



Original Article

Association of physical activity with metabolic syndrome in a predominantly rural Nigerian population



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ABSTRACT

Aims: Physical activity is an essential determinant of health. However, there is dearth of evidence regarding prevalence of physical activity in developing countries, especially its association with metabolic syndrome risk factors. This study assessed the association of physical activity with metabolic syndrome in a Nigerian population.

Materials and methods: A cross-sectional study was carried out on apparently healthy persons who are ≥ 18 years old. The World Health Organisation (WHO) Global Physical Activity Questionnaire (GPAQ) was used to collect five domains of physical activity. Participants were classified as physically active or inactive based on meeting the cut-off value of 600 MET-min/week. Metabolic syndrome was diagnosed using the Joint Scientific Statement on Harmonizing the Metabolic Syndrome criteria.

Results: Overall prevalence of physically active individuals was 50.1% (CI: 45.6–54.7%). Physical inactivity is significantly more in females ($p < 0.01$) and among participants > 40 years old ($p < 0.0001$). Whereas individuals with metabolic syndrome appeared more likely to be physically active (OR = 1.48, CI: 0.71–3.09); physical inactivity showed to exist more among participants who were living in urban area (OR = 6.61, CI: 3.40–12.85, $p < 0.001$). Participants with prediabetes (OR = 1.69, CI: 0.62–4.61) and diabetes (OR = 1.91, CI: 0.65–5.63) were more likely to be physically inactive as compared to other metabolic syndrome risk factors.

Conclusion: The high prevalence of physical inactivity in this study population is a clear indication that concerted efforts to improve physical activity may be required. However, it seems that metabolic syndrome is not improved by being physically active. This suggests that interventions directed at physical activity alone may not produce optimal efficacy in this study population.

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1. Introduction

Metabolic syndrome and its risk factors like hyperglycaemia, dyslipidaemia, hypertension and obesity are leading cause of mortality and morbidity in low-mid income countries [1]. It is associated with a 2-fold increase in risk for cardiovascular diseases (CVD) and associated mortality as well as a 1.5-fold increase in risk for all-cause mortality [2]. Ongoing lifestyle changes of urbanization are enhancing the rate of physical inactivity and unhealthy

diets have been implicated as a contributory factor to the epidemiological transition of metabolic syndrome and related risks in low-middle income countries [3,4].

Insufficient physical activity has been identified as the fourth leading risk factor responsible for about 3.2 million deaths globally, where an estimated 31% of adults above 15 years of age were insufficiently active (men 28% and women 34%) [5]. It is estimated that one out of five adults globally is physically inactive [6]. In sub-Saharan Africa the prevalence of metabolic syndrome and its risk factors is considered to have attained an epidemic level [7–9], which in part is orchestrated by high prevalence of physical inactivity among urban area dwellers [10–13]. The metabolic syndrome can be prevented by action on the modifiable risk factors. Interventions that modify diet and physical activity, and weight control are very effective [14].

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The critical need for low cost, reliable and standardized tools to quantify and classify health enhancing physical activity in the developing nations of the world, informed the efforts of the World Health Organisation (WHO) in developing the Global Physical Activity Questionnaire (GPAQ) [15]. However, in Nigeria, the prevalence of physical activity and its association with risk factors for metabolic syndrome is scarcely reported, especially among rural populations. The decline in physical activity, as well as prevalence of metabolic syndrome is widely reported as an urban problem [7,8,10–13,16,17]. Therefore, the objective of this study is to assess the prevalence of physical activity and its association with metabolic syndrome and risk factors in a predominantly rural population in Nigeria.

2. Methods

2.1. Study design, population and ethical consideration

This study is a cross-sectional study in a predominantly rural population. Participants were recruited following a two stage cluster sampling technique as described in a previous study [18]. Of the 422 participants enrolled in the study, 77.3% were recruited from the rural population, while the remaining 22.7% was from the urban setting. Farming and trading were the predominant occupation, especially among the rural population. The study was part of Prediabetes and Cardiovascular Complications Study (PACCS). It was approved by the Human Research Ethics Committee of Charles Darwin University, Australia (HREC Reference: H14003), Human Research Ethics Committee of Novena University and the Local Government Ministry of Health at Kwale, Delta State Nigeria.

2.2. Physical activity

The WHO GPAQ was used to collect five domains of physical activity (vigorous-intensity work, moderate-intensity work, travel from place to place, vigorous-intensity recreation or moderate-intensity recreation) [19]. The GPAQ has been shown to have a good-excellent test-retest reliability in developing countries with an added advantage of capturing information on patterns of physical activity in key areas of life relevant to people in developing countries [15]. Trained research personnel engaged each study participant in a face to face interview to document their physical activity status.

The frequency of five different categories of activity ((1) vigorous-intensity work, (2) moderate-intensity work, (3) vigorous-intensity recreation/sports, (4) moderate-intensity recreation/sports, and (5) travel from place to place) was recorded in days per week and the duration of each session was also recorded in minutes per day. A continuous indicator: metabolic equivalent (MET) in minutes per week was used to estimate the population's physical activity. The frequency (days/week) and duration (min/day) for physical activity per domain was multiplied by its corresponding MET value and summed up to derive the overall physical activity in a week [19]. Participants were classified into dichotomous groups of either physically active or physically inactive:

Group 1 – Physically inactive: those who did not meet the total physical activity cut-off value of 600 MET min/week.

Group 2 – Physically active: those who met the total physical activity cut-off value of 600 MET min/week.

2.3. Anthropometric measurements

Protocol and measuring instrument used to assess obesity and hypertension in this study was as previously published [18]. Body

weight divided by the square of height (kg/m^2) was used to calculate the body mass index (BMI). The BMI of participants were grouped into underweight ($<18.5 \text{ kg/m}^2$), normal weight ($18.5\text{--}24.9 \text{ kg/m}^2$), overweight ($25.0\text{--}29.9 \text{ kg/m}^2$) and obese ($>30 \text{ kg/m}^2$). For central obesity, WC $>94 \text{ cm}$ was classified as obesity status 'Yes' in males and WC $>80 \text{ cm}$ is obesity status 'Yes' in females [20]. Hypertension was classified as systolic blood pressure reading $\geq 130 \text{ mmHg}$ and/or diastolic blood pressure of $\geq 85 \text{ mmHg}$.

2.4. Biochemical parameters

CardioChek[®] Professional Analyser was used to measure blood glucose level and lipid profile according to manufacturer's instructions. Participants fasted for at least 8 hours to qualify for fasting blood sample collection. The cut-off values of 100–125 mg/dL (prediabetes) and $\geq 126 \text{ mg/dL}$ (diabetes) for impaired fasting glucose, 140–199 mg/dL (prediabetes) and $\geq 200 \text{ mg/dL}$ for random blood sample were applied. For lipid profile, the cut-off values were $\geq 200 \text{ mg/dL}$ (hypercholesterolemia), $\geq 150 \text{ mg/dL}$ (hypertriglyceridemia), $\leq 40 \text{ mg/dL}$ (low HDL in men) and $\leq 50 \text{ mg/dL}$ (low HDL in women). Metabolic syndrome was defined as central obesity plus any two of hypertriglyceridaemia, low HDL, hypertension or hyperglycaemia. This is according to the Joint Scientific Statement on Harmonizing the Metabolic Syndrome definition for sub-Saharan ethnicity [20].

2.5. Demographic variables

Characteristics of variables collected were gender, age, highest level of education completed, main work status, and average income earnings. Average income grouping was as previously described [18]: low income ($<\$109/\text{month}$), low-mid income ($\$110\text{--}\$310/\text{month}$); upper-mid income ($\$311\text{--}\$640/\text{month}$) and high income ($>\$645/\text{month}$).

2.6. Statistical analysis

Descriptive data were performed to determine mean and standard deviation for continuous variables. Gender difference between metabolic syndrome risk factors and each domain of physical activity was assessed using Mann–Whitney *U* test.

Cross-tabulation between dichotomous variables of total physical activity and metabolic syndrome risk factors, education, work status and income status were generated to assess the prevalence of physical activity/inactivity across the different socio-demographic/economic variables and metabolic syndrome risk factors. The level of significance was tested using Pearson chi-square and 95% confidence interval (CI) derived through bootstrapping.

Correlation coefficients were calculated to investigate the relationship between sedentary time, total physical activity and each of WC, BMI, Systolic and diastolic blood pressure. Logistic regression analysis was applied using physical inactivity and activity (as independent variables) to predict occurrence of metabolic syndrome and risk factors (outcome variables). However, age, gender and location (rural/urban) of participants were fitted into the regression model as independent covariates, in order to adjust for confounders and generate adjusted odds ratio. Level of significance is set at 0.05, except otherwise indicated. Data analysis was carried out using IBM SPSS 22 and XLSTAT (Addinsoft, NY, USA) statistical packages.

3. Results

Table 1 shows the descriptive statistics of the metabolic syndrome risk factors and the domains of physical activity and sedentary time across the general population and gender. Among

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