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ORIGINAL RESEARCH

Breaking the Sedentary Cycle: Exploring the Link between Physical Activity and Academic Performance among Female College Students in Bangladesh

Rumana Akter[a]; Nadia Samsudin[b]; Richard Peter Bailey[b]

[a] Faculty of Sociology, Lalmatia Govt. Mohila College, Dhaka, Bangladesh; [b]Faculty of Social Sciences and Liberal Arts, UCSI University, Kuala Lumpur, Malaysia

Abstract

Most adults in Bangladesh do not meet the recommended levels of moderate to vigorous physical activity (PA). This is exacerbated by the increasing prevalence of sedentary lifestyles, particularly among female students in a socio-culturally restrictive context. During the transition period, when young adults adopt independent lifestyle choices, reduced PA can impact their health and academic outcomes. This study investigated the relationship between physical activity (PA) and academic achievement among female students at a government college in Bangladesh. To understand the correspondence, the gendering and spatialising of Dhaka's urban landscape have been described using Tonkiss' (2005) 'Geography of Gender.' A cross-sectional design was employed, using the Global Physical Activity Questionnaire (GPAQ) endorsed by the World Health Organization to assess total PA in terms of metabolic equivalents (METs). A random sample of 300 female students participated in this study. A basic random sampling technique and a random number generator in MS Excel were utilised to carry out the procedure from the previously acquired student list. Work, travel, and recreational activities are assessed in accordance with WHO recommendations (2020a), resulting in a high compliance rate (93.7%) with WHO physical activity (PA) recommendations among female students, which is a noteworthy finding given the restrictive setting or context of PA for girls and women in Bangladesh. Spearman correlation analysis revealed a significant positive relationship between METs and academic achievement. Findings suggest that regular PA has a positive impact on the physical, mental, emotional, and academic development of students in Bangladesh. This study's significant positive correlation between PA and academic achievement emphasises the importance of educational institutions promoting PA through structured educational opportunities and inclusive initiatives such as non-credit courses, designated spaces for PA, and extracurricular sports programs.

Keywords:
Academic performance, education opportunities, good health, physical activity, sport, well-being

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ORCID ID
Rumana Akter
https://orcid.org/0009-0003-3963-0739
Nadia Samsudin
https://orcid.org/0000-0003-3292-2870
Richard Peter Bailey
https://orcid.org/0000-0003-4650-6392

Introduction

Colleges and universities serve multiple purposes, with two primary functions often emphasised: fostering academic achievement and supporting students' holistic development, including their physical and mental well-being (MOE, 2010; Moscardini et al., 2020; UNESCO, 2015). These priorities are incorporated in curriculum design in Physical Education (PE) and other co-curricular activities involving sports and various types of Physical Activity (PA) to support cognitive, emotional, and social development (Bailey, 2017). However, these activities have traditionally been given a low status in academic settings, oftentimes perceived as secondary or even a distraction from the "true" purpose of education, namely, academic performance (Bleazby, 2015).

In recent years, declining levels of global PA have prompted international agencies and national health institutions to issue warnings about rising rates of non-communicable diseases such as diabetes, heart disease, musculoskeletal problems, and obesity (González et al., 2017). These concerns are particularly alarming among the youth, as insufficient PA during adolescence is strongly correlated with long-term health risks (Babaeer et al., 2022). Obese young people are around five times more likely to remain obese into adulthood (Simmonds et al., 2016). Over 50% of school-aged youth fail to meet the internationally recommended target of 60 minutes of moderate-to-vigorous physical activity (MVPA) per day—a figure that rises to 80% in high-income countries (Breda et al., 2018; Guthold et al., 2020; Tremblay et al., 2016).

Many young people seek to enrol in higher education courses each year, with the number of students entering tertiary education doubling over the last two decades (UNESCO Institute of Statistics, 2020). Consequently, this has led to calls for increased attention to the health behaviours of college students, a demographic particularly vulnerable to sedentary lifestyles. The transition to university typically brings new forms of independence characterised by reduced parental supervision and pressure-packed academic requirements. While the benefits of PA have been well-established in enhancing cognitive and brain functioning (Stillman et al., 2020), modernisation and automation have contributed to increased sedentary behaviours among young people (Thivel et al., 2018).

In Bangladesh, this global trend is reinforced by specific socio-cultural dynamics, with young people often considering PA unnecessary and favouring sedentary pastimes such as watching television, playing digital games, and engaging in social media. Additionally, the emphasis on academic achievement and curriculum completion over PE resulted in limited opportunities for structured PA within schools and colleges. Negative perceptions about the value of PA and its presumed interference with academic achievement further diminish participation in PA among college students (Hasan et al., 2020).

In this context, this study aims to investigate whether physical activity (PA) is associated with academic performance among female students in a government college in Bangladesh. While international research confirms the positive association between physical activity (PA) and educational outcomes, similar investigations remain scarce in South Asian contexts, particularly in Bangladesh. By featuring an underrepresented population in a resource-constrained setting, this study aims to expand the discourse to inform educational and public health policies that promote student well-being alongside academic achievement

in diverse contexts. The study aims to test the following hypotheses:
Null hypothesis (H_0): There is no association between physical activities and academic performance.
Alternative hypothesis (H_1): There is a significant association between physical activities and academic performance.

Literature review

Physical activity is defined as any bodily movement generated by skeletal muscles that requires energy expenditure and encompasses activities such as work, play, domestic chores, travel, and leisure activities (WHO, 2020a). The WHO (2020a) recommends a daily MVPA of 60 minutes, five or more days per week. Müller et al. (2022) report encouraging levels of adherence to PA guidelines, with more than 90% of participants in their study meeting the WHO standards for aerobic PA. However, other studies reveal concerning trends in Bangladesh, with adolescents residing in metropolitan, non-slum areas showing alarmingly high prevalence of inactivity (girls: 77.7%; boys: 64.1%) (Hossain et al., 2021).

Despite evidence confirming the benefits of regular engagement in PA to mental health, cognitive development, and academic achievement, research in Bangladesh linking PA with such benefits remains sparse, especially among female students. Academic achievement tracks a student's high school, college, and university goals (Shahjahan et al., 2021). It is measured by grade point average (GPA). It has been linked to several socio-demographic, psychological, and intellectual factors — including motivation, self-efficacy, emotional intelligence, task-oriented coping strategies, sleep-related factors, and conscientiousness (Brambila-Tapia et al., 2022). However, the potential contribution of PA to academic success has not been explored within the context featured in this study.

Cognitive processes, including memory, attention, language, praxis functions (the ability to execute finalised movements to achieve a goal), and gnostic functions (the ability to perceive and recognise), are integral to learning (Caponnetto et al., 2021). These cognitive abilities are strongly associated with long-term outcomes, such as educational attainment, vocational development, economic advancement, health, longevity, and overall life satisfaction (Lövdén et al., 2020; Pastor et al., 2022). Physical activity has been shown to improve executive functions by supporting neural efficiency and activity in brain areas associated with attention and working memory (Singh et al., 2018). Moreover, Wilson et al. (2021) uncovered five motivational factors of student engagement in PA: mastery of skills and abilities, social approval, physical and mental well-being, and interpersonal connections. Notably, motivation varied by both socioeconomic status and level of PA.

Although many countries have made progress in integrating structured PA into their academic curricula to support academic performance, Bangladesh has yet to fully implement systemic reforms, with limited long-term studies to support its initiatives in this direction. While many steps have been taken in Bangladesh — such as reevaluating the curriculum, providing teachers with training, and introducing student-centred learning to accelerate academic achievement — initiatives to improve attention, memory, and academic performance remain limited.

Research has consistently shown the value of PA in enhancing academic success. Physical activity has been shown to improve academic performance in cross-sectional, randomised-controlled, and longitudinal trials (Singh, 2012). Norris et al. (2020) found that incorporating PA during lectures

enhances student learning and engagement. Additionally, Jylänki et al. (2021) noted that 71% of publications in their review confirmed positive effects of PA on cognitive or academic performance.

Bangladesh has not given enough attention to this crucial matter, particularly to PA among female college students—a demographic often restricted by cultural norms, academic pressure, and limited access to gender-inclusive PA spaces. This study addresses the research gap by examining the association between PA and academic performance among female students in a Bangladeshi government college. As such, it aims to contribute to the literature landscape on how PA can serve academic goals, particularly among girls and women in low- and middle-income countries.

In Bangladesh, females frequently engage in outdoor recreational and social activities, a trend that often begins during puberty. The socio-cultural practices within Bangladeshi society delineate two separate domains for males and females. While males are permitted to engage in outdoor pursuits such as cricket, football, or cycling and participate in social interactions, females are often relegated to domestic duties. They are usually restricted from freely exploring the outdoors. Societal conventions frequently inhibit women from participating in team sports and socialising with males outside their familial relationships. In Bangladesh, women's freedom to walk freely in public spaces is limited due to harassment from particular male residents and their protective negotiation of the area (Shamma, 2021). Tonkiss (2005) seeks to theorise gender and space in cities. She investigated how gender and sexuality influence the perception and use of urban settings; specifically, how urban spatial configurations promote gender and sexual disparities and how women's spatial behaviours are influenced by fear and violence. She, therefore, highlighted how urban space is used in a gendered manner. So, guardians impose restrictions on young females due to concerns about their safety. Parents often discourage or limit their daughters from participating in outdoor pursuits, such as leisurely walks or cycling (Uddin et al., 2017). The unique variance of safety concerns was 33.1%, with 42.3% of the variation attributable to fear of sexual assault. Consequently, there is a substantial correlation between elevated levels of dread of sexual assault and heightened safety concerns among female students in Bangladesh (Nigar et al., 2025). The evident gender disparity in the quantity and nature of activities prompted us to conduct the study to comprehend the situation and challenge the cycle of sedentary behaviour.

Over the past few decades, there has been a notable increase in the emphasis on the impact of PA on academic performance. Countries like Denmark have implemented national initiatives to promote daily PA among students (Koch et al., 2021). Nevertheless, Bangladesh is experiencing a delay in implementing curriculum modifications and research initiatives specifically designed to promote PA. In this study, we focused on identifying the correlation between academic performance and PA to address the disparity.

Although the study primarily focused on measuring total PA and GPA, its conceptualisation was guided by the framework presented in Figure 1. This framework suggested cognitive, psychosocial, and institutional pathways as potential mediators, though these were not directly measured. However, these mediators were admittedly not directly measured. Nonetheless, the framework was instrumental in shaping the discussion and interpreting our findings, especially regarding the role of PA in enhancing cognitive function, psychosocial well-being, and school engagement.

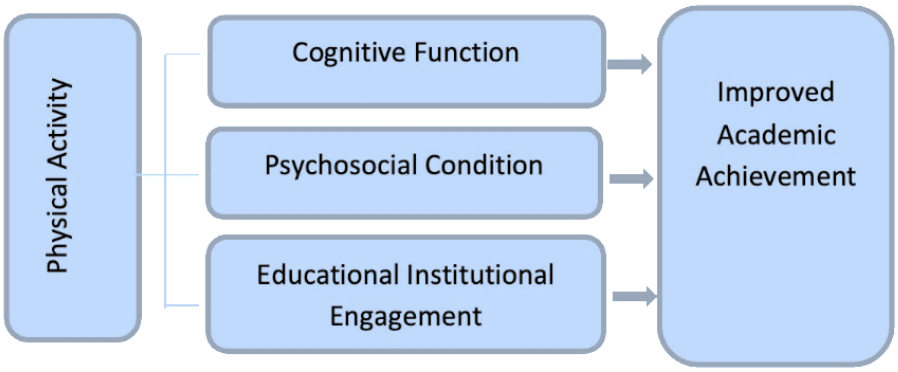


Figure 1. A Tentative Conceptual Framework of the Relationship between Physical Activity and Academic Achievement

Methodology

Study Design

This study employed a cross-sectional design to investigate the relationship between physical activity (PA) and academic achievement among female college students. Cross-sectional designs are particularly well-suited for examining associations among variables within a defined population over a specific time frame. They offer practical, efficient, and cost-effective approaches to such investigations (Levin, 2006). Although such designs do not allow causal inference, they contribute valuable insight into correlational configurations, particularly in under-researched contexts such as Bangladesh.

Study Context and Participants

This research was conducted at Lalmatia Government Mohila College, a prominent public women's college in Dhaka, Bangladesh, within the Sociology Department, which comprised approximately 700 students at the time. Based on Cochran's formula for computing sample size at a 95% confidence level, 300 participants were selected using a simple random sampling technique. We acquired the individual list from the department's office and then utilised the random number generator in MS Excel to execute the random sampling procedure. Consequently, the appointed individual was apprised to engage in the proceedings.

Ethical Considerations

Before data collection, participants received information sheets that detailed the study's purpose and explained the nature of their involvement. They were asked to consider this information before proceeding. Once potential participants had indicated their willingness to participate, they were provided with a consent form and asked to sign to show their understanding and willingness to engage in the study. Full ethical approval was granted by a central university ethics committee. Participants were assured that their personal information would be managed with strict confidentiality throughout the research process.

Instrumentation

Physical Activity Measurement: PA levels were assessed using the Global Physical Activity Questionnaire (GPAQ) version 2, developed by the WHO (2020b). The GPAQ examine PA across three domains: work-related activity, transportation, and recreational activity. It includes intensity categories of moderate to

vigorous. PA data were converted to Metabolic Equivalent of Task (MET) in minutes per week using the standard set by WHO (2020b). This instrument is considered a suitable tool for tracking PA, especially among Bangladeshi populations, including urban dwellers and women (Mumu et al., 2017).

Academic Achievement Measurement: Academic performance was operationalised as Grade Point Average (GPA) based on official examination results published by the National University of Bangladesh. GPA data were obtained with permission from the college administration and supported with information from the official university website to ensure accuracy.

Pilot Testing

The authors conducted a pilot study with 30 randomly selected students to check the clarity and reliability of the instrument. Cronbach's alpha indicates the internal consistency reliability of a factor's elements. It ranges from 0 (not at all reliable) to 1 (absolute reliability) (Arifin, 2018). Value level of reliability, Cronbach's Alpha Score and Level of Reliability: 0.0 – 0.20: Less Reliable; >0.20 – 0.40: Rather Reliable; >0.40 – 0.60: Quite Reliable; >0.60 – 0.80: Reliable; >0.80 – 1.00: Very Reliable (Ahdika, 2017). The Cronbach's alpha reliability coefficient was computed at 0.381, indicating "Rather Reliable" internal consistency. Despite the Cronbach's alpha reliability score of 0.381, we employed the instrument in our investigation because it has been verified in previous research, approved by the WHO, and validated in the Bangladeshi context by Mumu et al. in 2017. Again, it also covers the multidimensional nature of PA. Pilot data can be used in the final sample if the same sampling frame, procedures, and validated research instruments are used in both the pilot test and the main study (Thabane et al., 2010). The pilot sample was included in the final analysis because the instrument was validated in Bangladesh.

The instrument's established criterion and contemporaneous validity (based on prior research) influenced its selection in this study. The GPAQ has demonstrated validity in prior studies, including those comprising South Asian female populations (WHO, 2020). Given the standardisation of the GPAQ and its appropriate adaptation for Bangladeshi respondents (Mumu et al., 2017), the instrument was deemed valid for the objectives of this study.

Data Collection Procedure

Data were collected over four weeks. Researchers organised 10-20 group sessions, where participants were oriented and guided through the GPAQ survey using visual cards. Academic performance data were gathered simultaneously in coordination with the college records office. All surveys were administered in Bangla, the native language of the participants, to ensure understanding and accurate responses.

Data Analysis

Data were analysed using SPSS software (Version 28). Before analysis, data entries were screened for completeness, range validity, and the presence of outliers. When appropriate, frequency analyses presented data as a number (%), mean (SD), or median (IQR). WHO threshold values for GPAQ were calculated. Finally, Spearman's correlation coefficients were used to correlate overall GPAQ and domain-specific MET minutes per /day with academic achievement, as measured by Grade Point Averages. Intensity determines the time variable MET values (moderate or vigorous). MET values and activity levels determine PA. The GPAQ evaluated the values of the MET for overall energy expenditure across three domains: work, transportation, and recreation. The

MET values were determined as follows: moderate at 4.0, cycling and walking at 4.0 METs, and vigorous at 8.0 METs. Correlation coefficients were interpreted as follows: Poor: 0–0.20; Fair: 0.21–0.40; Moderate/Acceptable: 0.41–0.60; Strong: 0.61–0.80; Very Strong: 0.81–1.0. Statistical significance was set at $p < 0.05$ (two-tailed). Additional stratified analyses by domain-specific PA (work, transport, recreation) were also conducted.

Results

This study investigated the relationship between physical activity (PA) and academic performance among female students at a government college in Bangladesh. The Null Hypothesis (H_0) was "There is no association between physical activities and academic performance, while the Alternative Hypothesis (H_1) was "There is a significant association between physical activities and academic performance."

Table 1. Respondents Who Met the WHO Recommendation

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Recommended	281	93.7	93.7	93.7
	Not Recommended	19	6.3	6.3	100.0
	Total	300	100.0	100.0	

Table 1 shows that 93.7% of the study's respondents—female college students—met the WHO recommendations for PA, which define sufficient activity as achieving at least 600 MET-minutes per week. In contrast, WHO global data from 2020 reported that only 34% of adolescents aged 13 to 15 met these same guidelines. While this reference point pertains to a younger and more general global population, it underscores the relatively higher level of PA observed among the college-aged women in this study. This distinction helps contextualise the findings without conflating age groups or populations.

Figure 2. Distribution of Physical Activity Levels among Female College Students Based on WHO Recommendations

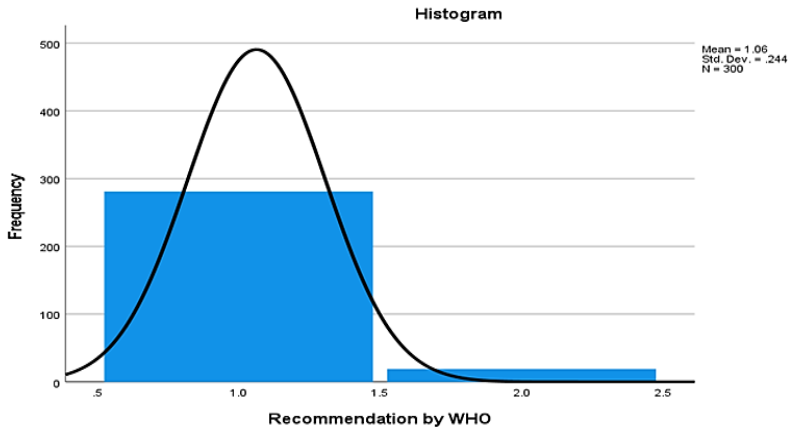


Figure 2 visually represents the distribution of PA levels among female college students in this study in relation to the WHO recommendations. The x-axis indicates adherence to WHO physical activity recommendations. A value of '1' (or values close to '1', such as '1.06') represents individuals who met the recommended guidelines, while higher numerical values indicate a deviation from meeting the recommendation. The histogram demonstrates a strong clustering of students around the 1.0 mark on the "Recommendation by WHO" axis, indicating that a substantial majority met or exceeded the WHO's recommended 600 MVPA per week. This visual representation supports the finding presented in the preceding paragraph, where Table 1 indicated that 93.7% of the respondents met these guidelines. The distribution, with a mean of 1.06 and a relatively small standard deviation of 0.244, further supports the high prevalence of sufficient PA within this specific cohort. The shape of the distribution, while skewed, still shows a strong peak at the recommended level, highlighting the contrast with broader global data on adolescent PA, as discussed in the text.

Table 2 presents the Spearman's rho correlation coefficients among different domains of PA (work-related METs, travel-related METs, and recreation-related METs), total METs, and academic performance. The table indicates several statistically significant positive correlations. Specifically, "Total METs" demonstrate strong positive correlations with "Work-related METs" ($r = 0.788$, $p < 0.001$), "Travel-related METs" ($r = 0.628$, $p < 0.001$), and "Recreation-related METs" ($r = 0.448$, $p < 0.001$). This suggests that overall PA levels are significantly associated with activity across all measured domains. More importantly, Table 2 reveals a statistically significant positive correlation between "Total METs" and "Academic Performance" ($r = 0.748$, $p < 0.001$). This strong association suggests that higher overall PA levels are associated with better academic performance in this population of female college students. Furthermore, individual domains of PA also show significant positive correlations with academic performance: "Work-related METs" ($r = 0.663$, $p < 0.001$), "Travel-related METs" ($r = 0.439$, $p < 0.001$), and "Recreation-related METs" ($r = 0.273$, $p < 0.001$). While the correlation with recreation-related METs is weaker than the others, it remains statistically significant.

These findings suggest a robust relationship between engagement in various forms of PA and academic success among the study's respondents. This evidence supports the notion that PA may play a beneficial role in academic outcomes for this specific cohort, aligning with the idea that promoting regular PA could be a valuable strategy for enhancing overall well-being and academic achievement among college students. However, as noted previously, the generalizability of these findings to broader or younger populations should be considered with caution.

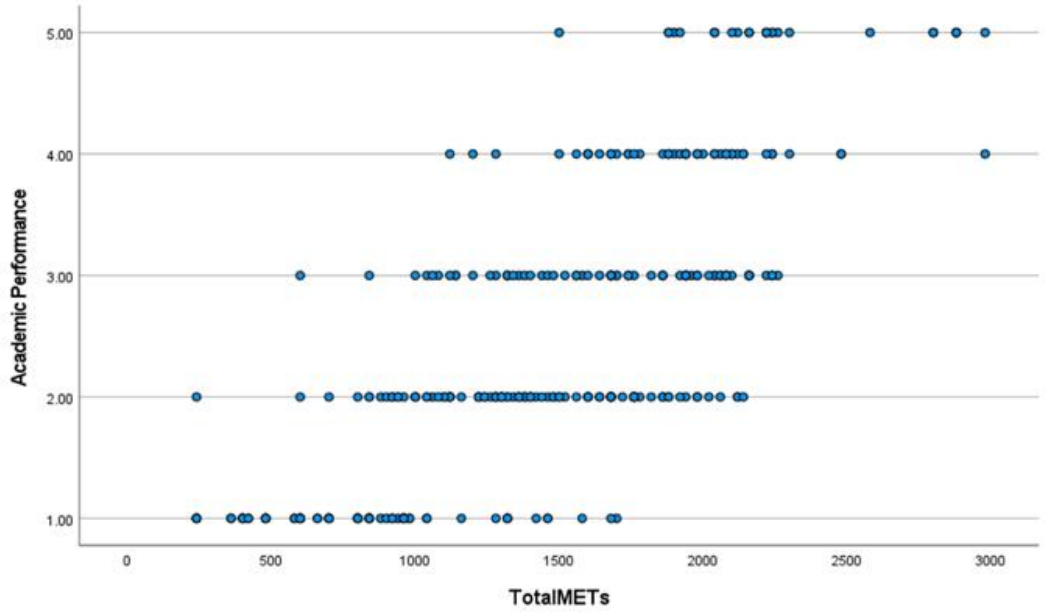
Table 2. Spearman Correlation Coefficients for All MVPA and GPA

			Work-related METs	Travel related METs	Recreation related METs	Total METs	Academic Performance
Spearman's rho	Work-related METs	Correlation Coefficient	1.000	.203**	-.004	.788**	.663**
		Sig. (2-tailed)	.	<.001	.942	<.001	<.001
		N	300	300	300	300	300
	Travel related METs	Correlation Coefficient	.203**	1.000	.233**	.628**	.439**
		Sig. (2-tailed)	<.001	.	<.001	<.001	<.001
		N	300	300	300	300	300
	Recreation related METs	Correlation Coefficient	-.004	.233**	1.000	.448**	.273**
		Sig. (2-tailed)	.942	<.001	.	<.001	<.001
		N	300	300	300	300	300
	Total METs	Correlation Coefficient	.788**	.628**	.448**	1.000	.748**
		Sig. (2-tailed)	<.001	<.001	<.001	.	<.001
		N	300	300	300	300	300
	Academic Performance	Correlation Coefficient	.663**	.439**	.273**	.748**	1.000
		Sig. (2-tailed)	<.001	<.001	<.001	<.001	.
		N	300	300	300	300	300

**. Correlation is significant at the 0.01 level (2-tailed).

In Table 3 (see Supplementary Material), the cross-tabulation illustrates a discernible trend indicating that academic performance tends to improve with increased levels of PA. A significant proportion of students exhibiting low MET scores are located in the lowest GPA band, with a corresponding increase in MET scores associated with a rise in GPA band scores. Students with low PA levels (total METs < 1000) tended to have the lowest GPA. For example, at 240 METs, four out of five students had GPAs below 2.75, with relatively few students in this MET range achieving GPAs higher than 3.00. In the intermediate MET range (1000-1600), students in this group began to show GPAs in categories as high as 3.25 and even 3.50 in some cases, although many remained in the lower ranges. A significant change was found in the high PA group (total METs ≥ 1600). This category comprised the majority of students with GPAs above 3.25, as well as all students who earned a perfect GPA of 4.00. For instance, learners with 2220 and 2880 METs had GPAs of 3.75 and 4.00, respectively. The cross-tabulation analysis revealed that positive levels of PA, as measured by metabolic equivalents (METs), were associated with improved academic achievement.

Figure 3. Scatter of Academic Performances and Total Mets



The scatter plot in Figure 3 provides visual confirmation of the strong positive correlation identified in Table 2 between PA (in terms of total METs) and academic success. While Table 2 provided the statistical measure (Spearman's rho), Figure 3 offers a direct visual representation of this association, making it easier to grasp the distribution and the general direction of the relationship. The plot graphically illustrates the phenomenon suggested by the data: that among these female college students, higher engagement in PA is broadly associated with better academic outcomes. This reinforces the argument that promoting PA could be a valuable strategy to support academic well-being in this specific population.

This study found a statistically significant link between PA and higher grades, supporting other research that suggests students who participate in organised activities perform better in college. Physical activity connects students to the college and its values, including academic success. It is also possible that college sports help people feel more connected to their colleges (Marsh & Kleitman, 2003). Furthermore, Galeano-Rojas et al. (2024) found that PA appears to be a possible coping mechanism for academic stress. This outcome may explain why college students in this study, who demonstrated a high rate (93.7%) of meeting WHO-recommended PA levels, showed a positive correlation between PA and a higher GPA, even after adjusting for MET values. The consistent adherence to PA recommendations observed in this population is notable, particularly within a context where cultural norms often restrict physical movement for girls and women in public spaces.

Discussion

This study aimed to investigate the relationship between PA and academic performance among female college students in Bangladesh. Our research also found a moderate correlation between PA and academic achievement. This outcome aligns

with moderate evidence from research employing randomised controlled trials, which suggests an association between moderate-to-vigorous-intensity PA and improvements in cognition, including academic achievement and performance on neuropsychological tests assessing processing speed, memory, and executive function (Erickson et al., 2019). While Barbosa et al. (2020) identified 41 systematic reviews and meta-analyses on the impact of PA on the academic performance of children and adolescents, reporting weak positive or negative correlations from systematic reviews and small to medium beneficial effects from meta-analyses, our findings are more consistent with those of more recent longitudinal studies. For instance, Teuber et al. (2024) conducted a daily longitudinal study and similarly concluded that universities should encourage PA to support student health and well-being, identifying a modestly positive correlation between PA and academic achievement.

The context of female college students in Bangladesh introduces unique considerations. Women's participation in public spaces, particularly where PA might occur, is often lower than that of men due to persistent patriarchal norms and social expectations. Phadke (2007, p. 1511) highlights the risks associated with women's presence in public spaces, including physical assault, reputational damage, and potential blame for being in a public space if assaulted, particularly sexual assault. Nahar et al. (2013) further support this view, arguing that patriarchy, gender norms, and the custom of purdah contribute to discrimination against girls in Bangladesh from birth, predisposing them to sexual harassment. Uddin et al. (2017) specifically found that Bangladeshi youth face gender-based environmental barriers to PA, with studies showing parents often encourage boys to exercise more than girls, which can impact educational aspirations (Moniruzzaman et al., 2017). Despite the significant cultural norms that restrict physical movement for girls and women in public spaces in Bangladesh, our study found that 93.7% of the female students met the WHO-recommended PA levels. This high compliance rate suggests that, even within a restrictive environment, female students are finding ways to engage in PA, which may contribute to their academic success. This is further supported by Hossain et al. (2021), who found that Bangladeshi university students who exercise frequently tend to perform better academically. However, it is important to consider that self-esteem and socioeconomic status may concurrently influence college performance. Hasan et al. (2020) note that students encounter environmental and social barriers that restrict their participation in PA, both on and off campus. Addressing these barriers is crucial for enhancing PA among students in Bangladesh, which could, in turn, help reduce overweight and obesity rates and improve overall health.

The primary strength of the present study lies in validating the GPAQ-2 without the use of accelerometers, which were used in some previous studies. This approach makes future research more feasible and accessible in similar contexts. Furthermore, the study meticulously followed the WHO's GPAQ recommendations, ensuring careful data collection and monitoring procedures to minimise measurement errors. While GPAQ has been shown to account for culturally relevant activities in Bangladesh (Mumu et al., 2017), the study also acknowledges findings by Moniruzzaman et al. (2017) that mechanisation, sedentary city living, better education, and higher socioeconomic status are associated with less PA among urban Bangladeshis. Unlike Babaeer et al. (2021), who found no significant relationships between university students' PA and active participation, our study observed a

significant correlation between MVPA hours and GPA. This suggests that active students may perform better academically, both in terms of classroom learning and test-taking. These positive changes, often stemming from young people's free, voluntary activities, can be challenging to quantify but are nonetheless impactful. Given the observed link, teachers and educational institutions should consider integrating physical exercise into academic planning and drills, recognising its potential to enhance overall student well-being and academic outcomes.

Limitations of the Study

Although this study provides valuable insights, several limitations must be considered when evaluating the results. First, cross-sectional designs may limit the ability to identify causal relationships between physical activity (PA) and academic attainment. Second, this study includes female college students attending a single government college in Bangladesh, which may affect the generalisability. Third, because PA was self-reported using the GPAQ, responses may be skewed due to recollection or social desirability bias, which could impair accuracy. Fourth, the conceptual framework shown in Figure 1 has a limited number of mediating elements. While these were chosen based on current literature and study feasibility, other potentially relevant mediators, such as mental health, sleep quality, or social support, were not considered and may have influenced the observed associations. Fifth, one constraint of the study is the low internal reliability of the GPAQ, as indicated by a low Cronbach's Alpha in the pilot test. This may impact the consistency of self-reported PA data and should be considered when evaluating the results. Sixth, this study did not account for potential confounding variables such as nutrition, sleep quality, mental health issues, academic pressure, and family support. These factors could have altered both PA levels and academic performance, thereby skewing the observed results. To improve external validity, future research should replicate and extend these findings to other spaces and student groups.

Conclusion and Recommendations

This study investigated the relationship between PA and academic performance among female college students in Bangladesh, a topic of significant promise given PA's documented benefits for intellectual, mental, and physical health (Stillman et al., 2020). Physical activity has been shown to enhance brain blood flow, mood, focus, and self-esteem, ultimately leading to increased academic success (Bailey, 2017). Utilising a cross-sectional design, we collected data on GPA and PA levels using the Global Physical Activity Questionnaire (GPAQ) from a random sample of 300 students out of a population of 700, following a pilot study that established reliability using Cronbach's alpha.

Overall, the study revealed a statistically significant positive correlation between academic achievement and PA, specifically demonstrating a linear relationship between MVPA hours and GPA. This alternative hypothesis was supported, indicating that increased PA is associated with higher academic performance among this demographic. The results align with the notion that PA can translate to improved performance in other learning tasks, such as vocabulary acquisition (Amico & Schaefer, 2020). Recognising that female adolescents may hold more negative attitudes towards PA

than males (Burton et al., 2019), unique engagement strategies are crucial. Promoting the 'feminine' benefits of PA, while potentially avoiding activities perceived as overly 'masculine,' could be a culturally sensitive approach to encourage participation among Bangladeshi females.

The intricate relationship between physical exercise and cognitive response is multifaceted. Stillman et al. (2020) state that three processes moderate the relationship between exercise and cognition. Their taxonomy explains cognitive benefits through (a) molecular and cellular adaptations (level 1), (b) brain structure and functional changes (level 2), and (c) behavioural and socioemotional changes (level 3). While much recent research has focused on the first two levels, this study contributes to supporting the behavioural implications, suggesting that PA enhances academic achievement and overall health. Therefore, educational institutions should actively promote PA, recognising its role in fostering students' physical, cognitive, and emotional development.

Based on these findings, we offer the following recommendations for educational institutions and future research. Firstly, it is recommended that educational institutions consider integrating non-credit PA opportunities into their curriculum to encourage regular engagement among students. Secondly, safeguarding and enhancing physical spaces where students, both males and females, can safely engage in PA is paramount. Looking ahead, future research initiatives should include more detailed assessments of students' academic behaviour to understand how PA influences study habits and engagement. Furthermore, it is essential to conduct research across various universities and demographics to determine how the link between PA and academic achievement may vary. Longer longitudinal studies are also needed to reveal how consistently physical activity (PA) affects scholastic achievement over extended periods. Finally, given the complexity of college success and PA, further research is required to determine how the academic culture of physically active students differs from that of their less active peers and how this difference influences their college performance.

While active play, recreation, sports, and safe active travel can all promote PA (WHO, 2020a), it is acknowledged that determining the optimal form, intensity, and timing of PA, as well as the potential impact of varying student ages, presents methodological constraints (Latino & Tafuri, 2023). Nevertheless, the successful implementation of PA initiatives among students could yield substantial benefits for the nation's current and future public health, overall well-being, and academic advancement.

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Ethical Clearance
This study was approved by the Research Ethics Committee of the University of Nottingham, Malaysia.

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The authors declare no potential conflicts of interest.

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Notes on Contributors
Rumana Akter, MA, is a Lecturer at Lalmatia Govt. Mohila College, Bangladesh. Her research interests include Quality Physical Education, sports and exercise management,

and exercise sociology. Please direct correspondence to rumana111@gmail.com

Nadia Samsudin, PhD, is an accomplished academic and researcher at UCSI University. She specialises in applied statistics in public health and currently works as a post-doctoral research fellow in the Faculty of Social Sciences and Liberal Arts (FOSSLA). Her expertise and contributions play a crucial role in advancing knowledge and improving public health outcomes. Please direct correspondence to nadia.samsudin@ucsiuniversity.edu.my

Richard Peter Bailey, PhD, is Professor of Education and Deputy Dean at UCSI University, Malaysia. He works at the interface between science and philosophy. Stanford University's list of top scientists in the world includes him for Clinical Medicine, Sport Sciences, and Education. Please direct correspondence to richardbailey@ucsiuniversity.edu.my

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Supplementary Material

Table 3. Total Mets * Academic Performance Cross-Tabulation Analysis

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Per cent	N	Per cent	N	Per cent
Total METs * Academic Performance	300	100.0%	0	0.0%	300	100.0%

Total Mets * Academic Performance Cross Tabulation

		Academic Performance					
		<2.75	<3.00	<3.25	<3.50	<4.00	Total
Total METs	240	4	1	0	0	0	5
	360	2	0	0	0	0	2
	400	4	0	0	0	0	4
	420	2	0	0	0	0	2
	480	4	0	0	0	0	4
	580	2	0	0	0	0	2
	600	5	1	1	0	0	7
	660	2	0	0	0	0	2
	700	4	1	0	0	0	5
	800	5	1	0	0	0	6
	840	6	2	1	0	0	9
	880	1	1	0	0	0	2
	900	1	1	0	0	0	2
	920	2	2	0	0	0	4
	940	1	2	0	0	0	3
	960	5	1	0	0	0	6
	980	2	0	0	0	0	2
	1000	0	3	1	0	0	4
	1040	2	2	1	0	0	5
	1060	0	1	1	0	0	2
	1080	0	1	1	0	0	2
	1100	0	2	0	0	0	2
	1120	0	4	1	1	0	6
	1140	0	0	2	0	0	2

	1160	1	1	0	0	0	2
	1200	0	0	1	1	0	2
	1220	0	3	0	0	0	3
	1240	0	2	0	0	0	2
	1260	0	1	1	0	0	2
	1280	1	4	1	1	0	7
	1300	0	4	0	0	0	4
	1320	3	2	3	0	0	8
	1340	0	1	1	0	0	2
	1360	0	3	1	0	0	4
	1380	0	3	1	0	0	4
	1400	0	3	1	0	0	4
	1420	1	1	0	0	0	2
	1440	0	1	1	0	0	2
	1460	2	1	1	0	0	4
	1480	0	2	1	0	0	3
	1500	0	2	0	1	1	4
	1520	0	1	1	0	0	2
	1560	0	1	2	1	0	4
	1580	1	0	1	0	0	2
	1600	0	4	1	3	0	8
	1640	0	2	1	1	0	4
	1680	1	8	5	2	0	16
	1700	1	0	2	1	0	4
	1720	0	1	0	0	0	1
	1740	0	0	2	2	0	4
	1760	0	6	1	1	0	8
	1780	0	1	0	1	0	2
	1820	0	1	1	0	0	2
	1860	0	2	3	1	0	6
	1880	0	2	0	2	2	6
	1900	0	0	0	1	1	2
	1920	0	1	1	1	1	4
	1940	0	1	4	4	0	9
	1960	0	0	1	0	0	1
	1980	0	2	2	2	0	6
	2000	0	0	0	1	0	1
	2020	0	1	1	0	0	2

	2040	0	0	2	2	2	6
	2060	0	1	2	1	0	4
	2080	0	0	3	2	0	5
	2100	0	0	1	2	1	4
	2120	0	2	0	1	1	4
	2140	0	1	0	2	0	3
	2160	0	0	4	0	2	6
	2220	0	0	1	1	3	5
	2240	0	0	2	2	2	6
	2260	0	0	1	0	1	2
	2300	0	0	0	1	1	2
	2480	0	0	0	2	0	2
	2580	0	0	0	0	1	1
	2800	0	0	0	0	2	2
	2880	0	0	0	0	3	3
	2980	0	0	0	1	1	2
Total		65	98	67	45	25	300