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RESEARCH ARTICLE
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ESTIMATING THE ENERGY COST OF WALKING IN STUDENTS AND FACULTIES AND ITS ASSOCIATION WITH BMI AND PHYSICAL ACTIVITY. A CROSS-SECTIONAL STUDY FROM KHYBER MEDICAL UNIVERSITY PESHAWAR

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ABSTRACT

BACKGROUND:
Physical activity is defined as any sort of body movement that are performed voluntarily by skeletal muscles resulting in energy expenditure. About 31% of the human beings do not engage in physical activity. In the UK, the physical inactivity rate is very high, only 24% of females and 36% of males are involved in physical activity.

OBJECTIVE:
To measure the energy cost of walking in students and faculties and its association with BMI and Physical activity in Khyber Medical University Peshawar.

METHODS:
This Cross-sectional study recruited 346 participants through stratified random sampling to evaluate undergraduates and faculty of Khyber Medical University. After data collection by using the International Physical Activity Questionnaire-Short Form. BMI was obtained and a 100-meter walk was performed by all participants. Data was analyzed in SPSS and descriptive statistics were obtained and associations were correlated.

RESULTS:
Out of 346 sample, there were 177(51.2%) male and 169(48.8%) female. A total of 300(86.5%) were with normal BMI, obesity was found in 46(13.3%) of the sample.The sample which performed

Vigorous activity per day were 66.95%. 52.7% performed moderate activity and those with low physical activity were only 1.4% of the sample. The Physiological Cost Index was evaluated for normal and overweight categories of sample. The analysis showed non significant results. When Physiological Cost Index was evaluated with undergraduates, postgraduates and faculty. The analysis showed significant results.

CONCLUSION:
We found the association of energy cost of walking and physical activity(any type of activity) and also its relation with the BMI of an individual performing physical activity. A strong relation existed between cost effective walking, physical activity and BMI. Obesity was correlated in individuals with a low level of physical activity and high expenditure of energy.

KEY WORDS: Physical Activity, BMI, Cost effective Walking, Energy Cost, Physiological Cost Index

INTRODUCTION:
Energy consumption done by performing movements is defined as physical activity (PA) (1). The risk of serious diseases such as diabetes and hypertension is increased due to obesity and decreased PA in underdeveloped and developed countries (2). Obesity is increased fat deposition that may harm health (3). Obesity affects 20–40% of adult and 10–20% of children worldwide. According to previous studies 1.9 billion adults of age 18 years and above (39% men and 40% women) were considered overweight and out of these 650 million (15% women and 11% men) were obese (4). Obesity and PA is considered as fourth and fifth major cause of mortality throughout the world and these two are considered the cause of other serious disorders such as musculoskeletal issues, cancers of the liver, colon, prostate and cardiovascular diseases (5).
Weight divided by the square of height (kg/m2) is called body mass index (BMI) (6). BMI value 25 and greater is considered overweight, Obese when BMI is 30 and above (7-9). Obese individuals' body mass is formed of both fat-free mass and fat, and fat mass does not take any part in metabolism (10). People with greater BMI values use more energy for walking (11).In persons with normal weight walking speed is affected by total energy cost (12). In overweight person energy cost of walking is 0% to 33% greater hence obese persons will walk slower as compared to individual with normal weight to reduce their metabolic rate (13). The metabolic rate of energy is in direct relation to walking speed (14). In older adults of age >70 years Energy cost of walking (Cw) is 10–30% higher (15). BMI and PA have an inverse relation (16-17). Students at university have a decreased PA level which is a risk factor for getting overweight and obese which in turn affect their cognitive functioning and decision making (18) obese university students faces psychological problems such as depression, social isolation and anxiety which have negative effects on their academic achievements (19).
Students adapt sedentary behavior such as prolong sitting in lecture rooms for hours, using cars etc for small distances and avoiding stair use by using lifts which leads to physical inactivity. This may have negative effects on person health. Therefore we thought that it is essential to stand on rates of physical activity at the university students and faculty. This study will be conducted to measure the energy expenditure of walking and the effects of BMI of Underweight, Normal, overweight & Obese individuals on PCI. Physiological cost index will be assessed and it will be compared to the energy expenditure of person with different BMI and PA level.

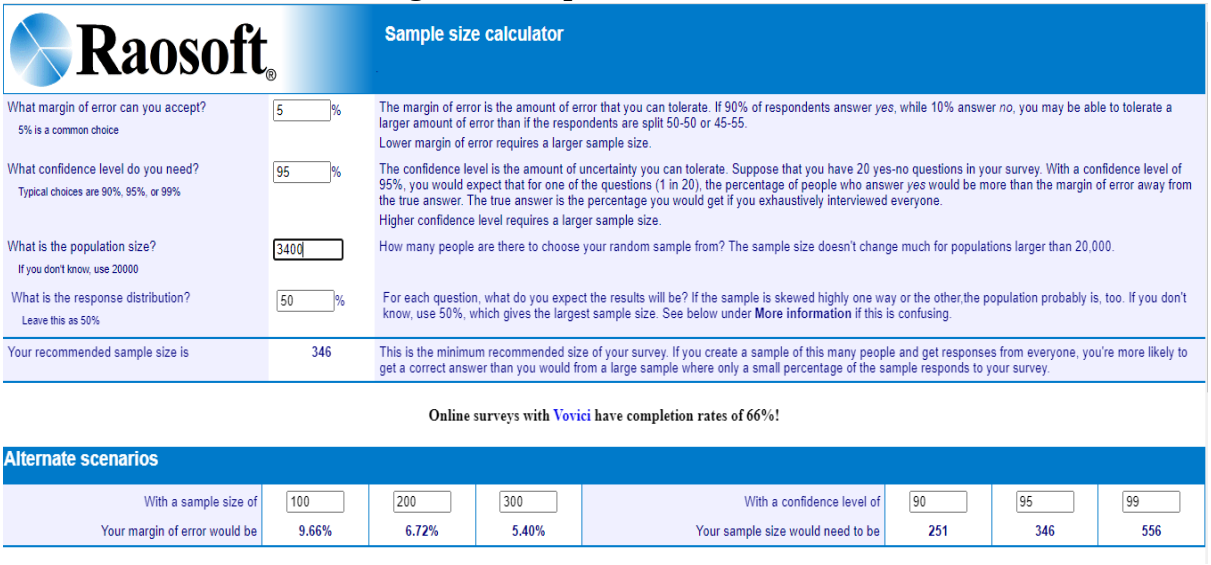
OBJECTIVES OF THE STUDY:
- To measure energy cost of walking in the students and faculty of Khyber Medical University Peshawar.
- To measure its association with BMI and PCI.

METHODOLOGY:

3.1 STUDY DESIGN:

The study design for this study was Cross sectional study. This study was type of observational study, where the data was analyzed from the subset of population at a specific point of time. Sample size of this study was 346 according to raosoft calculator.

Figure 1 Sample size calculations



Stratified random sampling technique was used in this study. In statistics, stratified sampling is a method of sampling from a population which can be partitioned into subpopulations. In statistical surveys, when subpopulations within an overall population vary, it could be advantageous to sample each subpopulation independently. Data was collected from the students (Under graduates and post graduates) and the faculty of Khyber Medical University Peshawar. Duration of the study was kept six months. In this duration the study was completed from data collection till the write up process.

Healthy students and faculty of age 18 to 60 years of both genders (male and female) and individuals who were willing to participate in the study and gave informed consent will be included in the study while subjects with musculoskeletal Disorders, respiratory Disorders, cardiovascular Disorders, neurological Disorders, metabolic Disorders and psychiatric Disorders was excluded from the study. Study proposal was approved from Institutional Ethical Committee and Advanced Studies & Research Board. After approval participants were selected from the study settings and written informed consent was obtained after explaining study purpose and procedure.

The IPAQ-SF questionnaire was filled by each participant and their height (m) and weight (kg) was measured and BMI was calculated using the standard formula (kg/m2).Rest 5 min were given to each participant. In which Resting HR was measured. Each participant walked with normal speed for 6 minute, the normal speed on a straight floor track, and their walking speed was measured. During the walking test, a pulse oximeter with a finger probe was attached to the finger of the participant continuously to measure HR. Rest was given to individual till HR returned to resting rate. Then, PCI was calculated using the following formula

PCI (b / min) = Walking HR(b/ min) −Resting HR(b/ min)

Walking Speed: The speed is measured in meters per minute when participant walk on level ground.

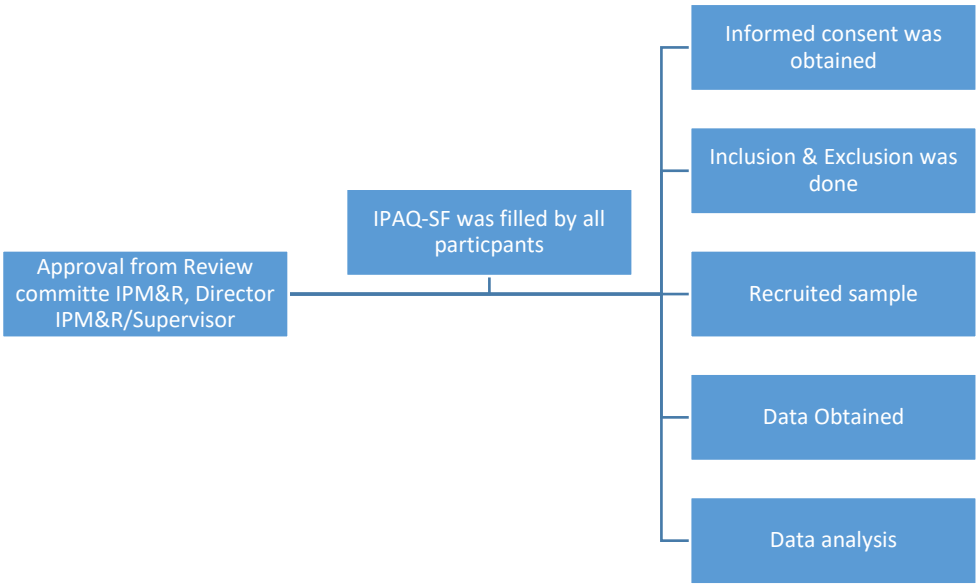


FIGURE 2 FLOW CHART

Data was scrutinized using SPSS version 26. General characteristics of the subjects were measured using frequencies, mean, percentages, demographic data, and standard deviation . Chi square test was used to find association between BMI & PA and also for PCI. The significance level was set at $\alpha = 0.05$.

RESULT:

SAMPLE CHARACTERISTICS:

Out of total population 346 participants were recruited. There were 177(51.2%) male and 169(48.8%) female. A total of 300 (86.5%) were with normal body mass index, obesity was found in 46(13.3%) of the sample. Out of the total sample, 269 participants were undergraduates, 63 of them were enrolled in post graduation degree program and only 14 faculty members of Khyber medical university participated in the study. Baseline characteristics are shown in table 1.

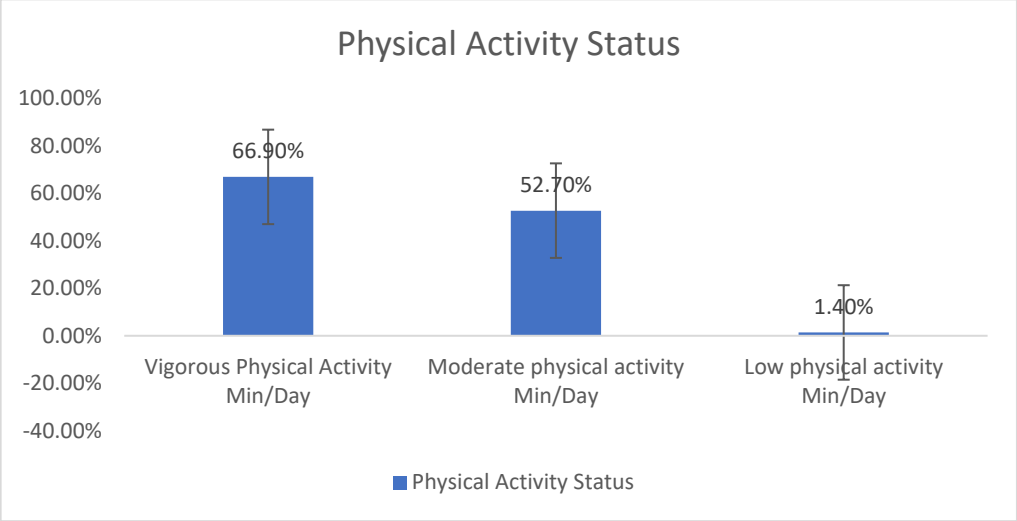
Table 1: Baseline Characteristics

BASELINE CHARACTERISTICS		
LEVELS	Undergraduate	269 (77.74%)
	Post graduate	63 (18.20%)
	Faculty	14 (4.04%)
GENDER	Male	177(51.2%)
	Female	169(48.8%)
BMI		
	Normal	300(86.5%)
	Obesity	46(13.3%)

4.2 STATUS OF PHYSICAL ACTIVITY

When data was analyzed to find out the physical activity status of total sample. The sample which performed Vigorous activity per day were 66.95% of the total sample. 52.7% performed moderate activity a day and those who were engaged in low physical activity were only 1.4% of the sample.

Figure 3: Physical Activity Status



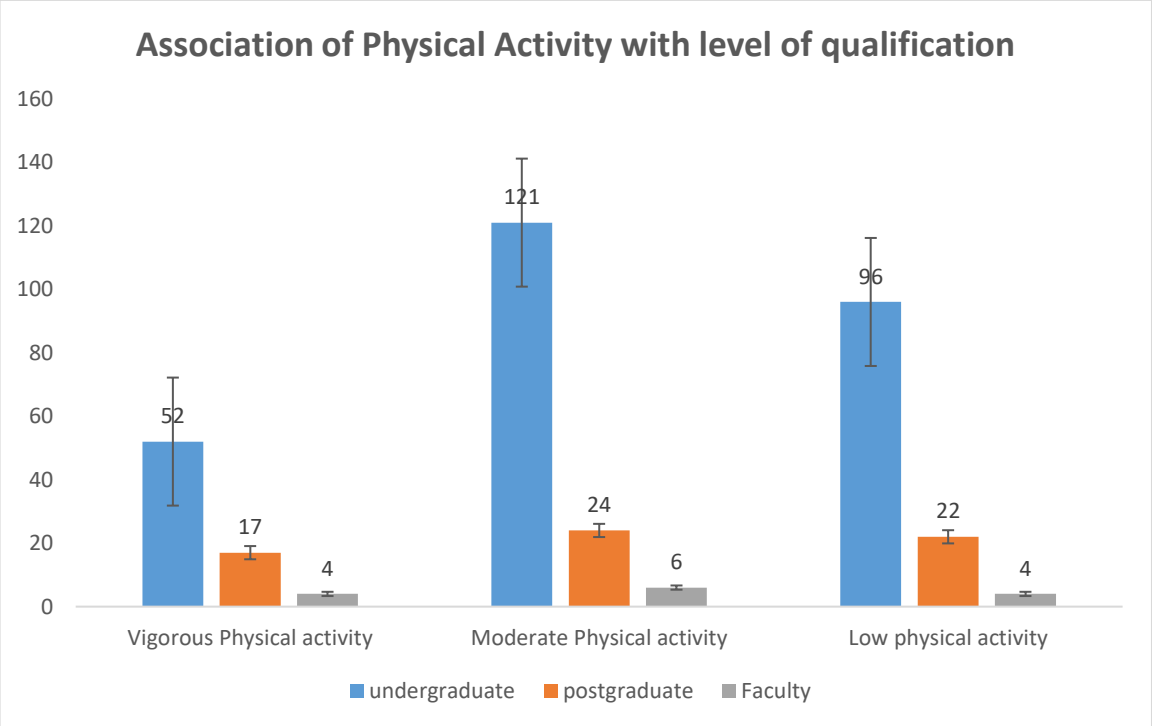
COMPARISON OF LEVEL OF PHYSICAL ACTIVITY AMONG SAMPLE

Chi-square test was applied for cross tabulation. P-value for association between level of physical activity and level of participants was 0.635 which showed non-significant results and no association between level of physical activity and level of participants. Results are shown in table 2.

Table 2: Association of Physical Activity with level of qualification

Level of Physical activity	Level of Qualification			P-value
	undergraduate	postgraduate	Faculty	
Vigorous Physical activity	52	17	4	
Moderate Physical activity	121	24	6	0.635
Low physical activity	96	22	4	

Figure 2: Association of Physical Activity with level of qualification



4.7. COMPARISON OF PCI AMONG SAMPLE

When Physiological Cost Index was evaluated with undergraduates, postgraduates and faculty using one way Anova test, the analysis showed non-significant results. Means and standard deviations are shown in table 7.

Table 3: Effect of PCI on Level of Qualification

PCI	Category of Sample	Mean	Std. Deviation	Sig
Physiological Cost Index	Undergraduates	0.45	0.01	0.077
	Post Graduates	0.40	0.02	
	Faculty	0.56	0.06	

COMPARISON OF LEVEL OF PCI WITH GENDER

The Physiological Cost Index was evaluated for male and female categories of sample using independent T test. The analysis showed significant results. Means and standard deviations are shown in table 9.

Table 4: Effect of PCI on Gender

PCI	Category of Sample	Mean	Std. Deviation	Sig
Physiological Cost Index	Male	0.47	0.27	0.015
	Female	0.42	0.23	

COMPARISON OF PCI WITH BMI

The Physiological Cost Index was evaluated for normal and overweight categories of sample using independent sample t test. The analysis showed non-significant results. Means and standard deviations are shown in table 12.

Table 5: EFFECT OF PCI ON BMI

PCI	Category of Sample	Mean	Std. Deviation	Sig
Physiological Cost Index	Normal	0.44	0.25	0.955
	Overweight	0.43	0.27	

DISCUSSION

When energy cost of walking in students (both undergraduates and postgraduates) and faculty of Khyber Medical University, Peshawar was assessed to find the association of energy expenditure with BMI and Physical activity, it was analyzed that out of total population, 346 participants were recruited in the study. There were 177(51.2%) male and 169(48.8%) female. A total of 300(86.5%) were with normal body mass index, obesity was found in 46(13.3%) of the sample. Out of the total sample, 269 participants were undergraduates, 63 of them were enrolled in post-graduation degree program and only 14 faculty members of Khyber medical university participated in the study. When data was analyzed to find out the physical activity status of total sample. The sample which performed Vigorous activity per day were 66.95% of the total sample. 52.7% performed moderate activity a day and those who were engaged in low physical activity were only 1.4% of the sample.

Majority of the sample of our study did not participate in vigorous activity each day a week but did participate few days a week and the bulk sample (66.9%) did not perform any vigorous activity any day of a week. When moderate activity was evaluated, 52.7% of the sample were not involve in any sort of moderate activity any day a week but some of them did participate in moderate sort of physical activity on alternate days a week. And when sample was analyzed for low level physical activity then major chunk of the sample (30.8%) reported that they were involved in minimal amount of physical activity all days a week. The study also found level of physical activities in students and faculty. The majority of the faculty was involved in vigorous type of physical activity, then post graduates were actively performing vigorous physical activity. Undergraduates were relatively less involved in

vigorous type of physical activity. For moderate and low type of physical activity, faculty was more active compared to graduates. In UK, physical inactivity rate is very high, only 24% female and 36% males are involved in physical activity of 30 minutes for 5 times a week, this is the least recommended time for keeping the person active and physically able. However children in UK are more active compared to the time when they reach adulthood (20). In India, Adolescents and youth are not active on a regular basis and are reported to have low physical activity. About one third of students does not participate in leisure time activities.(21) In contradiction to our study, in southeast Asia to about 43% in the Americas and the eastern Mediterranean, inactivity rises with age, is higher in women than in men, and is increased in high-income countries. The proportion of 13–15- year-olds doing fewer than 60 min of physical activity of moderate to vigorous intensity per day is 80•3% (80•1–80•5); boys are more active than are girls.(22) In China, In both rural and urban settings, younger adults, men, and southern residents were more likely to be physically active and to participate in work-related and leisure-time physical activity than older adults, women, and northern residents.(23) In Saudi Arabia, , the prevalence of physical inactivity in males increased from early adulthood (16–30 years) to reach its peak at a later age (46–60 years) (24).

When BMI was correlated with metabolic equivalent of different level of Physical Activity, it was found that metabolic equivalent of vigorous, moderate and low level of physical activity were significantly correlated with BMI with P Value less than 0.05. When same correlation was analyzed between metabolic equivalent of activity levels and PCI. The results showed significant correlation with all values resulted with P Value less than 0.05. When these results were compared with literature, it was evaluated that some of the studies had contrasting results to ours, while majority were in favor of our study. In contrast to findings one study by Luisa Aires et al, who conducted a cross sectional study where 111 sample was used to evaluate association between Physical Activity and BMI, where PA was assessed by accelerometer for 7 days. Pearson correlation was used to find correlation and the result showed that BMI and physical activity were not correlated with each other. (25) Another study conducted by Scott T. Leatherdale et al in 2008 analyzed association between Physical activity and BMI, the results showed that those adults who had low level of physical activity were more obese than those who had higher level of physical activity. In the sample 16.3% students were less active, moderate active were 68.7% those who were vigorously active consisted of 15.0% of the sample. Value of P for association between PA and BMI was less than 0.05 showing significant association (26).

CONCLUSION

In majority of the literature, surveys are conducted on whole population to find physical activity level. In some other studies, different type of questions were asked to assess physical activity level, some had taken specific type of activities only to conclude it into physical activity. Physical activities and the tools used for its measurement vary in many aspects. Keeping in mind the limitations of this study, and by using The International Physical Activity Questionnaire (IPAQ) and 100m walk test. We found the association of energy cost of walking and physical activity (any type of activity) and also its relation with the BMI of an individual performing physical activity. This study was subjected to perform a survey on students and faculty of university. Therefore, the following conclusion was drawn. A strong relation existed between cost effective walking, physical activity and BMI. Obesity was correlated in individuals with a low level of physical activity and high expenditure of energy. The mean physiological cost index of faculty was highest then undergraduates, and the lowest mean physiological cost index was for post graduates. Also the mean Physiological cost index of female in our study was relatively larger compared to male. Apart from that, when physical activity status in this study was compared with BMI, those who were having weight in normal range were found to be more active in performing vigorous, moderate and low level physical activities compared to those whose weight was in overweight range and were relatively obese. The study also found level of physical activities in students and faculty. The majority of the faculty was involved in vigorous type of physical activity, then post graduates were actively performing vigorous physical activity.

Undergraduates were relatively less involved in vigorous type of physical activity. For moderate and low type of physical activity, faculty was more active compared to graduates.

6.1 LIMITATIONS

Due to lack of time and resources, only a subjective research was conducted and evaluation of all the related risk factors could not have been done. The findings are based on subjective assessment and objective assessment on recall basis with no experimental evaluation.

6.2 RECOMMENDATIONS

Due to lack of time and resources, this study could not include a larger population which should be considered in further studies. This study was deprived of analytical or experimental study on each and every variable which is strongly recommended to be considered in the future study.

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