



Physical Activity and Endurance Levels of 1st Year UST High School Students

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ABSTRACT

Background and Purpose: Lifestyle related diseases such as compromised cardiopulmonary functions and obesity are brought about by lack of physical activity. As a component of physical fitness, this study aims to determine endurance levels of UST first year high school students and correlate them to the levels of physical activity the students engaged within a week. **Methodology:** 402 first year high school students, aged 11 – 14 years old, enrolled in the University of Santo Tomas were included to participate in the study. The Physical Activity Questionnaire for Older Children (PAQ-C) was administered to determine levels of physical activity. 188 students were given parental consent to participate in the 20m Shuttle Run Test to determine their physical endurance. Height, weight and BMI measurements were also taken. **Results:** Most of the students had scores in PAQ – C of 2 to 3 indicating low - moderate levels of physical activity and finished only up to the second to third out of the fifteen levels of the Multi Stage Fitness Test. The boys generally had fair aerobic capacity and the girls had a good aerobic capacity based from Table for Normative VO₂max by the Cooper Institute for Aerobics Research, Dallas, TX (1997). As for the participants' BMI, based on the Center for Disease Control the boys were at risk for overweight while the girls were of healthy weight. Compared to the performances indices (mean age- and sex-specific z-scores) of the 37 countries in the study of Olds T et al, our participants ranked last. However, 14 year old girls were slightly better than Singaporean children who scored -0.79. **Discussion and conclusion:** This study was able to determine a moderate level of physical activity and physical performance of UST First Year High School students and a significant but low level of correlation between physical activity levels and aerobic capacity of UST First Year boys

Keywords: *physical activity, adolescent, body mass index, endurance*

INTRODUCTION

Physical fitness, defined as “a set of attributes that people have or achieve that relates to the ability to perform physical activity,” is affected by factors such as maturation, physical activity, heredity and the environment.¹ Among younger children, heredity and maturation (age) have more influence on physical fitness but as children grow older, maturation and genetics become less important as healthy lifestyle begins to become more important in influencing health.²

Physical activity is defined as any bodily movement produced by the skeletal muscles that results in energy expenditure³ and has also been correlated with cardiovascular risk factors. Physical activity has many health benefits, including reduced risk of cardiovascular disease^{4,5} ischemic stroke⁶⁻⁸ non-insulin-dependent (type 2) diabetes⁹⁻¹⁵ colon cancers¹⁶⁻¹⁹ osteoporosis,²⁰⁻²² depression²³⁻²⁶ and fall-related injuries²⁷⁻³⁰. Physical activity is also associated with numerous mental health benefits including enhanced emotional health³¹, improved cognitive functioning³² and better quality of life³³

In this modern age where electronic gadgets such as television and computer entice the children, the

pediatric population might be at risk of decline in physical activity which predisposes them to an inactive lifestyle. The Japanese Ministry of Education, Science and Culture showed that distance run performance (1000 m and 1500 m) of 12-17-year-old Japanese children between 1985 and 1998 had decreased by 0.4% per year³⁴. In another recent study, Australian children were tested using the 20 m Shuttle Run Test, the same age group also showed decreased endurance levels between year 1995 to 2000³⁵. Aside from the decrease in endurance levels, overweight and obesity in the young are also becoming a global problem. In 1998, Armstrong et al reported a relationship of higher body mass index (BMI) and skinfold in children who spend more time watching television³⁶. There have also been estimates of the prevalence of overweight and obesity in children and have increased by a magnitude of two to five times in developed countries and up to almost four times in developing countries.³⁷

In the Philippines, children were used to playing traditional Filipino games like "sipa", "timbang preso", and "luksong tinik" among others. However, in these times, they are seldom seen engaging in such activities and would rather watch their favorite television shows or play computer games. These make them physically inactive.

Inactivity during childhood and adolescence is likely to lead to a sedentary lifestyle, thus setting the stage for heart diseases, diabetes, high blood pressure, obesity and some forms of cancer³⁸. As health care professionals, we need to go beyond the conventional setting of treating patients after they come in for rehabilitation. As physical therapists, we are not only limited to dealing with musculoskeletal and neurological cases but we are also concerned with optimizing the physical fitness of our patients and clients. As physical activity plays a role in physical fitness, we should change the way physical activity is perceived especially by the younger population. Identifying amounts and levels of physical activity and levels of endurance will help promote awareness of the importance of prevention of lifestyle diseases. Also, as there is no current local literature for profile of physical activity, BMI and endurance levels of our Filipino adolescents, this study hopes to provide new data for future references.

Therefore, the objectives of this study are to:

1. Describe the level of physical activity of the first year High School students of the University of Santo Tomas by the use of the Physical Activity Questionnaire for Children (PAQ-C);
2. Assess their aerobic capacity through the Multi Stage Fitness Test;
3. Obtain their Body Mass Index (BMI); and

4. Correlate the subjects' physical activity level, aerobic capacity and Body Mass Index.

METHODOLOGY

Research Design

Observational research study with correlations on the levels of physical activity and performance on tests of aerobic fitness.

Participants

All UST first year high school students were eligible to participate in the study. They were asked to answer the Physical Activity Questionnaire for Children (PAQ-C). Specific inclusion criteria for the 20 meter Shuttle Run Test were: (1) physical examination clearance from the UST Health Service and (2) signed written informed consent from the parents allowing the students to participate in the exercise testing. Exclusion criteria were: (1) musculoskeletal complaints and (2) fever, severe colds and malaise

Outcome Measures

1. Students' level of physical activity was assessed using the Physical Activity Questionnaire for Older Children (PAQ-C). PAQ-C which is a valid and reliable tool in assessing intensity of physical activity. The questionnaire consists of 10 items that cover a child's physical activities within a 7-day period. A score of one to five is given from lowest to highest physical activity level. The mean of the first nine questions determines the over-all physical activity level. The questionnaire had been supported by the two studies of Kowalski, Crocker, and Faulkner as a valid measure of general physical activity levels of children between 8 to 15 years³⁹⁻⁴⁰
2. Stretch stature height in meters.
3. Weight in kilograms.
4. BMI. Computed as weight in kilograms over height in meters squared.
5. VO₂ max levels using the Multi Stage Fitness Test (MSFT) also known as the 20 Meter Shuttle Run Test or the Bleep or Beep Test. The last stage finished and the speed of that stage was noted. Performance on tests of aerobic fitness were taken using L'eger et al's formula of $VO_2 \text{ max} = 31.025 + 3.238(\text{speed}) - 3.248(\text{age}) + 0.1536(\text{speed})(\text{age})^{41}$. Kemper et al validated the MSFT and concluded that it was a suitable tool to evaluate maximal aerobic power of children between 12 to 14 years¹³.

Procedures

Ethical Approval was obtained from the Research Center for the Health Sciences of the Faculty of

Medicine and Surgery. After the initial set of preparations, letters were sent to the UST High School Principal to ask for permission to conduct the study and to the UST Health Service to ask for the list of students who were cleared from the physical examination conducted at the start of the school year.

A reliability testing among the assessors was conducted prior to testing to ensure accuracy of measurements for height and weight. Group training on how to manage the Multi stage Fitness Test was also conducted prior to the actual test. Laboratory preparations such as calibration of testing materials to be used, printing of data sheets and finalization of the schedule and venue for the testing were also accomplished.

Upon inclusion of all the participants in the study, the Physical Activity Questionnaire for Children (PAQ-C) was administered to the students during their Physical Education Class. The consent forms were distributed to be signed by the parents and obtained the following day. Upon screening, those cleared from the physical examination by the UST Health Service and allowed by their parents to participate in the multi stage fitness test (MSFT) were scheduled for testing. Tests were either done as early as 8AM in the morning or as late as 4PM as determined by their students' physical education classes. During the test, the students were instructed to wear light and comfortable clothes and footwear and were given water to rehydrate themselves after the test.

On the day of the test, the Detecto Scale was used to ascertain the weight and height of the participants. They were asked to stand on the center of the weighing scale while the assessor read the scale. After which, the participants' stretch stature was measured. They were asked to inhale maximally and look straight ahead while the assessor assured that the zygomatic arch was parallel to the ground. This ensured head and neck in neutral position. Height and weight variables were necessary for BMI computation.

Polar heart rate monitors were also attached to each of the subjects' xiphisternal area to monitor actual heart rate response and maximum heart rate achieved during the test. A general orientation among the participants regarding the procedures of the MSFT was done prior to the actual test.

A MSFT CD was used instead of a cassette tape to ensure better accuracy of the test. A smooth, leveled path of 20 m was measured and marked where participants were asked to run by groups of seven. During the test, participants were instructed to run 20 m in varying speeds following

the pace set by the Shuttle Run Test (Protocol 1 Level 1 = 8.5 m/hr; Level 7 = 11.5km/hr). The participants were asked to run up to the point of volitional fatigue or upon experiencing signs of exercise intolerance such as dizziness, nausea and light headedness. Participants were forced to stop when they were unable to reach the 20m mark in time with the beep, for three consecutive times.

Data Analysis

The following statistical procedures were used in this study:

1. One Way ANOVA was used to determine reliability of height and weight measurements performed by assessors
2. T-test to measure baseline characteristics of subjects
3. Pearson correlation coefficient was used to determine relationship of VO2max, BMI values, and PAQ-C scores
4. Z-test was used to compare the performance indices

RESULTS

Reliability

Differences in height (F crit=5.14, p=0.93) and weight (F crit=5.14, p=0.20) measurements performed by the 3 assessors in this study were not statistically significant.

Table 1 shows the MSFT participants' baseline characteristics. There were significant differences on height, weight and BMI measurements between boys and girls while age differences were not found to be statistically significant.

Table 1. Participants' Baseline Characteristics			
	Boys(N=78)	Girls(N=110)	P Value
Mean Age	12.78±0.53	12.86±0.61	0.34
Mean Height	159.11±7.38	153.44±5.20	4.03E-09*
Mean Weight	57.25±14.51	48.55±10.39	3.34E-06*
Mean BMI	22.48±4.86	20.56±4.06	0.004*

* p value <0.05 considered significant

PAQ-C

A total of 402 out of the 520 first year UST students had valid responses to the PAQ-C and were included for analysis. The remaining 118 were excluded due to invalid responses to the questionnaire such as multiple answers to various items and skipping one or more items.

There were a total of 187 (47%) boys and 215 (53%) girls. Mean PAQ-C scores for the boys was 2.50±0.62 while a mean of 2.30±0.60 was found for the girls.

For those who were included in the MSFT and BMI assessment (N=188, Boys=78 and Girls=110), mean PAQ-C scores were 2.56±0.57 for the boys and 2.32±0.56 for the girls.

MSFT

From the initial 402 students who were included in the PAQ-C analysis, only 202 passed the inclusion criteria for the MSFT. 200 students were not given parental consent to participate in the test. A total of 188 students participated in the MSFT from the 202 who passed the inclusion criteria. Fourteen students were excluded (10 students were unable to complete the data from their PAQ C survey questionnaires; 2 students lacked data on height and weight and 2 had conflict with schedule). Among the 188 students who participated in the MSFT, 78 were boys (41%) and 110 were girls (59%). Mean VO2max values as computed from L'eger et al's formula of $VO_2 \text{ max}$ were 39.27±2.85 mlO2/kg/min for the boys and 36.61±5.25mlO2/kg/min for the girls.

Computing for the estimated VO2max and based on the normative values set by The Cooper Institute for Aerobics Research, the mean VO2max values for boys (39.26±2.85 mlO2/kg/min) is considered fair and mean VO2max values for girls (36.73±5.25 mlO2/kg/min) is considered good.⁴²

BMI

From the 188 students who were assessed for BMI, mean BMI values were 22.48±4.86 for the boys and 20.56±4.06 for the girls. According to the BMI-for-age percentiles provided by the Center for Disease Control (CDC) BMI Guidelines, the mean BMI for boys in this study, with mean age of 13 years, falls between the 85th to 95th

for overweight. While the mean BMI for the girls with the mean age of 13 falls between the 5th and 85th percentile, which means they are of healthy

weight.⁴³ When compared with the proposed standard definition of childhood overweight and obesity worldwide,⁴² the participants in the study were not overweight nor obese. BMI measurements for boys fell below the 98th percentile whereas those for girls fell below the 75th percentile. The standard BMI at 30 kg/m² for 13 year old boys is 26.48 while the standard for girls was 27.76.⁴³

Correlations between levels of physical activity and performance on tests of aerobic fitness

The study did not find enough evidence to provide a significant correlation between PAQ-C Scores and BMI values (r=0.056, p=0.634) and VO2max and BMI values (r=-.297, p=.008) for the boys. However, a significant low correlation (r=.322, p=0.004) existed between PAQ-C and VO2max .

For the girls, there was no significant correlation between PAQ-C scores and BMI values (r=-.097, p=.315), PAQ-C scores and VO2max (r=.045, p=.640) and VO2max and BMI values (r=-.042, p=.665).

Performance Index

Tables 2 and 3 show the performance indices of first year UST High School Students as computed against the mean and standard deviation of running speed at the final completed stage of MSFT set by Olds T et al.⁴⁴

Compared to the performance indices (mean age-

Table 2. Performance indices for boys at the completed stage of MSFT

Age	1 st Year USTHS Students		Standard Values ⁴⁴		Performance Index
	Number of Participants	Mean±SD (km/hr)	Number of Participants	Mean±SD (km/hr)	
11	1	9	15,480	10.716±1.202	-1.43
12	31	9.47±0.48	24,544	10.951±1.237	-1.20
13	42	9.58±0.59	27,535	11.166±1.303	-1.21
14	4	10.25±0.29	27,106	11.517±1.323	-0.96

percentile, which means that the boys are at risk

and sex-specific z-scores) of the 37 countries in the

Table 3. Performance indices for girls at the completed stage of MSFT

Age	1 st Year USTHS Students		Standard Values ⁴⁴		Performance Index
	Number of Participants	Mean±SD (km/hr)	Number of Participants	Mean±SD (km/hr)	
11	3	9.33±0.29	15,446	10.135±1.011	-0.79
12	38	9.20±0.36	24,225	10.241±1.041	-1.00
13	65	9.14±0.27	27,110	10.220±1.061	-1.02
14	4	9.27±0.29	24,924	10.311±1.086	-0.79

study of Olds T et al⁴³, the participants in our study ranked last, having z-scores lower than -0.867 which was recorded for Singaporean children.⁴³

DISCUSSION

In this study, baseline characteristics among boys and girls were noted to be significantly different for height, weight and BMI measurements. For this reason, all outcomes were computed independently for boys and girls.

Monitoring the amount of physical activity among children has been given attention due to reports and findings that overweight and obesity in the young are becoming global problem. Estimates of prevalence of overweight and obesity in children has increased a magnitude of two to five times in developed and to almost four times in developing countries due to many factors, one of each is physical inactivity.³⁷ Physical activity is important for weight control and physically active individuals are likely to have lower prevalence of obesity.⁴⁵ In this light, interventions have been conducted to increase the physical activity levels of the children like the one conducted by Simons-Morton et al in 1991 where they tested the efficacy of a school based intervention program to promote a healthful lifestyle.⁴⁶

The Body Mass Index (BMI) evaluates a person's weight in relation to height. It helps determine if a person is of healthy weight but is not a direct measure of body fatness.⁴⁵

In this study, The BMI-for-age of the boys found to be between the 85th to 95th percentiles in the BMI Guidelines of the Center for Disease Control (CDC),⁴² at this level, the boys are at risk for overweight. On the other hand, the BMI-for-age of the girls in this study falls between the 5th and 85th percentile, which means they are of healthy weight. Comparing the results of the study with worldwide data gathered by Cole TJ et al, all participants in the study were neither overweight nor obese.⁴² The boys fall below the 98th percentile whereas the girls fall below the 75th percentile. However, a study conducted a few years back found that the older the child and the higher his BMI, the more likely they would be an overweight adult, giving childhood BMI predictive value of risk for adulthood obesity.⁴⁷ They also indicated that young males with high BMI-for-age were more likely to be overweight adults than young females with high BMI-for-age.⁵¹

Borderline obesity in children increases the risk for cardiovascular risk factors such as glucose intolerance, hypertension, and dyslipidemia once they grow older.^{48,49,50} Other health problems related to obesity include obstructive sleep apnea, nonalcoholic steatohepatitis, and slipped capital femoral epiphysis.⁵⁰⁻⁵¹ Boys also experience anxiety, loneliness, low self-esteem, and anger⁵²⁻⁵³.

In this study, the authors deemed it necessary to measure the VO₂ max to monitor the aerobic fitness of the participants. The boys who took the MSFT had a mean VO₂max value of 39.27±2.85, based from Leger et al's computation ($VO_2 \text{ max} = 31.025 + 3.238(\text{speed}) - 3.248(\text{age}) + 0.1536(\text{speed})(\text{age})$). Based on the table for Normative VO₂max by the Cooper Institute for

Aerobics Research, Dallas TX (1997), the mean value of VO₂ max in boys is a fair rating and the mean value for girls (36.61 +/- 5.25 mlO₂/kg/min) is a good rating for cardiovascular endurance. Cardiovascular endurance is related to good levels of physical activity.

PAQ-C and BMI

In a study conducted on the daily physical activity and its relation to aerobic fitness in children aged 8-11 years, it was found out that physical activity correlated with endurance levels²⁰. However in our study, a significant correlation between physical activity levels (measured by the PAQ -C) and aerobic capacity (expressed in VO₂max) existed only among the boys and a non-significant relationship was found among the girls. The results maybe supported by the study of Pivarnik JN and Pfeiffer KA on the importance of physical activity, wherein there is no strong association between physical activity and fitness. Though there are a number of valid aerobic tests in the literature, the varying degrees of the physical activity of children pose methodological problems in quantitatively measuring them.

In comparing the performance indices (measured in kilometres per hour) of the first year UST high school students (USTHS) to the other performance indices of the 37 countries in the study of Old T et al⁴⁴, the first year USTHS participants ranked last. The 14 year old girls' performance index of -0.79 was slightly better than performance index of female Singaporean children who scored -0.867. Though 11-year old and 14-year old girls in this study recorded indices of -0.79, the small number of participants involved does not make this value generalizable.

CONCLUSIONS AND IMPLICATIONS

The UST first year high school students have an average level of physical activity as measured by the Physical Activity Questionnaire for Children. The boys have fair aerobic capacity or cardiovascular endurance and the girls have good endurance levels. The boys' BMI-for-age is between the 85th-95th percentile which is at risk for overweight and the girls BMI-for-age is between the optimum 5th-85th percentile which is considered a healthy weight.

Physical inactivity is one of the major modifiable risk factors in the development of health related diseases. Its importance in the prevention of such conditions has been established in current researches. Since a decline in physical activity levels has also been associated with aging, it is therefore imperative that clinicians promote awareness and emphasize the role of physical activity in disease prevention. Aerobic fitness and good cardiovascular endurance can help in the prevention and management of such conditions.

Current literature also implicates childhood BMI as having predictive value for risk of adulthood obesity especially more so in young males with high BMI-for-age as compared to females with the same high BMI-for-age. Therefore children, specifically boys found to be at risk for overweight are likely candidates for obesity in the future carrying with them the increased risk for various cardiovascular diseases. Improvements in aerobic fitness and good cardiovascular endurance can also help prevent such conditions.

Limitations and Recommendations

The data gathered in this research cannot be generalized since it only included a limited number of participants affiliated to a private school only. If possible inclusion of other children in both private and public schools, so as to represent the general population, should be done in order to obtain data or norms for physical activity levels for children and adolescence.

PAQ-C Questionnaire for Older Children only measures generally physical activity levels. The authors recommend a measure for specific caloric expenditure, frequency, duration and intensity of exercise that would make the findings more concrete. Due inadequate or lack of answers in PAQ-C, the sample size of those who answered PAQ-C and those who participated in the MSFT were not the same. This poses another limitation in the study.

The authors recommend continuous monitoring of the children who participated in the study and observe any decline or change in physical activity levels. Instituting personal physical activity routines in the homes, schools and community may be beneficial. In this way, the harmful effects of physical inactivity and risk for overweight in children may be prevented.

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