Association Between The Physical Activity And Metabolic Syndrome In Residents Of Navi Mumbai

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ABSTRACT
Metabolic syndrome, a cluster of conditions increasing the risk of cardiovascular disease and Type 2 diabetes, has become a significant public health concern. Physical inactivity is a known contributor to metabolic syndrome, yet its prevalence and impact within urban populations remain understudied. This pilot study explores the association between physical activity and the incidence of metabolic syndrome among residents of Navi Mumbai, India. Using the Global Physical Activity Questionnaire (GPAQ-2), data on physical activity levels were collected from 252 participants, and metabolic syndrome was assessed based on key indicators such as hypertension and Type 2 diabetes. The findings indicate that 54.9% of the participants were physically active, with men (62.9%) being more active than women (49.6%). A significant association was found between physical inactivity and metabolic diseases ($p < 0.00001$), highlighting the role of exercise in mitigating metabolic syndrome risks. These results emphasize the need for targeted interventions promoting physical activity as a preventive measure against metabolic syndrome. Further large-scale studies are warranted to validate these findings and develop evidence-based health policies for urban populations.

Keywords: *Metabolic Syndrome, Physical Activity, Cardiovascular Risk, Public Health, Navi Mumbai, Diabetes, Hypertension*

INTRODUCTION

Metabolic syndrome is a collection of conditions that heighten the risk of cardiovascular diseases (CVD) and Type 2 diabetes. It involves the simultaneous presence of various established cardiovascular risk factors that are interconnected and contribute to fundamental physiological processes and pathways. The principal components of metabolic syndrome encompass insulin resistance/hyperglycemia, obesity, dyslipidemia, and hypertension (1). By considering the interconnected nature of these factors, we can gauge the pathophysiology of cardiovascular diseases. As indicated by various studies (2), metabolic syndrome is influenced by modifiable lifestyle and behavioural factors, such as alcohol consumption, smoking, physical activity, and dietary habits. It has been observed that modifying these factors can adversely affect the risk of developing metabolic syndrome. Conversely, non-modifiable risk factors are associated with genetic elements that remain impervious to lifestyle or dietary changes (Grundy, 2008). Assessing metabolic syndrome can aid in identifying individuals at a heightened risk of developing CVD and Type 2 diabetes, while also enabling a deeper exploration of the interplay between these risk factors, which can enhance treatment adherence should the condition manifest (Alberti et al., 2009).

Physical inactivity can contribute to the development of metabolic syndrome by promoting weight gain, particularly in the abdominal area, and by impairing insulin sensitivity (Després & Lemieux, 2006). Regular physical activity is crucial for maintaining a healthy weight, improving insulin sensitivity, and managing blood pressure and lipid profiles (Warburton et al., 2006).

Metabolic syndrome is a significant risk factor for cardiovascular diseases, including heart disease and stroke (Grundy, 2006). Individuals with metabolic syndrome are at a higher risk of atherosclerosis the buildup of plaque in the arteries), which can lead to coronary artery disease and other cardiovascular problems (Haffner et al., 1998).

Engaging in regular physical activity, along with maintaining a healthy diet, can help prevent or manage metabolic syndrome and reduce the associated risk of cardiovascular diseases (Yamaoka & Tango, 2012). It's essential for individuals to incorporate exercise into their daily routines to support overall health and well-being (Pate et al., 1995).

The present study examines the association between physical activity and the occurrence of metabolic syndrome in residents of Navi Mumbai, India. This is a pilot study which is done to assess the feasibility of a larger, more comprehensive study. The findings of the study can provide valuable insights into the prevalence of metabolic syndrome in this cohort. Identifying a link between physical activity and metabolic syndrome can inform preventive strategies. If physical inactivity is found to be a significant risk factor, it can highlight the importance of promoting exercise and an active lifestyle to reduce the risk of metabolic syndrome.

METHODOLOGY

Participants

Participants (n = 252), >18 years of age were enrolled who lived in Navi Mumbai city for at least six months before the survey. Excluded from the study were pregnant women, bedridden adults, and those who had a disability that limits activity.

Questionnaire

The study employed the Global Physical Activity Questionnaire version-2 (GPAQ-2) to assess physical activity levels, (WHO). This questionnaire consists of 16 questions that evaluate sedentary behaviour and three distinct domains of physical activity: work, transportation, and leisure-time physical activity.

Survey participants were inquired about their involvement in vigorous and moderate physical activities related to work and leisure, provided these activities lasted for at least 10 minutes without interruption. Regarding transportation-related activities, only continuous moderate-intensity activities for a minimum of 10 minutes were considered. Participants were further asked to specify the number of days they engaged in that activity in a typical week and the amount of time spent on it in a typical day.

The responses to these frequency and duration inquiries were utilized to compute the total time individuals spent engaging in physical activities, expressed in MET (Metabolic Equivalent of Task) minutes per week. In this context, vigorous-intensity activities are described as those causing individuals to breathe significantly harder than normal, while moderate-intensity activities are those leading to somewhat harder-than-normal breathing (Mengesha, et al, 2019).

DATA ANALYSIS

Within each of the three domains of physical activity as assessed by the GPAQ, responses to questions about how often and for how long physical activities are performed are utilized to convert the cumulative time spent on these activities into an energy expenditure metric known as MET-minutes.

A MET, or Metabolic Equivalent of Task, is a measure of the ratio of the metabolic rate during specific physical activities to the resting metabolic rate. One MET is defined as the energy expenditure equivalent to sitting quietly, which is approximately 1 kilocalorie per kilogram of body weight per hour. In comparison to the energy expenditure while at rest, engaging in moderate-intensity activities results in a fourfold increase in caloric consumption, whereas vigorous-intensity activities result in an eightfold increase. Consequently, for the purposes of this calculation, moderate-intensity activities in the realms of work, transportation, and leisure are assigned a value of 4 METs, while vigorous-intensity activities are assigned a value of 8 METs.

As a result, converting 75 minutes of vigorous-intensity activity per week into MET-minutes involves multiplying 75 minutes by the assigned 8 METs, resulting in 600 MET-minutes per week. In turn, the overall physical activity score is determined by summing all MET-minutes per week derived from moderate- to vigorous-intensity activities undertaken in the workplace, during transportation, and in leisure-time. Achieving a total of ≥600 MET-minutes per week signifies an adequate level of physical activity or being considered physically active, while a total below <600 MET-minutes per week indicates an insufficient level of physical activity, or physical inactivity.

RESULTS

1. Characteristics of the study population

Out of a total 252 subjects enrolled for the study, males make up approximately 51.16% of the group and females constitute around 48.84% of the group. The average age of the entire group is approximately 42.67 years, and the age range within the group spans from 25 years as the minimum age to 65 years as the maximum age.

Characteristics	Value	%
Number	252	
Males	129	51.2
Females	123	48.8
Average Age (in years)	42.67 ± 12.83	

The study group encompassed individuals with diverse professions, including those engaged in private corporate jobs, business, teaching, farming, medical practice, government employment, homemaking, and retirement. The specific distribution of these professions is presented in Figure 1, which provides a visual representation of how many individuals belong to each of these professional categories within the study group.

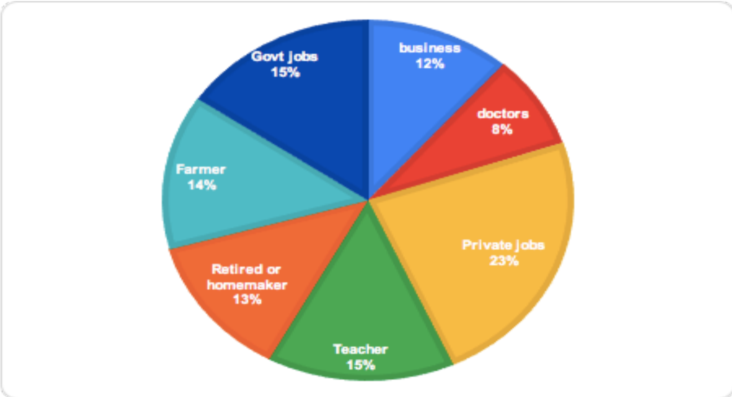

Fig 1: Distribution of subjects according to their profession

2. Self-reported physical activity

Among all the study participants, a significant portion, specifically 29.1%, reported that they did not engage in any continuous physical activity lasting at least 10 minutes within the three physical activity domains. In contrast, of the remaining 70.9% who did participate in such activities, the majority (45.0%) reported engaging in moderate-intensity physical activities at their workplaces, and a smaller percentage (35%) reported engaging in physical activities during their travels to and from various places. The majority of the people involved in the physical activity at work were framers and homemakers. These activities were notably common in the study population. However, it's important to note that vigorous- and moderate-intensity leisure-time activities were the least frequently practiced by adults in the study.

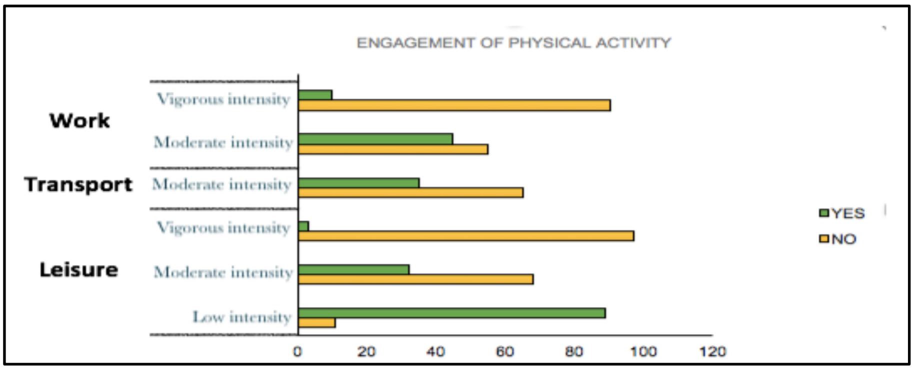

Fig 2: Proportion of adults (25–65 years) who engaged in physical activity by specific domains and intensity level in Navi Mumbai city

In this study, 54.9% of adults were found to be physically active, and a larger percentage of men, specifically 62.9%, were physically active compared to women, where 49.6% were physically active.

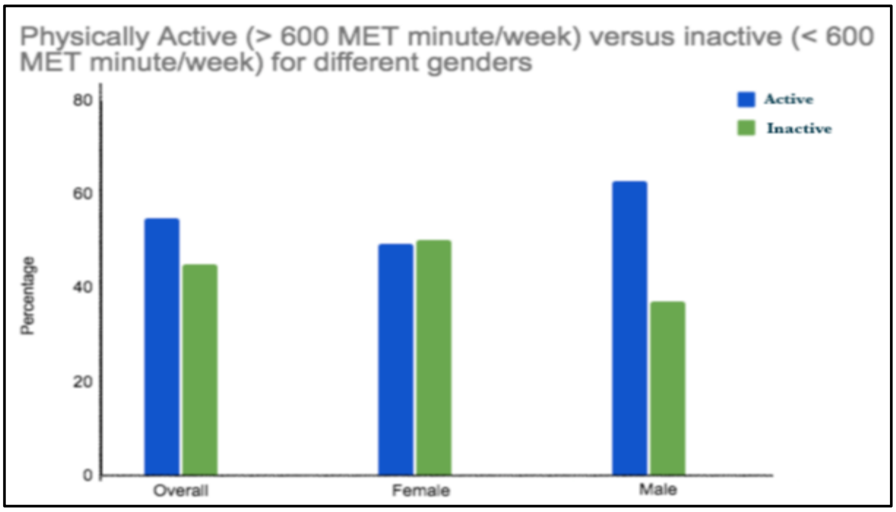

Fig 3: Proportion of adults (25–65 years) who achieved the WHO global recommendations on physical activity for health by gender in Navi Mumbai city

3. Association of physical activity with incidence of metabolic diseases

The study included a total of 187 individuals who had metabolic diseases, such as hypertension and type 2 diabetes. Out of these 187 individuals, 149 were classified as physically inactive. Additionally, there were 164 individuals in the study who did not have any metabolic disease. To examine the association between metabolic diseases and physical activity, a chi-square test was conducted. The p-value obtained from the chi-square test was less than 0.00001 ($p < .00001$). This extremely low p-value suggests a highly significant result. It indicates that the association between metabolic diseases and physical activity is statistically significant, and the relationship observed in the study is unlikely to be due to chance.

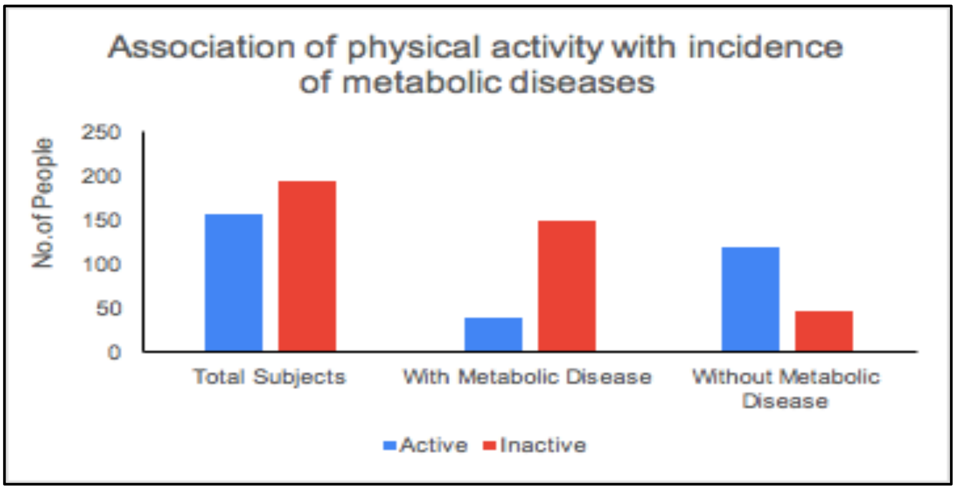

Fig 4: Proportion of adults (25–65 years) engaged in different physical activity and suffering from metabolic diseases in Navi Mumbai city.

DISCUSSION

The present study investigated the association between physical activity and the prevalence of metabolic syndrome among residents of Navi Mumbai. The findings highlight the critical role of physical activity in mitigating metabolic diseases such as hypertension and type 2 diabetes. Our results indicate that a significant proportion of the study population (29.1%) did not engage in continuous physical activity lasting at least 10 minutes in any of the assessed domains (work, transportation, leisure). This lack of activity aligns with global trends where sedentary lifestyles are increasingly prevalent, contributing to rising rates of metabolic disorders (Lee et al., 2012). Notably, the majority of participants who reported physical activity engaged in moderate-intensity activities primarily related to work and transportation, reflecting the active lifestyles of homemakers and farmers in the region. However, leisure-time physical activities were least practised, underscoring a potential area for public health interventions aimed at promoting recreational exercise (Hallal et al., 2012).

The gender disparity observed, with 62.9% of men being physically active compared to 49.6% of women, is consistent with previous studies suggesting that men generally report higher levels of physical activity than women (Bauman et al., 2012). This difference could be attributed to socio-cultural factors, occupational demands, and opportunities for physical activity that vary between genders (Trost et al., 2002).

The statistically significant association between physical inactivity and metabolic diseases ($p < 0.00001$) found in our study supports the well-documented link between sedentary behaviour and increased risk of metabolic syndrome (Ford et al., 2005). The high prevalence of metabolic diseases among physically inactive individuals underscores the urgent need for targeted interventions to promote physical activity as a preventative measure (Booth et al., 2012).

The utilisation of the Global Physical Activity Questionnaire version-2 (GPAQ-2) provided a comprehensive assessment of physical activity across various domains, offering insights into specific areas where interventions could be most effective (Armstrong & Bull, 2006). By converting physical activity into MET-minutes, the study was able to quantify activity levels and establish a clear threshold for adequate physical activity, as defined by the World Health Organization (WHO, 2010).

CONCLUSION

The study found a strong and statistically significant association between having metabolic diseases (specifically, hypertension and type 2 diabetes) and being physically inactive. The chi-square test results strongly support this association, with a very low p-value indicating that the relationship is highly unlikely to have occurred by random chance. This suggests that physical inactivity is more prevalent among individuals with these metabolic diseases.

The present study is based on a relatively small cohort of participants. Future research endeavors should involve a larger and more extensive sample size to validate the findings of this current study. Moreover, Future research should focus on longitudinal studies to establish causal relationships and explore the effectiveness of specific interventions designed to enhance physical activity across different population segments.

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