Factors Affecting Levels of Health-Related Physical Fitness in Secondary School Students in Selangor, Malaysia

Kamil Abidalhussain Aboshkair*[,1,2], Saidon Bin Amri[1], Kok Lian Yee[1] and Bahaman Bin Abu Samah[1]

[1]*University Putra Malaysia, Faculty of Educational Studies, Department of Sports Science, 43400 UPM Serdang, Selangor Darul Ehsan, Malaysia*

[2]*University of Baghdad, Al-Jadriya Campus, UOB, Baghdad, Baghdad, Iraq*

Abstract: The purpose of this study was to measure health-related fitness of children based on different implementation levels of the physical education program. Another was to determine the effect of anthropometric and social factors on students' health-related fitness. A total of 918 students' age 13, 14, and 16 years old were selected from three different implementation levels program. The total score of the checklist questions was used as criteria in classifying implementation levels in Selangor schools. Heights and weights were measured, from which the BMI was calculated. Data concerning students' family income were collected from school files. Data on student involvement in a variety of PA during and outside of school hours were gathered from information given by students (SKAF questionnaire). Tanner, self-reported assessment was used to estimate students' stage of maturation. Length was considered as indicator of adolescent growth. While, students' health-fitness was measured by a battery of health fitness tests. Effectiveness of these factors on students' health-related fitness was determined by comparing the pre-post-health-fitness tests scores of students. Results indicated that children in the high-implementation-level have better-health fitness performance on both pre-test and post-test measurements than children in the low-implementation level. However, health- fitness performances that reflect significant differences were different among age groups. The older age groups generally performed better on overall fitness tests than did the younger age groups. Several covariates had strong relationships with pre and post-test fitness scores for different age groups such as; height, weight, BMI, maturity status, time spent in PA, race, and family income. Variations of health-related fitness performance between students involved in this study are most likely contributing to the different implementation levels. Thus, a well-programmed and supervised PE program can develop the health status of students at all levels of education.

Keywords: Implementation level of a physical education program, Quality Physical education program, Quality physical education teacher, Adolescent health-related physical fitness.

INTRODUCTION

Saavedra *et al*. [1] considered health-related physical fitness as the dynamic state of energy and vitality that allows people to perform daily tasks, enjoy active leisure and cope with unexpected emergencies without undue fatigue. Health-related physical fitness is associated with the physical wellbeing of an individual, which implies a correlation between health fitness and sports. Specific movement skills are needed for the development of fitness components, such as strength, power, or endurance. A common assumption is that health-related physical fitness is plausible for all despite their level of motor skills [2].

A relationship between PE and health exists. PE is a way of promoting high standards of health, and health is an integral part of PE. At present, the vital role of vigorous exercise and fitness in promoting the health of the individual is being emphasized. People who achieve good health and fitness should be able to live a more successful life, and would be less vulnerable to diseases. The improvement of physical fitness, especially cardiovascular endurance, has been equated with the improvement of health status or disease prevention [3]. A vigorous PA is defined as an activity that causes a marked increase in breathing or heart rate, and is perceived as a difficult or very difficult activity [4]. Regular exercise and participation in sports are known to improve fitness and physical performance [5-9].

The achievement of a high standard of health depends on the development of physical wellbeing, fitness, and good habits for healthy living. The promotion of physical wellbeing and fitness is one of the ways to attain good health, which results from continuous and regular participation in PA. Optimum physical fitness cannot be attained without consideration of emotional, mental, and social fitness, as well as the development of habits of healthful living [10].

Physical fitness has been defined in many ways; however, two definitions are most commonly used. From a physiological point of view, physical fitness is

*Address corresponding to this author at the University Putra Malaysia, Faculty of Educational Studies, Department of Sports Science, 43400 UPM Serdang, Selangor Darul Ehsan, Malaysia; Tel: 006-017-991 7928; Fax: 03-89480119; E-mail: kml_aboshkair@yahoo.com

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defined as the capacity to adapt to and recover from strenuous exercise. Clarke [11] gave a more general definition that considers physical fitness as the ability to carry out daily tasks with vigor and alertness, without undue fatigue, and with ample energy for leisure-time pursuits, and to meet unforeseen emergencies. Caspersen, Powell, & Christenson [12] defined physical fitness as a set of attributes that people possess or have achieved. Malina *et al*. [13] defined physical fitness as a state or condition that permits the individual to carry out daily activities without undue fatigue and with sufficient energy reserves to enjoy active leisure. Miller [14] indicated that physical fitness is defined from different views; some consider it synonymous with cardiorespiratory fitness, whereas others relate it to muscular strength and endurance. The definition of health is thus divided into two types: health-related and skill-related. Health-related physical fitness includes cardiorespiratory fitness, muscular strength, muscular endurance, flexibility, and body composition.

The school is considered an excellent place to provide students with the opportunity of daily PA, teach the importance of regular PA to health, and build the skills that support active lifestyles (Active Living Research [15]. To achieve the total benefit of PE for the students, PE must be taught well and organized through an effective PE program. The PE teacher is the first factor to be concerned in such an effective program. During his or her work with students at school, he or she teacher should be concerned with the physical development of his students. Second, he should be able to change the students' behavior and make them realize the meaning and importance of PE. Finally, he should be able to achieve and maintain his belief in the importance of a high standard of health and fitness for his students.

Good implementation of a PE program leads to better development of the health and fitness of students. Teaching PE is not easy; seemingly, it is a complicated task that requires highly qualified people with the appropriate skills. The Centers for Disease Control and Prevention [16] indicated that PE specialists teach longer lessons, spend more time developing skills, impart more knowledge, and provide more moderate-to-vigorous physical activities than do classroom teachers provide. Teaching PE is perceived to be a complex job that requires confident individuals for it to be accomplished.

The Centers for Disease Control and Prevention in U.S [16] indicated that providing students with a substantial percentage of their recommended amount of PA is one of the major goals of school-based PE programs. Therefore, when measuring the implementation level of the PE program, the quantity and quality of the PA provided to students should be given consideration. A study conducted by McGraw *et al.* [17] suggested that the implementation measures for PE programs include the opportunities for PA and the number of minutes required for students to complete a PA at school.

The effective implementation of the PE program depends on several elements, such as availability of sports facilities, equipment, adequacy of the number of qualified PE teachers, effectiveness of teaching and learning process, involvement of the students, status of PE within the school, and financial support. PE in Malaysian schools faces a number of difficulties. Many secondary and primary schools suffer from inadequate sports facilities and equipment, as well as insufficient financial support [18-21]. Accordingly, the level of implementation of the PE program in Malaysian schools varies from school to school. Consequently, the level of physical fitness of the students in Malaysians schools varies as well. The measurement of the implementation of the PE program is an essential evaluation component of the health of any successful public schools.

Based on the information gathered from previous studies, PE programs are not properly implemented. Consequently, the level of physical fitness of the students is not acceptable. In the current study, data on the implementation level of the PE program are used to determine the status of the implementation program (this objective is the focus of a research, Kamil *et al*., unpublished research), and possibly, to determine the effect of different implementation levels on the health-related physical fitness of the students. With this considered, the researcher designed the present study to determine the effect of different implementation levels of the PE program on the health-related physical fitness of the students.

According to numerous studies in this field [13, 22-28], health-related physical fitness is influenced by various other factors, such as body size, maturity status, growth status, nutritional status, time spent performing the physical activity, and family income. Several studies indicated that children who differ in maturity status also differ in body size, physique, and physical performance [29-32]. Hence, another concern of the current study is the effect of these factors on the health-related physical fitness of the student.

Objectives of the Study

1. Measure the health-related physical fitness of the children enrolled in these PE programs with different implementation levels;
2. Investigate the relation between different implementation levels and health-related physical fitness among 13, 14, and 16 years old children in Selangor;
3. Investigate the relation between health-related physical fitness and other factors that influence children's health fitness based on different implementation levels;
4. Drew authority's attention and particularly those who are involved in the educational sectors to identify clearly how well programmed and supervised of the PE program can develop the health status of students at all levels of education.

MATERIALS AND METHOD

Sample and Data Set

The study was conducted in February 2010 during the academic school year 2010-2011. One of the objectives of this study was to find out schools with different implementation levels of the PE program. The total score of checklist questions of Jemaah Nazir Sekolah [33] was used as criteria in classifying implementation levels of the PE program in Selangor schools. Based on data gathered from 38 selected schools, implementation levels were classified into three categories: high, moderate, and low. Following this classification, one school was randomly selected from each implementation level to be the samples for the second part of the current study (this objective is the focus of a research, Kamil *et al*., unpublished research).

Based on Cohen [34] for determining the sample size with great power value: 0.80 at significant level of alpha value: 0.5 and effect size: moderate, three different groups were assigned for 13, 14, and 16 years old in each of these schools selected. Each group consisted of 102 students (51 boys and 51 girls). Accordingly, the total number of participants included in the sample was 918.

Procedure

Permission for the study was obtained from the Ministry of Education and University Putra Malaysia. Consent to participate in the study was obtained from the principal of each school involved in this study. Written parental consent was required for students to participate in this study.

Anthropometric Measurements

Under the supervision of the researcher, a team of 10 well-trained senior undergraduate students from University Putra Malaysia collected anthropometric (weight and height) measurements. Height and weight measurements were obtained according to the guidelines established by Lohman *et al*. [35]. The children's weight (down to 0.1 kg) was measured during morning hours after breakfast without shoes and heavy outer clothing. Height (down to 0.1 cm) was measured with the schoolchildren shoeless and facing away from the scale. All these measurements were measured using a portable stadiometer. Each student was given duplicate measurements for height and weight, and the averages for both readings within ± 0.5 cm or 0.5 kg, respectively, and were used in the data analysis. Body mass index (BMI) was calculated as body mass (kg) by squared height (m).

Socio-Demographic Information

A standardized format questionnaire was used to collect the data on name of student, name of school, age, and gender. Data concerning student's family income were collected from school files. Based on information obtained from the school files, socioeconomic status was assessed according to the family income.

Time Spent in Physical Activities in and Out of School Hours Time

Data on student involvement in a variety of PA during and outside of school hours were gathered from information given by students, and thus were based on the self-reported questionnaire designed to collect data from school children aged 13, 14, and 16 years old. The Soal Selidik Kegiatan Aktiviti Fizikal (SKAF) questionnaire measures student involvement in such activities. The SKAF questionnaire has satisfactory levels of reliability and validity, and is suitable for use in large-scale school-based data collections for child and adolescent populations [36].

This type of self-reported questionnaire should be appropriate to measure PA in a large number of populations, over a period long enough to be represented in everyday life and with a minimum discomfort to subjects. The students were asked to

indicate the number of hours (0-4h) and 15-minimum increments (0-15 minimum) that each type of PA was performed for each day of the previous week.

Maturity Status

Maturation refers to development that includes the changes that occur in the characteristics of adults. In other words, maturation means changes in the body towards adulthood, such as breast development for girls and pubic hair for boys. Kail & Cavanaugh [37] reported that puberty begins at the average age of 10 in girls and 12 in boys; however, many boys and girls who mature late or early experience psychological consequences. Both male and female students were being assessed. Each student was providing with descriptions and diagram of Tanner [38], self-reported assessment to estimate their stage of maturation. Trained teachers of the same gender were exploited to explain the characteristics and stage of development to the sample. The criteria used by Tanner [38] have acceptable reliability and validity and are suitable for use in large-scale school-based data collections for child and adolescent populations. Numerous studies were in line with this issue [39-41].

Growth Status

Physical growth is defined as an increase in the mass of body tissues from infancy through adulthood. Growth can be classified into three stages: infant, childhood, and puberty [24]. Physical growth is clearly seen between ages 12 and 17. During puberty, boys are heavier and taller than girls when growth is complete because boys naturally have a longer pre-pubertal growth period than girls. According to Gokhale *et al*. [24], length is considered an excellent indicator of adolescent growth because it is not subject to daily changes as is weight.

Health-Related Physical Fitness Measurement

The primary objective of any PE program is the development of students' physical fitness. A poor performance in physical fitness tests means an individual is inactive, and greater concern should be given to his health. In the current study, physical fitness was determined by introducing students to a battery of health-related physical fitness tests. The same team of undergraduate students from University Putra Malaysia under the supervision of the researcher himself performed a set of health-related physical fitness tests in a study sample. These tests included the following: (a) one-minute push-up with extended legs for boys and bent-knees for girls to assess upper body muscular strength, (b) seven stages sit-up test to gauge abdominal muscular strength and endurance, (c) sit-and-reach test to assess low back flexibility, and (d) multi stage 20-meter shuttle run to assess cardiovascular fitness. To predict the maximal oxygen uptake the equation of Leger *et al*. [42] was used:

Y = 31.025+3.238 X-3.248A+0.1536AX, Where Y= VO2max (ml/kg/min), X= maximal shuttle run speed (km/hr), A= age (yr.).

This test is appropriate for determining cardiorespiratory fitness in schoolchildren. The number of laps completed by each student was recorded and then used to estimate cardiorespiratory fitness expressed as maximal oxygen uptake ($ml \bullet kg \bullet min^{-1}$).

All measurements were carried out under standardized conditions on an indoor hall except 20-meter shuttle run, which performed on an outdoor field. All fitness tests were performed twice, and the best score was retained, except for the multi stage 20-m shuttle run test, which were performed only once.

Statistical Analysis

M and SD for anthropometry and all other variables of this study were computed for 13, 14, and 16 year-old schoolchildren boys and girls. Multivariate analysis MANOVA and MANCOVA were performed to determine the effectiveness of different implementation levels of the PE program on student's health-related physical fitness with and without the presence of all covariates. The covariate variables for the pre-test health-related physical fitness tasks include height, weight, BMI, race, family income, time spent in PA during and outside of school hours, and maturity status. While, covariate in the post-test health-related fitness tasks were the same as in the pre-test fitness, with the addition of the pre-test health-related physical fitness performance scores and post-test height, which were measured at the time of the post-test of fitness. The students' health-related fitness status was determined by comparing the pre-and post- health-related physical fitness differences between boys and girls in these three different implementation level's schools. Data was analyzed using SPSS Version 16.0 (Statistical Package for the Social Sciences, version 16.0, SSPS 1 Inc, Chicago, Illinois, USA).

RESULTS AND DISCUSSION

M and SD for anthropometry and other covariate variables were computed for 13-, 14-, and 16-year-old

Table 1: Descriptive Statistics for Anthropometry and other Covariates Variables for Girls and Boys by Implementation Levels and Age Group

Girls	Implementation level of the physical education program																							
	High								Moderate								Low							
	13		14		16		Total		13		14		16		Total		13		14		16		Total	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Age in years	12.6	0.3	13.6	0.3	15.7	0.3	13.9	1.3	12.7	0.3	13.7	0.3	15.7	0.3	14.0	1.3	12.6	0.3	13.6	0.3	15.7	0.3	14.0	1.3
Pre height	150.5	6.1	153.8	6.5	154.8	4.9	153.0	6.1	153.9	5.8	156.1	5.0	159.0	6.0	156.3	6.0	148.9	6.6	154.6	5.3	154.0	5.7	152.5	6.4
Pre weight	47.6	11.3	48.6	15.3	49.9	11.6	48.7	12.8	45.4	12.4	47.1	7.2	50.9	11.8	47.8	10.9	41.0	9.0	52.4	14.9	51.4	13.7	48.3	13.7
Pre BMI	21.0	4.5	20.4	5.6	20.8	4.5	20.7	4.9	19.1	4.4	19.4	3.1	20.1	4.5	19.6	4.1	18.4	3.2	21.8	5.4	21.6	5.4	20.6	5.0
Stage of maturity	2.1	0.5	2.6	0.7	4.1	0.5	2.9	1.0	1.8	0.6	2.4	0.5	4.0	0.6	2.8	1.1	1.5	0.5	2.3	0.4	4.0	0.3	2.6	1.1
Monthly income	3680.9	1709.9	3125.5	732.9	3211.2	1555.4	3339.2	1412.2	3504.5	1838.9	3024.2	1205.1	2790.2	1054.9	3106.3	1430.1	2520.4	1101.9	2583.0	1489.2	2331.4	1287.7	2478.3	1298.4
Time spent in PA	16144.8	8453.2	14999.5	6356.9	14806.2	4928.7	15757.8	22710.8	12928.7	2845.1	16219.7	7431.2	12526.8	4209.2	14622.6	3708.6	13808.1	3301.3	16144.8	8453.2	14999.5	6356.9	14806.2	4928.7

Table 2: Descriptive Statistics for Anthropometry and other Covariates Variables for Girls and Boys by Implementation Levels and Age Group

Boys	Implementation level of the physical education program																							
	High								Moderate								Low							
	13		14		16		Total		13		14		16		Total		13		14		16		Total	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Age in years	12.7	0.3	13.6	0.3	15.7	0.3	14.0	1.3	12.8	0.3	13.7	0.3	15.7	0.3	14.0	1.2	12.7	0.3	13.6	0.3	15.7	0.2	14.0	1.3
height	150.4	7.4	158.4	8.7	166.0	7.3	158.3	10.1	154.9	6.6	162.0	7.4	168.7	4.9	161.9	8.5	147.1	8.8	158.4	8.2	167.6	6.4	157.7	11.5
weight	45.0	13.6	52.7	18.3	64.0	15.8	53.9	17.8	48.4	13.0	52.4	12.7	61.4	15.3	54.1	14.7	44.4	13.5	51.8	13.7	64.5	21.2	53.6	18.4
BMI	19.5	5.2	20.7	6.2	23.1	5.3	21.1	5.7	20.1	5.2	19.8	4.2	21.5	5.1	20.5	4.9	20.4	5.5	20.7	5.4	22.8	6.8	21.3	6.0
Stage of maturity	1.9	0.5	2.5	0.5	4.1	0.4	2.8	1.0	1.7	0.6	2.4	0.6	4.1	0.5	2.7	1.2	1.5	0.5	2.1	0.5	4.0	0.5	2.5	1.2
Monthly income	3180.6	1355.7	3023.1	971.5	3473.5	1067.0	3225.8	1150.9	2983.1	930.1	2754.3	831.4	2581.9	980.4	2773.1	924.8	2555.9	1014.1	2093.1	661.9	2229.0	620.5	2292.7	804.4
Time spent in PA	16040.1	8231.3	19233.2	8566.1	20873.9	9209.9	18715.7	8853.3	17595.9	10044.8	16141.9	5440.1	18373.2	4655.5	17370.4	7135.5	14812.4	73822.4	14360.2	3133.7	16025.2	4342.6	15065.9	5278.1

schoolchildren (boys and girls). These measurements are presented in Tables **1** and **2**. For boys and girls, the 13- and14-year-old boys in the moderate-implementation-level school were significantly older than their peers in the other two levels. However, no significant differences were observed between boys and girls of the three-implementation levels in the 16-year-old group. Boys and girls of the moderate-implementation-level school were significantly taller than those in the other two-implementation levels for all age groups. The 14-and16-year-old boys in the high-implementation-level school were significantly heavier and had higher BMI compared to their counterparts the other two-implementation level schools. In contrast, 13-year-old and 14-year-old girls in the high-implementation level school were heavier and had higher BMI than the groups in the other two-implementation levels.

In terms of maturity status, both boys and girls aged 13 and 14 in the high-implementation-level school were more advanced than their colleagues in the other two-implementation levels' schools, but not the 16-year-old group. Monthly family income in the high-implementation-level school was higher than the other implementation levels at all age groups. The overall means of time spent in physical activity by the high-implementation levels' student was significantly greater than that spent by the moderate and low-implementation-level students. On average, the high-implementation-level boy students recorded 18715.7 kcal kg-1 wk-1 total energy expenditure/per week, whereas girls spent 15757.8 kcal kg-1 wk-1 total energy expenditure/per week.

Results indicated that most of these children participated in this study were Malay 615 (67.0%). The Chinese 188 (20.45%), Indians 104 (11.35%), and others 11 (1.2%) formed the second largest population in the current study, which reflected the demographic characteristics of Malaysia in terms of ethnic distribution and gender proportion.

The Bonferroni post hoc test comparison for mean differences was conducted to determine differences in the specific implementation level group for each of the health-related physical fitness items between different implementation levels and age groups for the pre-test health-related physical fitness variable. Results observed in Table **3** indicate that the performance of boy and girl students in the high-implementation-level school was better on overall pre-health-related physical fitness tests than moderate- and low-implementation-level schools for all age groups. Positive effect of high implementation level for 13-year-old boys was observed on all pre-health-related physical fitness tests except for the sit-up. All pre-health-related physical fitness tests for boys 14 and16 years old were

Table 3: Bonferonni Post hoc Tests of Mean Differences Between Implementation Levels by Age Groups for Pretest Health-related Physical Fitness Variables Showing a Significant MANOVA F-ratio

Pre-health fitness variables	Implementation levels	Implementation levels	Mean Difference by age group					
			13 (n=306)		14 (n=306)		16 (n=306)	
			Boys	Girls	Boys	Girls	Boys	Girls
Push-up	High	Moderate	4.73	-2.63	-0.57	-5.18**	3.77	0.47
	High	Low	2.77	3.63**	6.19**	2.78*	8.47**	4.84**
	Moderate	Low	-1.96	6.26**	6.77**	7.96**	4.71*	4.37**
Sit-and-reach	High	Moderate	4.64**	-1.64	-5.46**	3.74*	-0.27	1.35
	High	Low	7.93**	1.95	3.79*	14.31**	13.13**	4.07
	Moderate	Low	3.29	3.59**	9.26**	10.58**	13.39**	2.72
7 stage sit-up	High	Moderate	-0.96**	-0.19	-0.29	-0.19	0.53	0.35
	High	Low	0.22	0.92**	0.96**	0.14	1.29**	0.29
	Moderate	Low	1.18**	1.12**	1.26**	0.33	0.77*	-0.06
20 m shuttle run (VO2max)	High	Moderate	0.54	1.05*	0.71	0.70	2.59**	0.13
	High	Low	2.37**	2.43**	5.31**	2.90**	5.40**	2.79**
	Moderate	Low	1.84*	1.38**	4.59**	2.19**	2.81**	2.67**

*P< 0.05.
**P< 0.01.

positively influenced by the high-implementation-level school compared with the other two-implementation level schools. Girls in the 13-, 14-, and16-year-old groups were shown as positively affected on overall health-related physical fitness performances by the high-implementation-level school compared with other groups.

Further MANCOVA was performed to determine differences between different implementation levels and age groups with all covariates. Results presented in Table **4** show differences in pre-health-related physical fitness performance among the different implementation levels and the age groups for both boy and girl students, even after adjusting for the effect of these covariates. Results indicate that both boys and girls students were different on all the health-related physical fitness performance tasks. The influence of several covariates on health-related physical fitness performances was evident for the boys group only. The pre-test height and weight influenced the 20 m shuttle run, the BMI influenced the push-up, and the race influenced the sit-and-reach and 20 m shuttle run groups. Girls demonstrated age group differences in all pre-health-related physical fitness tests, whereas boys showed age group differences only on the sit-and-reach and 20 m shuttle run (Table **4**).

Specific implementation level's differences for each of the post-test-health-related physical fitness performance tasks using the Bonferonni post hoc test are reported in Table **5**. Both boys and girls students in the high-implementation-level school had better performance than the other implementation levels' schools on all health-related physical fitness tasks, except for the push-up for the girls group. The moderate-implementation-level school also exhibited better performance on all post-test health-related physical fitness tasks compared with the low-implementation-level school. The covariates were the same as in the previous question, with the addition of the pre-test health-related physical fitness performance scores and post-test height, which were measured at the time of the post-test of fitness.

Further MANCOVA was performed to determine the differences between different implementation levels and age groups, with presence of all of covariates. Results presented in Table **6** show differences in post-test health-related physical fitness performance for different implementation levels and age groups of boys and girls students, even after adjusting for effect of these covariates. However, health-related physical fitness differences post-tests were eliminated after adjusting covariates for both boys and girls. Boys

Table 4: MANCOVA for Pre-health-related Physical Fitness Performance by Implementation Levels, Age Group, and all the Covariates for Boys and Girls

	Implementation level	Age	Pre-height	Pre-weight	BMI	Race	Income	Physical activity	Maturity status
Girls									
Push-up	32.46**	6.41**	0.47	0.04	0.27	0.22	0.07	0.54	0.14
Sit-and-reach	32.53**	11.69**	0.42	0.15	0.16	3.68	0.32	0.08	0.41
Sit-up	4.89**	0.69	0.02	0.26	0.39	0.14	1.04	0.49	0.00
20m shuttle run	60.69**	41.46**	0.79	1.34	0.29	0.45	0.00	0.20	0.32
Multivariate F	25.07**	14.82**	0.46	0.51	0.29	1.12	0.33	0.35	0.24
Eta square	0.19	0.12	0.00	0.01	0.00	0.01	0.00	0.00	0.00
Boys									
Push-up	10.35**	2.34	1.72	2.42	11.01**	2.04	0.01	0.17	3.99*
Sit-and-reach	40.48**	16.85**	0.21	1.15	0.42	10.95**	1.98	0.12	0.77
Sit-up	17.44**	0.98	4.95*	0.26	1.31	2.13	0.04	0.01	0.07
20m shuttle run	44.48**	25.73**	12.77**	7.72**	0.77	5.98*	0.14	1.98	0.69
Multivariate F	21.07**	12.81**	6.13**	3.58**	3.69**	3.98**	0.61	0.65	1.12
Eta square	0.16	0.10	0.05	0.03	0.03	0.04	0.01	0.01	0.01

*P< 0.05.
**p< 0.01.

Table 5: Bonferonni Post hoc Tests of Mean Differences Between Implementation Levels for Posttest Health-related Physical Fitness Variables Showing a Significant MANOVA F-ratio

Variables	Implementation levels	Implementation levels	Mean Difference by age	
			Boys	Girls
Push-up	High	Moderate	3.09*	-1.97*
	High	Low	4.89**	5.09**
	Moderate	Low	1.80	7.05**
Sit-and-reach	High	Moderate	0.49	0.36
	High	Low	5.39**	3.95**
	Moderate	Low	4.91**	3.59**
7 stage sit-up	High	Moderate	0.28	0.01
	High	Low	0.95**	0.53**
	Moderate	Low	0.68**	0.52**
20 m shuttle run (VO2max)	High	Moderate	1.30*	0.25
	High	Low	3.39**	2.35**
	Moderate	Low	2.09**	2.10**

*P< 0.05.
**P< 0.01.

Table 6: MANCOVA for Posttest Health-related Physical Fitness Performance by Implementation Levels, Age Group, and Covariates for Boys and Girls

Posttest fitness variables	Implementation level	Age	Pre push-up	Pre sit-and-reach	Pre sit-up	20m shuttle run	Pre height	Pre weight	BMI	Post height	Race	income	physical activity	Maturity
Girls														
Push-up	3.81*	7.24**	871.84**	0.86	0.29	8.68**	0.00	0.02	0.00	0.00	0.05	3.19	2.46	0.50
Sit-and-reach	14.12**	22.07**	4.50*	1570.32**	0.06	1.44	3.30	0.03	0.17	4.26*	0.37	0.00	3.25	5.59*
Sit-up	0.44	9.68**	0.05	2.43	596.89**	0.05	0.22	0.00	0.03	0.48	0.07	1.68	0.76	1.12
20m shuttle run	2.60	12.86**	3.40	1.85	5.43*	260.11**	0.25	0.42	0.69	1.64	2.80	0.69	0.28	0.92
Multivariate F	4.82**	12.72**	223.05**	395.94**	150.56**	65.74**	0.93	0.13	0.23	1.52	0.89	1.49	1.87	1.99
Eta square	0.04	0.11	0.67	0.79	0.58	0.38	0.01	0.00	0.00	0.01	0.01	0.01	0.02	0.02
Boys														
Push-up	2.38	8.20**	463.08**	4.41*	6.74**	4.34*	4.96*	5.19*	5.24*	3.07	1.08	5.67*	0.50	1.47
Sit-and-reach	5.30**	5.22**	0.13	523.42**	0.24	13.87**	0.99	0.58	0.56	2.87	2.67	1.19	1.25	5.64*
Sit-up	8.25**	7.73**	1.32	0.05	364.58**	1.16	0.00	0.21	1.51	0.44	2.59	5.33*	3.29	0.09
20m shuttle run	2.55	3.68*	6.65**	4.36*	2.14	278.24**	0.71	0.09	0.64	0.20	0.57	1.64	1.22	0.77
Multivariate F	4.55**	6.81**	120.18**	148.38**	94.92**	69.41**	1.97	1.45	2.21	2.00	1.20	3.98**	1.36	2.36*
Eta square	0.04	0.06	0.53	0.58	0.47	0.39	0.02	0.01	0.02	0.02	0.01	0.04	0.01	0.02

*P< 0.05.
**p< 0.01.

between implementation levels differed on sit-and-reach and sit-up, whereas girls differed on push-up and sit-and-reach.

The current analysis also revealed the effect of several covariates on health-related physical fitness performances for both boys and girls. All pre-test

health-related physical fitness performance significantly affected the post-test health-related physical fitness performance of boys and girls. Furthermore, push-up performance for boys was influenced by pre-test height, weight, BMI, and income. Sit-and-reach was influenced by maturity and sit-up was affected by income. The sit-and-reach performance of girls was influenced by post-test height and maturity status. Additionally, the analysis also revealed that boys and girls exhibited differences among age groups in all health-related physical fitness performance. Summaries of all these results are presented in Table **6**.

Specific age group differences between age groups for post-test health-related physical fitness variables were derived by conducting a pairwise comparison of estimated marginal means adjustment for the covariates. Results show that the 14- and 16-year-old boys and girls performed significantly better on all health-related physical fitness tasks than their 13-year-old counterparts (Table **7**).

DISCUSSION

The student participants of the present study were randomly selected from the three different implementation level schools. They had similar builds; however, their schools had different implementation levels. Among the schoolchildren, physical performance was affected by biological factors such as body size and physique due to varying status of maturity [13, 43, 44].

In the present study, a comparison of anthropometric dimensions among children from the three school with different implementation levels displayed similar findings. Overall, children from schools with higher implementation levels were taller than their peers from schools with lower implementation levels. Furthermore, children from the higher implementation level group were heavier and had higher BMI. As a result, they had larger arm and muscles, which may have affected their physical performances.

The present study has also revealed significant differences in maturity status between 13- and 14-year-old boys and girls in all three implementation levels. However, no significant differences existed in maturity status between 16-year-old boys and girls. The 13- and14-year-old boys and girls from the higher implementation level group matured earlier than their peers from lower implementation level groups did. According to several studies, children who differ in maturity status also differ in body size, physique, and physical performance [29-32]. At the same time, such up growth may not occur until the later teen years [45]. All students were enrolled during their early adolescence, their body sizes may be due to accelerated growth rate from maturation and hereditary influence.

Table 7: Pairwise Comparisons of Estimated Marginal Means Between Age Groups for Posttest Health-related Physical Fitness Performance Variables revealing a Significant MANCOVA F-ratio

Variables	Boys					Girls				
	Age	M	Age	M	Md	Age	M	Age	M	Md
Push-up	13	23.38	14	26.19	-2.79**	13	20.35	14	20.29	2.08**
	13	23.38	16	24.19	-0.21	13	20.35	16	23.15	2.12*
	14	26.19	16	24.19	2.58	14	20.29	16	23.15	0.04
Sit-and-reach	13	23.25	14	27.01	0.89	13	25.66	14	25.03	-2.76**
	13	23.25	16	25.56	3.62*	13	25.66	16	26.19	-1.98
	14	27.01	16	25.56	2.73*	14	25.03	16	26.19	0.79
Sit-up	13	4.87	14	5.43	-0.41**	13	3.63	14	4.22	-0.46**
	13	4.87	16	5.14	0.11	13	3.63	16	3.84	-0.03
	14	5.43	16	5.14	0.51*	14	4.22	16	3.84	0.43*
20m shuttle run	13	41.15	14	43.44	-0.81	13	36.60	14	38.78	-1.03**
	13	41.15	16	47.78	-2.54**	13	36.60	16	41.33	-1.69**
	14	43.44	16	47.78	-1.73**	14	38.78	16	41.33	-0.66

A comparison of family monthly income showed significant differences between implementation levels and age groups. Results indicated that the families of children from all age groups in the lower implementation level had significantly lower family monthly incomes than families in the high implementation level. The 14-and16-year-old boys in the high-implementation-level school were significantly heavier and had higher BMI. The 13-and 14-year-old girls in the high-implementation-level school were heavier and have higher BMI than the other two-implementation levels groups.

Socioeconomic status is positively associated with BMI [46]. Skinfold is related to the body fat of an individual. The relation of skinfold fat to body fat differs by sex and changes as children mature [14]. For many years, numerous researchers used height and weight measurements as indicators of physical growth. BMI became one of the easiest and most reliable methods of estimating body fat. It can be used to assess nutritional status of children. It also provides a table indicating appropriate weight for certain heights and ages. In other words, BMI is considered an indicator of height and weight relationship. A positive relationship was found between health-related fitness and educational income levels, which appeared to be most evident in the lowest educational and income groups [1]. Many demographic, socioeconomic, and behavioral risk factors predict mortality in the US [47].

The time spent by children engaged in physical activity in and out of school hours in the high-implementation-level school was better than time spent by their counterparts from lower implementation level groups. On average, boys from the high-implementation-level school spent 18,715.7 kcal kg-1 wk-1 total energy expenditure/per week, whereas girls spent 15,757.8 kcal kg-1 wk-1 total energy expenditure/per week.

According to a medical report, during adolescence, schoolchildren experience an increase in body fat. This increase is often associated with irregular meals and erratic food habits [48]. The decrease in energy expenditure through decreased PA is likely one of the major contributors to the global epidemic of obesity [49]. The finding of numerous studies conducted in Malaysia and other countries are in line with our findings [28, 50-53].

As indicated in the descriptive statistics, the overall performance of boys and girls on pre-test health-related physical fitness tasks was better in the high-implementation-level school than lower-implementation-level schools for all age groups. The high performance of students may be due to the effect of their size advantages, as indicated by the descriptive statistic. Based on early discussions, a relationship was found among growth status, maturity status, and health-related physical fitness performance. The significant differences in health-related physical fitness performance between children in high-implementation-level school and their peers from low implementation level are expected. These differences in health-related physical fitness performance do not refer to previous variables only. All health-related physical fitness performances of boys and girls continue to show the effect of implementation levels on pre-test heath-fitness performance, even after these variables and other variables related to socioeconomic status were controlled. Presumably, these differences in health fitness can be attributed to quality of instruction received under the PE program, and to the active sports participation of the high-implementation-level children.

The significant differences in health fitness performances among different implementation levels were not the same for the different age groups (Table **8**). These differences are due to variations on the covariates between different age groups. The older age group recorded more health-related physical fitness performance variables, which remained significant after the covariates were controlled. However, the implementation level effects on health-related physical fitness performance remained significant on all pre-health-related physical fitness variables for the 14-and16-year-old boys; for the 16-year-old girls, the effects remain significant only on push-up and 20 m shuttle run. For the 14-year-old girls, the implementation level effect remained on all health-related physical fitness performance, except for the sit-up, whereas it remained significant for 16-year-olds only on push-up and 20m shuttle run. For the 13-year-old boys, the effects remained significant on sit-and-reach, sit-ups, and 20 m shuttle run. For the girls of the same age group, it remained significant on all health fitness tests. Notably, the high-implementation-level students in the older age groups have been enrolled in the school longer than the younger age students.

In the current study, comparing health-related physical fitness performances of high-implementation-level students with lower implementation students in the 14-and16-year-old age groups did not necessarily

Table 8: Summary of Implementation Level Effect on Pre-test Health-related Physical Fitness Performances with Controlled Covariates by Age Groups

Gender	Age group	Pre-test- health-related physical fitness performance
Boys	13	pre sit-and-reach, pre sit-ups, 20m shuttle run
	14	Pre push-up, pre sit-and-reach, pre sit-ups, pre 20 m shuttle run
	16	Pre push-up, pre sit-and-reach, pre sit-ups, pre 20 m shuttle run
Girls	13	Pre push-up, pre sit-and-reach, pre sit-ups, pre 20 m shuttle run
	14	Pre push-up, pre sit-and-reach, pre 20 m shuttle run
	16	Pre push-up, pre 20 m shuttle run

show the performance characteristics of the children enrolled in the high-implementation-level school. Health-related physical fitness performance of high-implementation-level students at these ages is influenced by the number of years they spent in this school. This situation explains why the older groups perform better in health-related physical fitness tests than the younger age groups.

Based on previous discussions, the differences among children in these three implementation level schools must be noted. The implementation level effect of PE program on health-related physical fitness performance over a six-month school year is determined by controlling these differences. Additional post-test height measurements during health-related physical fitness post-tests were included as additional covariate to control growth effect. Moderate physical activity has beneficial influence on growth; excessive physical training may negatively affect it [54, 55].

MANOVA of post-test health-related physical fitness performance revealed significant differences for post-test health-related physical fitness performance among different implementation levels of boys and girls in all age groups. MANCOVA of post-test health fitness performance showed differences in post-test health-related physical fitness performance between different implementation levels and age group, even after adjusting covariate effect. However, the post-tests of health-related physical fitness differences were eliminated after adjusting the covariates for boys and girls. The boys across implementation levels differed on sit-and-reach and sit-up, whereas the girls differed on push-up and sit-and-reach.

MANCOVA was carried out to observe the effect of implementation levels of PE school program on post-test health-related physical fitness performance of both boys and girls, for each age group. According to the results, post-test health-related physical fitness performance was significantly affected by implementation level for boys and girls, in all age groups. However, the health fitness tests variables affected were not consistent between all age groups (Table **9**).

The results of the present study show that high implementation levels of physical education programs have beneficial effects on health-related physical fitness performance, especially with regard to the variables mentioned in Table **9**. The high implementation levels of a PE program positively affect health-related physical fitness performances. These positive effects in health-related physical fitness performance can be attributed to sports facilities of school, status of PE inside school, quality of schoolteacher, school leader attitude towards PE,

Table 9: Summary of Posttest Health-related Physical Fitness Performance Significantly Affected by Implementation Levels of the Physical Education School Program for Boys and Girls by Age Group

Gender	Age group	Post-test- health-related physical fitness
Boys	13	Push-up
	14	sit-and-reach, sit-ups
	16	Pus-up, sit-and-reach, sit-ups
Girls	13	sit-and-reach
	14	sit-and-reach, sit-ups, 20 m shuttle run
	16	Pus-up

involvement of students, and teaching and training programs of schools.

The pre-test health-related physical fitness performance, especially among the youngest age group, was the most influential variable in predicting health-related physical fitness performance. The significant effect of high implementation level on post-test health-related physical fitness performance, after controlling all covariates and pre-test health-related physical fitness and growth, reflects the effect of the teaching and training program adopted by the high-implementation-level school.

Physical activity is an environmental factor, often viewed as exerting a favorable influence on growth and maturation [54, 56]. However, a number of well-known factors may affect the outcome of the physical performance, such as body composition, age, gender, level of physical activity, or skill [57]. Based on these results, the teaching training stimulus provided to children in the high-implementation-level school seems to induce positive effects on health-related physical fitness performance than growth factors alone.

The significant effect of high-implementation-level schools on the health-fitness performance of children may enhance love for sports activities in school students. Children in high-implementation-level school spend more time on sports activities outside school hours than their peers from other implementation level schools. According to a number of recent studies, expanded enrolment in PE activities inside school may increase adolescent PA levels [58, 59]. Several studies reported that the impact of physically active academic lessons of greater intensity might provide larger benefits for BMI and academic achievement [60-62].

Improved child performance in health-related physical fitness is possible because of PE program implementation levels quality. It can also be attributed to a number of physiological adaptations, such as increased glycolytic enzyme activity and oxidative enzymes [63-65]. Skeletal muscle enzyme changes are specific to the mode of training. Resistance exercise increases muscle mass and endurance exercise increases muscle capillary density, mitochondrial protein, fatty acidoxidation enzymes, and more metabolically efficient forms of contractile and regulatory proteins [62, 66]. These factors can explain variations in the effect of implementation levels of PE program on health-related physical fitness performance between age groups. Because the teaching and training process for each lesson is not equal to age groups in these different implementation level schools, differences exist in the mode of teaching and training for each age group. These differences lead to different types of physiological adaptation interpreted by differences in health-related physical fitness performance. Body size differences among different age groups and maturity status can also contribute to health-related physical fitness variations.

Based on the overall results, the older groups of boys and girls performed better in all health-related physical fitness performance than the younger age group. The possible explanation for such differences is the type of teaching and training adaptation, the limitations of physiological capacities, and the growth and maturation characteristics of the younger age groups.

In conclusion, children in the high-implementation-level school have better-health fitness performance on both pre-test and post-test measurements than children in the moderate and low-implementation-level schools. The evidence from the present study reflects the effectiveness of teaching and training under the PE program in successfully developing health-related physical fitness performance of students (post-test) in high-implementation-level schools. However, some of these differences can be attributed to differences in physical characteristics.

The effects of high-implementation-level school, on a number of health-related physical fitness performance scores, were eliminated after controlling the physical characteristics of children. Available information suggests that these results may be due to a number of factors. The teaching program in the high-implementation-level school fails to induce greater positive effects on some health-related physical fitness performance variables than growth factors alone. Second, physiological limitations may prevent further improvement of some of the health-related physical fitness performance tasks. However, the present findings have suggested further investigation have yet to be carried out and provide exact explanations for these differences. PE teachers in all implementation levels do their best to further develop their teaching and training PE program and to improve health-related physical fitness performance on tests.

One of the most important goals of PE program for Malaysian secondary schools is to promote health-related physical fitness among students, as well as

educate them on the concept of physical fitness and a healthy lifestyle. With the limitations of the current study, this aspect of PE program effectiveness cannot be determined. A longitudinal study involving continuous evaluation of the physical fitness performance of schoolchildren and their performance in school, activities as well as sports competition, are needed.

Variations of health-related physical fitness performance between students involved in this study are most likely contributing to the different implementation levels of the PE program. Thus, a well-programmed and supervised PE program can develop the health status of students at all levels of education. Accordingly, multiple plans are necessary to prevent health-related problems and enhance health-related physical fitness among schoolchildren. Policymakers, curriculum developers at Ministry of Education in Malaysia, and other teacher-training institutions must review and adapt a PE curriculum that promotes health among students.

Implications for Schools

The findings of this study revealed significant negative performance in overall health-related fitness performance among Selangor low implementation level schoolchildren. That is most likely contributing to the different implementation levels of the PE program in these schools. Thus, if well programmed and supervised, the PE program can develop the health-fitness status of children at all levels of education. Accordingly, multiple plans needed to prevent health-related fitness problems. Policy makers, curriculum developers at Ministry of Education in Malaysia and other teacher-training institutions should review and adapt PE curriculum to promote the health of schoolchildren. Much more consideration should be given to the PE program inside schools. The number of qualified PE teacher's inside schools should increase. Consequently, multiple plans are needed to solve these problems.

Human Subjects Approval Statement

This study received exempted approval from Ministry of Education, Malaysia, and University Putra Malaysia's institutional review board.

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