical activities; NS, not significant.

including information on time spent in intensive physical activity per day (≥6 metabolic equivalents (METs)). All measurements were made between October and December by the same investigator.

Anthropometric measurements

Standing height was measured to the nearest 0.5 cm (Seca Stadiometer 208) with shoes removed, feet together, and head in the Frankfort horizontal plane. Body mass was measured to the nearest 0.5 kg (Seca Beam Balance 710) with shoes, sweaters, coats, and jackets removed.

Assessment of motor and health related fitness parameters

Six motor and three cardiovascular health related fitness parameters were assessed in all subjects. Data on motor and one (aerobic fitness) of the three health related parameters were obtained using the procedures described in the Eurofit Test Handbook.[11] The six motor fitness parameters were: sit and reach (SAR), flamingo balance (FLB), standing broad jump (SBJ), hand grip (HGR), sit ups (SUP), and plate tapping (PLT) tests. Aerobic fitness was determined using the 20 m shuttle run test. The remaining two cardiovascular health measurements included percentage body fat and time spent in intensive physical activity. Brief descriptions of all the tests follow.

- SAR: Reaching as far as possible from a sitting position. This test measures the flexibility of the hamstrings, buttocks, and lower back.
- FLB: Balancing on one leg as long as possible while standing on the preferred foot. This test measures general balance.
- SBJ: Jumping for distance from a standing start. This test measures explosive strength.
- HGR: Squeezing a calibrated hand dynamometer as forcefully as possible with the dominant hand. Static strength is assessed.
- SUP: Maximum number of sit ups achieved in 30 seconds. This test measures the endurance of the abdominal muscles.
- PLT: Rapid tapping of two plates alternately with the preferred hand. This test measures speed of upper limb movement.
- Aerobic fitness: This was assessed by the Legér *et al*[12] 20 m shuttle run test. In brief, subjects start running up and down a 20 m track at an initial speed of 8.5 km/h, which gets progressively faster (0.5 km/h every minute), in accordance with a pace dictated by a sound signal on an audio tape. Several shuttle runs make up each stage of the test, and pupils are instructed to keep pace with the signals for as long as possible. The actual score is the half stage fully completed before the subject drops out. This is then used to predict maximal oxygen uptake (VO_2MAX) in ml/kg/min.[13]
- Percentage body fat: This was calculated from two skinfolds (triceps and medial calf; average of two measurements), with a Harpenden (John Bull, West Sussex RH15 9LB, UK) calliper, according to the guidelines introduced by Lohman.[14]
- Time spent in intensive physical activity: The Physical activity recall questionnaire (PARQ) of Aaron *et al*[15] was used. With a one month interval and 40 pupils of similar age to our subjects, the questionnaire's reproducibility coefficient was found to be 0.92.

Subjects were asked to indicate all organised physical activities—that is, activities as members of sports clubs, including competition—in which they had participated at least 10 times during the preceding year, including school PE. Detailed information on frequency and duration of participation was asked for. The time spent in all activities was summed to derive an overall organised physical activity estimate in hours a day. This information, combined with the metabolic cost in METs for each activity,[16] was then used to estimate the time spent in activities with a metabolic equivalent of ≥6 METs.

Statistical analysis

All data were assessed to be normally distributed. Descriptive statistics were performed for all parameters. Differences between the PE and PE+ groups were identified by Student's independent *t* tests. Multiple linear regression analyses were used (with motor and cardiovascular health related fitness parameters as dependent variables) to investigate if the assessed parameters were influenced by confounding factors (independent variables) such as age, body mass, height, and participation in extracurricular organised physical activities (adjusted analyses). The SPSS (version 10 for windows) statistical package was used, and significance was set at $p<0.05$.

RESULTS

Table 1 shows descriptive statistics for all parameters studied, together with p values from *t* tests. In general, subjects in the PE group had inferior motor and cardiovascular health related fitness profiles compared with those in the PE+ group. Of the nine parameters studied, seven showed significant differences between the two groups, with percentage body fat (20.3 (8.8) *v* 13.9 (3.5); $p<0.001$), aerobic fitness (34.7 (3.7) *v* 43.9 (4.2); $p<0.001$), and time spent in intensive physical activity (0.2 (0.2) *v* 0.7 (0.3); $p<0.001$) the most prominent. In the PE

Table 2 Suggested thresholds for selected cardiovascular health risk factors in children[26 27]

Variable	Health	Risk
Body fat (%)	⩽15%	>20%
Aerobic fitness ($\dot{V}O_{2MAX}$ in ml/kg/min)	⩾40	<40
Physical activity (⩾6 METs – hours/day)	⩾0.5	<0.5

group, these three cardiovascular health related parameters failed to fulfil the requirements for combating future health risks (table 2).

Table 1 also shows the multiple linear regression analyses results (adjusted analysis). Corrections for age, height, weight, and participation in extracurricular organised physical activities reduced the number of significant differences between motor fitness parameters to only two ($p<0.05$). In contrast, all cardiovascular health related fitness parameters remained unaffected at $p<0.001$.

DISCUSSION

The aim of this study was to examine the current national Greek PE programme for secondary schools in relation to selected motor and cardiovascular health related fitness parameters in 13 year old schoolboys. As expected, boys who participated only in school PE classes and free habitual play (PE group) had inferior motor and cardiovascular health related fitness profiles compared with their counterparts who were also involved in extracurricular organised physical activities (PE+ group). This finding is in line with the intervention study of Manios *et al*,[17] in which significant differences were detected in both motor and cardiovascular health related fitness components between pupils involved only in PE classes and those who participated in extracurricular physical activities.

Although our findings do not imply causality, it is tempting to suggest that the significantly less time spent in intensive physical activity by the children in the PE group may partly account for them. Reduced physical activity levels may prevent, among other things, motor fitness improvements,[18] aerobic fitness enhancement,[19] and control of body fatness[20] in children. Guidelines for adolescents emanated from the International Consensus Conference on Physical Activity[21] suggest engagement three or more times a week in continuous physical activity (lasting 20 minutes or longer) of moderate to vigorous levels of exertion.

Sedentary lifestyle and the associated poor aerobic fitness coupled with excess body fat are significant predictors of developing coronary heart disease.[22] Coronary heart disease is the primary cause of morbidity and mortality in Greece, showing a continuing upward trend over the last few decades.[23] Furthermore, it has been found that childhood obesity predisposes to adult obesity[24] and that physical activity patterns in adulthood seem to be established during childhood and adolescence.[25] It is worrying therefore to note that, in the PE group, key aspects for maintaining cardiovascular health, such as body fat, aerobic fitness, and activity levels, failed to match the suggested safe thresholds.[26 27] For instance, the predicted mean $\dot{V}O_{2MAX}$ of 34.7 ml/kg/min was found to be considerably lower than the acceptable level of 40 ml/kg/min for children of comparable age.[26] As shown by the PE+ group, increases in $\dot{V}O_{2MAX}$ and other aspects of cardiovascular health related fitness are the result of intensive physical training above the normal increases attributable to age and a corresponding adolescent spurt.[28]

Our findings indicate that the current national Greek PE programme is associated with low fitness levels in general, and, worryingly, it is insufficient to bring about beneficial adaptations in cardiovascular fitness with reference to future cardiovascular health. These findings are in line with data from other countries, questioning the validity of school PE classes in general[10 29] and partly contradict the assertion that school PE lessons should fulfil most of the fitness needs of children.[9]

Chronological age and body size affect both motor[30] and health related[31] fitness parameters. We therefore further corrected our data for age, height, and weight (adjusted analysis). Compared with the t test results, for which only the effectiveness of the Greek PE programme was considered, adjusted analysis showed a decrease in the significance of motor fitness indices. In contrast, the cardiovascular health parameters remained unaffected. These findings imply a stronger association of the three confounding variables with motor fitness indices than with cardiovascular health equivalents. Given that adolescent stature and body weight are under genetic regulation,[32] motor fitness may be less influenced by exercise and physical conditioning than health related fitness. This observation may have important practical implications in designing school curricula, with more attention on developing cardiovascular health than motor fitness. This is also supported by the fact that the traditional emphasis on motor and sport skills in PE has been criticised as being contrary to the goals of health related fitness.[33]

Within the limitations of the present study, it is concluded that PE classes in Greek secondary schools are associated with low motor and cardiovascular health related indices. However, given that motor abilities are under genetic control, broadly based primary prevention strategies aimed at improving the quality of school PE should therefore concentrate on improving cardiovascular health, rather than motor fitness, if future Greek adult morbidity and mortality from coronary heart disease is to be reduced. The national PE curriculum for Greek secondary schools needs serious reconsideration after the conduction of rigorous research.

Take home message

Improving certain aspects of cardiovascular health should be the main aim of Greek secondary school PE, if adult morbidity and mortality from coronary heart disease is to be controlled.

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