Original Article

PHYSICAL ACTIVITY AND ITS ASSOCIATION WITH NON-COMMUNICABLE DISEASES: FINDINGS OF A POPULATION-BASED CROSS-SECTIONAL STUDY IN BANGLADESH

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ABSTRACT

Background: Low physical activity is a leading risk factor for non-communicable diseases (NCDs). The present study aimed to assess physical activity and its association with NCDs in the context of Bangladesh.

Methods: The study was a population-based cross-sectional study. We used the data generated by the country-wide survey conducted in Bangladesh in 2018. The survey was conducted using 496 primary sampling units developed by the Bangladesh Bureau of Statistics. Following the step-wise approach of the World Health Organization, the survey enrolled 8185 participants aged 18-69 years using a multi-stage sampling technique. The study conducted a face-to-face interview with Global Physical Activity Questionnaire to collect data on physical activity.

Results: The average duration of physical activity was 244.8 minutes per day, while the median duration was 128.6 minutes. The prevalence of low physical activity was 12.6%, and it was higher among the participants aged 55-69 years (19.5%), women (14.7%), and urban dwellers (14.3%). Low physical activity was also higher (17.7%) among the participants with more than secondary level education. Participants with low physical activity were 1.36 times (OR=1.36, ρ=0.006) more likely to have diabetes mellitus, 1.53 times (OR=1.53, ρ<0.001) more likely to have hypertension, 1.58 times (OR=1.58, ρ<0.001) more likely to have dyslipidemia, and 1.18 times (OR=1.18, ρ=0.020) more likely to have obesity than those without low physical activity.

Conclusion: Country-wide programs and interventions for promoting physical activity are essential to reduce the burden of NCDs in a developing country like Bangladesh.

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INTRODUCTION

The physical activity comprises behaviors that include various bodily movements, which result in energy expenditure. A study revealed that low physical activity accounts for 6-10% of non-communicable diseases (NCDs) and 9% of premature mortality from NCDs [1]. Another study depicted that a higher proportion of death in Bangladesh was due to NCDs such as cardiovascular diseases, cancer, diabetes mellitus (DM), and chronic respiratory disease, which has already become a leading public health problem [2]. Most of the NCDs occur in low and middle-income countries due to an epidemiological transition caused by several risk

factors like urbanization, tobacco and alcohol consumption, low physical activity, overweight, and obesity, increased fat and salt intake, low intake of fruit and vegetable, and raised blood pressure, blood glucose, and cholesterol level, etc. [3]. According to 'Non-communicable Diseases progress monitor 2020' in Bangladesh, the prevalence of death from NCDs was 67%, and the total number of deaths due to NCDs was 572600 [4].

As a part of the Global Action Plan 2013, World Health Organization (WHO) proposed a 25% relative reduction in the risk of premature death due to NCDs by 2025 by reducing the prevalence of four major risk factors such as low physical activity, smoking, harmful use of alcohol, and unhealthy diet. WHO has defined physical activity as <150 minutes of moderate activity in a week or equivalent for adults aged 18 or over. The goal of WHO regarding physical activity is to achieve a 10% relative reduction in the prevalence of insufficient [5].

The Technical Note updated by WHO outlined a set of ten progress monitoring indicators to show the progress achieved in countries in the implementation of selected national commitments on NCDs. One of the crucial indicators was concerned about the member state's implementation of at least one recent public awareness program and motivational communication for physical activity, including mass media campaigns for physical activity behavioral change [4]. According to 'Non-communicable Diseases Progress monitor 2020,' five out of eleven countries have reached the target, and Bangladesh has not achieved the target yet [4]. A policy analysis study of Bangladesh revealed that, although the government of Bangladesh initiated many NCD-related policies or programs, there is still lacking proper planning, implementation, and monitoring [6].

Country prevalence (age-standardized) of low physical activity ranged from 1.6% to 52.6% for men and from 3.8% to 72.0% for women. Low physical activity was also higher in the older age group [7]. According to the report of the centers for disease control and prevention (CDC), more than 15% of adults in all states and territories were physically inactive, and these estimates ranged from 17.3 to 47.7% [8].

Low physical activity is a leading risk factor for life-threatening diseases like NCDs. Low physical activity is evident as the cause of 30% of cardiovascular diseases (CVD), 27% of diabetes mellitus (DM), and 25% of breast and colorectal cancer [9]. As per the Global Physical Activity Questionnaire (GPAQ) framework, the level of physical activity was divided into three groups; high, moderate, and low [10]. The present study considered low and physically inactive levels as insufficient physical activity. The present study aimed to determine the profile of physical activity, prevalence of low physical activity, and its association with major NCDs in Bangladesh.

METHODS

Study design and setting

Our study obtained data from the STEPs survey 2018, a country-wide cross-sectional population-based study in Bangladesh. The data produced by the survey were made public in the open-access Dryad data repository (http://datadryad.org/doi:10.5061/dryad.zkh18937f) and the archive of the National Institute of Preventive and Social Medicine (NIPSOM). The sampling strategy and data collection methods for the survey were elaborately described in another article [11]. In short, the study recruited the participants by multi-stage and geographically stratified probability-based sampling from 496 Primary Sampling Units (PSUs) as updated by the Bangladesh Bureau of Statistics (BBS). One PSU was excluded later due to inaccessibility. Based on selection criteria, 8185 participants participated in STEP-1 and STEP-2, and 7208 participants joined in STEP-3.

Data collection

The STEPS survey 2018 used a standardized pre-tested questionnaire based on WHO STEPS questionnaire version 3.2 for data collection. The survey collected data through face-to-face interviews, physical measurements, and the collection of samples of body fluid (blood and urine). After collection, data were transferred into the cloud through Open Data Kit (ODK) software using an android device. Data were stored in the Organizational Network Analysis (ONA) database server. Field activities were actively supervised by investigators; instruments used for physical measurement and laboratory investigations were calibrated following standard procedure. The instruments were validated with the same sample findings of another standard national laboratory, and the central laboratory of NIPSOM tested all blood and urine samples. The survey took all possible measures to ensure quality data in every step. Our study retracted all other data related to NCDs like diabetes mellitus, dyslipidemia, salt consumption, etc., from the dataset generated by the STEPs survey 2018 of Bangladesh.

Measurements

Measurement of low physical activity: The STEPS survey used the Global Physical Activity Questionnaire (GPAQ) to collect data on physical activity and measure the prevalence of low physical activity. It was a previously developed questionnaire used by WHO for physical activity surveillance and measuring the level of physical activity. The survey inquired the respondents regarding the amount of time spent on physical activity in three key domains; work, transport, and recreational in moderate and vigorous-intensity levels on a typical day each week for obtaining data on total minutes of physical activity. The vigorous-intensity minutes were later converted into moderate-intensity minutes by multiplication with 2. The total physical activity (in minutes) was expressed as moderate-intensity minutes per day. Collected data on physical activity were then converted into Metabolic Equivalent Tasks (MET) values for calculating a person`s overall energy expenditure. According to GPAQ data, the following MET values were used: for moderate work, MET value= 4.0, for vigorous work, MET value= 8.0, for cycling and walking, MET value= 4.0, for moderate recreation, MET value= 4.0, and vigorous recreation MET value= 8.0 [12]. The present study considered an adult (aged more than 18 years) as physically inactive who didn't meet WHO recommendations on physical activity for health. Criteria of low physical activity included doing less than 150 minutes of moderate-intensity physical activity or less than 75 minutes of vigorous-intensity physical activity, or less than an equivalent combination of moderate- and vigorous-intensity physical activity achieving at least 600 MET-minutes throughout a week [13].

Measurement of household wealth index: For estimating household wealth score, we used principal component analysis during survey data analysis to get scores for the household wealth index. Households were given scores based on the number and kind of consumer goods (television, bicycle, car, etc.) they own and housing roof characteristics. We compiled the National wealth quintiles by assigning the household score to sample individuals, ranking them by household score, and dividing the distribution into five equal categories, each comprising 20% of the population.

Statistical methods

Data were weighted by age, sex, and residence. We cautiously checked and verified the consistency and relevancy of the data. We used WHO STEPS recommended guidelines for cleaning and analyzing data. The prevalence of low physical activity was estimated using the STEPS recommended cut-off values [13]. Data were analyzed using SPSS version 25.0. Descriptive statistics included frequency, percentage, mean, and median, while inferential statistics included the Chi-square test and logistic regression. Outcome measures and differences between groups were calculated with a 95% confidence interval and significant at a p-value <0.05.

Ethical considerations

The study obtained ethical approval from the National Research Ethics Committee (NREC) of Bangladesh Medical Research Council (Ref: BMRC/NREC/2016-2019/463, Date: 04/02/2018). Before completing the questionnaire, participants read the informed consent. The study enrolled only those participants who gave informed consent. Participation in this study was voluntary and anonymous. We didn't ask for any sensitive personal information. The survey used the WHO NCD STEPS survey consent form to obtain informed written consent from every participant. We strictly maintained the confidentiality and anonymity of data. We carried out all activities in conformity with the revised declarations of Helsinki.

RESULTS

Among all (8185) participants, 53.5% were women and 46.5% were men. The rural residents (51.1%) had a higher proportion than the urban (48.9%) residents.

Physical activity

The average duration of total physical activity of moderate intensity (267.2 minutes per day) and the median duration (145.7 minutes per day) were higher in the participants aged 40-54 years. The average energy expenditure (7482.4 MET-minutes/week) and the median energy expenditure (4080.0 MET-minutes/week) on physical activity were also higher in the age group 40-54 years. The average duration of physical activity of moderate intensity (minutes per day) was higher in men (357.8) and rural residents (281.2) than in women (146.8) and urban residents (207.5). The average energy expenditure on physical activity (MET-minutes per week) was higher in men (10019.6) and rural residents (7874.2) than in women (4111.2) and urban residents (5810.3). Overall, the average duration of physical activity of moderate intensity was 244.8 minutes, and the average energy expenditure on physical activity was 6854.3 MET minutes per week (Table 1).

Table 1. Total physical activity and energy expenditure by background characteristics (n=8185)

Background characteristics	Total (n)	Overall energy expenditure MET-min/week*		Total physical activity of moderate-intensity (min. per day)**	
		Average	Median (p25 - p75)	Average	Median (p25 - p75)
Age (Years)					
18-24	1026	5668.3	3110.0 (1315.0-6760.0)	202.4	111.1 (47.0-241.4)
25-39	3484	7036.0	3960.0 (1680.0-9100.0)	251.3	141.4 (60.0-325.0)
40-54	2490	7482.4	4080.0 (1680.0-10200.0)	267.2	145.7 (60.0-364.3)
55-69	1164	6081.8	3260.0 (840.0-8190.0)	217.2	116.4 (30.0-292.5)
Gender					
Women	4360	4111.2	3000.0 (1260.0-5280.0)	146.8	107.1 (45.0-188.6)
Men	3804	10019.6	6480.0 (1680.0-15840.0)	357.8	231.4 (60.0-565.7)
Residence					
Rural	4169	7874.2	4560.0 (1680.0-10800.0)	281.2	162.9 (60.0-385.7)
Urban	3995	5810.3	3240.0 (1140.0-7020.0)	207.5	115.7 (40.7-250.7)
Education					
No education / <Primary	3678	8379.9	5040.0 (1680.0-11880.0)	299.3	180.0 (60.0-424.3)
Primary	2533	6278.2	3360.0 (1600.0-7940.0)	224.2	120.0 (57.1-283.6)
Secondary	888	5790.0	3360.0 (1200.0-6720.0)	206.7	120.0 (42.9-240.0)
More than secondary	1065	3919.4	2280.0 (840.0-4900.0)	140.0	81.4 (30.0-175.0)
Wealth index					
Poorest	1632	7402.7	3850.0 (1680.0-10080.0)	264.4	137.5 (60.0-360.0)
Poor	1642	7659.1	4200.0 (1680.0-10515.0)	273.5	150.0 (60.0-375.5)
Average	1610	7210.4	3940.0 (1680.0-9600.0)	257.5	140.7 (60.0-342.9)
Rich	1639	6442.4	3360.0 (1400.0-8400.0)	230.1	120.0 (50.0-300.0)
Richest	1641	5615.1	3280.0 (1120.0-6720.0)	200.5	117.1 (40.0-240.0)
Total (18-69)	8185	6854.8	3600.0 (1480.0-8940.0)	244.8	128.6 (52.9-319.3)

*MET (Metabolic equivalent of task): for vigorous activity 1 minute equates to 8 units of MET; for moderate activity 1 minute equate to 4 units of MET.

**Minutes spent on vigorous-intensity activities per day are multiplied by 2, to derive equivalent minutes of moderate-intensity activities, which is then summed up to derive total physical activity in minutes of moderate-intensity activity per day.

p25 = 25th percentile; p75 = 75th percentile

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Prevalence of low physical activity

Overall, the prevalence of low physical activity was 12.6% (95% CI=11.9-13.4) and it was higher among the participants aged 55-69 years (19.5%, 95% CI=17.3-21.9), women (14.7%, 95% CI=13.7-15.8), and urban respondents (14.3%, 95% CI=13.2-15.4). Low physical activity was higher in the ever-married group (24.5%, 95% CI=20.4-29.0) and the respondents who had educational qualifications more than secondary level (17.7%, 95% CI=15.4-20.1). The prevalence of low physical activity was also higher among the richest (15.1%, 95% CI=13.4-16.9) participants (Table 2).

Table 2. Prevalence of low physical activity by selected background characteristics (n=8185)

Attributes		Total (n)	Prevalence, % (95% CI)
Age (in years)	18-24	1026	13.2 (11.1-15.4)
	25-39	3489	10.4 (9.4-11.4)
	40-54	2503	12.3 (11.1-13.7)
	55-69	1167	19.5 (17.3-21.9)
Gender	Men	3804	10.2 (9.3-11.2)
	Women	4381	14.7 (13.7-15.8)
Residence	Urban	4002	14.3 (13.2-15.4)
	Rural	4183	11.1 (10.1-12.1)
Marital status	Never married	535	10.8 (8.3-13.8)
	Currently married	7250	12.1 (11.4-12.9)
	Ever married*	400	24.5 (20.4-29.0)
Highest level of education	No education / <primary	3678	11.1 (10.1-12.2)
	Primary	2533	12.6 (11.3-13.9)
	Secondary	888	12.0 (10.0-14.4)
	More than secondary	1065	17.7 (15.4-20.1)
Wealth index	Poorest	1638	12.2 (10.7-13.9)
	Poor	1646	11.5 (10.0-13.1)
	Average	1615	10.6 (9.1-12.2)
	Rich	1645	13.7 (12.1-15.5)
	Richest	1641	15.1 (13.4-16.9)
Overall		8185	12.6 (11.9-13.4)

*Ever married: Separated/divorced/widow/widowed; %: Percentage; CI: Confidence Interval

Low physical activity and major non-communicable diseases

Low physical activity was prevalent among 15.7% of participants having diabetes mellitus (DM) and 16.3% of participants having hypertension (HTN). On the other hand, the prevalence of low physical activity was 16.0% among the participants having dyslipidemia and 13.6% among the participants having obesity. The study revealed that the participants with low physical activity were 1.36 times (OR=1.36, ρ=0.006) more likely to have diabetes mellitus and 1.53 times (OR=1.53, ρ<0.001) more likely to have hypertension than those without low physical activity. Similarly, the participants with low physical activity were 1.59 times (OR=1.59, ρ<0.001) more likely to have dyslipidemia and 1.18 times (OR=1.18, ρ=0.020) more likely to have obesity than those without low physical activity (Table 3).

Table 3. Association between low physical activity and major non-communicable diseases

Major NCDs		Low physical activity		OR (95% CI)	Significance, (*P*-value)*
		Yes n (%)	No n (%)		
Diabetes Mellitus	Yes (n=677)	106 (15.7)	571 (84.3)	1.36 (1.09-1.70)	0.006
	No (n=6371)	764 (12.0)	5607 (88.0)	Reference	
Hypertension	Yes	337 (16.3)	1731 (83.7)	1.53	<0.001

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	(n=2068)			(1.32-1.75)	
Dyslipidemia	No (n=6088)	690 (11.3)	5398 (88.7)	Reference	
	Yes (n=2164)	346 (16.0)	1818 (84.0)	1.59 (1.37-1.84)	<0.001
Obesity	No (n=4897)	525 (10.7)	4372 (89.3)	Reference	
	Yes (n=2403)	328 (13.6)	2075 (86.4)	1.18 (1.03-1.36)	0.020
	No (n=5607)	661 (11.8)	4946 (88.2)	Reference	

* *P*<0.05, significant at 95% confidence interval; OR= Odds Ratio

DISCUSSION

The STEPs survey of Bangladesh was a country-wide cross-sectional population-based survey conducted in 2018 to determine the national prevalence of NCD risk factors like low physical activity. The present study estimated the prevalence of low physical activity by the background characteristics of the country's population. The study also identified major NCDs associated with low physical activity in Bangladesh.

In the present study, the average duration of moderate-intensity physical activity was 267.2 minutes/day in the age group 40-54 years, followed by 251.3 min/day in the age group 25-39 years. Overall energy expenditure was also higher in the participants aged 40-54 years (7482.4 MET-min/week) and 25-39 years (7036.0 MET-min/week). The prevalence of low physical activity was highest among the age group 55-69 years (19.5%) and lowest in the age group 25-39 years (10.4%). According to the STEPS survey of 2010 in Bangladesh [14, 15], the prevalence of low physical activity was 34.9% and 35.6% among the participants aged 55-64 years and 25-34 years. This difference indicates that low physical activity has decreased in Bangladesh, which may be due to rising awareness of people through mass media communication and health education interventions.

The present study included an almost equal percentage of men and women (46.5% vs. 53.5%) and found that the average duration of physical activity was lower in women than in men (146.8 min/day vs. 357.8 min/day). The average energy expenditure on physical activity was also lower in women than in men (4111.2 MET-min/week vs. 10019.6 MET-min/week). The prevalence of low physical activity was also higher in women than men (14.7% vs. 10.2%), but it was lower in comparison to 2010 (men, 14.8% and women, 50.3%) [14, 15]. This reduction in the prevalence of low physical activity could be due to the changes in lifestyle and occupational activities through diverse employment, especially among the women of Bangladesh. Another national cross-sectional survey conducted in Bhutan [16] and Pakistan [17] also revealed a higher prevalence of low physical activity among women than in men. It may be because men are more involved in outdoor activities and earning livelihoods following the social and cultural norms of the countries like Bangladesh in Southeast Asia.

The average duration of physical activity was higher among rural residents (281.2 min/day) than in urban (207.5 min/day) residents. The prevalence of low physical activity was also higher in the urban (14.3%) than in the rural (11.1%) residents. Another study conducted in Kerala, India [18] also found a higher prevalence of low physical activity in urban residents. The rural residents of the countries like Bangladesh in the Indian subcontinent are used to walking, cycling, agricultural work, etc., due to their topographical location, occupational patterns, and scarce social and communication amenities. All of these enhance the physical activities of the rural residents in their daily life. On the other hand, increasing urbanization, lack of scope for sports and recreation, more automobile facilities, and a sedentary lifestyle forced urban residents to increase the prevalence of low physical activity.

The length of physical activity decreased with increasing levels of education and household wealth. The prevalence of low physical activity was comparatively higher among the respondents having a higher level of education (17.7%). It is a fact that educated people are more involved in official and intellectual activities with a sedentary lifestyle in Bangladesh. On the other hand, illiterate people with a lower level of education are used to doing agricultural, laborious, and energy intrusive activities, which require more body movements. This finding recommends promoting physical activities of the more educated urban residents with sedentary occupations within their residing and working environment.

The estimated prevalence of low physical activity was 12.6% in the current study, and it was 33.8% revealed by the STEPS survey 2010 in Bangladesh

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[14]. It indicates that the prevalence of low physical activity has been decreasing gradually in Bangladesh due by dint of health promotional and awareness-raising interventions in the country.

The present study revealed that low physical activity was significantly associated with NCDs like DM, hypertension, dyslipidemia, and obesity. There was a 1.36 times higher chance of developing DM, 1.53 times higher chance of developing hypertension, 1.59 times higher chance of developing dyslipidemia, and 1.18 times higher chance of developing obesity among respondents having low physical activity. These findings depicted a higher risk of non-communicable diseases due to low physical activity among the population of Bangladesh.

Thus the study findings conserve enormous policy implications to devise country-wide effective programs and interventions to create amenities for enhancing physical activities with an especial emphasis on the women, elderly, urban residents, and people involved in a sedentary occupation. Community-based health education programs also must be launched to raise awareness among the country's people about the merits of physical activity and the risk of NCDs due to low physical activity through mass media communication and social mobilization.

CONCLUSION

Low physical activity is associated with major non-communicable diseases like diabetes mellitus, hypertension, dyslipidemia, and obesity. Reducing the prevalence of low physical activity and promoting physical activity could improve the health of the people and can prevent the burden of NCDs substantially in the country.

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Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper**.**

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