

# A nationwide cross-sectional survey of prevalence and association of physical activity with suicidal, psychosocial, and risky-health indicators among adolescents in Bangladesh

MD. JOBAIR KHAN (✉ [khan\\_pavel08@yahoo.com](mailto:khan_pavel08@yahoo.com))

North South University <https://orcid.org/0000-0002-9418-1759>

Sayma n/a

Uttara University

Balasankar Ganesan

Institute of Health & Management

Mohammed Usman Ali

The Hong Kong Polytechnic University

Auwal Abdullahi

The Hong Kong Polytechnic University

S. M. Mahmudul Hasan

German University Bangladesh

Atiqur Rahman Khan

Integrated Disability Service Center, JUPF

Mohammad Delwer Hossain Hawlader

North South University

Stanley John Winser

The Hong Kong Polytechnic University

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## Research Article

**Keywords:** Adolescent, Suicide, Anxiety, Depression, Physical activity, and Education

**Posted Date:** August 8th, 2023

**DOI:** <https://doi.org/10.21203/rs.3.rs-3074350/v1>

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# Abstract

## Background

Physical activities among adolescents are limited, and suicidal, psychosocial, and risky health indicators are alarmingly rising in low-resource countries, including Bangladesh. Thus, this study investigates the prevalence, associations and relative contributors of physical activity with suicidal, psychosocial, risky-health indicators.

## Methods

This is a secondary analysis of GSHS database. A total of 2058 adolescents in grades 7 to 10, aged 11 to 17 years completed a self-administered questionnaire. Sex-stratified logistic regression was utilized to evaluate associations between physical activity and suicidal, psychological, and risky-health indicators. A two-step cluster analysis was performed to identify the risky indicators. Hierarchical regression examined the aforementioned factors' contributions to physical activity.

## Results

Half of the adolescents (boys 18.9% vs. girls 30.3%) indicated satisfactory physical activity following WHO guidelines. Most active group of frequency of activity and walking or bicycle to school were positively associated with suicidal behavior. Isolated adolescents suffered anxiety despite frequent engagement in physical activity. Reduced frequency of physical activity was significantly associated with sexual activity, smoking, tobacco product usage (girls), alcohol abuse (boys), and ever-abusing drug use (boys and girls). Cluster analysis revealed girls and boys were predisposed to physical abuse and bully, respectively. Hierarchical regression models showed a significant contribution of selected predictors to physical activity.

## Conclusion

Increased physical activity through regular walking and bicycling may lower suicidal behavior among adolescents. The most active groups of physical activity were associated with predictors and varied by sex; boys were bullied, while girls were subjected to physical abuse.

## Introduction

The health benefits of a physically active lifestyle during adolescence are exclusively evident [1, 2]. They include enhanced cardio-respiratory and musculoskeletal fitness, cardio-metabolic health, and positive effects on weight status, cognitive development and prosocial behavior [3, 4]. However, globally, about 80.3% of school-going adolescents aged 13–15 years do not perform a minimal level of physical activity (PA) in their daily life [5]. This is because it is recommended that adolescents participate in at least 60 minutes of moderate-to-vigorous PA per day to reap its health benefits [6].

Worse still, in the majority of countries and regions around the world, girls engage in significantly less activity than boys [7]. This trend remained unchanged until 2018 [8]. One proposed elucidation for this gender disparity is

that, girls may be more concerned with health and fitness, whereas competitive activities may appeal to boys more than girls [9]. Engaging in physical activity has beneficial effects in both boys and girls such as positive mood, higher self-esteem, as well general physical and psychological well-being [10–15] Psychological well-being can in turn help prevent suicidal behaviors [14].

Suicidal behaviors include ideation, planning, and attempts of suicide, and are common among school-aged adolescents in Bangladesh [11, 15, 16]. Suicidal ideation and attempts range from 12.1 to 29.9% and 4.1 to 10.5% [17] are much more common than actual suicidal cases which contribute 8.5% [15]. The negative consequences of suicidal behavior strongly imply the need to develop strategies to address this public health issue [10]. However, although previous studies have identified risk factors and estimated the prevalence of suicidal behavior among adolescents in Bangladesh; [11] there seem to be no large-scale studies have been conducted to investigate how suicidal behavior is mitigated by regular participation in PA. Consequently, this study investigated the associations of PA with suicidal, psychosocial, and risky-health indicators, and the relative contributions of selected factors to PA in Bangladeshi school-aged adolescents.

## **Methods**

We used the STROBE checklist [18] when writing our report, as given in supplementary Table 2. This is a secondary analysis of GSHS 2014 datasets [19].

## **Study design**

The GSHS 2014 study was conducted as a cross-sectional two-stage cluster sampling design reported. Survey selected a comprehensive sampling procedure that included grades 7, 8, 9, and 10, and adolescents aged between 13 and 17. In the first step of the process, schools were selected using a probability that was directly proportionate to student enrollment. In the second step, a method of random selection was used to select the classes within each school, and all of the students enrolled in those classes were given the opportunity to participate in the study. Participants completed a self-administered questionnaire and recorded answers on a piece of paper that could be scanned by a computer. The institutional, student and the overall response rates were 97%, 94% and 91% respectively.

## **Survey administration**

The data obtained from the GSHS was developed to collect information from school-aged adolescents in developing countries like Bangladesh. The WHO and the Centers for Disease Control and Prevention worked collaboratively to conduct the survey. The data for GSHS were acquired by using a typical school-based methodology, a standardized scientific sample selection approach, and a mix of basic questionnaire modules with extended and country-specific questions. The survey's full explanations are elsewhere [19, 20].

## **Explanatory Variables**

The explanatory variables include suicidal, psychosocial, and risky-health behaviors, which were evaluated by assessing anxiety, bully, loneliness, and the absence of close school friends. The lifestyle-related behaviors were determined using these indicators: sexual intercourse, drug abuse, smoking, tobacco products other than cigarettes, alcohol consumption, and physical abuse.

## **Outcome Variables**

The amount of physical activity that adolescents undertake was the outcome variable. A summary indicator of adolescents' daily PA was used for the purpose of this research. This indicator included walking or cycling as categorical variables, while physical education and sitting activity were classified as binary variables.

The survey item assessing the GSHS using the item PA was as follows: "During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? For the last 7 days, add up all the time you spent in PA, like walking or riding a bicycle to class. Count up the days with at least 60 minutes of PA in the past week." The response times ranged from 0 to 7 days. For the items of physical education and sitting activity, the response options were yes (1) and no (0). Further details given in supplementary file.

## Statistical Analyses

A previous study showed disparities between male and female adolescents in terms of PA and mental health behaviors [21]. Therefore, analyses were stratified by gender. Chi-squared tests were conducted to examine the proportions of boys and girls in the least active, somewhat active, and most active groups with those who reported suicidal, psychosocial, and risky-health behaviors.

Separate models for suicidal, psychosocial, and risky-health behavior outcome variables on categorical variables for frequency of exercise and walking or cycling to school were created using gender-stratified multinomial logistic regressions. Binary logistic regression was used to assess significant differences in physical education (PE) class attendance and sitting activity behaviors-related outcomes by male and female students. Results from the multinomial and binary logistic regression analyses were given as odds ratios (ORs) with 95% confidence intervals. Odds ratios (ORs) were considered statistically significant if  $p < 0.05$  and the 95% confidence interval (CI) did not include 0 [22].

The second stage was to find clusters based on the predictor variables. These variables were thus identified as classification variables. A two-step cluster analysis (TSCA) was used to achieve this objective. Through clustering, the number of two-step cluster analysis clusters was automatically computed. Two-step cluster analysis has various characteristics that distinguish it from traditional clustering techniques (i.e., K-mean and hierarchical). This capability provides the definition of clusters based on categorical and continuous variables extracted from large data sets, the specification of the relevance of predictor variables included in the study, and the automated determination of the number of clusters. Model fit was assessed using Schwarz's Bayesian information criterion (BIC) and the average silhouette coefficient, which evaluated cluster cohesion and separation metrics. Among a finite set of models, the BIC was used as a selection criteria; the model with the lowest Bayesian information criterion was favoured [23]. The silhouette coefficient is a common way to measure the internal validity of a model. It ranges from 0 to 1, with 1 being the best. A good model fit is represented by the lowest Bayesian information criterion value, coupled by the greatest values of Bayesian information criterion change (ratio of Bayesian information criterion changes to the ratio of distances), as well as an average silhouette coefficient that is equal to or higher than 0.50 [24].

Then, using the best-fit hierarchical multiple regression methods, to investigate the relative contributions of selected factors to the adolescents' PA. In the analysis, covariates were not controlled because we were investigating natural subpopulations. The computer program SPSS, Version 26.0 (IBM Corp., Armonk, NY: IBM Corp.), was used to analyze the data.

## Results

In our sample, there were 2058 Bangladeshi school students, with more than half girls (63%). A total of 35.2% were 14 years old, 34.6% were 15 years old, 20% were 13 years old, 6.2% were 16 years old, 3.1% were 12 years old, 0.7% were 17 years old, and 0.3% were 11 years old. The sample was dispersed throughout all of the different grades in the school: 27.6% were in 7th grade, 10.4% in 8th, 51.3% in 9th, and 10.7% in 10th. Most participants possessed normal body weight (81%), 7.5% were overweight, 10.2% were underweight, and 1.3% had obesity (not shown).

The prevalence estimates and chi-squared p-values of the suicide-related outcomes, psychological states, and health-related behaviors stratified by sex are shown in the supplementary file, Table 1. Overall, 49.2% of the sample was sufficiently active (not shown). There were significant sex differences in the proportion of young people in each of the activity subgroups: more girls than boys were in the least active category, whereas more boys were in the somewhat active and most active categories. Within the most active group, the sub-group with less PA among boys than girls (18.9% vs. 30.3%) was selected as being sufficiently active according to WHO requirements. Just under half of the sample (48.4%) reported participation in 3 or more days in physical education classes, while one-quarter (26.7%) reported participation in 5 or more days.

Table 1  
Frequency of physical activity, bicycling, physical education class and sitting activity, association with suicidal behavior for boys and girls

| Characteristics                                           |                               | Suicidal Ideation    |                     | Suicidal Plan         |                     | Suicidal Attempt     |                     |
|-----------------------------------------------------------|-------------------------------|----------------------|---------------------|-----------------------|---------------------|----------------------|---------------------|
|                                                           |                               | Boy Girl             |                     | Boy Girl              |                     | Boy Girl             |                     |
|                                                           |                               | OR (95% CI)          |                     | OR (95% CI)           |                     | OR (95% CI)          |                     |
| Frequency of activity<br>(Days per week)                  | Least active<br>(0–2 days)    | Reference            |                     |                       |                     |                      |                     |
|                                                           | Somewhat active<br>(3–5 days) | 0.8<br>(0.87, 0.91)  | 0.6<br>(0.64, 0.67) | 0.7<br>(0.77, 0.80)   | 1<br>(1.02, 1.08)   | 0.2<br>(0.28, 0.29)  | 0.8<br>(0.87, 0.92) |
|                                                           | Most active<br>(6–7 days)     | 1.1<br>(1.08, 1.11)  | 2.3<br>(2.27, 2.35) | 2.1<br>(2.098, 2.143) | 1.4<br>(1.40, 1.44) | 0.9<br>(0.97, 1.00)  | 1.2<br>(1.24, 1.28) |
| Walk or Bicycle to school<br>(Days per week)              | Least active<br>(0–2 days)    | Reference            |                     |                       |                     |                      |                     |
|                                                           | Somewhat active<br>(3–5 days) | 0.5<br>(0.58, 0.61)  | 0.6<br>(0.62, 0.66) | 0.4<br>(0.46, 0.47)   | 0.7<br>(0.74, 0.79) | 0.5<br>(0.58, 0.60)  | 2.1<br>(2.02, 2.22) |
|                                                           | Most active<br>(6–7 days)     | 2.2<br>(2.25, 2.31)  | 1.7<br>(1.70, 1.75) | 2.5<br>(2.52, 2.58)   | 1.2<br>(1.25, 1.28) | 1.7<br>(1.77, 1.82)  | 1.3<br>(1.36, 1.40) |
| Physical Education Class Attendance<br>(Days per week)    | 3 or more days                | 0.8<br>(0.82, 0.84)  | 1.3<br>(1.29, 1.33) | 0.6<br>(0.65, 0.66)   | 1.6<br>(1.61, 1.66) | 0.4<br>(0.43, 0.44)  | 1.5<br>(1.54, 1.59) |
|                                                           | 5 or more days                | 0.6<br>(0.66, 0.68)  | 1.4<br>(1.42, 1.47) | 0.3<br>(0.38,0.39)    | 1.9<br>(1.88, 1.93) | 0.2<br>(0.24, 0.25)  | 1.1<br>(1.10, 1.14) |
| Sitting activity                                          | 3 or more hour per day        | 1.1<br>(1.08, 1.120) | 1.5<br>(1.55, 1.62) | 0.8<br>(0.826, 0.84)  | 0.8<br>(0.81, 0.84) | 1.3<br>(1.36, 1.400) | 1.3<br>(1.27, 1.33) |
| P value = 0.000, OR = Odd Ratio, CI = Confidence Interval |                               |                      |                     |                       |                     |                      |                     |

The odds ratio (OR) and the p-values for suicidal behavior-related outcomes and PA-related behaviors stratified according to sex are shown in Table 1. Overall, higher frequency of activity and "walk or bicycle to school" behaviors were associated with lower levels of suicide-related behavior. All outcomes of physical education class attendance and suicidal ideation, ideation and attempt were significantly higher OR for girls than boys. Boys had

significantly higher ORs for suicidal plans and attempts in sitting activity behaviors than girls. Although girls had the higher OR for suicidal ideation when sitting for 3 or more hours per day.

Table 2 presents the characteristics of the sample and the sex-adjusted OR of psychosocial behavior by specified characteristics. Both male and female students who were most active per day over the last week compared to those who were not were 2 times and 1.5 times (OR 2.1, OR 1.4), respectively, less likely to have no close friend. In addition, male students who were most active in the last 7 days compared to those who were least active were almost three times (OR 2.9) less likely to suffer from anxiety. Females who did not sit for three hours or more were 63% and 58% less likely to be bullied and feel lonely, respectively, than those who did. Students who did not attend 5 or more days in PE class compared to those who did have a 37% (male) and 22% (female) lower risk of being bullied.

Table 2

Associations between frequency of physical activity, bicycling, physical education class and sitting activity, psychosocial behavior for boys and girls

| Characteristics                                                                                 |                            | Anxiety              |                     | Bully               |                     | Loneliness           |                         | No close friend         |                       |
|-------------------------------------------------------------------------------------------------|----------------------------|----------------------|---------------------|---------------------|---------------------|----------------------|-------------------------|-------------------------|-----------------------|
|                                                                                                 |                            | Boy Girl             |                     | Boy Girl            |                     | Boy Girl             |                         | Boy Girl                |                       |
|                                                                                                 |                            | OR (95% CI)          |                     | OR (95% CI)         |                     | OR (95% CI)          |                         | OR (95% CI)             |                       |
| Frequency of activity                                                                           | Least active               | Reference            |                     |                     |                     |                      |                         |                         |                       |
| (Days per week)                                                                                 | (0–2 days)                 |                      |                     |                     |                     |                      |                         |                         |                       |
|                                                                                                 | Somewhat active (3–5 days) | 0.3<br>(0.34, 0.35)  | 0.4<br>(0.44, 0.47) | 0.6<br>(0.66, 0.67) | 0.3<br>(0.38, 0.40) | 0.3<br>(0.37, 0.39)  | 0.4<br>(0.41, 0.43)     | 11.7<br>(11.01,12.45)   | 0.9<br>(0.94, 0.98)   |
|                                                                                                 | Most active<br>(6–7 days)  | 2.9<br>(2.87, 2.97)  | 0.9<br>(0.89, 0.93) | 1.2<br>(1.20, 1.22) | 0.8<br>(0.88, 0.90) | 0.72<br>(0.73, 0.75) | 1.067<br>(1.052, 1.083) | 2.140<br>(2.113, 2.167) | 1.4<br>(1.39, 1.43)   |
| Walk or bicycle to school                                                                       | Least active               | Reference            |                     |                     |                     |                      |                         |                         |                       |
| (Days per week)                                                                                 | (0–2 days)                 |                      |                     |                     |                     |                      |                         |                         |                       |
|                                                                                                 | Somewhat active (3–5 days) | .4<br>(0.422, 0.43)  | 0.5<br>(0.50, 0.53) | 0.6<br>(0.61, 0.63) | 0.5<br>(0.54, 0.56) | 0.4<br>(0.43, 0.44)  | 0.3<br>(0.36, 0.37)     | 0.8<br>(0.79, 0.83)     | 0.9<br>(0.92, 0.97)   |
|                                                                                                 | Most active<br>(6–7 days)  | 2.5<br>(2.52, 2.620) | 1<br>(1.00, 1.04)   | 0.8<br>(0.86, 0.88) | 0.8<br>(0.87, 0.88) | 1.5<br>(1.56, 1.59)  | 1<br>(1.07, 1.10)       | 0.5<br>(0.52, 0.54)     | 1.2<br>(1.26, 1.29)   |
| PE attendance                                                                                   | 3 or more days             | 0.9<br>(0.93, 0.96)  | 1.4<br>(1.43, 1.48) | 0.9<br>(0.93, 0.94) | 1.7<br>(1.77, 1.80) | 1<br>(1.01, 1.03)    | 1.1<br>(1.13, 1.16)     | 0.9<br>(0.90, 0.93)     | 0.6<br>(0.662, 0.67)  |
| (Days per week)                                                                                 | 5 or more days             | 0.8<br>(0.86, 0.90)  | 1.7<br>(1.75, 1.81) | 1.3<br>(1.36, 1.38) | 1.2<br>(1.20, 1.23) | 1<br>(1.04, 1.069)   | 1<br>(1.05, 1.09)       | 1.1<br>(1.16, 1.19)     | 0.5<br>(0.53, 0.55)   |
| Sitting activity                                                                                | 3 or more hour per day     | 0.7<br>(0.70, 0.73)  | 2<br>(1.98, 2.07)   | 0.9<br>(0.95, 0.97) | 1.6<br>(1.61, 1.66) | 1<br>(1.04, 1.06)    | 1.5<br>(1.55, 1.61)     | 1<br>(1.06, 1.09)       | 1.76<br>(1.736, 1.78) |
| *P value = 0.787, ** P value = 0.004, P value = 0.000, OR = Odd Ratio, CI = Confidence Interval |                            |                      |                     |                     |                     |                      |                         |                         |                       |

Adolescents with risky-health behaviors, including ever having sexual intercourse (girls vs. boys, OR 3 vs. 0.7), ever abusing drugs (boys vs. girls, OR 13.5 vs. 7.4), and smoking (girls vs. boys, OR 2.8 vs. 0.0), had a greater likelihood of being in the most active group in terms of frequency of activity. Girls than boys students who were most active in terms of frequency of activity, walking or bicycling to school groups, attended 3 or hours days in PE class including setting activity had a lower chance of engaging in sexual intercourse. While boys had significantly higher OR for most active group in frequency of activity, walking or bicycling to school groups, attended 3 or hour per days in PE class, setting activity and drug abuse than girls. In addition, boys had a higher OR for both outcomes of PE class attendance and smoking, as illustrated in Table 3.

Table 3

Associations between frequency of physical activity, bicycling physical education class and sitting activity, sexual intercourse, drug abuse and smoking for boys and girls

| Characteristics                                                                                            |                            | Sexual Intercourse   |                         | Drug Abuse            |                        | Smoking              |                       |
|------------------------------------------------------------------------------------------------------------|----------------------------|----------------------|-------------------------|-----------------------|------------------------|----------------------|-----------------------|
|                                                                                                            |                            | Boy Girl             |                         | Boy Girl              |                        | Boy Girl             |                       |
|                                                                                                            |                            | OR (95% CI)          |                         | OR (95% CI)           |                        | OR (95% CI)          |                       |
| Frequency of activity<br>(Days per week)                                                                   | Least active<br>(0–2 days) | Reference            |                         |                       |                        |                      |                       |
|                                                                                                            | Somewhat active (3–5 days) | 0.3<br>(0.30, 0.31)  | 0.8<br>(0.80, 0.85)     | 2.7<br>(2.67, 2.79)   | 10.7<br>(10.34, 11.15) | 1.2<br>(1.14, 1.3)   | 0.6<br>(0.64, 0.67)   |
|                                                                                                            | Most active<br>(6–7 days)  | 0.7<br>(0.72, 0.73)  | 3.060<br>(2.993, 3.128) | 13.5<br>(13.32,13.87) | 7.4<br>(7.03, 7.82)    | 0.0<br>(0.09, 0.10)  | 2.8<br>(2.81, 2.90)   |
| Walk or Bicycle to school<br>(Days per week)                                                               | Least active<br>(0–2 days) | Reference            |                         |                       |                        |                      |                       |
|                                                                                                            | Somewhat active (3–5 days) | 0.8<br>(0.789, 0.81) | 0.5<br>(0.52, 0.55)     | 1.3<br>(1.30, 1.36)   |                        | 3.9<br>(3.68, 4.180) | 1.3<br>(1.325, 1.413) |
|                                                                                                            | Most active<br>(6–7 days)  | 0.7<br>(0.74, 0.76)  | 1.63<br>(1.60, 1.67)    | 4.2<br>(4.15, 4.29)   | 1.6<br>(1.59, 1.67)    | 0.2<br>(0.21, 0.22)  | 1.5<br>(1.55, 1.60)   |
| Physical Education Class Attendance<br>(Days per week)                                                     | 3 or more days             | 0.4<br>(0.42, 0.42)  | 2<br>(2.05, 2.13)       | 1.4<br>(1.41, 1.46)   | 0.3<br>(0.36, 0.389)   | 3.6<br>(3.60, 3.70)  | 0.9<br>(0.96, 0.99)   |
|                                                                                                            | 5 or more days             | 0.6<br>(0.61, 0.631) | 0.9<br>(0.88, 0.92)     | 0.2<br>(0.27, 0.28)   | 0.4<br>(0.39,0.42)     | 4.2<br>(4.18, 4.28)  | 1.3<br>(1.36, 1.40)   |
| Sitting activity                                                                                           | 3 or more hour per day     | 0.9<br>(0.95, 0.97)  | 1.9<br>(1.94, 2.04)     | 3.6<br>(3.64, 3.75)   | 0.3<br>(0.295, 0.33)   | 0.7<br>(0.75, 0.78)  | 0.8<br>(0.84, 0.88)   |
| Tobacco product = Tobacco other than cigarettes, P value = 0.000, OR = Odd Ratio, CI = Confidence Interval |                            |                      |                         |                       |                        |                      |                       |

The frequency of physical and sitting activity, as well as the use of tobacco products, were significantly higher in girls than in boys. There were large differences in the adolescent lifestyle in terms of frequency of activity. Male adolescent alcohol abuse was lower with more exercise. Most activity groups were associated with lower levels of alcohol abuse in female adolescents who walk or use bicycles to school. For both girls and boys, subgroup comparisons revealed significant differences in the possibility of being physically abused between the somewhat

active and most active subgroups and the least active subgroups, with the somewhat active and most active group having lower levels of the possibility of being physically abused. Non-significant differences in OR were observed for girls who did not attend 5 hours or more in PE class and were physically abused compared with those who did. In the currently tobacco products user and physically abused adolescent categories, girls had a significantly higher OR than boys students in the sitting 3 or more hours per day group, as shown in Table 4.

Table 4

Associations between frequency of physical activity, bicycling physical education class and sitting activity, alcohol and physically abuse for boys and girls

| Characteristics                                                                                 |                                | Tobacco Products     |                        | Alcohol Abuse        |                     | Physically Abuse     |                        |
|-------------------------------------------------------------------------------------------------|--------------------------------|----------------------|------------------------|----------------------|---------------------|----------------------|------------------------|
|                                                                                                 |                                | Boy Girl             |                        | Boy Girl             |                     | Boy Girl             |                        |
|                                                                                                 |                                | OR (95% CI)          |                        | OR (95% CI)          |                     | OR (95% CI)          |                        |
| Frequency of activity<br>(Days per week)                                                        | Least active<br>(0–2 days)     | Reference            |                        |                      |                     |                      |                        |
|                                                                                                 | Somewhat active<br>(3–5 days)  | 1.4<br>(1.41, 1.46)  | 2.1<br>(2.10, 2.21)    | 0.3<br>(0.31, 0.32)  | 0.1<br>(0.17, 0.19) | 1.3<br>(1.34, 1.37)  | 0.5<br>(0.513, 0.53)   |
|                                                                                                 | Most active<br>(6–7 days)      | 0.5<br>(0.50, 0.52)  | 1.1<br>(1.15, 1.19)    | 4.2<br>(4.16, 4.35)  | 0.9<br>(0.86, 0.96) | 3.3<br>(3.329, 3.37) | 0.7<br>(0.78, 0.79)    |
|                                                                                                 |                                |                      |                        |                      |                     |                      |                        |
| Walk or Bicycle to school<br>(Days per week)                                                    | Least active<br>(0–2 days)     | Reference            |                        |                      |                     |                      |                        |
|                                                                                                 | Somewhat active<br>(3–5 days)  | 0.7<br>(0.69, 0.73)  | 0.8<br>(0.80, 0.86)    | 0.1<br>(0.193, 0.20) | 0.3<br>(0.31, 0.35) | 1.5<br>(1.54, 1.58)  | 1.9<br>(1.92, 1.99)    |
|                                                                                                 | Most active<br>(6–7 days)      | 0.8<br>(0.83, 0.85)  | 0.9<br>(0.91, 0.94)    | 0.9<br>(0.95, 0.99)  | 7.8<br>(7.32, 8.42) | 2.1<br>(2.11, 2.13)  | 1.2<br>(1.28, 1.30)    |
|                                                                                                 |                                |                      |                        |                      |                     |                      |                        |
| Physical Education Class Attendance<br>(Days per week)                                          | 3 or more days                 | 1.7<br>(1.68, 1.728) | 1<br>(1.0, 1.03)       | 0.5<br>(0.58, 0.60)  | 2.1<br>(2.05, 2.24) | 0.9<br>(0.90, 0.91)  | 1*<br>(0.99, 1.00)     |
|                                                                                                 | 5 or more days                 | 1.2<br>(1.24, 1.27)  | 1.1<br>(1.12, 1.16)    | 0.3<br>(0.31, 0.33)  | 0.3<br>(0.33, 0.38) | 0.9<br>(0.90, 0.91)  | 0.98**<br>(0.98, 0.99) |
|                                                                                                 |                                |                      |                        |                      |                     |                      |                        |
|                                                                                                 |                                |                      |                        |                      |                     |                      |                        |
| Sitting Activity                                                                                | Sitting 3 or more hour per day | 1.3<br>(1.28, 1.32)  | 12.3<br>(11.60, 13.24) | 6.5<br>(6.47, 6.71)  |                     | 0.8<br>(0.83, 0.84)  | 1.2<br>(1.22, 1.25)    |
| *P value = 0.628, ** P value = 0.006, P value = 0.000, OR = Odd Ratio, CI = Confidence Interval |                                |                      |                        |                      |                     |                      |                        |

Figures 1 and 2 depict the sex-stratified distributions of the three and two clusters for girls and boys, respectively, including the significant predictors. The silhouette measurements for girls were good, while the measurements for boys were fair. Physical abuse indicators were the most important predictors of girls' scores 1. For boys, they were mostly subjected to bullying by others. All suicidal and psychosocial behaviors were recognized as key predictors among girls and boys.

Table 5 described the estimates of the relative contributions of suicidal, psychosocial, and risky-health determinants with the frequency of PA behavior, based on gender. The initial models only included risky health behaviors for girls and psychosocial factors for boys. The R2 values for the frequency of PA increased by 0.006 and 0.020, respectively, in models that independently contained psychosocial indicators for girls and risky-health indicators for boys. The final model included all three groups of variables, and the final R2 values for this model were 0.014 for girls and 0.051 for boys.

Table 5  
Hierarchical regression model for frequency of physical activity

| Sex                                                                                                                                                                                                                      | Model                                                        | R Square | P Value |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|----------|---------|
| Female                                                                                                                                                                                                                   | Risky-health (Lifestyle)                                     | 0.018    | 0.00    |
|                                                                                                                                                                                                                          | Risky-health (Lifestyle) + Psychosocial                      | 0.020    | 0.00    |
|                                                                                                                                                                                                                          | Risky-health (Lifestyle) + Psychosocial + Suicidal behaviors | 0.026    | 0.00    |
| Male                                                                                                                                                                                                                     | Psychosocial                                                 | 0.018    | 0.00    |
|                                                                                                                                                                                                                          | Psychosocial + Risky-health (Lifestyle)                      | 0.036    | 0.00    |
|                                                                                                                                                                                                                          | Risky-health (Lifestyle) + Psychosocial + Suicidal behaviors | 0.046    | 0.00    |
| *For boys: Psychosocial = Bully, No close friend, Loneliness & anxiety; Risky-health (Lifestyle) = Physically abuse, Smoking & Tobacco other than cigarette; Suicidal behaviors = Suicidal plane, ideation and attempt.  |                                                              |          |         |
| *For girls: Risky-health (Lifestyle) = Physically abuse, Smoking & Tobacco other than cigarette; Psychosocial = Bully, No close friend, Loneliness & anxiety; Suicidal behaviors = Suicidal plane, ideation and attempt. |                                                              |          |         |

## Discussion

Still, suicidal behavior, mental health, and lifestyle-related indicators among adolescents are negligible issues. Using a nationally representative data set, this study quantified the influence of PA on the risk factors of these behaviors. This study reported that half of the sample (49.2%) of Bangladeshi adolescents recorded reaching the satisfactory level of PA prescribed by WHO for a healthy lifestyle [6]. Frequent PA was associated with reducing levels of suicidal ideation, plan and attempt. Additionally, most active group of PA was associated with predictors, and it varied by sex; girls were physically abused, and boys were bullied.

According to WHO guidelines, girls were non-significantly less likely than boys to be inactive, with only 30.3% of girls and 18.9% of boys being sufficiently active. This finding was not consistent with previous studies of activity levels in 14–16 year old Indian, Pakistani, and European adolescents [12, 25–27]. The least active and somewhat active groupings had the highest disparities in psychological indicators, whereas daily exercise showed additional benefits. Adolescents who did not engage in three or more hours of sitting activity per day added an adequate psychosocial benefit to girls. Less than half of boys (42.4%) and less than one-quarter (21.9%) of girls

reported engaging in physical activities regularly. It was pointed out that opportunities for boys to participate in sports and other physical activities are skewed [7].

Although it has been found that PE attendance was not associated with mental health outcomes in American adolescents, there are chances to improve PE attendance and, eventually, enhance daily PA [21]. In addition, among Bangladeshi adolescents, the age-adjusted prevalence of suicidal behavior was noted at 12%, indicating the vulnerability that these populations face [11]. Although it has been found that PE attendance was not associated with mental health outcomes in American adolescents, there are chances to improve PE attendance and, eventually, enhance daily PA [21]. In addition, among Bangladeshi adolescents, the age-adjusted prevalence of suicidal behavior was noted at 12%, indicating the vulnerability that these populations face [11]. We examined participation in PE attendance individuals to identify the association which may be particularly beneficial to suicidal indicators and psychosocial wellbeing. All suicidal and psychosocial outcomes and PE attendance were significantly associated with a higher OR among girls participating in PE class five or more days.

Our study figured out an association between greater levels of PA and better psychosocial outcomes, with both lower and higher activity thresholds linked to weaker mental health, particularly among girls. This is consistent with earlier studies in populations with similar demographics [12]. However, a number of concepts have been offered to explain the inverse link that exists between PA and psychological health problems [28]. One of them was that the social relationships resulting in the formation of regular PA may have a positive influence on mental health [29]. Our findings indicate that even slight increases in PA have a significant impact on mental health, lending credence to the concept that a key policy purpose for enhancing mental health was to specifically target those who were completely inactive [12, 30].

Adolescents who spent three or more hours per day sedentary had the greatest differences in psychosocial indicators. This was consistent with previous findings on the relationship between sedentary habits among adolescents and poor mental health outcomes, despite the fact that some findings have been inconsistent [31, 32]. Long-term sedentary behavior increases social isolation and loneliness, which are associated with suicidal behaviors [21].

The major flaws in this study were: 1) We used a self-reported tool to measure PA, which may be prone to recall bias; 2) Adolescents from different cultures, sexes, and age groups had different ideas about what PA; and 3) Since this was a cross-sectional study, we couldn't figure out if there was a cause-and-effect relationship between PA and the outcomes or if there was a temporal relationship between PA and the outcomes. Strengths of this study were: (1) the use of regression and cluster models to account for the clustered structure of the data; (2) a large and representative sample of adolescents from Bangladesh; and (3) to avoid underestimating activity levels, the instrument explicitly included physical education class and three or more hours of sitting activities.

## Conclusions

Increased physical activities, such as regular walking and bicycling, may lower suicidal behavior. Developing strategies to help adolescents adopt and engage in regular physical activity is paramount. Individual or group physical activity awareness programs and cognitive behavioral therapy should be intensified. Integration of community-based interventions to promote well-being and discourage sedentary behaviors among less active adolescents is also imperative. Furthermore, it would be advantageous to develop physical activity guidelines for adolescents tailored to suicidal, psychosocial, and risky-health indicators.

# Abbreviations

PA= physical activity

STROBE= Strengthening the Reporting of Observational Studies in Epidemiology

GSHS= Global School-Based Student Health Survey

PE= Physical education

BIC= Schwarz's Bayesian information criterion

OR= Odd Ratio

# Declarations

## *Ethical approval and Consent to participate*

Not needed, as used secondary dataset for the analysis.

## *Funding*

None

## *Competing interests*

None declared.

## *Data availability statement*

Available at <https://extranet.who.int/ncdsmicrodata/index.php/catalog/485>

## *Consent for publication*

None.

## *Code availability*

Available on reasonable request.

## *Author Contributions*

MJK conceptualized, designed, visualized, and drafted the main manuscript. BG, S, MUA, AA, ARK, SMMH, and MDHH critically reviewed the manuscript. SJW supervised and critically reviewed the manuscript. All authors have read and agreed to the published version of the manuscript.

## *Acknowledgement*

This study makes use of data from the Global School-Based Student Health Survey (GSHS). The World Health Organization, both designed and executed the survey to support GSHS. We are thankful to EQUATOR for allowing us to

participate in their GoodReports randomized trial.

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## Figures

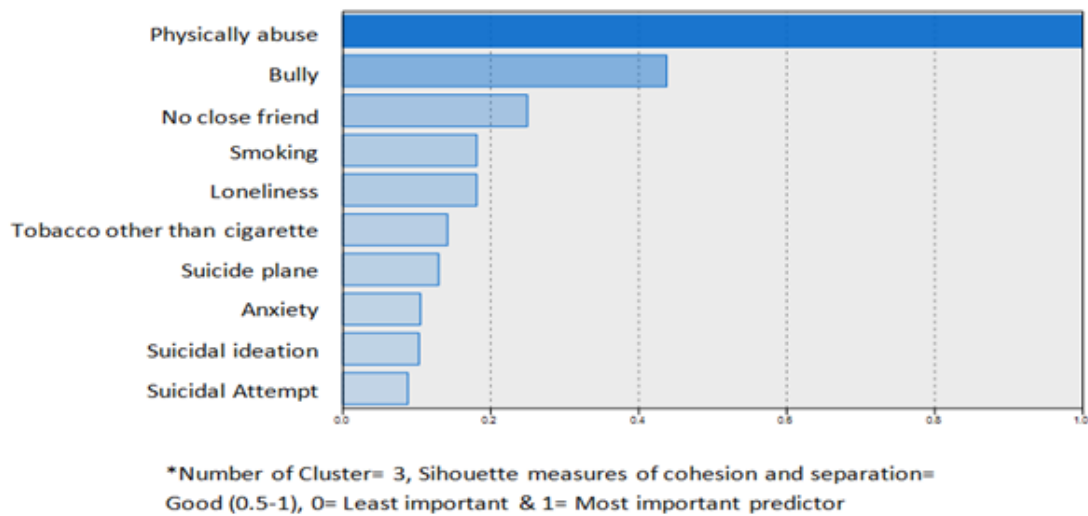


Figure 1

Two-step factor cluster analysis identifies important predictors of girls

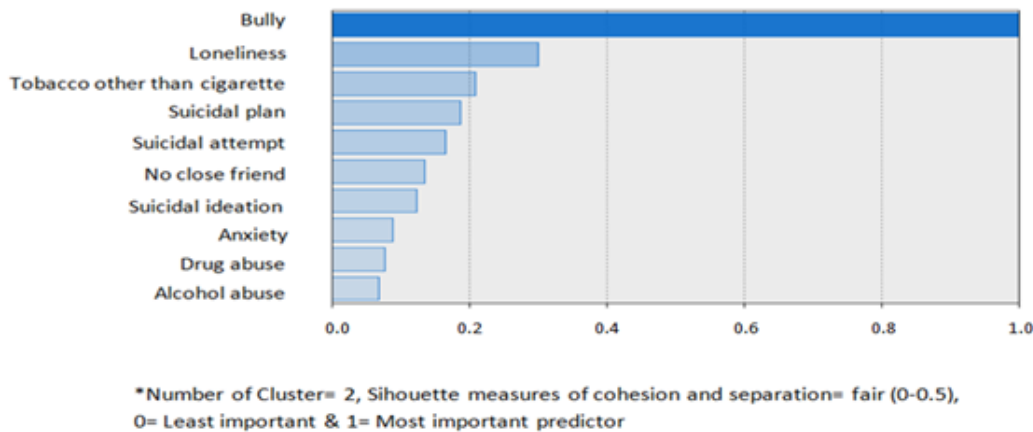


Figure 2

Two-step factor cluster analysis identifies important predictors of boys

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