Physical activity and its correlation with various measures of obesity among medical students and young faculty

Bhavna Pramod Joshi, Swati Manikrao Mahajan, Deepak Narayan Tayade *

Department of Community Medicine, MGM Medical College, N-6, CIDCO, Aurangabad, Maharashtra, 431003, India

ARTICLE INFO

Keywords:
Physical activity  
Non-communicable disease  
Obesity  
Lifestyle medicine  
Medical students

ABSTRACT

**Background:** Physical inactivity is important modifiable risk factor for major NCDs. Medical students and faculty who are physically active are more probable to prescribe physical activity to their patients, drastically improving clinical outcomes.

**Objectives:** 1) To describe physical activity of participants in terms of pattern, type & levels. 2) To correlate physical activity with various measures of obesity.

**Methods:** This cross-sectional study was conducted among 350 medical students and young faculty aged 18–35 years. Physical activity was assessed using WHO GPAQ. Physical activity pattern was described in work, travel and leisure domains. It was classified into vigorous and moderate intensity activity types. Levels were defined as insufficiently, moderately and highly active. Measurement of various obesity parameters was done. Data was analyzed using SPSS v25.0.

**Results:** Of all respondents, 193 (55.14%) were males and 157 (44.86%) were females. The prevalence of insufficient physical activity was 20.57%. Respondents reported highest physical activity in leisure domain (1222.45 ± 1590.8 mean METM/W). BMI was significantly correlated with physical activity in transport (p = 0.018) and leisure (p < 0.0001) domains. Neck circumference was significantly correlated with physical activity in transport (p = 0.018) and leisure (p < 0.0001) domains. Waist circumference was significantly correlated with physical activity in leisure domain (p < 0.0001).Waist circumference (p = 0.036) and neck circumference (p = 0.004) were significantly correlated with levels of physical activity. Total 327 (93.42%) respondents reported sedentary time >6 h/day.

**Conclusion:** This population needs to adopt changes in their lifestyle to increase physical activity especially in travel domain with reduction in sedentary time.

1. Introduction

In 21st century, non-communicable diseases (NCDs) have emerged as the leading cause of morbidity and mortality. The major NCDs share some common risk factors – metabolic risk factors like increased blood sugar, increased blood cholesterol, obesity, etc and modifiable behavioral risk factors like harmful use of tobacco and alcohol, physical inactivity; unhealthy diets.1 A huge proportion of NCDs is preventable through modification in these risk factors. Of all these, physical inactivity is the fourth leading cause for global mortality.2

Physical inactivity kills 3.2 million people annually, causing 6% of all deaths globally. It is equal to mortality caused due to high blood glucose. Physical inactivity increases the risk for all-cause mortality by 20–30%. It is an important modifiable risk factor for coronary heart disease, type II diabetes, obesity, colon & breast cancer, musculoskeletal diseases and psychological disorders.3 Research has proved dose-response relations between physical activity and improved health outcome.4

Globally, 1 in 4 adults do not meet the recommended levels of physical activity.5 The age-standardized estimate of insufficient physical activity in India is found to be 34.03%.6 India ranks 39th among 46 countries in walking.7 This becomes an essential factor in view of an upsurge of cardio-vascular problems reported among young adults.7 Young adults (18–35 years) are vital part of the economically productive age group, both at present and in future. As young people readily adapt to changes, corrections in lifestyle are easier to execute in this age group and will go a long way in decreasing avoidable disease burden.

This age group becomes all the more important when it comprises of...

---

* Corresponding author.

E-mail addresses: joshibhavna1402@gmail.com (B.P. Joshi), deoswati@yahoo.co.in (S.M. Mahajan), drdntayaderesearch@gmail.com (D.N. Tayade).

https://doi.org/10.1016/j.cegh.2023.101363

Received 4 February 2023; Received in revised form 28 February 2023; Accepted 15 July 2023

Available online 22 July 2023

2213-3984/© 2023 The Author(s). Published by Elsevier B.V. on behalf of INDIACLEN. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
physicians and budding doctors. Literature shows that the prevalence of cardiovascular risk factors is higher among young Indian doctors. It is observed that, physicians tend to neglect their own health due to lack of time, stress, sedentary lifestyle and higher socio-economic status. Finding balance between all professional hardships and personal lives, leave no scope for personal health care.

Research purports that a social contagion process drives the inter-person spreading dynamics of obesity. The competing spread of physical activity belief and physical inactivity belief can contain and eradicate this social contagion of obesity. Physicians can thus play an important role by prescribing and encouraging physical activity among patients. Moreover; physicians, residents and medical students, who exercise regularly, are in better position to discuss fitness and prescribe exercise to their patients. The probability of promoting physical activity during patient counseling increases if the doctor himself is physically active. When physicians prescribe physical activity to previously sedentary patients, their health outcomes improve significantly.

With this view, the present study was undertaken.

1.1. Aim

To study the levels of physical activity and its correlation with various measures of obesity.

1.2. Objectives

1. To describe the physical activity of respondents with respect to domain-wise pattern, level and type.
2. To correlate between physical activity and various measures of obesity.
3. To find association of physical activity with other related factors like age, gender, addiction and history of NCDs.

2. Methods

Study type & duration: This cross-sectional study was carried out in a tertiary care teaching hospital. The study was completed within a year.

Ethical considerations: Ethics committee approval (MGM-ECRHS/2016/12) and administrative permissions for the study were obtained. Written informed consent for participation and publication of results were obtained from each participant.

Study population: It comprised of the medical students and faculty in age group of 18–35 years.

Sample size & sampling method: The prevalence of physical inactivity in urban Maharashtra was reported to be 65.4%. Accordingly, the sample size was calculated by the formula for observational study which came to be 347.75. After rounding off, the sample size was taken to be 350. Stratified random sampling method was used to draw suitably representative sample.

List of all the undergraduate students, interns, postgraduate students and faculty was obtained from the administrative office. The persons belonging to 18–35 years age group were identified based on their date of birth and assigned serial numbers. The total number of eligible population was 909, of which 600 (66%) were undergraduate students, 100 (11%) were interns, 162 (18%) were postgraduate students and 47 (5%) were faculty. Proportionate random sample was drawn from each stratum. Thus, sample of 350 included 231 (66%) undergraduate students, 39 (11%) interns, 62 (18%) postgraduate students and 18 (5%) faculty. Respondents were selected randomly with the help of Microsoft Office Excel 2010 generated random numbers. In case of refusal, the next enlisted person was approached, until the required sample size was met.

Inclusion & Exclusion Criteria: We included UG students, interns, PG Students & medical faculty aged 18–35 years and who were willing to give written informed consent. Pregnant women, persons with previous cardiac events, persons having loco motor disability, neck deformities and thyroid disorders like Grave’s disease, goitre, thyroiditis, thyroid tumors were excluded from the study.

Study instrument: The study instrument had three main parts: a) Personal and demographic information, b) Pre-tested semi-structured interview schedule based on WHO Global Physical Activity Questionnaire (GPAQ) and c) Physical measurements made by the interviewer. The physical measurements included: weight, height, waist circumference (WC), hip circumference (HC), neck circumference (NC). For all measurements, standardized methods were followed.

The interview was conducted in the medical college during working hours. A written informed consent was obtained after explaining the study purpose in detail. Anonymity and confidentiality was assured. After completion of the interview, physical measurements were made by the investigators. Privacy was maintained throughout data collection process.

The physical activity of the respondents was measured in terms of metabolic equivalent for tasks minutes per week (METM/W) according to the GPAQ. The GPAQ enquires about physical activity pattern in work, transport and leisure domains. The physical activity types were moderate intensity activity (MIA) and vigorous intensity activity (VIA). Levels of physical activity were classified as insufficiently active (<600 METM/W), moderately active (600–3000 METM/W) and highly active (>3000 METM/W).

The respondents having BMI greater than 24.99 kg/m² were classified as high risk category. WC of 102 cm or more for males and 88 cm or more for females was categorized as high risk. High risk waist hip ratio (WHR) was considered to be >1.0 for males and >0.85 for females. High risk cut off values for NC were taken to be >37 cm for males and >34 cm for females.

Person was labeled tobacco user if he/she used any kind of smoking and/or smokeless tobacco product, daily for more than one year. Harmful alcohol consumption was defined as consumption of pure alcohol on average per day of more than 60 gm for men and more than 40 gm for women.

Data management: The data of 350 respondents was collected, cleaned and compiled using Microsoft Excel 2010. It was analyzed using Statistical Package for the Social Sciences (SPSS) v25.0. For qualitative data, Pearson’s chi-square test was applied where a ‘p’ value of <0.05 was deemed statistically significant. For quantitative data, mean, standard deviation and range was calculated. The normality of METM/W data was checked using Shapiro-Wilk procedure. It showed non-normal distribution (Statistic 0.842, d.f. 350, p < 0.0001). Hence, the Kolmogorov-Smirnov Z test was performed to find differences in two categories and Kruskal-Wallis H test was performed for differences in outcome measurements in more than two categories. A p value of <0.05 was deemed statistically significant.

3. Results

Of the 350 respondents, 193 (55.14%) were males and 157 (44.86%) were females. The mean age was found to be 22.59 ± 3.73 years. All respondents belonged to modified Kuppuswamy’s upper socio-economic class. 30 (8.57%) of these were married. None of the respondents were separated, divorced or widowed. Chi square test shows no statistically significant difference among respondents with respect to strata (p = 0.322), religion (p = 0.574) or marital status (p = 0.835).

The mean, standard deviation and range respectively for height was 167.30 ± 9.81 cm and 52 (140 & 192); weight was 66.65 ± 14.41 kg and 80 (35 & 115); BMI was 23.70 ± 4.90 kg/m² and 21 (16 & 37); WC was 85.05 ± 11.96 cm and 68 (60 & 128); HC was 99.13 ± 8.82 cm and 61 (67 & 128); NC was 34.60 ± 3.62 cm and 19 (26 & 44).

Of all the respondents, 34 (9.71%) were found to be underweight. Total 116 (33.14%) were overweight (high risk), majority of whom i.e. 88 (25.14%) were pre obese. Of the overweight, 76 (65.51%) were males and 40 (34.48%) were females. There was statistically significant difference between the BMI of males and females ($\chi^2 = 7.549$, d.f. = 1, p
significant \( (\chi^2 = 9.352, d.f. = 3, p = 0.025) \) (Graph 1).

Respondents who had high risk WC were 56 (16.0%), high risk WHR were 28 (08.0%) and high risk NC were 110 (31.42%).

Tobacco consumption was reported by 16 (4.57%) males in form of smoking cigarettes. Harmful alcohol consumption was reported by 15 (7.77%) male and 6 (3.82%) female respondents.

Among the respondents, 17 (4.85%) reported to have some kind of NCD namely hypertension, chronic obstructive pulmonary disease (COPD) and diabetes mellitus (DM). Family history of hypertension, DM, COPD, cancer and arthritis was reported by 220 (62.85%) respondents.

Regarding physical activity, the mean total METM/W spent doing VIA were found to be 2067.83 ± 1016.15 with range of 6720 (0 ± 1490.84 with range of 8640 (0 ± 198.25) was 2067.83 (1222.45 with range of 9.352, d.f. = 3, p = 0.006). The association between BMI category and strata was also significant \( (\chi^2 = 9.352, d.f. = 3, p = 0.025) \) (Graph 1).

Respondents who had high risk WC were 56 (16.0%), high risk WHR were 28 (08.0%) and high risk NC were 110 (31.42%).

The prevalence of insufficient physical activity was found to be 20.57% (72/350). The mean METM/W spent doing VIA were found to be 923.31 ± 780.5. The mean METM/W spent in travel domain was 647.13 ± 780.5.

The mean METM/W spent doing VIA were found to be 923.31 ± 1490.84 with range of 8640 (0 & 8640) and for MIA were 1144.51 ± 1136.15 with range of 6720 (0 & 6720). The Kruskal Wallis H test \( \chi^2 \) and p value among different strata for VIA was 12.529 & 0.006 while that for MIA was 10.132 & 0.017 respectively (Graph 2) (Table 1).

The distribution of respondents with respect to strata and BMI is shown in Graph 1. The results show statistically significant negative correlation between physical activity of leisure time in normal and high risk categories based on neck circumference \( (s = 2.125, p < 0.0001) \). Also, total physical activity was significantly different between these two groups \( (s = 1.819, p = 0.003) \). Similar test for normal and high risk BMI, WC and WHR did not show significant difference in domain-wise physical activity.

Statistically significant difference was found in different levels of physical activity with respect to gender \( (\chi^2 = 7.287, d.f. = 2, p = 0.026) \), education \( (\chi^2 = 20.655, d.f. = 4, p < 0.0001) \) and marital status \( (\chi^2 = 18.547, d.f. = 2, p < 0.0001) \). Higher proportion of females i.e. 34 (21.65%) was insufficiently active as compared to males. Greater proportion of respondents holding post-graduate degree i.e. 8 (44.44%) were insufficiently active. 15 (50.00%) of married respondents were insufficiently active. However, with respect to religion there was no statistically significant difference in levels of physical activity \( (\chi^2 = 4.07, d.f. = 4, p = 0.396) \).

High activity levels showed statistically significant higher measures of WC and NC (Table 4).

The levels of physical activity did not show significant difference with regards to either tobacco consumption \( (\chi^2 = 1.684, d.f. = 2, p = 0.431) \) or harmful consumption of alcohol \( (\chi^2 = 1.375, d.f. = 2, p = 0.497) \).

Similarly, no significant difference was found between the level of physical activity with regards to having NCDs \( (\chi^2 = 1.056, d.f. = 2, p = 0.590) \) and having family history of NCDs \( (\chi^2 = 0.065, d.f. = 2, p = 0.968) \).

Sedentary time is the time spent sitting and reclining, excluding sleep. It varied from 3 h to 18 h per day in the respondents with mean of 10.83 h and standard deviation of 2.563. Only 23 (6.57%) respondents reported sedentary time of less than 6 h per day. Most of the respondents (174, 49.71%) reported sedentary time of 7–11 h daily. Sedentary time of 12 h and above was reported by 153 (43.72%) respondents. Total 327 (93.42%) respondents had sedentary time of more than 6 h per day. The highest mean sedentary hours per day was observed in faculty (11.75 h) followed by under-graduate students (11.32 h). On the other hand, the lowest sedentary time was found among post-graduate students (mean of 9.38 h daily) followed by interns (mean of 9.72 h daily). Kruskal Wallis H test was applied to check difference between the four strata with respect to sedentary time. Significant difference was found between the strata with respect to mean sedentary time \( (p value < 0.0001) \). Significant association was found between sedentary time category and body mass index category of the respondents \( (p = 0.028) \).
4. Discussion

The prevalence of insufficient physical activity found here was 20.57%. On similar note, a 2020 study from Kerala found that 28.9% of
UG medical students were physically inactive.\textsuperscript{17} Another study from Davangere, Karnataka reported more than 67% of medical students were inactive.\textsuperscript{18} However, in 2022, a study conducted in Western Balkans asserted that 62.3% of medical students were involved in regular physical activity.\textsuperscript{19} The dissimilarity can be attributed to the geographical and cultural differences. However, a study reported lesser prevalence among under-graduate medical students in Bangalore, India (15.4%).\textsuperscript{20} The reason might be age of population studied.\textsuperscript{21} A 2016 study from Thailand reports that the prevalence of physical inactivity among medical students there was 50.5%.\textsuperscript{22} The reasons cited for this were sedentary lifestyle and overtime shift work of the medical students.

In the present study, most of the physical activity is during leisure time and least is at work. Apichai Wattanapiset et al. reported similar findings among medical students of southern Thailand.\textsuperscript{23} On the contrary; Krishnakumar Padmapriya et al. reported lower leisure time activities among medical students in Bangalore. They purport that this difference could be due to less physical activity programs, recreational facilities and busy curriculum of the medical students there.\textsuperscript{24} 33.14% of the respondents in present study had high risk BMI. Chythra Rao et al. found this prevalence to be 24.16% among under-graduate medical students in Manipal.\textsuperscript{25} Thus, more individuals of present study are at risk.

Higher physical activity was found in the respondents with high risk obesity measurements. Reason might be greater awareness or the inadequacy of intensity of the activities undertaken. Also, the proportion of lean body mass may differ. We found significant negative correlation between physical activity during transport and physical measurements like BMI and NC. Similarly, Christopher Millett et al. observed that the persons active during transport were significantly less likely to be overweight or obese.\textsuperscript{24} In current study, statistically significant difference is present between levels of physical activity with respect to gender. Previous studies support similar findings.\textsuperscript{14,20,25}

Also, respondents having higher education were significantly more inactive. This might be due to more sedentary nature of work as well as lack of time.

The respondents who were married were significantly more inactive. The reason might be lack of time due to increased responsibilities.

5. Conclusion

The prevalence of insufficient physical activity was found to be high (20.57%). Considerable number of respondents i.e. 153 (43.72%) reported sedentary time of more than 12 h per days. Thus, this population is at risk of developing NCDs and needs to adopt changes in their lifestyle.

Strength of Study: This study is unique as it explores the pattern, type and level of physical activity at different milestones of the medical career. GPAQ, a standardized questionnaire was used for data collection.

Limitation: It is a cross-sectional study based on self-reported physical activity.

Implications: This study suggests that there is a need to devise a special program to increase physical activity for medical professionals.

**Recommendations**

A qualitative study encompassing focused group discussions may be undertaken to find the reasons for physical inactivity among the respondents, especially the females. One of the key tactics for increasing physical activity level is development of social support from peer groups. Simple modifications in day to day life can help increase physical activity. Emphasis should be laid on taking break periodically during which stretching exercises or strolling can be done at chair side or in between seeing patients or studying.

**Source of funding**

None.

**Declaration of competing interest**

The authors have no conflicts of interest.

**Acknowledgements**

We are grateful to the Dean, MGM Medical College, Aurangabad. We are thankful to the study participants, Dr. Gautam Shroff, Dr. Deepak Bhosle and all members of Department of Community Medicine for their support.

**References**


15 Global physical activity questionnaire (GPAQ) [Internet]. Who.int. [cited 2022 Nov 20]. Available from: https://www.who.int/publications/m/item/global-physical-activity-questionnaire.

16 Current Information on Use and Harm from ALCOHOL in the WHO South-East Asia Region (Alcohol Control Series No. 6). World Health Organization, Regional Office for South-East Asia; 2007.


