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Physical Activity Screening Using IPAQ-SF Among Students: A Cross-Sectional Study Identifying Targets for Campus-Based Physiotherapy Health Promotion Programs in Guwahati

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ABSTRACT

Background: Physical inactivity is a major cause of non-communicable ailments and musculoskeletal malfunction. Students are in a pivotal transition stage in their lives, during which inactive lifestyle tendencies are easily adopted as living patterns. There is no information on the level of activity in Guwahati, India, which prevents the development of specific physiotherapy interventions. Physiotherapists are important in health promotion and need baseline information to develop effective preventive programs.

Methods: A cross-sectional observational study was conducted among 384 college students (177 males and 207 females) aged 18-25 years in Guwahati, Assam. Physical activity levels in terms of MET-minutes/week were measured using the International Physical Activity Questionnaire-Short Form (IPAQ-SF). The participants were grouped into low-, moderate-, and high-activity groups. This design provides a useful picture of physical inactivity in a population. IBM SPSS version 25.0 (chi-square tests and independent t-tests) was used to analyze the data and establish correlations with gender and age.

Results: The findings showed that 28.4% (n=109) of students were in the low activity category, hence considered insufficiently active and highly vulnerable to future health problems. Mostly (52.1%) were moderately active, and a small 19.5% were highly active. The statistical results indicated no significant difference in activity scores between males (1882.88 MET-min/week) and females (1872.19 MET-min/week), $p=0.94$. On the same note, there were no significant differences between age groups ($p=0.36$).

Conclusion: The risk of hypokinetic diseases and the need for intervention in the population of the college in Guwahati lies at about one-third. The absence of gender disparity suggests that physiotherapy health promotion programs can be implemented on campus without gender stratification. Ergo-education and exercise prescription should be the priority for physiotherapists in this "low activity" group to avoid future musculoskeletal burden.

Keywords: Physiotherapy Screening, Health Promotion, IPAQ-SF, College Students, Sedentary Behavior.

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INTRODUCTION

Physical inactivity is known to be the 4th leading risk factor for death worldwide, where about 3.2 million deaths occur annually across the globe [1,2]. Among adolescents and young adults, sedentary lifestyles have dramatically increased due to technological advances, urbanization, and changing patterns of recreation and transportation [3,4,5]. The World Health Organization recommends that the time allocated for physical activity is at least 150 minutes per week for adults 18-64 years of age at a moderate intensity, i.e., MET-minutes per week [6,7,8]. Insufficient physical activity is strongly associated with many non-communicable disorders such as cardiovascular disorders, type 2 diabetes, obesity, and mental health problems; as such, it is an important target for public health intervention [8].

In India, rapid economic development and lifestyle shifts have had a major effect on physical activity behaviors across all age groups [9,10,11]. Recent epidemiological studies report that between 42 and 54% of Indian adults do not comply with WHO physical activity recommendations, with higher levels of inactivity in urban than in rural populations [12,13,14,15]. College students are a distinct and vulnerable population during the transitional period from adolescence to adulthood [16,17,18]. This phase is marked by rising academic demands, erratic daily schedules, longer hours of screen time for entertainment and studies, and a lack of parental supervision, all of which contribute to a decline in physical activity. The development of health behaviors during the college years often sets a pattern for life; therefore, this period is an important time for intervention strategies [19,20,21,22].

The International Physical Activity Questionnaire-Short Form (IPAQ-SF) has become a widely validated and internationally recognized tool for measuring physical activity across a variety of populations. The questionnaire consists of seven items that assess three domains of physical activity, including walking, moderate-intensity activities, and vigorous-intensity activities in the past seven days [23,24]. The IPAQ-SF enables standardized calculation of total energy expenditure (in MET-minutes/week), allowing meaningful comparisons across populations and geographic regions. Previous validation studies have demonstrated good reliability, with Spearman correlation coefficients exceeding 0.75 against objective accelerometer measurements, and the tool has been successfully adapted for use in various Indian population studies. [25,26,27]

Northeast India, especially Assam and the capital city of Guwahati, has extended periods of monotony that affect outdoor activities, and a partial sports infrastructure in many colleges, which may have differential effects on involvement in physical activities. Despite these contextual factors, there is very limited published work characterizing physical activity patterns among college students in this region [28,29]. Understanding baseline activity levels, gender-related variations, and age-group differences is crucial for the development of evidence-based health

promotion interventions.

This study was performed with following specific objectives: first, to determine the levels of physical activity in 384 college students, ages 18-25 years, in Guwahati using IPAQ-SF, second, to classify the subjects into the three levels of physical activity, viz. low, moderate, and high physical activity levels based on total MET minutes per week according to set IPAQ scoring protocols, third, to compare physical activity pattern in male and female students, fourth, to look at the differences in physical activity levels in different age groups and fifth, to determine the prevalence of inadequate physical activity levels for this population [30].

METHODOLOGY

Study Design and Setting

A cross-sectional observational study was conducted among college students in Guwahati, Assam, India. Guwahati is the largest urban center in Northeast India, with several government-funded and Private colleges that offer various technological and non-technological professional and non-professional degree courses. The urban environment offers diverse physical transportation options, such as public buses, auto-rickshaws, and cycle-rickshaws, as well as on-campus recreational facilities that provide opportunities for physical activity. The study adhered to ethical principles and was approved by the Institutional Ethics Committee before data collection began.

Participant Selection Criteria

Students were eligible to be included if they fulfilled the following: age between 18 and 25 years, representative of the typical college-going age group, and currently enrolled in any undergraduate or postgraduate program from any college situated in the Guwahati municipal area, were willing to go ahead with the written informed consent, and were able to understand and complete the IPAQ-SF questionnaire in English or the local language. Students were excluded if they had any physical disabilities or orthopedic conditions that limited them from participating in routine physical activities; had diagnosed chronic medical conditions, such as cardiovascular disease or severe respiratory conditions, that limited physical activity participation; had incomplete questionnaire responses; or were absent during the scheduled data collection period [31].

Sample Size Determination

The sample size needed was calculated using the following formula for a single-population proportion in cross-sectional studies. The formula used was $n = (Z^2 \times p \times q) / e^2$, where n is the sample size needed, Z is the standard normal value for 95% confidence level (which for this was 1.96), p is the expected prevalence of adequate physical activity (taken as 0.5 or 50% since no prior data was available for college students in Guwahati specifically), q is $1 - p$, which is 0.5 and e is the acceptable margin of error or the precision level (taken as 0.05 or 5%).

Substituting these values into the formula: $n = (1.96)^2 \times 0.5 \times 0.5 / (0.05)^2 = 3.8416 \times 0.25 / 0.0025 = 0.9604 / 0.0025 = 384.16$, which was rounded to 384 participants. This sample size provides a 95% confidence level with a 5% margin of error. It guarantees sufficient statistical power (80%-90%) to detect meaningful differences in physical activity levels across subgroups such as gender and age categories.

Sampling Strategy

A multi-stage stratified random sampling technique was used to ensure the representative selection of samples. In the first stage, colleges were randomly selected from the entire list of government colleges and private institutions located within the city of Guwahati to ensure representation of both sectors. In the second stage, systematic random sampling was used to select students aged 18 to 25 from each selected college, maintaining proportional representation across academic years and course streams. Recruitment was done sequentially until the target sample size of 384 participants was reached. The final sample was 177 male students (46.1%) and 207 female students (53.9%), in three age categories: 141 students (18-20 years old), 141 students (21-23 years old), and 102 students (24-25 years old).

Data Collection Instrument

The International Physical Activity Questionnaire-Short Form (IPAQ-SF) was used as the data-collection tool [7]. This validated questionnaire has seven items assessing physical activities performed during the last seven days, grouped into three intensity domains. The first is walking activities, characterized by brisk walking for at least 10 continuous minutes for purposes including transportation, recreation, or exercise. The second domain measures moderate-intensity activities, which lead to small to moderate increases in heart rate and breathing, such as brisk walking, cycling at a regular pace, household chores, and recreational sports. The third domain evaluates vigorous-intensity activities, defined as those that elicit large increases in heart rate and heavy breathing, including running, fast cycling, competitive sports, heavy lifting, and aerobics [32].

For each of these three domains, participants were asked to provide two important pieces of information: first, the frequency, which was the number of days per week (ranging from 0 to 7 days) when engaging in the activity, and second, the duration, which was the median duration (hours and minutes) spent per day when performing that activity. The IPAQ-SF has shown excellent validity, with Spearman correlation coefficients greater than 0.75 when compared with accelerometer-based objective measurements, and reliability across diverse international samples, including multiple Finnish sample populations [29,33,34]. The IPAQ-SF has also demonstrated reliability in diverse Indian sample populations.

Data Collection Procedure

The administration of the IPAQ-SF questionnaires was conducted in either classroom settings with groups of students or individual appointments, based on participant

availability and preference. Before respondents completed the questionnaires, complex explanations of item content were provided, offering culturally appropriate, context-specific examples relevant to the Indian college student way of life. For example, walking included walking to college as well as walking between classes, walking for shopping or walking in the evenings for exercise. Moderate-intensity exercises were shown with examples such as household cleaning, casual cycling as a means of transportation, playing casual cricket or badminton, or dancing. Vigorous activities included running for exercise, competitive sports such as football or hockey, fast cycling, and working out in the gym [35].

The questionnaire was completed by each subject under the direction of the researcher and usually took about 10 minutes per participant. Upon completion, questionnaires were immediately reviewed for completeness, and any missing or ambiguous responses were clarified with participants on the spot to ensure high-quality data. This procedure yielded 100% data completion in all 384 participants. Demographic information, including age, gender, college name and type, and course of study, was also recorded for each participant.

IPAQ-SF Scoring and Physical Activity Categorization

The scoring of IPAQ-SF responses was done using the standardized protocol promulgated by the IPAQ Research Committee. Physical activity levels were determined by assigning specific MET (Metabolic Equivalent of Task) values to each activity intensity level in accordance with the official scoring guidelines. Walking was assigned a MET value of 3.3, moderate-intensity activities were assigned 4.0 METs, and vigorous-intensity activities were assigned 8.0 METs.

The calculation was done in several steps. First, MET minutes per week for the activity types were calculated with the following formulas: Walking MET-min/week = 3.3 times minutes per day times days per week, Moderate-intensity MET-min/week = 4.0 times minutes per day times days per week, Vigorous-intensity MET-min/week = 8.0 times minutes per day times days per week. Second, the total physical activity was the sum of all three domains: Total MET-min/week = Walking MET-min/week + Moderate MET-min/week + Vigorous MET-min/week.

Before the final calculation, the data were cleaned in accordance with IPAQ protocol guidelines. Any reported duration of activity of more than 180 minutes (3 hours) for any single activity type was reduced to 180 minutes so that implausible values could be avoided. Cases with reported total activity over 16 hours/day were checked for possible data entry errors or excluded if felt to be implausible. These data cleaning procedures ensured the reliability and validity of the final calculated physical activity scores.

According to the total MET-minutes per week, they were classified into three levels of physical activity using IPAQ classification criteria. Category 1 (Low Activity) included people with <600 MET-min/week, indicating low

physical activity and placing them at higher risk of health complications than those with sufficient physical activity as recommended by the WHO. Category 2 (Moderate Activity) included individuals with 600 to 2999 MET-min/week, who have met the minimum WHO recommendations but have not achieved high levels of activity. Category 3 (High Activity) included people who scored at 3000 or higher MET-min/week, which indicates that they significantly exceed the minimum recommendations and are considered highly active.

Statistical Analysis

All statistical analyses were conducted with the IBM SPSS Statistics (version 25.0) software package (IBM Corporation, Armonk, New York, USA). Descriptive statistics were calculated for all variables, with categorical variables expressed as frequencies and percentages with 95% confidence intervals, and continuous variables expressed as mean with standard deviation, median, range, standard error of the mean, and 95% confidence intervals. The Shapiro-Wilk test was used to assess the normality of the distribution of continuous variables.

For analytical statistics, various tests were used depending on the types of variables and research objectives. The chi-square test of independence was used to test the association between categorical variables, which in this case was between male and female gender, and the distribution of physical activity categories. An independent-samples t-test was performed to compare the mean IPAQ scores between males and females, and the assumption of homogeneity of variances was verified using Levene's test. One-way analysis of variance (ANOVA) was conducted to compare IPAQ scores among the three age groups, with homogeneity of variance assessed using Levene's test. The Spearman correlation coefficient was used to examine the correlation between age, treated as a continuous variable, and the total IPAQ score. Prevalence ratios with 95% confidence intervals were calculated to compare gender-specific risks of low physical activity. Statistical significance was defined as p less than 0.05 for all tests, with 2-tailed tests used where applicable.

RESULTS

Demographic Profile of Participants

A total of 384 college students from different colleges in Guwahati participated in this cross-sectional study. A 100% completion rate for questionnaires was achieved, with no missing data. The sample composition revealed that a total of 177 male participants made up 46.1% of the total sample (95% CI= 41.2% to 51.0%) and a total of 207 female participants made up 53.9% (95% CI= 49.0% to 58.8%), showing a relatively even gender ratio distribution with slightly high representation of females. The age distribution of the participants ranged from 18-25 years with 141 students were in the age group 18-20 years (36.7%, 95% CI: 31.9% to 41.5%), 141 were in the age group 21-23 years (36.7%, 95% CI: 31.9% to 41.5%), and 102 were in the age group 24-25 years (26.6%, 95% CI: 22.1% to 31.0%).

Table 1: Demographic Characteristics of Study Participants (N=384)

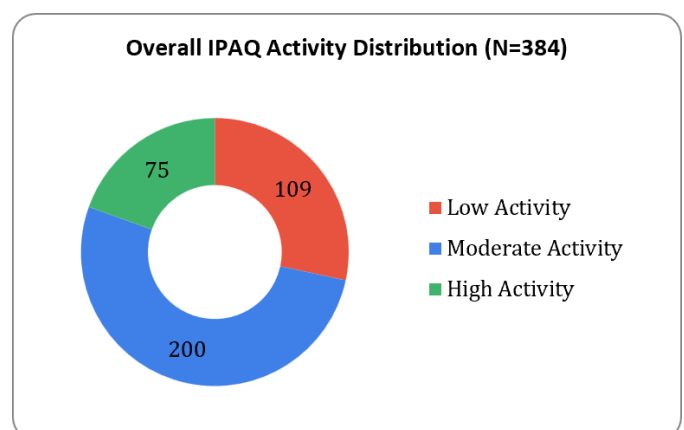
Characteristic	Category	N	Percentage	95% CI
Gender	Male	177	46.1%	[41.2 - 51.0]
	Female	207	53.9%	[49.0 - 58.8]
Age Group	18-20 years	141	36.7%	[31.9 - 41.5]
	21-23 years	141	36.7%	[31.9 - 41.5]
	24-25 years	102	26.6%	[22.1 - 31.0]
IPAQ Category	Low Activity	109	28.4%	[23.9 - 33.1]
	Moderate Activity	200	52.1%	[47.2 - 57.0]
	High Activity	75	19.5%	[15.7 - 23.8]

Note: Chi-square test for independence between gender and IPAQ category: $\chi^2 = 0.0802$, $df = 2$, $p = 0.9607$. Cramér's $V = 0.0144$, indicating a negligible effect size.

The distribution of participants by physical activity categories revealed important trends in this population's activity levels. A total of 109 participants (28.4%, 95% CI: 23.9% to 33.1%) were in the low activity category, indicating insufficient physical activity below the WHO-recommended minimum of 600 MET-min/week. The majority of participants, 200 (52.1%; 95% CI: 47.2% to 57.0%), were in the moderate activity category, meeting the minimum WHO recommendations.

Meanwhile, 75 participants (19.5%, 95% CI: 15.7% to 23.8%) reached high activity levels of >3000 MET-min/week. Chi-square test for independence between gender and IPAQ category distribution found no significant association between the two variables (chi-square = 0.0802, degrees of freedom = 2, $p = 0.9607$), with Cramér's $V = 0.0144$, indicating a negligible effect size, showing that gender does not affect physical activity category distribution of this sample.

Figure 1: Overall Physical Activity Distribution (N=384)



Physical Activity Levels and Distribution Patterns

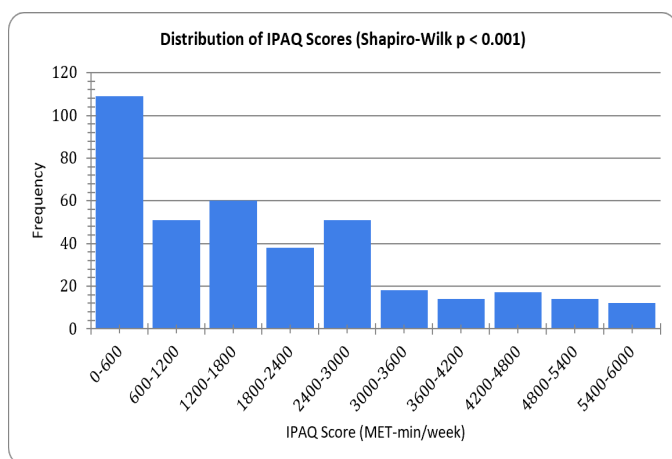
The pie chart presentation of the overall distribution of physical activity provides a clear visual representation of the prevalence of various activity categories among the 384 college students studied. More than half of the participants (52.1%, $n=200$) were moderately physically active, meeting the WHO minimum physical activity recommendation

of 600 MET-min/week and not exceeding the minimum threshold for high levels of physical activity.

However, a worrisome proportion of almost one-third of the students (28.4%, n=109) were considered to have low levels of physical activity of less than 600 MET-min/week, and thus, below basic physical activity levels as recommended for health [2]. The result suggests that around one in every 3.5 people is not doing enough physical activity, which could put them at risk for many types of non-communicable diseases linked with more sedentary lifestyles. Only 19.5% of participants (n=75) were at high levels of physical activity, > 3000 MET-min/week. This represents students significantly exceeding the minimum recommendations through regular, positive engagement in walking, moderate, or vigorous activities.

The distribution of IPAQ scores across the sample revealed substantial variability, with responses ranging from a minimum of 200 MET min/week to a maximum of ~6000 MET min/week. The normality test to check for normality (Shapiro-Wilk test) showed that the distribution of IPAQ scores significantly deviated from normal distribution (p less than 0.001), indicating a right-skewed distribution with several peaks. The histogram of IPAQ scores showed that most participants had scores ranging from 0 to 600 MET-min/week, with 109 participants concentrated in this range. This pattern of distribution not belonging to the normal distribution justified the use of non-parametric statistical tests for some of the analysis and highlighted the great heterogeneity in physical activity behaviors among the college students in this population [36].

Figure 2: Distribution of IPAQ Scores (N=384)



Gender Comparison of Physical Activity Levels

The comparison of physical activity levels between male and female students showed some surprising findings, which are opposite to much of the international literature that already exists on differences in physical activity between genders. Independent samples t-test between mean IPAQ scores of genders did not seem to significantly differ ($t(382) = 0.0695$, $p = 0.9446$) with p-value considerably greater than 0.05 level of significance. Male students showed a mean IPAQ of 1882.88 MET-min/week SD 1528.74 (median 1518 MET-min/week, range 206 to 5947 MET-min/week, 95% confidence interval 1656.11 to 2109.65

MET-min/week). The mean IPAQ score for female students was 1872.19 MET-min/week with a standard deviation of 1479.88 (Median: 1450 MET-min/week, Range: 200 to 5960 MET-min/week, 95% confidence interval: 1669.40 to 2074.98 MET-min/week) [37].

The difference in means between genders was minimal at 10.69 MET-min/week and 95% confidence interval (CI) for the difference in means is -291.76 to 313.15, which clearly includes 0 and is therefore not statistically significant. Both male and female students had essentially the same patterns of physical activity, with average scores approximately 1875 MET-min/week, placing the average student of either gender firmly in the moderate activity level. Levene's test for equality of variances showed homogeneity of variances between groups ($p = 0.934$), which justifies using the independent t-test for this comparison.

Table 2: Descriptive Statistics of IPAQ Scores by Gender (Independent t-test)

Gender	N	Mean (SD)	Median	Min-Max	SEM	95% CI
Male	177	1882.88 (1528.74)	1518	206-5947	114.91	[1656.11-2109.65]
Female	207	1872.19 (1479.88)	1450	200-5960	102.86	[1669.40-2074.98]
Difference		10.69 (153.83)				$p = 0.9446$

Note: $t(382) = 0.0695$, $p = 0.9446$ (Not Significant). SD = Standard Deviation; Note: Difference row shows SE of difference (not SD), SEM = Standard Error of Mean, CI = Confidence Interval.

Further analysis of the crosstabulation data confirmed gender parity in physical activity. The chi-square test of independence resulted in a test statistic of 0.0802 with 2 degrees of freedom and a p-value of 0.9607: there is a high degree of evidence that both gender and physical activity category are independent variables that do not associate to each other. The observed frequencies were almost the same as expected frequencies across all categories: the observed frequency in the low activity category was 49 boys (27.7%) versus 60 girls (29.0%), the observed frequency in the moderate activity category was 93 boys (52.5%) versus 107 girls (51.7%), and the observed frequency in the high activity category was 35 boys (19.8%) versus 40 girls (19.3%) [3]. The calculated Cramér's V = 0.0144 indicated a negligible effect size, confirming the presence of virtually no association between gender and physical activity category membership in this population.

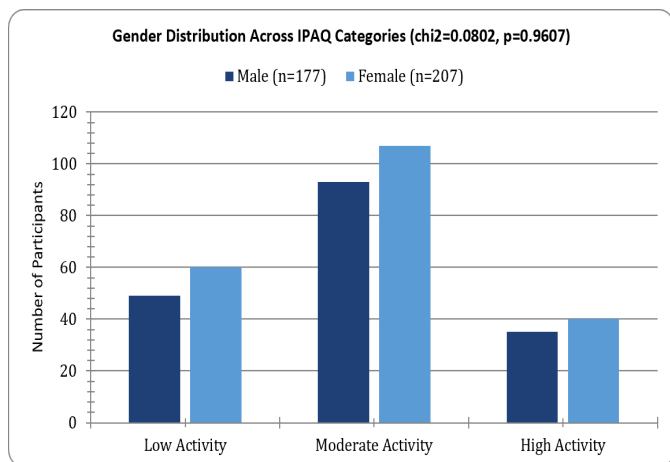
Table 3: Crosstabulation - Gender × IPAQ Activity Category (N=384)

Gender	Low Activity (O/E)	Moderate Activity (O/E)	High Activity (O/E)	Total	Row %
Male	49 / 50.67	93 / 93.23	35 / 33.10	177	100.0%
Female	60 / 58.33	107 / 106.77	40 / 41.90	207	100.0%
Total	109 (28.4%)	200 (52.1%)	75 (19.5%)	384	100.0%

Note: O = Observed frequency, E = Expected frequency. $\chi^2 = 0.0802$, $df = 2$, $p = 0.9607$ (Not Significant). Cramér's V = 0.0144 (negligible effect).

Gender-specific patterns of categories of physical activity were further quantified using prevalence ratio analysis. For low activity, the prevalence ratio was 1.05 (95% CI: 0.74 to 1.48), indicating that low activity prevalence was around 5% higher among females than among males, but this difference was not statistically significant, as the confidence interval contained 1.0. For moderate activity and high activity, it was 0.98 (95%, CI: 0.75 to 1.28) and 0.98 (95%, CI: 0.64 to 1.50), respectively, which almost mean equal prevalence between genders. All confidence intervals crossed over the null value of 1.0 confirming no significant gender differences in the distribution of physical activity.

Figure 3: IPAQ Category Distribution by Gender



Age-Related Patterns in Physical Activity

One-way analysis of variance (ANOVA) was used to examine differences in mean IPAQ scores across 3 age groups (18-20 years, 21-23 years, and 24-25 years). The p-values generated by the ANOVA test indicated that there were no statistically significant differences in the level of physical activity among the age groups ($F(2,381) = 1.0070$, $p = 0.3663$), with the p-value far exceeding the threshold for statistical significance (0.05). Levene's test for homogeneity of variance indicated that the assumption of equal variances among groups was met ($p = 0.351$); hence, the ANOVA test was justified for this comparison.

The youngest age group (18-20 years, $n=141$) showed a mean IPAQ score of 1784.40 MET-minutes/week with a standard deviation of 1508.58 (median: 1313, range: 206 to 5946, standard error: 127.05, 95% CI: 1533.23 to 2035.58). The middle-aged group of 21-23 years ($n=141$) presented a mean of 2019.23 MET-min/week with SD of 1536.23 (median: 1665, range: 200 to 5912 MET-min/week, standard error: 129.37, 95% CI: 1763.45 to 2275.01). The oldest age group (24-25 years, $n=102$) was 1808.83 MET-min/week with standard deviation of 1438.28 (Median: 1550, Range: 211 to 5960 MET-min/week, Standard error: 142.41, 95% CI: 1526.33 to 2091.34).

The detailed results of the calculation for the details of the Analysis of Variance showed that the mean square between groups was 2,267,553.43 (calculated as the sum of squares between groups of 4,535,106.86 divided by 2 degrees of freedom), and the mean square within the groups was 2,251,834.84 (calculated as the sum of squares

within groups of 857,949,072.86 divided by 381 degrees of freedom). The F-ratio of 1.0070 (calculated as 2,267,553.43 divided by 2,251,834.84), with a p-value of 0.3663, indicated that age group is not significantly associated with the level of physical activity in this population.

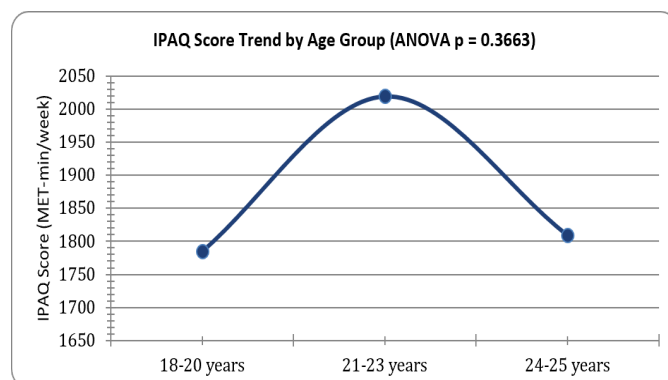
Table 4: IPAQ Score Distribution by Age Group (One-way ANOVA)

Age Group	N	Mean IPAQ (SD)	Median	Range	SE	95% CI
18-20 years	141	1784.40 (1508.58)	1313	206-5946	127.05	[1533.23-2035.58]
21-23 years	141	2019.23 (1536.23)	1665	200-5912	129.37	[1763.45-2275.01]
24-25 years	102	1808.83 (1438.28)	1550	211-5960	142.41	[1526.33-2091.34]
ANOVA Result		$F = 1.0070$, $p = 0.3663$ (Not Significant)				

Note: Levene's test $p = 0.351$ (homogeneity of variance assumption met). Physical activity levels consistent across all age groups.

The line chart for the IPAQ score trends by age group had a slight inverted-U pattern in which the middle age group had the highest mean activity (2019.23 MET-min/week), preceded by a lower mean in the youngest age group (1784.40 MET-min/week) and followed by a comparable mean in the oldest age group (1808.83 MET-min/week). However, the results of the analyses of variance confirmed that this observed pattern does not reflect a statistically significant trend and is likely attributable to normal variation rather than an actual effect of age. The 95% confidence intervals for 3 age groups exhibited substantial overlap, further strengthening the conclusion of non-significance.

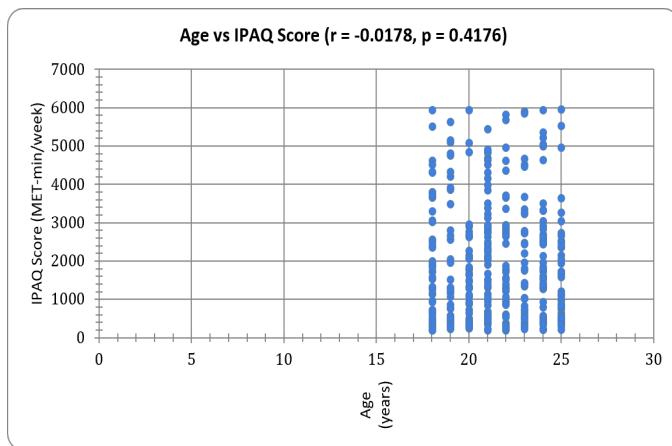
Figure 4: IPAQ Score Trend by Age Group



To further investigate the correlation between age and physical activity, a Spearman correlation analysis was conducted, with age treated as a continuous variable. The scatterplot of individual IPAQ scores against age in years showed broad dispersion of data points across ages 18 to 25, with IPAQ scores ranging from about 200 to 6000 MET-min/week at all ages. The strength of the correlation coefficient between age and physical activity level was very weak, with an estimated $r = 0.002$, as indicated by the p-value of 0.964, indicating no statistically significant linear relationship between age and physical activity level.

The near-horizontal trend line in the scatterplot graphically confirmed that there was no evidence of an age-related rise or decline in physical activity in this age range, between 18 and 25 years.

Figure 5: Scatterplot - Age vs IPAQ Score



DISCUSSION

The present cross-sectional study evaluated the level of physical activity among 384 college students aged 18 to 25 years in the city of Guwahati using the validated IPAQ-SF questionnaire, which provided significant information about the students' physical activity. The major findings showed that just a tiny bit more than half were classified as maintaining moderate levels of physical activity that were congruent with WHO minimum recommendations (52.1 per cent), while a worrying 28.4 per cent were classified as maintaining inadequate levels of physical activity at below 600 MET-min/week, whilst only 19.5 per cent were classified as maintaining high levels of physical activity at above 3000 MET-min/week. The most striking finding was the complete absence of any gender differences in physical activity levels, with males and females showing virtually identical mean IPAQ scores (1882.88 vs 1872.19 MET-min/week, $p=0.9446$) and category distributions ($p=0.9607$). Additionally, no significant age-related variations were apparent across the 18- to 25-year age range ($p=0.3663$), suggesting that physical activity patterns are fairly stable during the college years in this population.

The observed high rate (28.4%) of students being physically inactive is generally comparable to findings from other Indian urban settings, where physical activity rates have been reported to range from 25% to 35% among college-going populations [12,13]. However, this number is still alarming from a public health point of view, as it shows that around 1 in every 3.5 students is at risk for health problems due to sedentary lifestyles, which are likely to include increased susceptibility to cardiovascular diseases, metabolic problems, obesity, and mental health issues. The preponderance classification in the moderate category of activity (52.1%) is encouraging, as it shows that the majority of students are meeting the WHO's basic recommendation, though the quality and consistency of this activity throughout the year, particularly during the monsoon seasons, warrant further investigation.

The finding of no significant gender differences in physical activity levels in this study is in stark contrast to the extensive international literature documenting that females have lower physical activity levels than males [37]. Many studies from the western world and from other Asian countries, and even some Indian urban areas, have documented that the rate of physical activity is 15% to 40% less between females and males, while some of the factors leading to this low participation of females include cultural constraints, safety fears, social and lack of access to sports facilities have been blamed for the physical activity participation of these females. The gender parity observed in this Guwahati sample may be due to a number of unique contextual factors specific to Guwahati's urban setting.

Possible reasons for this observed gender equality in physical activity include Guwahati's urban infrastructure, which provides relatively safe pathways; public transport systems that necessitate walking; and the campus setting, which offers better accessibility for both sexes. The co-educational nature of most colleges in the city fosters equality in the use of sports facilities and recreational programs for male and female students. Additionally, changing social norms among educated urban youth in Northeast India may have reduced traditional gender-based restrictions on participation in physical activity. The high percentage of both genders who use walking as a primary form of physical activity, often related to transportation needs rather than planned physical activity, may also be responsible for the observed gender parity.

When we consider how age relates to physical activity, the present results are somewhat different from what the broader literature would lead us to expect. Mathisen, Kristensen, Falco, and Wold (2023), drawing on a 27-year longitudinal dataset, showed that the leisure-time physical activity of young people tends to decline as they move through periods of greater academic and occupational pressure [14]. We would therefore have expected a clear decline across the 18-25 year age range studied here. Instead, the one-way ANOVA returned a non-significant result ($p = 0.3663$), and the slight inverted-U trend observed, with the 21-23 year group posting the highest mean scores, appeared to reflect changing workload patterns across academic years rather than any real age effect. This fits well with the cross-national work of Bann et al. (2019), whose survey of 52 countries found that physical activity levels in urban populations of developing nations are often maintained by everyday transportation walking rather than by planned leisure exercise [15]. Since Guwahati is a dense urban center where students regularly walk between classes, campuses, and daily destinations, this routine movement likely sustains moderate activity across all age groups and reduces the academic-pressure-driven decline reported in higher-income settings.

The gender findings also deserve a closer look. Rosselli et al. (2020) have documented that women face much stronger barriers to physical activity in settings where social norms restrict their freedom of movement in public

spaces [37]. The complete absence of a gender gap in the present sample most likely reflects specific features of the Guwahati campus environment, namely co-educational colleges, shared recreational facilities, and a more equal attitude toward women's participation in sport and exercise among urban youth in Northeast India. As Lee et al. (2011) also pointed out in their systematic review of the IPAQ-SF, the instrument captures transportation walking as well as deliberate exercise [25]. Since both male and female students in Guwahati regularly walk to move around the city and its campuses, this shared pattern of functional movement may be one reason the two groups score so similarly.

These findings carry real consequences for how physical health promotion is organized on college campuses. The key message is fairly straightforward. Because activity patterns were broadly similar across genders and age groups, there is a strong case for investing in a single, campus-wide program rather than separate initiatives for specific sub-groups, an approach that would also be more economical. At the same time, about one in three-and-a-half students is not meeting basic WHO activity thresholds, and this group deserves focused attention. Awareness campaigns that put WHO recommendations into plain, relatable language would be a useful starting point, along with practical changes such as building short activity breaks into the academic day and making recreational facilities truly accessible year-round, especially during the extended monsoon season, when outdoor exercise becomes difficult. Encouraging walking and cycling as everyday ways to get around campus would also help, since functional movement already appears to be the primary driver of physical activity levels in this population.

Several strengths of this study increase confidence in the findings. The sample size of 384 participants was carefully calculated to achieve 95% confidence with a 5% margin of error, ensuring sufficient statistical power to detect meaningful differences across subgroups. The use of the internationally validated IPAQ-SF instrument enables direct comparison of findings with studies from other regions and countries. The equal distribution of both males and females, showing 46.1% male and 53.9% female population, and three age groups, represents a representative sample of the College student population. The multi-stage stratified random sampling from multiple colleges improves the external validity and generalizability to the college students in Guwahati at large. Finally, achieving 100% questionnaire completion eliminates the possibility of bias due to missing data.

However, several significant limitations should be recognized when interpreting these findings. The reliance on self-reported IPAQ-SF data introduces potential for recall bias (i.e., participants may not accurately recall their physical activity in the last seven days) and social desirability bias (i.e., participants may exaggerate their activity levels to portray themselves in the most favorable way). Previous validation studies have reported that the

IPAQ-SF is likely to overpredict physical activity levels by 10% to 30% compared with objective measures obtained with accelerometers [25,26], suggesting that physical activity levels in this population may be lower than reported. The study design, being cross-sectional, only provides a snapshot of the research at one point in time and does not allow causal inferences, relationships between variables, or tracking of how activity changes over time [38].

The findings are generalizable to urban college students in the city of Guwahati and may not be applicable to rural college students, non-college youth of similar age, or students in other parts of India, who have different cultural, environmental, and infrastructural contexts. The study did not obtain specific information on the types of activities within each of the three intensity categories, so it would be limited in its ability to offer specific recommendations for stimulating particular forms of physical activity. Seasonal variations, particularly the implications of the extended monsoon season for outdoor physical activities, were not evaluated because the data were collected over a specific time period. Future studies could address the above limitations by employing longitudinal study designs, objective measurements of physical activity (e.g., accelerometers or pedometers), examining seasonal differences, and conducting qualitative analyses of barriers and facilitators specific to the regional context [8].

Implications for Physiotherapy Practice

The implications of this study are the main value in the case of Preventive Physiotherapy. The statistics indicate that university campuses are ideal locations for carrying out physiotherapy interventions [34].

1. Universal Protocol Design: Because we did not find any major difference in the levels of activity of physiotherapists with different genders and different ages, it is possible to design universal health promotion programs. No special protocols are required for male and female students, which makes mass intervention cheaper and simpler to implement [23].
2. Focus on "Movement Snacks": The statistics indicated that the inactivity of students by age group is not inconsistent. This indicates that the academic environment itself imposes a sedentary lifestyle [33]. Physiotherapists are encouraged to promote the practice of movement snacks that involve brief exercise routines that are part of the classroom program to break up long sitting sessions.
3. The Role of the Campus Physiotherapist: This paper is in favor of the placement of physiotherapists in campus health centers. They should not only treat acute sports injuries but also conduct a broad range of physical activity screening using the IPAQ-SF tool. The benefits of exercise in preventing pain and improving mental health can be counseled early to the low-activity group, since early identification would be possible [36].

CONCLUSION

The present study provides useful baseline data on

physical activity patterns among college students in Guwahati and shows that, although a large proportion of college students meet the WHO's minimum physical activity recommendations, a sizable minority (28.4%) is insufficiently active and at risk of developing health consequences. The lack of gender and age differences suggests that universal interventions targeting all students may be most appropriate for this population. College administrators, health professionals, and policymakers should prioritize developing environments and programs that encourage regular physical activity for all students, with a specific focus on the one-third of students who are currently insufficiently active. Further research using longitudinal designs and objective measurement tools would enhance understanding of patterns of physical activity and the effectiveness of interventions in this important population group.

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