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Original Article

Association between physical activity and diabetic complications among Bangladeshi type 2 diabetic patients

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ABSTRACT

Background: The aim of the study was to assess the association of physical activity (PA) with the presence of diabetes related complications among Bangladeshi type 2 diabetic subjects.
Methods: This cross-sectional study was conducted in the Out Patient Department (OPD) of BIRDEM, Bangladesh. A group of 977 subjects were randomly selected and followed up. Diabetes was diagnosed following the WHO study group criteria. The level of PA was categorized into inactive/low (<150 min/week) and moderate-to-vigorous (≥150 min/week). The WHO recommended Asian criteria was used to identify general obesity. Retinopathy was detected by fundal photography, CKD by serum creatinine and hypertension was diagnosed clinically. Univariate and multivariate analyses were used to assess the associations of PA with diabetes related complications.
Results: Out of the 977 subjects investigated, 468 were male and 509 were female (mean ± SD of age, 56 ± 8 years). In the study subjects, 74% were either inactive or in low PA and of them 65.1% were overweight/obese. Analysis showed that inactive/low PA was associated with all the three diabetes related complications ($p < 0.001$)—hypertension, retinopathy, and nephropathy. Multivariate analysis showed that inactive/low level of PA was strongly associated with complications like retinopathy ($p < 0.001$) and hypertension ($p = 0.01$) in the female patients. It was also found to be highly associated with retinopathy ($p < 0.001$) among the male patients.
Conclusion: A large number of urban Bangladeshi population are involved only in low PA or remain inactive themselves, which is leading to obesity and it seems to have a strong association with diabetes related complications in this population.

1. Introduction

Diabetes mellitus (DM) has emerged as a major public health challenge around the world. Not only the developed country but also low and middle-income countries face the greatest burden of DM. It has become one of the major causes of mortality in the long run and based on WHO fact sheet, an estimated 1.6 million deaths were directly caused by diabetes globally in year 2015 [1]. The global prevalence of diabetes among adults over 18 years of age has increased and was recorded to be 8.5% in year 2014 [1]. In developed countries, diabetes is known to be the seventh leading cause of death in year 2015 [2]. The Diabetes Atlas of the International Diabetes Federation (IDF) estimated in 2011 that the global DM prevalence was 8.3% in the age group 20–79 years. The number of people living with DM is projected to reach 551.9 million by 2030 [3]. Bangladesh is one of the countries out of many in South Asian region which has the second largest number of adults with diabetes; more than 7.1 million, 8.4% or 10 million according to research published in WHO bulletin in 2013 [4]. By 2030, Bangladesh is likely to emerge as the eighth highest-ranking country in terms of the number of people with DM [3].

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The management of diabetes mellitus and the prevention of the complications are important challenges of the present time. Studies indicate that genetic factors do not account entirely for the development of diabetes, and several environmental triggers have been implicated [5]. Physical activity (PA) is the key element in the prevention and management of type 2 diabetes. For patients with diabetes, insufficient PA is considered the most important risk factors for developing macro and microvascular complications [6]. Regular PA helps to maintain weight loss and prevent weight regain [7]. Regular exercise and aerobic fitness also improve insulin sensitivity, glycaemic control [8,9], may decrease the risk of developing diabetes [10,11], and may reduce overall mortality in patients who have type 2 diabetes [12]. PA exerts numerous beneficial health effects on glycaemic control, insulin sensitivity, blood pressure, lipid profile, and endothelial function, and the evidence favouring a physically active lifestyle in the treatment of chronic diseases is substantial [13]. With the help of many studies that has been conducted over the years, it is now well established that participation in regular PA can improve blood glucose control and can prevent or delay type 2 diabetes, along with positively affecting lipids, blood pressure, cardiovascular events, mortality, and quality of life [14].

However, studies have shown that about 35% of diabetic patients from Bangladesh do not participate in any PA [15]. For Bangladeshi diabetic patients, this could be followed for the elevation of the complications of the disease. Before that, the fact we need to evaluate the scenario of the association between PA and diabetic complications, which is extremely needed for Bangladeshi diabetic patients. Moreover, there is still a paucity of published studies on this association among Bangladeshi type 2 diabetic mellitus (T2DM) patients. Therefore, the aim of this study was to investigate the association of PA with the presence of diabetes related complications among Bangladeshi type 2 diabetic patients.

2. Methods

2.1. Study design, and setting

A hospital-based cross sectional study was conducted in the years of 2009 and 2010 among a representative sample of Bangladeshi T2DM patients. A total, 977 patients were randomly selected from the Out-Patient Department (OPD) of the Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM), which serves as the primary destination for diabetic patient across Bangladesh. Furthermore, BIRDEM is a sister concern of the Diabetic Association of Bangladesh and is a WHO Collaborating Centre for research into the prevention and control of diabetes. In addition to having its own primary care facility, BIRDEM serves as a referral centre for 57 affiliated associations. Being a charity organization, it attracts patients from diverse demographic and socio-economic backgrounds from across Bangladesh. Routinely, newly diagnosed patients in the BIRDEM undergo thorough clinical and biochemical investigations to determine their diabetic profile and the presence of any complications.

2.2. Study procedures

Data were collected in a predesigned interviewer administered questionnaire. The selection of the study participants was based on some inclusion and exclusion criteria. Patients, aged ≥30, with type 2 diabetes having necessary clinical reports were primarily included in the sampling list. This list was further refreshed by excluding the patients with pregnancy, advised for hospitalization, and those who were unable to answer to a short list of simple questions about their disease and PA.

2.3. Measures

Physical and anthropometric measurements were taken from the patients adopting standard operating procedure. The classification and diagnosis of diabetes was made by the reporting physician according to the World Health Organization (WHO) criteria [16]. The ophthalmologic examination included best-corrected visual acuity with an illuminated Snellen chart, slit-lamp bio microscopy and also detailed fundus examination by both indirect ophthalmoscopy and contact lens bio-microscopy conducted by retinal specialist [17]. Retinopathy was categorized from fundus photography, CKD by serum creatinine, and we used the grading categories of retinopathy as no diabetic retinopathy (NDR) and any stages of diabetic retinopathy (DR). The cutoff considered for hypertension was blood pressure ≥140/≥90 mmHg. Patients on antihypertensive drugs have also been considered as hypertensive. In this study, the level of PA was categorized into inactive/low (<150 min/week) and moderate-to-vigorous (≥150 min/week) in accordance with the American College of Sports Medicine and the American Diabetes Association [18]. The WHO recommended Asian criteria was used to identify general obesity as healthy weight (BMI 18.5–22.99 kg/m^2), overweight (23.0–24.99 kg/m^2) and obese (25.0 and above kg/m^2) [19,20].

2.4. Statistical analysis

All statistical analyses were performed by using Statistical Package for Social Science (SPSS) version 20. The descriptive statistics of mean, standard deviation and percentages were calculated for the entire sample. Chi-square test was used to examine differences in the prevalence of different categorical variables. Both univariate and multivariate analysis were performed to assess the associations of PA with diabetes related complications. The 'p' value less than 0.05 was considered as statistically significant for this study.

3. Results

A total of 977 diabetic patients were interviewed (Table 1) of which 468 were male (47.9%) and 509 were female (52.1%). A

Table 1
Sample characteristics (n = 977).

Variable	Result, n (%)
Gender	
Male	468 (47.9)
Female	509 (52.1)
Age Group	
<45 years	115 (11.8)
46–60 years	617 (63.2)
>60 years	245 (25.1)
Employment status	
Employed	373 (38.2)
Unemployed	604 (61.8)
Physical Activity Level	
Inactive/low	723 (74)
Moderate to vigorous	254 (26)
BMI category	
Underweight	19 (1.9)
Normal weight	332 (34)
Overweight	279 (28.6)
Obese	347 (35.5)
Mean of the variables	
Age in years (m± SD)	56 ± 8
Monthly family income	20026.10 ± 12534.08
BMI (m± SD)	24.18 ± 2.95

Results are expressed as mean (m) ± standard deviation (SD) and number (n) of the respondents. *BMI* Body Mass Index.

Table 2
Distribution of PA level according to age, gender and BMI category (n = 977).

Variables	Level of physical activity		
	Inactive/low, n (%)	Moderate to vigorous, n (%)	χ^2 value (p-value)[a]
Gender			
Male	387 (53.5)	81 (31.9)	35.26 (<0.001)
Female	336 (46.5)	173 (68.1)	
Age Group			
<45 years	69 (9.5)	46 (18.1)	79.09 (<0.001)
46–60 years	421 (58.2)	196 (77.2)	
>60 years	233 (32.3)	12 (4.7)	
Overweight and/or obesity			
Yes	471 (65.1)	155 (61.0)	1.39 (0.24)
No	252 (34.9)	99 (39.0)	

[a] p value is significant at the 0.01 level (2-tailed).

plurality of the study participants' age range was between 46 and 60 years (63.2%) and the mean age of all the participants was 56 ± 8 years. Majority of the patients were obese (35.5%). The percentage of both overweight and obesity was 64.1%. Approximately, one fourth of the participants (26%) were involved in moderate-to-vigorous PA, where females were more active (68.1%) than their male counterpart, which is statistically highly significant ($p < 0.001$; Table 2). Out of 723 diabetic patients who had inactive/low PA, 65.1% were overweight/obese.

Irrespective of gender, this study revealed that inactive/low PA was significantly associated with all the three diabetes related complications—hypertension ($p < 0.001$), retinopathy ($p < 0.001$), and nephropathy ($p < 0.001$) (Table 3). Binary logistic regression analysis showed that the patients who were inactive or involved in low level of PA, males were 21 times (95% CI: 8.55–52.55) and female patients were 22 times (95% CI: 12.03–40.51) higher likely to suffer from diabetic retinopathy (Table 4). In terms of female diabetic patients, it was also found that inactive/low PA was strongly associated with the complication, hypertension ($p = 0.010$).

4. Discussion

To the best of our knowledge, this is the first study to report Bangladeshi population-level estimates of the association between a range of diabetes complications and PA. In agreement with the previous epidemiological studies [21–26], we found that inactive/low level of PA was statistically highly significant with hypertension, retinopathy and nephropathy of the type 2 diabetic patients. Inactive in PA and/or low levels of PA is independent, modifiable risk factors for the progression of insulin resistance, and poor health outcomes with type 2 diabetes [27,28]. Our study showed that female diabetic patients were more vulnerable to the type 2 diabetic complications such as hypertension and retinopathy than their male counterpart. Similar findings were also found among the type 2 diabetic patients in middle-aged population in Pakistan [29].

PA, a preventable risk factor for obesity that is significantly associated with diabetes mellitus [24]. The upsurge in the prevalence of type 2 diabetes is inextricably linked to the increase in obesity [30]. Our study found that nearly two-thirds of the diabetic patients with low PA in Bangladesh were obese. This finding is supported by the other review report of Eckel et al. [31]. Recent systematic reviews on intervention studies, performed in different settings and populations, proved that PA focused lifestyle interventions can be effective in the prevention of hypertension [32], diabetes mellitus and its complications [33–35]. It is proved by the systematic review and meta-analysis that observance to guidelines suggested minimum PA level reduced the incidence of both hypertension (RR = 0.94; 95% CI: 0.92–0.97) and diabetes mellitus (RR = 0.74, 95% CI: 0.72–0.77) [14,32,34].

Table 3
Relationship between inactive/low PA level and diabetic complications according to gender (n = 977).

Complications	Inactive/low physical activity	
	Male (r/p values)	Female (r/p values)
Hypertension	0.162/<0.001	0.252/<0.001
Retinopathy	0.414/<0.001	0.206/<0.001
Nephropathy	0.175/<0.001	0.569/<0.001

Spearman's non-parametric correlation coefficient's test was done as a test of significance. Correlation is significant at the 0.01 level (2-tail0ed).

Table 4
Association of PA with various complications of the diabetic patients as explored by binary logistic regression (n = 977).

Complications	β Value	p value	Exp(B)	95.0% CI	
				Lower Bound	Upper Bound
Male					
Hypertension	0.010	0.973	1.010	0.584	1.746
Retinopathy	3.054	<0.001	21.200	8.553	52.550
Nephropathy	0.101	0.718	0.904	0.522	1.565
Female					
Hypertension	0.610	0.010	1.841	1.159	2.925
Retinopathy	3.095	<0.001	22.079	12.034	40.505
Nephropathy	0.298	0.232	0.742	0.455	1.210

β for standardized regression coefficient. PA was taken as dependent variable, whereas other variables were taken as independent variable.

5. Conclusions

The principal implication of this study is to highlight the importance of PA for the prevention of type 2 diabetes in the middle-aged population of Bangladesh which is experiencing a rapid and substantial decline of PA levels as a result of poor dietary habits and sedentary behaviors. In parallel with decreasing levels of PA, the prevalence of obesity has increased significantly in Bangladesh and consequently, diabetes mellitus has become a major public health issue. Therefore, promoting an active lifestyle or regular exercise should receive the highest public health priority in the country. A large number of urban Bangladeshi population are involved in the only low level of PA, which is leading to obesity, and it seems to have a strong association with diabetes related complications in this population. Furthermore, coordinated education and motivation program should be undertaken to improve awareness on this issue.

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Compliance with ethical standards

This study was conducted maintaining ethical standards to the highest possible extent. Prior to the assessment, informed consent was taken from all the patients, participated in this study. This study was approved by the Ethics Committees of the Diabetic Association of Bangladesh.

Conflicts of interest

The authors declare that they have no conflict of interest.

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