

Association of Physical Activity with Metabolic Syndrome among Patients Attending Diabetes Out-Patient Department of a Tertiary Care Hospital in Kolkata, India

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Abstract:


Introduction: Metabolic syndrome, or MetS is a major cause of morbidity and mortality among diabetic patients. Physical activity could be beneficial in preventing the various components of MetS. **Objectives:** To evaluate the association of physical activity with glycemic control and presence of MetS among the study population and to estimate the burden of metabolic syndrome in patients attending the diabetes out-patient department (OPD) of a tertiary care hospital in Kolkata. **Method:** An observational study with a cross-sectional design was conducted on 384 patients with diabetes mellitus seeking healthcare service from the Diabetes OPD of a tertiary care hospital of Kolkata from 8th April to 8th June 2023, using a predesigned, pretested and structured schedule that included the International Physical Activity Questionnaire. The participants were selected by a consecutive sampling technique. Face-to-face interviews, review of records and anthropometry were carried for data collection. **Results:** Among the 384 participants, 57.8% had inadequate physical activity. Patients performing adequate vigorous physical activity had a higher odds ratio of having ideal/satisfactory glycaemic control. Adequate moderate (OR 0.595, 95% CI 0.361-0.983, p 0.043) or vigorous (OR 0.139, 95% CI 0.049-0.395, p <0.001) physical activity had a significantly lower odds ratio of having MetS. **Conclusion:** Performing physical activity for adequate duration helps in attaining satisfactory glycemic control and preventing MetS in diabetic patients.

Keywords: Diabetes Mellitus Type 2, Exercise, International Physical Activity Questionnaire, Metabolic Syndrome, Outpatients

Introduction:

Metabolic syndrome (MetS), also known as “Syndrome X” or “insulin resistance syndrome”, includes a group of metabolic abnormalities like central obesity, hypertriglyceridemia, low levels of high-density lipoprotein (HDL) cholesterol, hyperglycemia, and hypertension.^[1] This syndrome is often associated with

diabetes mellitus and the risk of cardiovascular diseases, stroke and premature death. Risk factors for this syndrome are obesity/overweight, sedentary lifestyle, genetic predisposition, ageing and lipodystrophy.^[1] MetS can be diagnosed if any three of the following five criteria are fulfilled, viz, elevated waist circumference, hypertriglyceridemia, reduced HDL-C, hypertension

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and uncontrolled fasting glucose.^[2] These features can be efficiently managed through lifestyle modification involving an appropriate balance of physical activity and caloric intake.^[2]

Noubiapet et al.^[3] in their meta-analysis of global data from the general adult population observed that the prevalence of MetS varied from 12.5% to 31.4% globally. The prevalence of MetS was reported as 24.5% (22.5–26.6) for a fasting plasma glucose ≥ 5.6 mmol/L in this study.^[3] Bhalwar reported that the age-adjusted prevalence of MetS was 25% (31% in women and 18.5% in men) in urban populations of India.^[4] As per the systematic review and meta-analysis of data from the adult Indian population by Krishnamoorthy et al.^[5] in 2020, the burden of MetS was 30%. Meher et al.^[6] stated that 1.1% women and 0.7% men in West Bengal had metabolic syndrome. MetS is a common finding in patients with diabetes mellitus, as reported in previous studies.^[7-9] India is often regarded as the “Diabetic Capital of the World”. As per NFHS-5 data, 13.5% women and 15.6% men in India have diabetes mellitus.^[10] In West Bengal, the prevalence of diabetes mellitus among women and men was recorded as 17.5% and 21.3% respectively.^[11] Thus, MetS is an important public health problem in India and West Bengal.

Physical activity has been known to reduce the risk of both type 2 diabetes mellitus and MetS in adults.^[12,13] As per WHO recommendations, at least 150–300 minutes of moderate-intensity aerobic physical activity; or at least 75–150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate and vigorous-intensity activity throughout the week is recommended for adults with type 2 diabetes mellitus.^[14] There is a dearth of studies explaining the role of physical activity in MetS, especially among diabetic patients in India. Thus, this study was conducted to estimate the burden of metabolic syndrome in patients attending the diabetes out-patient department (OPD) of a tertiary care hospital in Kolkata; to identify the participants with inadequate physical activity and; to evaluate the association of physical activity with glycemic control and presence of MetS among the study population.

Methods:

Study type, design, settings and duration: Descriptive type of observational study with cross-sectional design was conducted in the Diabetes OPD of Institute of Post-Graduate Medical Education & Research and Seth Sukhlal Karnani Memorial Hospital (IPGME&R and SSKMH), Kolkata, from 8th April 2023 to 8th June 2023.

Study population and selection criteria: The study was conducted on patients with diabetes mellitus seeking healthcare services from the Diabetes OPD of a tertiary care hospital, Kolkata. The study included patients aged between 18–65 years with diagnosed type 2 diabetes mellitus who were able to present their laboratory investigation reports (FBS, PPBS, Serum HDL and Serum Triglycerides) on samples taken within the last 3 months from the date of data collection. Pregnant and lactating women and those unable to respond to the questions due to their mental instability were excluded from the sample.

Sample size estimation and sampling technique: Sample size was estimated as 374 using Cochran’s formula $[Z^2p(p-1)/l^2]$, where Z is the standard normal deviate (taken as 1.96 at 95% CI), p is the prevalence of MetS in diabetic patients [taken as 50.7% from a study by Lira et al.^[15] and l is relative error (10%)]. The final sample size was calculated as 411 after considering a non-response rate of 10%. The patients were selected through a consecutive sampling technique. As the total number of days for data collection was 24, so as to achieve the required sample size, 18 participants, fulfilling eligibility criteria, were selected consecutively every day from the OPD.

Study tools, techniques and methods of data collection: The patients were approached after they consulted the physician at the Diabetes OPD. They were explained the purpose of the study and were assured that the data provided by them would be anonymous and confidential. A predesigned, pretested and structured schedule including the International Physical Activity Questionnaire (IPAQ)^[16] was employed to collect data from the participants by interview. In addition, anthropometric measurements (height, weight, waist circumference), measurement of blood pressure and

review of records (previous OPD prescriptions and laboratory investigation reports) were also done.

Study variables: While the dependent variable was the presence of MetS in diabetic patients, the independent variables included socio-demographic characteristics, clinical profile related to diabetes (duration, family history, current glycemic control) and adequacy of physical activity (using IPAQ).

Operational definition

1. MetS–As per National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) criteria, MetS is present if any three of the following five criteria are fulfilled, viz, elevated waist circumference (≥ 102 cm in men, ≥ 88 cm in women), elevated triglycerides (≥ 150 mg/dL), reduced HDL-C (< 40 mg/dL in men, < 50 mg/dL in women), elevated blood pressure (≥ 130 mm Hg systolic BP or ≥ 85 mm Hg diastolic BP) and elevated fasting glucose (≥ 100 mg/dL).^[2]
2. Glycemic control –As per ICMR guidelines, it can be defined as a fasting blood sugar (FBS) < 126 mg/dl and a post-prandial blood sugar (PPBS) < 181 mg/dl for patients on medication for type 2 diabetes mellitus.^[17]
3. Adequate physical activity –Patients with type 2 diabetes mellitus should engage in at least 150 minutes of moderate-intensity aerobic physical activity; or 75 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of these activities throughout the week as per WHO recommendations.^[14]

Statistical analysis: Data were then tabulated in Microsoft Office Excel 2019 (Microsoft Corp, Redmond, WA, USA), and analysis was done using Statistical Package for the Social Sciences (IBM, New York City, USA) Version 25.0. Descriptive statistical measures were employed to summarize the data. The dependent variables did not follow normal distribution (Kolmogorov-Smirnov test: p value = < 0.001 ; Shapiro-Wilk test: p value = < 0.001). Data were checked for multicollinearity; Variance Inflation Factor was found to be less than 10 and tolerance was greater than 0.1. Thus, binary logistic regression was employed to ascertain the

relationship between the dependent and the independent variables. A p-value of < 0.05 was considered significant.

Ethics statement: Data collection was initiated after approval from the Institutional Ethics Committee (IEC) (IEC/2023/211, dt. 08/04/23). Informed written consent of the suitable participants in the local language was taken prior to enrolment. Left thumb impression was taken from the illiterate participants in place of signature in the presence of an impartial witness

Results:

The final sample included 384 patients with type 2 diabetes (non-response 6.6%). Majority of the participants were in the age group of 50-59 years (34.3%), were males and were married. Most of them were educated up to the primary level (46.9%) and belonged to Class IV socio-economic status (32.2%) as per the Modified BG Prasad Scale, updated in October 2023.^[18][Table 1]

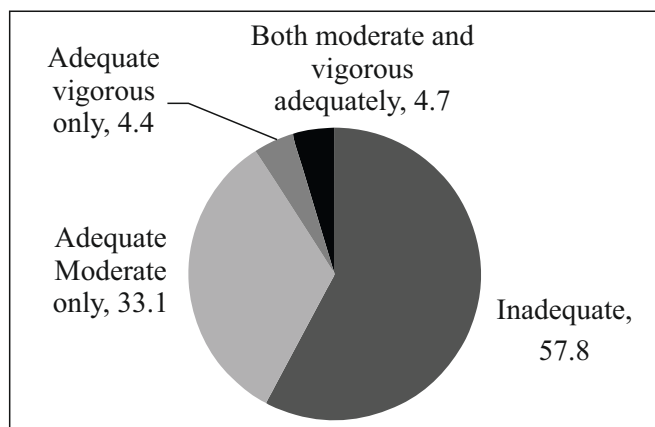
Table 1: Distribution of study participants according to their socio-demographic characteristics (N=384)

Socio-demographic variables	Number (%)
Age group (in completed years)	
18-29	15 (3.9)
30-39	43 (11.2)
40-49	117 (30.5)
50-59	132 (34.4)
60 & above	77 (20.1)
Gender	
Male	202 (52.6)
Female	182 (47.4)
Education	
Illiterate	66 (17.2)
Literate	39 (10.2)
Primary	180 (46.9)
Middle & Secondary	43 (11.2)
Higher Secondary & above	56 (14.6)
Marital Status	
Married	341 (88.8)
Single	16 (4.2)
Widow/ Widower	27 (7.0)
Socio-economic status (As per Modified BG Prasad Scale, October 2023)	
Class V	94 (24.5)
Class IV	124 (32.3)
Class III	81 (21.1)
Class II	52 (13.5)
Class I	33 (8.6)

Table 2: Distribution of study participants according to their diabetes profile (N=384)

Diabetes profile	Number (%)
Duration of diabetes	
<1 year	62 (16.1)
1-5 years	123 (32.0)
6-10 years	91 (23.7)
>10 years	108 (28.1)
Family history of diabetes	
Yes	174 (45.3)
No	210 (54.7)
Current glycemic control	
Ideal/Satisfactory	57 (14.8)
Unsatisfactory	327 (85.2)

Figure 1: Distribution of the study population according to the adequacy of physical activity performed by them. (N=384)



Based on IPAQ, it was noted that 57.8% had inadequate physical activity. [Figure 1]

Figure 2: Distribution of the study population according to the presence of MetS. (N=384)

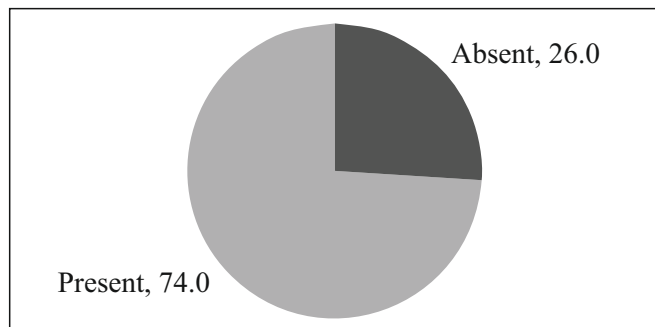


Table 2 shows the diabetes profile of the participants. Most of the participants were diabetic for more than 10 years. Strikingly, 85.2% patients did not have satisfactory glycemic control in spite of taking medications.

MetS was observed in 74% participants. Among the 284 participants with MetS, 60.2% had elevated blood pressure, 42.2% had increased waist circumference, 56.3% had uncontrolled FBS, 64.1% had hypertriglyceridemia and 45.3% had low HDL-C. [Figure 2]

Binary logistic regression was employed to check the association of physical activity with glycemic control and the presence of MetS. Patients performing adequate vigorous physical activity had a higher odds ratio of having ideal/satisfactory glycemic control (OR 3.141, 95% CI 1.024-9.633, p 0.045). Adequate moderate (OR 0.595, 95% CI 0.361-0.983, p 0.043) or vigorous (OR 0.139, 95% CI 0.049-0.395, p <0.001) physical activity had a significantly lower odds ratio of having MetS. Engaging in vigorous physical activity for an adequate duration was protective against having elevated blood pressure (OR 0.094, 95% CI 0.029-0.301, p <0.001) or having increased waist circumference (OR 0.021, 95% CI 0.062-0.795, p 0.021). Patients performing a combination of moderate and vigorous physical activity had a significantly lower odds ratio of developing hypertriglyceridemia (OR 0.335, 95% CI 0.122-0.918, p 0.034).

Discussion:

Physical activity is well known to have countless health benefits. Numerous studies have been conducted in the past to study the role of physical activity in the prevention of various non-communicable diseases. This research is different as it lays emphasis on the role of physical activity in the prevention of MetS in patients with established diabetes mellitus.

The percentage of diabetic patients on medication with unsatisfactory glycemic control was much higher in the present research (85.2%) compared to studies conducted by Bereda^[19] in ambulatory clinic in Ethiopia

(60.7%); Borgharkar et al^[20] in urban healthcare facilities across 26 states and union territories in India (76.6%) and; Pan et al^[21] in an urban health centre of West Bengal (37.5%). This could be because the study area in the current survey is a tertiary care hospital where complicated cases are referred for management from the peripheral institutions.

The problem of inadequate physical activity in the current study (57.8%) was almost double the observation of Wang et al^[22], where 28.6% Chinese diabetic patients performed low physical activity. This belief was strengthened by the findings of Paulin et al^[23] in Tamil Nadu, where similar to our study, 56% diabetics were physically inactive.

In the study by Lira et al^[15] in urban primary health centres of Floriano, 50.7% diabetic patients had MetS. The burden of MetS among type 2 diabetics was much higher in our work (74%); the research by Essafi et al^[24] at the Endocrinology, Diabetology, and Nutrition department of the Hassan II University Hospital in Fez (78.4%) and; the cross-sectional study by Singh et al^[25] in Varanasi (more than 70%). In the present survey and the Fez-based study^[24], high blood pressure was the most common abnormality in type 2 diabetes patients with MetS. This suggests that patients with type 2 diabetes are more prone to develop hypertension. Complimenting the observations of Park et al^[26] in Korea and Banerjee et al^[27] in Durgapur, the current research reported a positive relation between physical activity and glycemic control.

Lee et al^[28] in their analysis of data from the Korean National Health and Nutrition Examination Survey, 1999–2012 noted that physical inactivity was associated with fasting glucose, HDL cholesterol, and waist circumference among diabetics with MetS. Alike our study, El Bilbeisi et al^[29] also employed IPAQ for assessment of physical activity among type 2 diabetes patients with MetS in Palestine. This study portrayed that the level of physical activity has a relationship with triglycerides, HDL-cholesterol and blood pressure.^[29] An Indian study by Goyal et al.^[30] using the Global Physical Activity Questionnaire revealed that physical inactivity

was associated with hypertriglyceridemia in males and with raised hip circumference, blood pressure, triglycerides and FBS in females. The current study established the role of adequate physical activity in preventing hypertension, increase in waist circumference and hypertriglyceridemia. But, our research failed to confirm the association of physical activity with HDL-cholesterol and FBS which was evident in other studies.^[29,30] Moreover, this research confirmed that physical activity is protective against MetS in patients with type 2 diabetes. Thus, patients with type 2 diabetes should engage in adequate physical activity to prevent the onset of MetS which might result in morbidity and mortality.

Limitation:

The survey helped in furnishing evidence in favour of physical activity in diabetics. Still, the research had few limitations, viz, shorter duration of study, inclusion of patients from a single OPD and lack of intervention to address the issue of physical inactivity.

Conclusions:

A substantial number of diabetic patients in Kolkata suffer from MetS. A major chunk of diabetic patients do not engage themselves in adequate physical activity. Performing moderate-to-vigorous physical activity for an adequate duration helps in preventing MetS in diabetic patients. Vigorous physical activity is also beneficial in attaining glycemic control.

Recommendation:

A major chunk of diabetic patients do not engage themselves in adequate physical activity. Performing moderate-to-vigorous physical activity for adequate duration helps in preventing MetS in diabetic patients. Vigorous physical activity is also beneficial in attaining glycemic control.

Declaration

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Conflict of Interest: Nil

Use of AI: Nil

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