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HIGH PREVALENCE OF OBESITY AND PHYSICAL INACTIVITY AMONG SELECTED WORKERS IN KANO STATE NIGERIA

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ABSTRACT

There is increasing burden of cardiometabolic diseases in Africa. Increasing rates of physical inactivity and obesity are partly responsible for this development. The aim of this study was to determine the prevalence of physical inactivity and obesity among selected workers in Kano State, Nigeria. In this cross sectional study of 466 workers attending a part-time degree program at Bayero University Kano, Nigeria, body weight was measured using a standard digital weighing scale, body height was measured using a portable stadiometer, circumferences (waist and hip) were measured using an inelastic measuring tape and physical inactivity using a standardized questionnaire. Data analysis was done in R statistical environment. The subjects consisted of 280 males and 186 females with respective mean ages of 37 (±8.7) and 36 (±9.6). Mean waist circumference for males and females was 87.9 (±13.4) and 86.4 (±13.2) respectively. Both males and females sit on an average of 10 hours per weekday. Almost 2/3 of both male and female subjects were physically inactive. About the same proportion of the study subjects have generalized obesity (58% of male and 66% of female subjects). More than ¾ of female subjects and 2/3 of male subjects were centrally obese using waist-to-hip ratio measure. The high prevalence rates of physical inactivity and obesity among this group of urban workers mean they are at a particularly high risk of cardiometabolic diseases and should be a priority group for public health intervention programs designed to reduce the burden of cardiovascular disease and diabetes.

Keywords: Physical inactivity, Obesity, Cardiovascular disease, Diabetes, Nigeria

INTRODUCTION

Obesity has been defined as abnormal accumulation of fat in the body to the extent that leads to impairment of health (WHO, 2000). A simple correlate of total body fat is the body mass index (BMI), defined as weight in kg divided by square of height in meters (g/km^2). There are 4 (four) categories of abnormal BMI; the preobesity and classes I-III of obesity. The ranges of the categories are, respectively, 25-29.99kg/m^2, 30-34.99kg/m^2, 35-39.99kg/m^2 and values of 40kg/m^2 or greater (WHO, 2000).

Regional distribution of fat can vary substantially for the same level of body fat mass or BMI based on sex, age or ethnic characteristics with Chinese and South Asians having higher central adiposity than Europeans for a given BMI and fat mass (Lear et al., 2007) and males having higher abdominal fat than males for the same BMI or body fat mass (Stevens et al., 2010). Consequently, the World Health Organization defined sex-specific central obesity as waist-hip ratio > 0.9 in males and > 0.85 in females (World Health Organization, 2008). The body also recommended ethnic-specific cut off of waist circumference for defining central obesity such as the values of ≥ 94cm and ≥ 102cm for increased and substantially increased cardiovascular risks for Caucasian males with the corresponding values for females being ≥ 80cm and ≥ 88cm respectively (World Health Organization, 2008).

Physical inactivity is any level of activity (including moderate and vigorous) that has not met the specified physical activity guidelines. This contrasts to sedentary behaviour which is any waking behaviour with energy expenditure ≤ 1.5 metabolic equivalent of task (MET = energy expenditure at rest which is about 3.5ml of O2/kg/minute) (Sedentary Behaviour Research Network, 2012). The Sedentary Behavior Research Network (SBRN) divided the 24 hour of a day into three behaviours of sleep (about 1METs), sedentary behaviour (≤ 1.5METs) and physical activity (> 1.5METs). Physical activity can be light (1.5-3METs), moderate (3 to less than 6METs) or vigorous (≥ 6METs) in intensity and when its level has not reached recommended guidelines it is referred to as physical inactivity (Tremblay et al., 2017).

There is a worldwide pandemic of obesity with the highest prevalence found in the Americas and the lowest prevalence is found Asia followed by Sub-Saharan Africa (Chooi et al., 2019). The global south made up of Africa and South America have the highest prevalence rates of central obesity [above 50% (Wong et al., 2020)]. The least active regions in the world are the rich part is South and Central America with 39.1% of adults in the region failing to meet the WHO physical activity recommendations (Guthold et al., 2018). This is followed by the rich regions of the word (North America and Europe). Sub-Saharan Africa has the lowest prevalence of physical inactivity at 21.4% (Guthold et al., 2018). Obesity and physical inactivity are associated with increased risk of diabetes (Seo et al., 2017; Smith et al., 2016; Tajik et al., 2019), hypertension (Deng et al., 2018; Liu et al., 2017; Tajik et al., 2019), stroke (Smith et al., 2016; Suk et al., 2003), coronary heart disease (Kim et al., 2021; Silveira et al., 2021; Wahid et al., 2016), chronic kidney disease (Chang et al., 2019; Parvathaneni et al., 2021; Silveira et al., 2021) and all-cause mortality disease (16,20). The aim of this study is to estimate cardiometablic risk by measuring the prevalence rates of generalized and central obesity as well as physical inactivity among selected workers in Kano State Nigeria.

MATERIALS AND METHODS

Study Design

The study design was cross-sectional study

Study Area

The study was conducted in Bayero University Kano (BUK), a university located in the North-West Region of Kano State in Nigeria, a lower middle income (World Bank, 2021) Western African nation. Kano State has total land area of 21,276.9 Km^2 and a projected population of 12,150,811 by 2017 (Figure 1) (Abdulkadir et al., 2018).

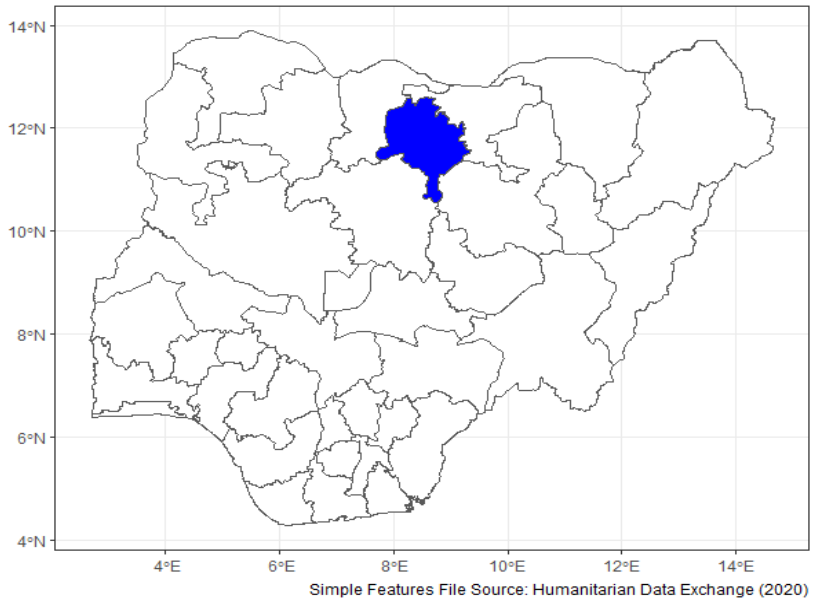

Figure 1: Map of Kano State in Nigeria

Study Population

The participants are students of the School of Continuing Education (SCE) of Bayero University Kano. The university is a leading tertiary institution in Nigeria founded in 1976 and about fifty thousand (50,000) students currently enrolled (MacArthur Foundation, 2024). SCE is a part-time program school meant mostly for workers with classes taking place mostly on weekends. There are 25 programs across five (5) departments and currently enrolls more than four thousand (4, 000) students (Bayero University kano, 2024)

Sample Size Calculation

The minimum sample size of three hundred and forty five (345) was calculated using Epitools (EPITOOLS, 2021) online calculator assuming an estimated obesity prevalence of 34% based on a recent meta-analysis (Bashir *et al*., 2021b). 466 subjects were recruited into the study.

Sampling Methods

Sampling was a multi-stage sampling method. The 25 programs in the school were assigned numbers 1 to 25 and then two numbers representing two (2) programs were randomly selected using runif() random number generator function in R (R Core Team, 2021). Next, each of the four (4) levels of the selected programs were assigned numbers and two (2) levels were randomly selected from each of the selected programs using the same runif() random number generator function in R (R Core Team, 2021). The four selected levels had the sample size equally divided and systemic sampling (every other student in a serialized list) was employed to recruit the desired sample size.

Inclusion Criteria

Inclusion Criteria were any student of the SCE BUK who

i. is a worker
ii. gave informed consent

Exclusion Criteria

Exclusion Criteria were any student who

i. is not a worker
ii. is pregnant
iii. refused participation in the study

Ethical Considerations

Ethical clearance was sought from Bayero University Health Research Ethical Committee (BUK-HREC) and the Kano State Ministry of Health ethical committee (NHREC/17/03/2018). Informed written consents was sought from the study participants

Body Weight

Body weight was measured using an electronic weighing scale (Seca, Germany) with maximum reading of 150Kg and accuracy of 0.1Kg. With the scale reading zero, the subject stood on the centre of the scale without support and with the weight distributed evenly on both feet (Centers for Disease Control and Prevention, 2014).

Height

Height was measured using a portable stadiometer (Seca, Germany) with maximum of 200cm and accuracy of 0.1cm. With the subject standing with the feet together and the heels, buttocks and upper part of the back touching a wall and the head placed in the Frankfort plane (a position of the head whereby the lower edge of the eye socket is in the same horizontal plane as the notch superior to the tragus of the ear). When aligned, the Vertex was the highest point on the skull (Centers for Disease Control and Prevention, 2014).

Body Mass Index

The Body Mass Index (BMI) was calculated as weight (in kilograms) divided by the square of height (in meters). Normal BMI was defined as the range 18.50-24.99 kg/m^2. Values at 25.0kg/m^2 and above were defined as abnormal (WHO, 2000). There are 4 (four) categories of abnormal BMI; the preobesity and classes I-III of obesity. The ranges of the categories are, respectively, 25-29.99kg/m^2, 30-34.99kg/m^2, 35-39.99kg/m^2 and values of 40kg/m^2 or greater (WHO, 2000).

Waist Circumference

Waist circumference was measured using an inelastic measuring tape (MEDLINE, 1-800-Medline, USA). With the subject assuming a relaxed standing position with the arms folded across the thorax, measurement was taken at the mid-point between the lower costal (10th rib) border and the iliac

crest at the end of expiration. Central obesity was defined as values ≥ 94cm in males and ≥ 80cm females (WHO, 2000)

Hip Circumference and Waist-Hip Ratio

Hip circumference was measured using an inelastic measuring tape (MEDLINE, 1-800-Medline, USA). With the subject assuming a relaxed standing position with the arms folded across the thorax, the circumference was taken at the level of the greatest posterior protuberance of the buttocks which usually corresponds anteriorly to about the level of the symphysis pubis (Centers for Disease Control and Prevention, 2014). Central Obesity was defined as waist-to-hip ratio > 0.9 in males and > 0.85 in females (WHO, 2011).

Physical Activity Measurement

Physical activity was measured using English version of Hausa IPAQ-SF, a Nigerian version of the International Physical Activity Questionnaire Short Form (Oyeyemi *et al*., 2011). The 7 (seven) items of the questionnaire quantify the four levels of activity i.e. vigorous activity, moderate activity, walking and sitting time. These were reported both as categorical and quantitative variables. As quantitative variable, the physical activity was recorded in metabolic equivalent minutes (MET-minutes) per week. 1 (one) MET is regarded as the energy expended at rest. Thus METs units are multiples of the energy expended at rest. Walking was regarded as equal to 3.3METs, moderate activity equal to 4METs and vigorous activity equal to 8METs. Energy expended for any activity would be calculated as:

Energy = METs × minutes taken doing the activity × number of days in a week the activity is done.

The unit is MET-minutes per week (Oyeyemi & Adeyemi, 2013). Physical inactivity was defined as any activity which does not meet the following criteria of moderate physical activity:

i. 3 (three) or more days of vigorous-intensity activity for at least 20 minutes per day,
ii. 5 (five) or more days of moderate intensity activity or walking for at least 30 minutes per day, or
iii. 5 (five) or more days of any combination of walking, moderate intensity, or vigorous-intensity activities achieving a minimum of 600 MET-minutes per week.

Sitting time was reported as minutes per weekday

Data Visualizations and Statistical Analysis

All visualizations and data analyses were done in R statistical environment (R Core Team, 2021). Means, standard deviations and proportion were calculated using intercept-only multilevel models in brms R package (Bürkner, 2017). Sex group was used to define the model levels. Visualizations were done using gglplot2 (Wickham, 2016) R package.

RESULTS AND DISCUSSION

Characteristics of the Study Subjects

Four hundred and sixty six (466) subjects recruited into the study had their data analysed. 60% of the subjects are males with mean age of 37 years (±8.7) and 40% are females with mean age of 36 years (±9.6). Male and female subjects have similar mean waist-to-height ratio. Both males and females sit on an average of 10 hours per weekday. Male subjects have higher neck and waist circumference and waist-to-hip ratio (Table 1)

Table 1: Characteristics of the Study Subjects

Variable	Males	Females
Number (%)	280 (60%)	186 (40%)
Age (Years)	37 (±8.7)	36 (±9.6)
Waist Circumference (cm)	87.9 (±13.4)	86.4 (±13.2)
Waist-to-Hip Ratio	0.91 (±0.20)	0.88 (±0.21)
Waist-to-Height Ratio	0.53 (±0.1)	0.53 (±0.1)
Sitting Time (Hours)	10 (±5.1)	10 (±6.1)
Body Mass Index (kg/m2)	26.2 (±6.0)	27.7 (±7.1)

Prevalence of Obesity and Physical Inactivity among the Study Subjects

Male subjects have higher rate physical inactivity (59%) than female subjects (54%). Females have higher rates of generalized overweight & obesity as measured by body mass index at 66% compared to the male prevalence of 58%. Females also recorded higher prevalence rates of central obesity as measured by waist-to-hip ratio (78% vs 62%) and waist circumference (69% vs 34%). Using WHtR measure, males and female subjects have similar rates of central obesity at 37% and 36% respectively (Figure 4)

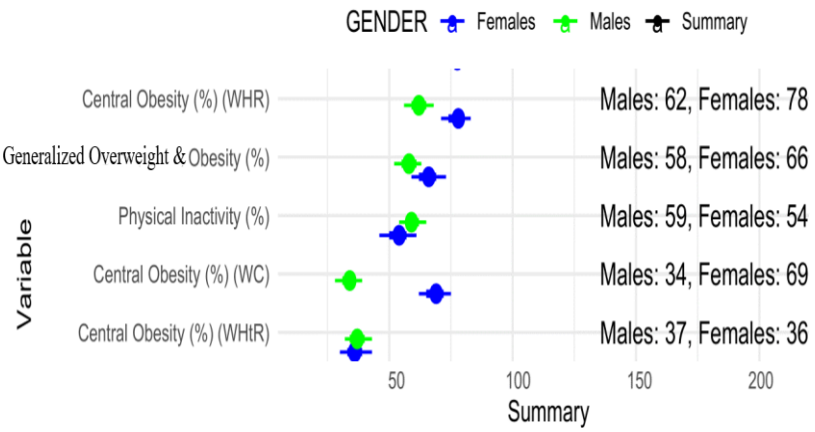

Figure 2: Prevalence Rates of Central Obesity Measures and Physical Inactivity

Discussion

The prevalence of generalized overweight and obesity in both female and male subjects is much higher than the national average of 39% found in a recent meta-analysis of 35 studies consisting of 52,816 subjects (Adeloye et al., 2021). Consistent with this difference was the fact that the pooled mean body mass index (BMI) found in the meta-analysis, 25.6 kg/m2 (Adeloye et al., 2021), is lower than the mean for the current study subjects (26.2kg/m^2 for males and 27.7kg/m^2 for females). This high prevalence of overweight and obesity is comparable to the rates found in Americas (64.2% and 28.35) (Chooi et al., 2019)

The high prevalence of central obesity among the study subjects was similarly higher than the national average found in a recent meta-analysis of eighteen studies consisting of 21,859 individuals which found thirty-nine percent (95% confidence interval [CI]: 25%-54%, I2 = 99.3%) of adult Nigerians are centrally obese (by International Diabetes Federation criteria) (Bashir et al., 2022). This higher prevalence of central obesity among the study subjects is reflected by the fact they have a mean waist circumference (87.9cm for males and 86.4cm for females) higher than the national average found (83.8cm) in the earlier mentioned meta-analysis (Bashir et al., 2022). The higher prevalence of obesity among females compared to males found in this study is consistent with a trend observed globally (Wong et al., 2020)

The 59% prevalence of physical inactivity among males is higher than the national male average of 49.3% found in a recent meta-analysis of fifteen studies covering a population of 13 814 adults (Adeloye et al., 2022). The female subjects' physical inactivity prevalence (54%), on the other hand, is comparable with the national estimate of 55.8% found in the same meta-analysis (Adeloye et al., 2022). The rates of physical inactivity among the study subjects was also higher than the 21.4% average reported for Sub-Saharan Africa (Guthold et al., 2018) and 39.1% reported for the rich part is South and Central America(Guthold et al., 2018)

Given the established known risks of obesity and physical inactivity, the high prevalence rates of these risk factors found in this study represent a potential for increasing burden of diabetes and cardiovascular diseases in the country. Table 2 showed the potential public health impact (as measured by the population attributable fraction, PAF) due to physical inactivity and obesity based on the prevalence estimates of this study and previously reported relative risk measures for diabetes (Seo et al., 2017; Smith et al., 2016; Tajik et al., 2019), hypertension (Deng et al., 2018; Liu et al., 2017; Tajik et al., 2019) and coronary heart disease (Kim et al., 2021; Silveira et al., 2021; Wahid et al., 2016). The proportion of hypertension, diabetes and coronary heart disease cases which could potentially be eliminated from the study subjects after eliminating generalized obesity are respectively 20%, 29% and18% for males and 23%, 33% and 20% for females. The corresponding figures for central obesity are 22%, 46% and 17% for males and 28%, 57% and 21% for females. The figures for physical inactivity are 3%, 12% and 10% for males and 3%, 11% and 9% for females.

Given the Nigeria's massive infrastructure deficit in healthcare (Alkali & Bello, 2020), the realistic option of controlling the burden of cardiovascular diseases and diabetes is to invest in public health programs for the prevention of cardiometabolic risks such as obesity and physical inactivity.

Table 2: Estimated Burden Population Attributable Fraction of Hypertension, Diabetes and CHD due to Physical Inactivity and Obesity among the Subjects

Risk Factor	Population Attributable Fraction (%)[a]		
	Hypertension[b]	Diabetes[c]	CHD[d]
Generalized Overweight & Obesity			
Females	23	33	20
Males	20	29	18
Central Obesity(WHR)			
Females	28	57	21
Males	22	46	17
Physical Inactivity			
Females	3	11	9
Males	3	12	10

a: Calculated based on the formula $PAF = p \times (\frac{RR-1}{RR}) \times 100$, where p = prevalence of the risk factor and RR = measure of adjusted relative risk (Rockhill et al., 1998)

b: RRs of 1.54, 1.55 and 1.06 for generalized obesity, central obesity and physical inactivity respectively(Deng et al., 2018; Liu et al., 2017; Tajik et al., 2019)

c: RRs of 2, 3.8 and 1.26 for generalized obesity, central obesity and physical inactivity respectively(Seo et al., 2017; Smith et al., 2016; Tajik et al., 2019)

d: RRs of 1.44, 1.38 and 1.2 for generalized obesity, central obesity and physical inactivity respectively (Kim et al., 2021; Silveira et al., 2021; Wahid et al., 2016)

WHR = waist-to-hip ratio

CHD = coronary heart disease

CONCLUSION

The high prevalence of physical inactivity and obesity found among the study population puts them at an increased risk of cardiovascular disease and diabetes compared to the general population. Controlling obesity can eliminate as much as 1/5 of hypertension and coronary heart disease cases and as much as 50% of diabetes cases among the study population. Future population based cohort studies are needed to establish if the higher physical inactivity and obesity prevalence rates are related to higher prevalence and incidence of diabetes, cardiovascular diseases and all-cause mortality among the study population.

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