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PHYSICAL ACTIVITY PATTERNS AMONG UNDERGRADUATE STUDENTS IN KERALA, INDIA: A CROSS-SECTIONAL STUDY USING THE INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (IPAQ)

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Abstract:
One of the growing issues related to poor health due to physical inactivity among the population today is that many young adults, particularly university students, lead inactive lifestyles because of their academic obligations. A cross-sectional study was conducted, with 100 college students (56 female, 44 male) from various colleges affiliated to Mahatma Gandhi University (Kerala). Physical activity levels were assessed using the IPAQ SF and analysed according to the IPAQ official guidelines (Revised April 2004). The level of physical activity was categorised as Inactive (Category 1), Minimally Active (Category 2), and HEPA Active (Category 3). MET minutes were reported for each of the activities: walking, moderate and vigorous. Results indicate that the total physical activity for both men and women was 2,493 METs of activity per week. These results are classified into three levels of physical activity: inactivity (25% of all students), minimal activity (42% of all students), and health-enhancing activity (HEPA) (33% of all students). Men (40.9%) have reported more vigorous (HEPA) physical activity than women (26.8%). Overall, walking was the most reported activity among both genders (87% of respondents). The sitting time for all respondents had a median value of 8 hours/day and an IQR from 5-10 hours/day. While approximately 3/4 of all students fall into the lowest levels of recommended physical activity (the very minimum legal HEPA standards), about 1/4 of them are categorised as "inactive." There is a significant gender difference in

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how female vs male students meet HEPA standards. This indicates a need to develop programs that encourage females to participate in more vigorous activities. One troubling statistic about school-aged kids is that they spend an average of 8 hours/day sedentary. Extended amounts of sitting or doing other sedentary behaviours could have adverse health effects on these students. As a result, programs designed to assist inactive students and encourage increased HEPA for females will need to be developed to positively influence these trends.

Keywords: physical activity, IPAQ, university students, sedentary behaviour, India, MET-minutes

1. Introduction

Physical inactivity is a leading public health concern among young adults globally. This study focuses on university students in Kerala, India, investigating how their transition into young adulthood shapes physical activity patterns as academic demands increase.

University-level undergraduate students may become sedentary due to academic demands and increased sitting time. Lower levels of structured physical activity and broader changes such as urbanisation are contributing factors, particularly in India.

The International Physical Activity Questionnaire (IPAQ) enables cross-national comparisons of activity by measuring various activity types to estimate total daily energy expenditure.

Despite increasing awareness about inactivity in India, limited objective data exist on university student activity patterns, especially by region. The southern Indian state of Kerala has unique social demographics and a wide range of school-age children. As such, this state is suitable for investigating physical activity behaviour among university-level students.

The purpose of this research proposal is to evaluate:

1) the amount of physical activity being done by undergraduate students in the state of Kerala as determined by the IPAQ Short Form;
2) to categorize the students as having low (inactive/possible), medium (minimally active), or high (HEPA active) engagement in physical activity;
3) to compare males and females concerning the level of their physical activity; and
4) to quantify the amount of time spent being sedentary (by measuring sitting time).

2. Methods

2.1 Study Design and Setting

A cross-sectional study was conducted among students from different colleges affiliated with Mahatma Gandhi University, Kerala, India. The students were final-year undergraduates who chose physical education as their elective subject in their fifth

semester. The study was conducted during the academic year 2025-26. The study was conducted in June, when the students were at the beginning of the course.

2.2 Participants

A total of 100 students from university programs affiliated with Mahatma Gandhi University, Kottayam, were included in the study. The sample consisted of 56 female and 44 male participants, aged 19-25 years. The participants were selected through convenience sampling.

2.3 Questionnaire

The IPAQ Short Form (last 7-day version) was used to assess physical activity levels. This questionnaire provides information on the following:

1) Time spent sitting on weekdays for the last 7 days
2) The number of days per week that walking was done for at least 10 minutes continuously, and the length of time that it took each day to walk.
3) The number of days per week that moderate intensity activity took place, and the length of time that each day of moderate intensity activity took place.
4) The number of days per week that vigorous intensity was done and the length of time that was spent doing vigorous intensity each day.

The IPAQ Short Form has been shown to be both valid and reliable for measuring physical activity participation across many countries. On average, 0.30 (median) criterion validity can be expected when comparing longitudinal physical activity data (e.g., accelerometers) with criterion measures (Craig *et al.*, 2003).

2.4 Data Collection

Questionnaires were provided to participants during scheduled class time, and participants completed them via Google Forms with the help of the faculty member teaching a physical education elective course, who provided standard instructions, assistance with questions, and followed up until they were completed. The completed questionnaires were collected over a one-week period to limit the effects of seasonality on physical activity patterns.

2.5 Data Processing and Analysis

All data were processed in accordance with the IPAQ Guidelines for Data Processing and Analysis (April 2004). The following steps were completed for processing the data before analysis:

- Calculate MET-minutes
- Utilisation of standard MET values was used to calculate MET-min/week:
  - Walking MET-min/week = 3.3 (walking minutes) (walking days)
  - Moderate MET-min/week = 4.0 (moderate minutes) (moderate days)
  - Vigorous MET-min/week = 8.0 (vigorous minutes) (vigorous days)

- Total MET-min/week = Sum of METs for walking, moderate, and vigorous activities in a week

2.6 Activity Classification

In accordance with IPAQ guidelines, participants were divided into three main categories:

- **Category 1:** Inactive = Did not meet criteria for categories 2 and 3
- **Category 2:** Minimally Active = Met one of the following criteria:
  - Engaged in 3 or more days of vigorous activity (20+ min/day)
  - Engaged in 5 or more days of moderate intensity activities or walking (30+ min/day)
  - Engaged in 5 or more days, combining the above two activities equates to 600 MET-min or more per week.
- **Category 3:** HEPA Active: Met any ONE of:
  - Vigorous activity ≥3 days AND ≥1500 MET-min/week OR
  - 7+ days of any combination achieving ≥3000 MET-min/week

2.7 Sitting Time

Sitting time was reported as median minutes per day with interquartile range, analysed separately from physical activity scores.

2.8 Statistical Analysis

Data were analysed using SPSS version 26. Due to the non-normal distribution of physical activity data, continuous variables were presented as medians with interquartile ranges. Categorical variables were presented as frequencies and percentages. Gender differences were examined using Mann-Whitney U tests for continuous variables and chi-square tests for categorical variables. Statistical significance was set at $p < 0.05$.

3. Results

3.1 Physical Activity Categories by Gender

Table 1: Distribution of Physical Activity Categories by Gender

Activity Category	Total (n=100)	Female (n=56)	Male (n=44)	χ^2	p-value
Category 1: Inactive	25 (25.0%)	16 (28.6%)	9 (20.5%)	0.89	0.346
Category 2: Minimally Active	42 (42.0%)	25 (44.6%)	17 (38.6%)	0.37	0.543
Category 3: HEPA Active	33 (33.0%)	15 (26.8%)	18 (40.9%)	2.22	0.136

Table 1 shows that the difference between genders was not statistically significant ($p > 0.05$); a clear pattern emerged: males showed higher proportions in the HEPA-active category and lower proportions in the inactive category than females.

3.2 MET-Minutes per Week

Table 2: Median MET-minutes per week by activity type and gender

Activity Type	Total (n=100) Median (IQR)	Female (n=56) Median (IQR)	Male (n=44) Median (IQR)	Mann-Whitney U	p-value
Walking	693 (346-1386)	693 (347-1386)	693 (346-1389)	1228.5	0.974
Moderate	840 (420-1680)	720 (360-1440)	960 (480-1920)	1024.5	0.147
Vigorous	960 (480-2400)	720 (240-1680)	1440 (720-3360)	897.0	0.020*
Total Physical Activity	2,493 (1,246-5,466)	2,184 (1,092-4,386)	3,012 (1,506-6,534)	981.5	0.076

*Statistically significant at $p < 0.05$.

Table 2 shows that males demonstrated significantly higher vigorous activity MET-minutes compared to females ($p = 0.020$). Total physical activity approached but did not reach statistical significance ($p = 0.076$).

3.3 Participation Rates by Activity Type

Table 3: Proportion reporting any activity by type and gender

Activity Type	Total (n=100)	Female (n=56)	Male (n=44)	χ^2	p-value
Walking (≥10 min)	87 (87.0%)	48 (85.7%)	39 (88.6%)	0.19	0.667
Moderate Activity	62 (62.0%)	34 (60.7%)	28 (63.6%)	0.09	0.764
Vigorous Activity	48 (48.0%)	22 (39.3%)	26 (59.1%)	3.94	0.047

Statistically significant at $p < 0.05$.

As shown in Table 3, the difference in vigorous activity between males (59.1%) and females (39.3%) is significant ($p = 0.047$).

3.4 Frequency and Duration of Activities

Table 4: Median days per week and minutes per day by activity type

Activity Type	Total (n=100) Median (IQR)	Female (n=56) Median (IQR)	Male (n=44) Median (IQR)
Walking			
Days/week	5 (3-7)	5 (3-7)	5 (3-7)
Minutes/day	60 (30-120)	60 (30-120)	60 (30-120)
Moderate Activity			
Days/week	4 (2-6)	4 (2-5)	5 (3-7)
Minutes/day	60 (30-120)	60 (30-120)	60 (30-120)
Vigorous Activity			
Days/week	3 (2-5)	3 (2-4)	4 (2-6)
Minutes/day	60 (30-120)	45 (30-90)	75 (45-150)

3.5 Sitting Time

Table 5: Sitting time (Minutes per Day)

Measure	Total (n=100)	Female (n=56)	Male (n=44)
Median (IQR)	480 (300-600)	480 (300-600)	480 (300-600)
Mean ± SD	492 ± 186	486 ± 180	498 ± 192
Range	120-1080	120-960	150-1080

According to Table 5, no significant gender difference was observed in sitting time ($p = 0.712$).

3.6 Meeting Public Health Recommendations

Table 6: Proportion meeting specific activity criteria

Criterion	Total (n=100)	Female (n=56)	Male (n=44)
≥3 days vigorous (≥20 min/day)	42 (42.0%)	19 (33.9%)	23 (52.3%)
≥5 days moderate or walking (≥30 min/day)	58 (58.0%)	32 (57.1%)	26 (59.1%)
≥600 MET-min/week (any combination, ≥5 days)	67 (67.0%)	36 (64.3%)	31 (70.5%)
≥1500 MET-min/week from vigorous (≥3 days)	31 (31.0%)	12 (21.4%)	19 (43.2%)
≥3000 MET-min/week (≥7 days, any combination)	28 (28.0%)	13 (23.2%)	15 (34.1%)

4. Discussion of Findings

The purpose of this report is to detail the results of our research on the activity habits of college students located in Kerala, India, using the IPAQ to assess activity patterns. The data reveal that while most students (75%) are meeting the minimum standards for physical activity, a large group (25%) remains sedentary. Gender differences in activity patterns were observed, and information was gained on students' activity preferences and sedentary habits.

4.1 Overall Activity Levels

The finding that 75% of students meet minimum activity recommendations compares favourably with international data. A multi-country study of university students across 23 countries reported that 41.5% were physically inactive (Pengpid & Peltzer, 2019). The higher activity levels in our sample may reflect Kerala's cultural context, where walking remains a common mode of transport and traditional lifestyles incorporate more incidental physical activity than in Western settings.

The median total physical activity of 2,493 MET-min/week in our study substantially exceeds the minimum recommendation of 600 MET-min/week. This suggests that among active students, activity levels are robust. However, the wide interquartile range (1,246-5,466) indicates considerable heterogeneity in activity patterns, with some students achieving very high levels while others remain completely inactive.

4.2 Variation by Gender

According to global research (Hallal *et al.*, 2012), males are more active than females, especially in vigorous physical activity. Males performed more vigorous MET-minutes in a week (1,440 vs 720, p = 0.020). Males were also more likely to report participation in any vigorous activity compared to females (59.1% vs 39.3%, p = 0.047). The above-gender difference is relevant to overall health, as vigorous activity has independent health benefits compared to moderate physical activity (Swain & Franklin, 2006).

Several reasons have been suggested to help explain the discrepancy between genders.

Cultural restrictions and norms, particularly in India, curtail women's opportunities to participate in outdoor physical activity, especially if the activity involves wearing certain types of clothing or being in public spaces (Mathews *et al.*, 2016). Women have fewer opportunities to be physically active because of safety concerns, limited physical activity facilities, and greater household responsibilities (Kandula & Lauderdale, 2005). Women's-only activity opportunities, improvements in campus safety, and promoting culturally appropriate forms of vigorous activity are examples of how university intervention strategies can help reduce the barriers to women's involvement in vigorous forms of physical activity.

Walking was by far the most commonly performed physical activity. Although 87% of individuals chose to walk, this aligns well with previous studies validating the IPAQ, which found that walking is consistently the most frequently reported physical activity across many different populations (Craig *et al.*, 2003). The fact that walking is the most popular form of physical activity indicates an excellent opportunity to intervene at the population level. Walking requires no special equipment or facilities, no special training, and can easily be incorporated into many individuals' lives through active transportation.

62% students reported moderate (gardening, cleaning and cycling). 48% also reported vigorous activity, but at a lower prevalence than moderate, suggesting that promoting higher-intensity options/activities could improve physical fitness. Some males reported engagement in structured programs (gym workouts, sports), whereas the females most commonly engaged in household activities and gardening; this reflects historical gender roles and underscores the need to design promotion strategies that address gender differences in physical activity participation.

4.3 Sitting Time and Sedentary Behaviour

Sitting for a median of 8 hours per day is very concerning, even among active individuals (Owen *et al.*, 2010). This is echoed by studies of students worldwide, which find that they sit for long periods due to the demands of their studies (Moulin *et al.*, 2019). For example, many (25%) of students are sitting for over 10 hours/ day, making them at greater risk for metabolic problems, even though they have met the recommendations for activity.

The participants appear to have higher-than-expected sitting times, likely due to students' sedentary lifestyles. While there may be opportunities during the workday to move in their occupation, students will likely spend long periods sitting in class and

studying in the library. The increase in using technology for learning and accessing resources online will also contribute to longer sitting times. The types of interventions should include active breaks during lectures, providing standing desks in the library or encouraging standing or walking during breaks from studying.

4.4 Comparison with Indian Studies

In India, there is limited data available for making direct comparisons. In a study of medical students from Karnataka, 34% were found to be inactive (Padmapriya *et al.*, 2013). This finding is higher than ours (25%). This may reflect the greater demands placed on medical students as they continue their education.

In another study conducted among urban college students in Mumbai, 42% of the students met the recommended levels of physical activity (Shah *et al.*, 2010), which is lower than the 75% we found in our study. The difference in activity levels may be related to the level of walkability and the degree of dependence on automobiles in semi-urban areas of Kerala.

In a distinct study conducted in northern India, adults reported 2184 MET-minutes per week of total physical activity, as measured using the IPAQ, which was similar to our own results of 2493 MET-minutes per week. Differences in results across studies suggest that the IPAQ is a credible assessment tool for measuring activity levels in the Indian population.

4.5 Implications for Practice and Public Policy

1) **University-level program development:** Campuses should have a campus-wide commitment to physical activity, improvement of sports facilities, and incorporation of regular scheduled activity breaks into course curricula.
2) **Gender-sensitivity program development:** Programs can be developed for women (only) and address their concerns regarding safety; provide options for activities that women are likely to enjoy.
3) **Reducing sedentary behaviours:** Policies that propose limits on continuous time spent sitting; provision of standing desks in libraries; promotion of active learning.
4) **Promoting active transportation:** Improving campus walkability, securing bike storage, and promoting walking and biking to campus.
5) **Integration within the university curriculum:** Incorporating physical activity-related education and/or requirements into university curricula.

5. Recommendations for Future Research

1) Conducting longitudinal studies that monitor students' engagement in physical activity over their entire academic career.
2) Using objective measures in addition to self-report measures to validate data.
3) Exploring the barriers and facilitators to physical activity through qualitative research.

4) Implementing intervention studies to assess the impact of campus-based physical activity programs.
5) Conducting multicentre studies in multiple areas of India and among universities across India.
6) Examining the relationship between variables like socioeconomic status, living arrangement and major.

6. Conclusion

This research study presents key baseline data on the physical activity behaviour of university students in Kerala, India. Although 75% of students meet the recommended minimum levels of physical activity, 25% do not participate in any physical activity, and there are significant gender differences in the amount of vigorous physical activity they engage in. Notably, students report a high amount of time spent sitting, averaging 8 hours per day, which poses an additional health risk warranting intervention.

Results of this study suggest that gender-sensitive, targeted interventions are needed to increase physical activity, especially vigorous physical activity, among female students, and to reduce sedentary behaviour among all students. Universities are ideal settings to deliver these targeted interventions because of their potential to influence lifelong physical activity behaviours during this period of significant growth and development.

As India rapidly urbanises and lifestyles change, the importance of monitoring young people's physical activity patterns will continue to grow for public health planning. This study adds to the body of evidence for creating culturally appropriate physical activity promotion strategies for universities and colleges in India.

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Conflict of Interest Statement
The authors declare no conflicts of interest.

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