

A QUANTITATIVE STUDY OF THE LEVEL OF PHYSICAL ACTIVITY AND BODY MASS INDEX (BMI) AMONG TERTIARY STUDENTS IN GHANA: A CASE STUDY OF TAKORADI POLYTECHNIC.

Anthony Joe Turkson

Department of Mathematics and Statistics, Takoradi Polytechnic, Ghana.

ABSTRACT: *The study utilised cluster sampling to select participants. Body Mass Index (BMI) for each student was calculated and compared with that of the World Health Organization (W.H.O) Body Mass Index classification. Data were analyzed using Analysis of Variance (ANOVA). Majority (77.3%) of students did not exercise regularly; those who engaged in moderate activities spent less than the two and a half hours required for good health. Over seventy-seven percent were found to have anomalous weight. The mean BMI was normal (24.7kg/m^2) for students who exercised regularly, overweight (25.0 kg/m^2) for those who exercised occasionally and pre-obese (26.1 kg/m^2) for those who refrained from physical activity. It is recommended that all tertiary students in Ghana master in one or two sporting activities and engage in physical activities, they should also be abreast with the requisite time for each activity to benefit fully from physical activity.*

KEYWORDS: Physical activity, body mass index, risk of diseases, Polytechnic education

INTRODUCTION

The human body is like a complex machine; as much as it needs rest and appropriate dietary intake, it also needs physical activity. Physical activity (PA) is any body movement produced by skeletal muscles that require energy expenditure. According to W.H.O (2010), physical activity:

- Is a key determinant of energy expenditure, thus fundamental to energy balance and weight control.
- Reduces the risk of coronary heart disease, stroke and type II diabetes.
- Reduces the risk of colon cancer and breast cancer among women.

People should engage in adequate levels of physical activity throughout their lives. A person who does not exercise regularly consumes very little energy, resulting in accumulation of fats, and subsequently becomes overweight or obese. Physical activity also requires that one spends time outdoors. Sunlight on the skin helps the body to produce vitamin D, which brings added health benefits (American Heart Association, 2013). The importance of Physical Activities was revealed by China, when a policy was enacted in 2007 which obliged every student to master, at least, two basic physical activities and do sports for at least one hour a day in order to confront

concerns about declining youth health (Yang, 2006). Similarly, Spiridon (2008) in a study among obese and overweight students and students with normal weight revealed that students with normal BMI had better scores in Physical Education lessons than students who were obese and overweight.

A comparative study of 215 males with no regular physical exercise and 313 males with regular physical exercise revealed that males who did not undertake regular physical exercise had a significantly greater mean BMI compared with those who regularly exercised (Mukhopadhyal et. al., 2005). Samhita (as cited in Puri, 2001) explained that it was never advisable to take drugs when one feels uneasy without first doing physical exercise. It has been noted that management of time, multitasking and physical standing have the tendency of reducing sedentary behaviour (Ekblom-Bak et al, 2012; Teycheme et. al, 2011).

Studies on Physical activities and Health had shown the following results: Physical activities were increased to 150 min/week for grade 6 students and much more for grade 8 and 10 students in a school due to its importance. Active video games intervention had a consistent positive health effect on body composition among important sub-groups. Extracurricular school-based sports participants were significantly more physically active than children not participating in extracurricular school-based sports. Moreover, significant gender differences in children's attitude toward sports emerged at a very young age (Meester et al, 2014; Ekblom- Bak et al, 2012; Watts, 2014; Eccles and Harold, 2008). Finger et. al. (2014) revealed that parental education was more strongly associated with the outcome variables than parental occupation and income. Burkhauser and Cawley (2008) revealed that, BMI misclassified substantial fractions of individuals as obese or non-obese.

Moderate Physical Activity (MPA)

The following could be classified as MPA: washing and waxing a car, playing volleyball, washing windows or floors for, at least, 45 minutes, gardening, walking 2.8 km, shooting basketball, bicycling a distance of 8km, raking leaves, fast social dancing and walking for a distance of 3.2km for at least 30 minutes. Shovelng, swimming, stair walking and jumping rope for at least 15 minutes (American heart Association, 2013; National Institute of Health)

Vigorous Physical Activity

Vigorous activities include aerobic dance, biking faster than 16 km per hour, digging and hoeing, hiking uphill, karate, race walking, jogging, basketball, hockey and soccer, fast swimming and tennis. If one chooses a vigorous activity, one must do at least one and quarter hours a week. Moreover, it is better to spread one's activity throughout the week and stay active, at least, 3 days a week. The type of activity and the number of calories lost per a particular weight is shown in Appendix 2.

Body Mass Index

The body mass index (BMI) is a statistical measure which compares a person's weight and height. It is used to estimate a healthy body weight based on how tall a person is. Due to its ease of measurement and calculation, it is the most widely used diagnostic tool to identify weight problems within a population, whether individuals are underweight, overweight or obese. BMI is defined as the individual's body weight (in kg) divided by the square of his or her height (in meters). The unit of measurement is kg/m^2 . An adult whose weight is 90kg and height 1.83m will have a BMI of 26.85 kg/m^2 ($\text{BMI} = 90 \text{ kg} / (1.83 \text{ m})^2 = 90 / 3.35 = 26.85 \text{ kg/m}^2$). Accordingly, if this number (26.85 kg/m^2) is compared with the International Classifications in Appendix 1, such an adult is pre- obese. BMI also provides a simple measure of a person's "fatness" or "thinness"(W.H.O. 2009). This study was conducted to ascertain the level of physical activities and body mass index (BMI) among tertiary students in Ghana, using Takoradi Polytechnic as a case study.

METHODOLOGY

The target population was all the 8906 students of Takoradi Polytechnic (2008/2009 Academic year). A closed-type questionnaire was designed and used to collect data from the respondents. The questionnaire elicited information on age, gender, weight, height and physical activity levels. A weighing scale and tape measure were used to obtain data on weight and height respectively for those who had forgotten theirs. Instead of selecting all the subjects from the entire Polytechnic Population right off, the researcher took several steps and days in gathering the sampling units from different sections and departments of the Polytechnic.

In applying the formula for determining the sample size for such a study i.e. $n = \frac{N}{[1 + N(e)^2]}$,

where N = Total population of the Polytechnic, then at 95% confidence interval and a margin of error (e) of 5%, the minimum required sample size (n) was 383, but for ease of analysis the sample size was increased to 500. The return rate of the study was 97% (485). Out of this number, 2 students had their information on the forms incomplete so their data could not be used for the analysis. For each questionnaire, the BMI was computed using the formula, weight (kg in kilograms divided by the square of the height in meters and compared with the W.H.O classified BMI (Appendix 1). The questions were coded and entered into an SPSS 17 for analysis. Cross-tabulation and graphs were used to obtain the frequencies and percentages for each BMI and physical activity category. The data were further analyzed using one way Analysis of Variance

(ANOVA).

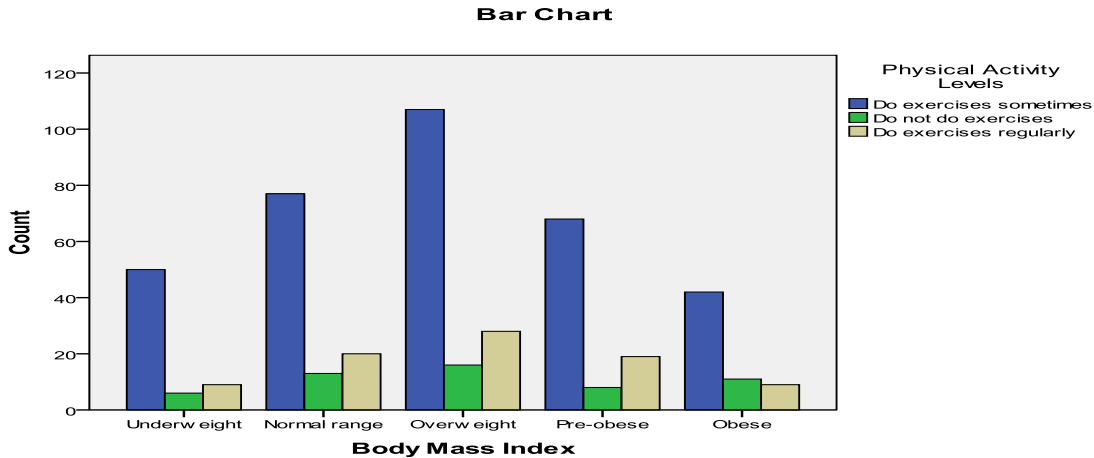


Figure 1. Bar chart showing Physical activity levels and BMI

RESULTS

The distribution of the 483 students according to their BMI levels and their physical activity status is shown in Figure 1. Majority of the students within each BMI category exercises occasionally. They were followed by those who did exercises regularly then those who did not. The trend changed slightly with the obese group; those who did not exercise followed those who did occasionally. It could also be inferred from Table 1 that 31.3 % of the students were overweight, 19.9 % were pre-obese, 12.8 % were obese, and 13.5 % were underweight. Only 22.7 % fell within the normal BMI range.

The distribution showed that a greater proportion of students were at risk of diseases associated with overweight and obesity. Again, the 13.5 % underweight students were at risk of diseases associated with underweight. Out of the 483 students sampled, 77.3 % were at risk of various weight-related diseases. The Table also indicated that of those who exercised regularly, 1.9 % were underweight, 4.1 % fell within the normal BMI range, and 5.8 % were overweight, while a total of 5.8 % fell within the pre-obese and obese category.

Table 1. Level of Physical activities against Gender, BMI, and time-nature of activity

	Physical Activity Levels			Total Freq. (%)
	Exercise sometimes Freq. (%)	Do not exercise Freq. (%)	Exercise regularly Freq. (%)	
Body mass Index				
Underweight	50 (10.4)	6 (1.2)	9 (1.9)	65 (13.5)
Normal range	77 (15.9)	13 (2.7)	20 (4.1)	110 (22.7)
Overweight	107 (22.2)	16 (3.3)	28 (5.8)	151(31.3)
Pre-obese	68 (14.1)	8 (1.7)	19 (3.9)	95 (19.7)
Obese	42 (8.7)	11(2.2)	9 (1.9)	62 (12.8)
Gender				
Male	229 (47.4)	23(4.8)	60 (12.4)	312 (64.6)
Female	115 (23.8)	31(6.4)	25 (5.2)	171(35.4)
Number of minutes per each days exercise				
Do not exercise	0 (0)	54 (11.2)	1(0.2)	55 (11.4)
Exercise at least 30 minutes per a day	245(50.7)	0 (0)	64 (13.3)	309 (64)
Exercise less than 30 minutes per each day	99 (20.5)	0 (0)	20 (4.1)	119 (24.6)
Number of times participants exercise in a week				
Do not exercise	0 (0)	54 (11.2)	1 (0.2)	55 (11.4)
Exercise, at least, 3 times a week	246(50.9)	0 (0)	54 (11.2)	300 (62.1)
Exercise, less than, 3 times a week	98 (20.3)	0 (0)	30 (6.2)	128 (26.5)

Note: Regularly means the person does at least 3 times a week of physical activity. Sometimes means the person exercises, at most, 3 times physical activity in a week and might skip some days.

It could further be inferred from Tables 1 that out of the 'regular exercise' category, 11.2 % of them exercised at least 3 times in a week while 6.2 % exercised less than 3 times in a week, moreover, 13.3 % of respondents spent at least 30 minutes each time they exercised while 4.1 % spent less than 30 minutes each time they exercised.

From Table 2, it could be deduced that out of the respondents only 35 percent were females while the rest were males, therefore, the same proportion must run through all category of BMI, a deviation from the stated proportion gives room for comments. The following were the proportion of females in the respective BMI categorizations; underweight, normal weight, overweight, pre-obese and obese; 38.5 % ($\frac{25}{65} \times 100$), 24.5%, 25.8%, 40% and 67.8%.

Figure 2 gives a comparative picture of males and females and the type of activities they were involved in; out of the 64 students engaged in cycling, males were more than females, of the 268 engaged in walking, females were more than males. Out of the 130 students engaged in running, males were more than females, of the 111 students involved in sports and games, females were more than males, again, of the 68 students involved in skipping (jumping rope), females were more than males. Finally, out of the 42 students engaged in aerobics, males were fewer than females. It is worth pointing out that some of the students were engaged in more than one activity.

Table 2. Gender against Body Mass Index

		Body Mass Index					
		Underweight	Normal range	Over weight	Pre-obese	Obese	Total
		Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)
Gender	Male	40(8.3)	83(17.2)	112(23.2)	57(11.8)	20(4.1)	312(64.6)
	Female	25(5.2)	27(5.5)	39(8.1)	38(7.9)	42(8.7)	171(35.4)
	Total	65(13.5)	110(22.7)	151(31.3)	95(19.7)	62(12.8)	483(100)

Table 3.Summary statistics of physical activity levels with Body Mass Index

	N	Mean	Std. Deviation	Std. Error	95% Interval for Mean Lower Bound	Confidence Upper Bound
Exercise sometimes	344	24.956	5.7089	.3078	24.351	25.562
Do not exercise	54	26.130	6.7937	.9245	24.275	27.984
Exercise regularly	85	24.735	4.6767	.5073	23.727	25.744
Total	483	25.048	5.6775	.2583	24.541	25.556

Table 4. Test of Homogeneity of Variances

Levine's

Statistic	df₁	df₂	Sig.
3.915	2	480	0.021

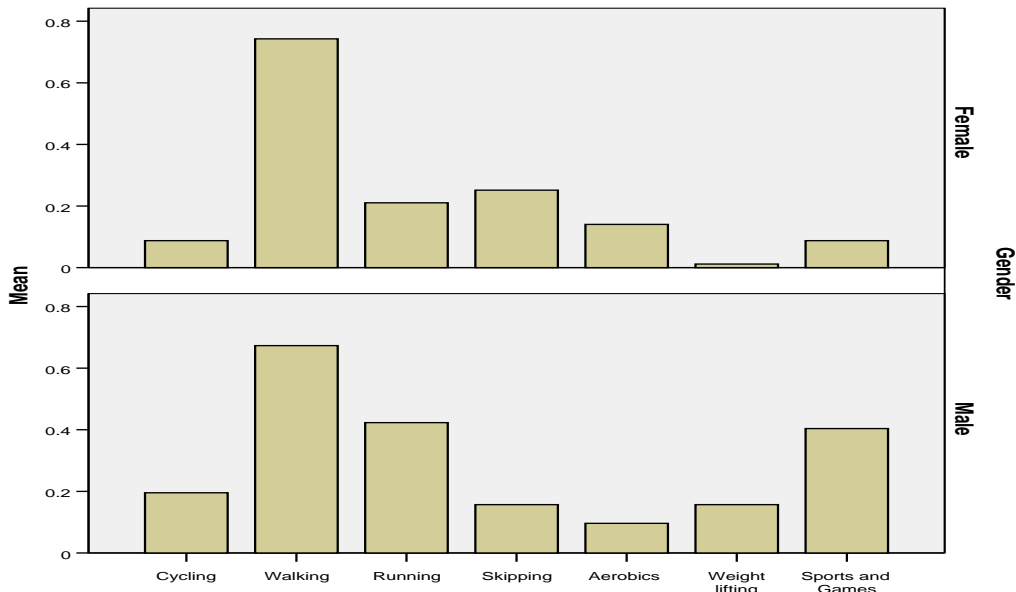


Figure 2. Distributions of types of exercises with gender

DISCUSSION

The major objective of the research was to ascertain Level of Physical Activity and Body Mass Index (BMI) among Tertiary Students in Ghana: A Case Study of Takoradi Polytechnic. The analysis revealed that majority (77.3%) of the students exercised occasionally; a few did it regularly (22.7%). The low patronage of physical activity might be attributed to the fact that there is no policy on physical activities in schools that specifies that students should learn and master one or two sporting activities and engage in such activities for at least one hour every day, as it pertains in other countries.

China's policy requires that educational institutions take measures to improve physical education, which requirement include more training for physical education instructors and actions to persuade teachers and parents to note that pursuing high education at the cost of students' health was useless" (Yang, 2006). China saw the need to include physical activities in their educational policies; so it is not surprising that they live longer than Ghanaians (Life expectancy for Ghana as at 2011 was 63.5 years and for China it was 75.6 years (World Health Review (W.H.R), 2010).

Those who refrained from exercise and those who exercised occasionally are at higher risk of contracting weight-related diseases than those who exercised regularly. Even among the eighty-five students who exercised regularly, only 23.5 % fell within the normal BMI category. The result confirms the assertion by Ekblom-Bak et al, (2012) and Teycheme et al, (2011) that a generally active daily life is associated with good health and longevity

The study also revealed that 76.5 % of the students were at risk of weight related- diseases. This development could be attributed to the fact that the students do not exercise according to the guidelines provided in Appendix 2 of this paper. Even though the indicated proportions were encouraging (Table 1), they did not give corresponding figures of the proportion of students falling within the normal BMI categorization (23.5 %). The shortfall could be attributed to the fact that every activity had a requisite number of hours associated with it (Appendix 2); failure to adhere to assigned times prevents the expected outcomes.

In another dimension, though the proportion of females to males was 35% to 65%, when it came to the distribution of BMI by sex, 38.5% of the females were underweight; fewer females (24.5%) were within the normal range, 25.8 % females fell within the overweight group. Forty percent (40%) of females fell within the pre-obese group and 67.8 % fell within the obese group (Table 2). Some schools of thought (Burkhauser and Cawley, 2008) contend that BMI misclassifies substantial fractions of individuals as obese or non-obese, according to them; BMI was less accurate classifying men than women. If this contention is true, then it is not surprising to see this kind of distribution.

Most students from the groups that exercised regularly, as well as those who exercised sometimes, engaged in moderate activities which required at least 2 hours 30 minutes per week to enjoy the benefits thereof. However, they spent just about 1 hour 30 minutes for these activities per day. This period falls short of the amount of time needed to maintain good health (Appendix 2). It is important that students have the right knowledge on each physical activity and its corresponding timing. From the summary statistics in Table 3, students who exercised regularly had a mean BMI of 24.7 kg/m^2 with 95 % confidence interval for mean as (23.7, 25.7) kg/m^2 , students who exercised sometimes had a mean BMI of 25.0 with 95 % confidence interval for mean as (24.4, 25.6) kg/m^2 . Students, who did not do any exercises, had a mean BMI of 26.1 with 95 % confidence interval equal to (24.3, 28.0) kg/m^2 .

The results from Table 3 give significant details on the BMI categorization presented in Table 1. The test result endorsed the BMI categorization of the students of the Polytechnic. The mean BMI values of all the groups are in consonance with earlier studies which revealed that those who did not undertake regular physical exercise had a significantly greater mean body mass index (BMI) as compared with those who undertook regular physical exercise (Mukhopadhyal et al, 2005). From the 95 percent confidence interval for the mean BMI, it could be concluded that if the entire tertiary student population were sampled, the mean BMI values for those who did not exercise would be between 24.3 kg/m^2 and 28.0 kg/m^2 ; those who exercised occasionally would have their mean BMI values fall between 24.4 kg/m^2 and 25.6 kg/m^2 and the mean BMI values for those who exercised regularly would fall between 23.7 kg/m^2 and 25.7 kg/m^2 , thus, the more regular the physical activity, the better the BMI value.

Levine's test for homogeneity of variances with significant values of $p < 0.05$ (Table 4) indicates that variances for BMI scores for each of the physical activity levels do indeed differ significantly. Figure 2 presents a comparison of type of physical activity and gender. The highest patronized physical activity was walking; and approximately the same number of males and females preferred that physical activity. More males selected running while more females chose aerobics. The least patronized physical activity was weight-lifting-- 0.2 % males and a negligible number of females.

Studies have shown that gender differences in children's attitude toward sports are quite strong and emerge at a very young age, and that these gender differences seem to be a consequence more of gender-role socialization than of "natural" attitudinal differences. The results of this study confirm earlier studies conducted by Mukhopadhyal et al. (2005) and Spiridon (2008) that people who exercise occasionally had a significantly greater mean BMI than those who undertook regular physical exercise.

CONCLUSION

From the above discussion, it could be concluded that majority of the students sampled did not do exercises regularly, for those who did it regularly; most of them were engaged in moderate level activities but spent less than the required 2 hours 30 minutes needed to maintain good health. About seventy-seven percent of the students were found to have anomalous weight. The study also showed that there were differences in gender and choice of physical activity. The distribution of students to the various BMI categorizations failed to align with the proportion of students who exercise occasionally, those who did not do it at all and those who did it always. Apparently, students do not know the time period required by physical activity to enable a person to enjoy the full benefits associated with the activity.

RECOMMENDATIONS

The study recommends the following measures to address the issue:

- The Ministry of Education should collaborate with the various stakeholders of Tertiary Education to come out with policy statements that will guide all tertiary students to master one or two sports and engage in physical activities while studying
- Management and Student Representative Council of Takoradi Polytechnic should issue a statement of concern about the health benefits of regular physical activity.
- Students must be educated about the various physical activities and their corresponding times needed to maintain good health so that they can enjoy the benefits thereof.

REFERENCES

- American Heart Association (2013). Physical activity improves quality of life. Retrieved from http://www.heart.org/HEARTORG/GettingHealthy/PhysicalActivity/StartWalking/Physical-activity-improves-quality-of-life_UCM_307977_Article.jsp
- Booth, J.N., Tomporowski, P.D., Boyle, J.M., Ness, A.R., Joinson, C., Leary, S.D., & Reilly, J. (2013). Associations between executive attention and objectively measured physical activity in adolescence: Findings from ALSPAC, a UK cohort. *Mental health and Physical Activity*, 6(3), 212- 219.
- Burkhauser, R.V., & Cawley, J. (2008). Beyond BMI: The value of more accurate measures of fatness and obesity in social research. *Journal of Health Economics*, 27(2), 519- 529.
- Eccles, J.S., & Harold, R.D. (2008). Gender differences in sport involvement: Applying the eccles expectancy –value model. *Journal of Applied Sports Psychology*, 3(1),7-35.

- Ekblom- Bak, E., Ekblom, B., Vikstrom, M., Ulf de Faire & Hellenius, M-L. (2012). The importance of non-exercise physical activity for cardiovascular health and longevity. *Br J Sports Med* 2014, 48:233-238 doi: 10.1136/bjsports-2012-092038
- Finger, J.D., Mensink, G.B.M., Banzer, W., Lampert, T., & Tylleskär, T. (2014). Physical activity, aerobic fitness and parental socio-economic position among adolescents: the German health interview and examination survey for children and adolescents 2003–2006 (KiGGS). *International Journal of Behavioral Nutrition and Physical Activity*, 11:43 doi: 10.1186/1479-5868-11-43.
- Meester, A. D., Aelterman, N., Cardon, G., Bourdeaudhuij, I.D., & Haerens, L. (2014). Extracurricular school-based sports as a motivating vehicle for sports participation in youth: a cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity*, 11:48, doi: 10.1186/1479-5868-11-48.
- Mukhopadhyay, A., Bhadra, M., Bose, K. (2005). Physical exercise, body mass index, subcutaneous adiposity and body composition among Bengalese boys aged 10-17 years of Kolkata, India. *Antropol Anz*, 63(1), 93-101.
- National Institute of Health: *Guide to physical activity*. Retrieved from http://www.nhlbi.nih.gov/health/public/heart/obesity/lose_wt/phy_act.htm
- Puri, A.S. (2001). *How to prevent common serious diseases*, 2nd ed. Sterling PVT Ltd, India.
- Spiridon, K., & Nikolas, D. (2008). Physical activity levels, exercise attitudes, self-perceptions and BMI type of 11 to 12-year-old children. *Journal of Child Health Care*, 12(3), 232-240.
- Teychenne, M., Ball, K., & Salmon, J. (2011). Perceived influences on and strategies to reduce sedentary behavior in disadvantaged women experiencing depressive symptoms: A qualitative study. *Mental health and Physical Activity*, 4(2), 95–102.
- Watts, A.W., Mâsse, L.C., & Naylor, P-J. (2014). Changes to the school food and physical activity environment after guideline implementation in British Columbia, Canada. *International Journal of Behavioral Nutrition and Physical Activity*, 11:50 doi: 10.1186/1479-5868-11-50 index.jsp?introPage=intro_3.html
- W.H. O. (2010). Social benefits of physical activity. Retrieved from http://www.who.int/dietphysicalactivity/factsheet_benefits/en/index.html
- W.H.O. (2009, November 5). Global Strategy on Diet, Physical Activity and Health: Retrieved from <http://www.who.int/dietphysicalactivity/pa/en/index.html>
- W.H.R.(2010).World Health Review. Retrieved from <http://www.worldlifeexpectancy.com/world-health-review/china-vs-ghana>
- Yang, G. (2009, November 5). Physical activity set to improve student's health. *Xinhua News Agency*. Retrieved from <http://www.chinagate.cn/english/education/49596.htm>

Appendix 1. International classification of adult underweight, overweight and obesity

Classification	BMI(kg/m ²)	BMI(kg/m ²)
	Principal cut-off points	Additional cut-off points
Underweight	<18.50	<18.50
Severe thinness	<16.00	<16.00
Moderate thinness	16.00 - 16.99	16.00 - 16.99
Mild thinness	17.00 - 18.49	17.00 - 18.49
Normal range	18.50 - 24.99	18.50 - 22.99
		23.00 - 24.99
Overweight	≥25.00	≥25.00
Pre-obese	25.00 - 29.99	25.00 - 27.49
		27.50 - 29.99
Obese	≥30.00	≥30.00
Obese class I	30.00 - 34.99	30.00 - 32.49
		32.50 - 34.99
Obese class II	35.00 - 39.99	35.00 - 37.49
		37.50 - 39.99
Obese class III	≥40.00	≥40.00

Source: Adapted from WHO, 1995, WHO, 2000 and WHO 2004.

Appendix 2. Calories/hour used by a 45.3kg, 68.2kg and 90.6kg person doing an activity

Activity	100 lb (45.3kg)	150 lb(68.18kg)	200 lb (90.6kg)
Bicycling, 10kmph	160	240	312
Bicycling, 20kmph	270	410	534
Jogging, 11 kmph	610	920	1,230
Jumping rope(skipping)	500	750	1,000
Running 8.8 kmph	440	660	962
Running, 16 kmph	850	1,280	1,664
Swimming, 25 yds/min	185	275	358
Swimming, 50 yds/min	325	500	650
Tennis, singles	265	400	535
Walking, 3.2 kmph	160	240	312
Walking, 4.8 kmph	210	320	416
Walking, 7.2 kmph	295	440	572

Source: The American Heart Association

Appendix 3. Benefits of Physical Activities

- Improves a person's health development.
- Makes people prepared physically, mentally and socially.
- Helps individuals strengthen their muscles and relieve stiffness.
- Creates mental alertness, relieves stress and makes people always cheerful.
- Builds endurance especially when one is engaged in exercises like dancing.
- Helps to keep body weight at reasonable level not over or under weight.
- Enables the individual to have an athletic appearance.
- Helps the person to look at the bright side of life.
- Increases productivity at the workplace
- Lowers worker absenteeism and turnover

- Produces better performance at schools
- Improves blood cholesterol levels
- Prevents and manages high blood pressure
- Prevents bone loss
- Boosts energy level
- Helps manage stress
- Releases tension
- Promotes enthusiasm and optimism
- Counters anxiety and depression
- Helps one fall asleep faster and sleep more soundly
- Improves self-image
- Increases muscle strength, increasing the ability to do other physical activities
- Provides a way to share an activity with family and friends
- Reduces coronary heart disease in women by 30-40 percent (W.H.O 2010, and Finger et al, 2014).