Relationship Between Physical Activity, Consumption of Fruits And Vegetables, And Obesity Among The Staff of A Tertiary Institution In Southwest Nigeria.

Authors:
[1]**Abimbola Morolayo OLUSUYI,** [2]**Kolawole Michael OLUSUYI,** [3]**Olatunji Jimoh FASORO,** [4]**Hafsat Abolore AMEEN,** [5]**Azeez Oyemomi IBRAHIM,** [6]**Michael Onasanmi ADEWUMI,** [7]**Tosin Anthony AGBESANWA,** [8]**Taofeek Adedayo SANNI**

[1]*Department of Community Health, College of Health Sciences and Technology, Ijero, Ekiti State, Nigeria. https://orcid.org/0000-0003-3783-1214*
[2]*Department of Family Medicine, Afe Babalola University, Ado-Ekiti, Ekiti State, Nigeria. https://orcid.org/0000-0001-7405-0594*
[3]*Department of Pharmacy, College of Health Sciences and Technology, Ijero, Ekiti, Nigeria. https://orcid.org/0000-0001-5224-8735*
[4]*Department of Epidemiology and Community Health, University of Ilorin, Ilorin, Nigeria. https://orcid.org/0000-0002-7724-7699*
[5]*Department of Family Medicine, Afe Babalola University, Ado-Ekiti, Ekiti State, Nigeria https://orcid.org/0000-0002-2395-9551*
[6]*Department of Environmental Health, College of Health Sciences and Technology, Ijero, Ekiti State, Nigeria. https://orcid.org/0009-0004-2874-5175*
[7]*Department of Family Medicine, Ekiti State University College of Medicine, Ado-Ekiti, Ekiti State, Nigeria https://orcid.org/0000-0003-1983-4964*
[8]*Department of Community Medicine, Afe Babalola University, Ado-Ekiti, Ekiti State, Nigeria and Department of Community Medicine, Federal Teaching Hospital, Ido-Ekiti, Ekiti State, Nigeria. https://orcid.org/0000-0002-0536-8184*
Corresponding Author:
Kolawole Michael OLUSUYI
Department of Family Medicine, Afe Babalola University, Ado-Ekiti, Ekiti State, Nigeria. https://orcid.org/0000-0001-7405-0594

ABSTRACT:
Introduction: Obesity has reached epidemic proportions in many adult populations in Nigeria and several other developing countries. The objective of this study was to determine the relationship between the level of physical activity, consumption of fruits and vegetables, and obesity. **Methods and Material**: This study used a cross-sectional design and a modified WHO STEPwise Approach to Chronic Disease Risk Factor Surveillance questionnaire to assess physical activity, fruit/vegetable consumption, and body mass index (BMI) of the respondents. Statistical analyses were carried out to evaluate the association between socio-demographic variables, fruit and vegetable intake, physical activity, and obesity. Statistical significance was P-values <0.05. **Results**: Total respondents recruited were 321. Respondents who were < 45 years were the majority (79.8%). Mean BMI was 25.55 ± 4.38. The proportion of overweight and obesity among them were 31.2% and 16.2% respectively. Both overweight and obesity constituted 47.4% of the population. Most of the staff had inadequate daily intake of fruits and vegetables, and moderate intensity level of physical activities. Obesity is associated with age, gender, marital status, place of residence, the number of days per week that fruits and vegetables were eaten, and the time spent on the moderate intensity recreational activities (sports). **Conclusion**: This study found that almost half of the staff were overweight or obese, and the levels of fruit/vegetable intake and physical activity were mostly low. Obesity prevalence correlated with many demographic and lifestyle factors. Workplace wellness programs may help address nutritional and physical activity behaviours to help reduce obesity rates.

Keywords: Obesity, overweight, body mass index, fruits and vegetables, physical activity, Diet, Lifestyle factors, Tertiary institution, Nigeria

INTRODUCTION:

Obesity is rapidly establishing itself as a public health problem in several developing countries.[1] In Nigeria, obesity has reached epidemic proportions in many adult populations. A systematic review of selected studies from 2001 - 2012 observed that the prevalence of overweight among adult populations varied from

20.3% - 35.1%, and that of obesity varied from 8.1% - 22.2%.[2]

The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) recommend that adults consume at least 400g or 5 portions of fruits and vegetables daily to reduce the risk of non-communicable diseases.[3] Additionally, the U.S. Department of Health and Human Services and WHO recommended that all healthy adults perform moderate-intensity aerobic physical activity for a minimum of 30 minutes on 5 days a week or vigorous-intensity aerobic activity for a minimum of 20 minutes on 3 days a week.[4] This study aims to investigate the relationship between physical activity, consumption of fruits and vegetables, and body mass index (BMI).

SUBJECTS AND METHODS:

This cross-sectional study was conducted among the staff of a tertiary institution in southwest Nigeria. The inclusion criteria consist of all staff aged 18 to 65 years who gave consent to participate in the study. A sample size of 321 was calculated using the formula: $n = \frac{z^2 pq}{d^2}$

The researcher and 4 trained research assistants recruited willing respondents in their various departments over the duration of 4 weeks using a multistage sampling method. The modified WHO STEPwise Approach to Chronic Disease Risk Factor Surveillance (STEPS) questionnaire was used to assess the intake of fruits and vegetables, and level of physical activities of the respondents. The questionnaire consisted of standardized questions on fruits and vegetables, physical activity (exercise, recreational activities, sports, traveling mode via walking and/or using pedal bicycle).[5]

The body weights of the staff were measured using Hanson's Bathroom weighing scale, and their heights were measured in meters using a Stadiometer. Their BMI was calculated and classified using the newly updated World Health Organization classification of BMI.[6]

Data analysis was conducted using the Statistical Package for Social Sciences, version 20 (SPSS v20). Bivariate analysis involved the use of Pearson's Chi-Square to evaluate the association between socio-demographic variables, fruit and vegetable intake, physical activity, and obesity. In both the Chi-Square and binary logistic analyses, BMI was categorized as 'obesity absent' and 'obesity present' using BMI cut-off of ≤/> 24.9. P-values less than 0.05 were taken as statistical significance.

Ethical consideration was obtained from the ethics and research committee of the institution. Informed consents were obtained from all the participants. Confidentiality and privacy were ensured, and only the investigators had access to the data.

RESULT AND DISCUSSION:

A total of 321 respondents were recruited for the study. The age of the respondents ranged from 20 to 64 years. The majority of respondents (79.8%) were younger than 45 years old. Interestingly, almost three-fifths (57.0%) resided in urban areas, despite the study being conducted in a rural town (Table 1). The study area's rural setting may also affect physical activity levels. Rural areas tend to have fewer opportunities for physical activity compared to urban areas. It's worth noting that the daily commute by vehicle may also impact physical activity levels. Additionally, the rural setting may also impact access to healthy food options. This study found that the majority of respondents did not consume adequate fruits and vegetables, with 64.5% and 59.2% respectively reporting less than 4 days per week of consumption (Table 1). This is consistent with a study among civil servants in Ibadan, Nigeria, where 69.7% of participants were found to have an inadequate intake of fruits and vegetables.[8] Similarly, a study in America found that only 12.2% of adults met the recommended fruit intake, and 9.3% met the recommended vegetable intake.[9] However, a study in North Central Nigeria found a higher proportion of respondents (69.2%) consuming fruits and vegetables, although the amount and frequency of consumption were not studied.[10]

The study found a high prevalence of overweight and obesity among the respondents, with 47.4% of the population falling into these categories (Table 1). The mean BMI was 25.55 ± 4.38, which is similar to the findings (25± 4) of a study among staff of Usmanu Danfodiyo University, Sokoto, Nigeria.[11] The prevalence of obesity in this study was lower compared to studies in similar settings in Ibadan and Kaduna (57.3% and 62% respectively),[8,12] but higher than a study (42.8%) in a similar setting in Ibadan.[13] These findings suggest that there is a need for interventions to promote healthy eating habits and physical activity among the population.

Table 1: The socio-demographic characteristics, Diet and BMI of the respondents.

Variable	Frequency	Percentage
Age (years)		
< 45	256	79.8
≥ 45	65	20.2
Mean ± SD	37.66 ± 8.38	
Gender		
Male	160	49.8
Female	161	50.2

Educational status		
Primary	15	4.7
Secondary	53	16.5
Tertiary	139	43.3
Postgraduate	114	35.5
Marital status		
Single	50	15.6
Married	267	83.2
Divorced/ Separated/ Widowed	4	1.2
Average monthly income (#)		
< 20,000	64	19.8
20,000 - <100,000	180	56.2
100,000 - <200,000	58	17.9
≥ 200,000	19	6.1
Place of residence		
Urban (in the State)	183	57.0
Rural (in the State)	130	40.5
Outside the State	8	2.5
Diet		
FRUIT SERVINGS		
Days eaten		
< 4	207	64.5
≥ 4	114	35.5
No. of servings		
< 5	294	91.6
≥ 5	27	8.4
VEGETABLE SERVINGS		
Days eaten		
< 4	190	59.2
≥ 4	131	40.8
No. of servings		
< 5	305	95.0
≥ 5	16	5.0
BMI		
>18.5	6	1.9
18.5 - 24.9	163	50.8
25.0 - 29.9	100	31.2
30.0 - >40	52	16.2

The physical activity levels (exercise) of the respondents were also assessed, and it was found that the majority (72.9%) carried out moderate intensity activities. However, most people performed physical activities for less than 30 minutes per day and less than 3 days per week (Table 2). This suggests that although the respondents were engaging in physical activities, they were not meeting the recommended daily and weekly durations.

The study also assessed physical activities while traveling, and it was found that the majority (86.6%) of respondents travelled by walking or pedal bicycle for at least 10 minutes continuously. However, only one-third (33.1%) performed it for 30-60 minutes per day, and most people performed it for only 3-5 days per week (Table 2). This suggests that only a few respondents were engaging in adequate physical activities while traveling.

The recreational activities of the respondents were also evaluated, and it was found that the majority (64.2%) performed moderate intensity recreational activities, such as brisk walking. However, among those who carried out moderate intensity recreational activities, the majority (60.7%) only performed it for less than 30 minutes, and in all recreational activity levels, most people performed physical activities for less than 3 days per week. This suggests that most respondents were not engaging in adequate recreational activities.

Table 2: Physical Activity: Exercises, and movements via walking / using pedal bicycle.

Variables	Frequency	Percentage
ACTIVITY LEVEL AT WORK		
Vigorous intensity	55	17.1

Moderate intensity	234	72.9
Low intensity	32	10.0
VIGOROUS INTENSITY		
Number of days performed (n = 55)		
< 3	20	36.4
3 – 5	22	40.0
> 5	13	23.6
Time spent doing the activity (n = 55)		
< 30 minutes	34	61.8
30 - 60 minutes	14	25.5
> 60 minutes	7	12.7
MODERATE INTENSITY		
Number of days performed (n = 234)		
< 3	88	37.6
3 – 5	104	44.4
> 5	42	17.9
Time spent doing the activity (n = 234)		
< 30 minutes	158	67.5
30 - 60 minutes	57	24.4
> 60 minutes	19	8.1
LOW INTENSITY		
Number of days performed (n = 32)		
< 3	17	53.1
3 – 5	12	37.5
> 5	3	9.4
Time spent doing the activity (n = 32)		
< 30 minutes	24	75.0
30 - 60 minutes	6	18.8
> 60 minutes	2	6.3
Walking or using pedal bicycle for at least 10 minutes		
Yes	278	86.6
No	43	13.4
Number of days performed (n = 278)		
< 3	55	19.8
3 – 5	127	45.7
> 5	96	34.5
Time spent doing the activity (n = 278)		
< 30 minutes	180	64.7
30 - 60 minutes	92	33.1
> 60 minutes	6	2.2

This study identified several factors associated with obesity, including age, gender, marital status, monthly income, and lifestyle habits. The findings revealed that respondents aged 45 years and older, females, those with postgraduate qualifications, those who earned a monthly income of #100,000 - < #200,000 and urban dwellers had a higher proportion of obesity (Table 3). These results are consistent with previous studies that have shown that older adults, women, urban dwellers, and those with higher socioeconomic status are more likely to be obese. [8,14–16] The study also found that single respondents had the lowest proportion of obesity, which contrasts with previous research that has shown that married individuals are more likely to be obese.[14] However, the finding that younger staff had lower odds of being obese compared to those over 44 years old is consistent with previous studies.[14]

The study found a paradoxical association between obesity and fruit and vegetable consumption, with higher proportions of obesity among those who ate fruits and vegetables for 4 days per week or more (Table 3), contrasting with findings in studies that found less proportion of obesity among those who adequately consume fruits and vegetables.[17] This paradoxical effect may be due to the large carbohydrate content in fruits, which could lead to higher body weight gain, and suggests that merely increasing fruit and vegetable intake without restricting other energy-dense foods may actually lead to weight gain.[18] However, the study did not find a significant association between obesity and the number of daily servings of fruits and vegetables eaten.

Table 3: Association between socio-demographic variables, Diets, and BMI

Variable	Obese (overweight + obese) Yes n (%)	No n (%)	Total N (%)	χ^2	*p* value
Age (years)					
< 45	113 (44.1)	143 (55.9)	256	5.230	**0.022***
≥ 45	39 (60.0)	26 (40.0)	65		
Gender					
Male	61 (38.1)	99 (61.9)	160	10.894	**0.001***
Female	91 (56.5)	70 (43.5)	161		
Education					
Primary	7 (46.7)	8 (53.3)	15	5.870	0.118
Secondary	24 (45.3)	29 (54.7)	53		
Tertiary	57 (41.0)	82 (59.0)	139		
Postgraduate	64 (56.1)	50 (43.9)	114		
Marital Status					
Single	12 (24.0)	38 (76.0)	50	11.912[Y]	**0.003***
Married	137 (51.3)	130 (48.7)	267		
Divorced/Widowed	3 (75.0)	1 (25.0)	4		
Average monthly income (#)					
< 20,000	30 (47.6)	33 (54.4)	63	15.429	**0.001***
20,000 - <100,000	67 (37.2)	113 (62.8)	180		
100,000 - <200,000	38 (66.7)	19 (33.3)	57		
≥ 200,000	10 (47.6)	11 (52.4)	21		
Place of residence					
Urban	95 (51.9)	88 (48.1)	183	2.928[Y]	0.231
Rural	54 (41.5)	76 (58.5)	130		
Outside the State	3 (37.5)	5 (62.5)	8		
Diet					
FRUITS					
Days per week eaten					
< 4	83 (40.3)	123 (59.7)	206		
≥ 4	62 (53.9)	53 (46.1)	115	5.529	**0.019***
Servings of fruit					
< 5	134 (45.4)	161 (54.6)	295		
≥ 5	11 (44.0)	14 (56.0)	25	0.019	0.891
VEGETABLES					
Days per week eaten					
< 4	74 (38.5)	118 (61.5)	192		
≥ 4	72 (55.4)	58 (44.6)	130	8.873	**0.003***
Servings of vegetables					
< 5	142 (45.8)	168 (54.2)	310		
≥ 5	3 (27.3)	8 (72.7)	11	1.473	0.225

χ^2: Chi square test; *: *p* value <0.05

The study also examined the relationship between physical activity and obesity, finding that respondents who had low intensity activity levels in physical exercise had a higher proportion of obesity (Table 4), while those who walked or used a pedal bicycle for at least 10 minutes continuously had a lower proportion of obesity. These findings are consistent with previous studies, such as Frank et al, which found that each additional kilometre walked per day was associated with a 4.8% reduction in the likelihood of obesity.[19] Regular physical activity is associated with a reduced risk of obesity. Additionally, the study found that the time spent on moderate intensity recreational activities had a statistically significant relationship with obesity, consistent with previous research that has shown that engaging in recreational activities can help reduce the risk of obesity.[20]

Table 4: Relationship between exercise, walking / using pedal bicycle, and BMI

	Obese (overweight + obese)				
	Yes	No	Total	χ^2	*p* value
Variable	**n (%)**	**n (%)**	**N (%)**		
ACTIVITY LEVEL AT WORK					
Vigorous intensity	27 (49.1)	28 (50.9)	55	0.629	0.730
Moderate intensity	108 (46.2)	126 (53.8)	234		
Low intensity	17 (53.1)	15 (46.9)	32		
VIGOROUS INTENSITY					
Number of days performed (n = 55)					
< 3	1 (5.0)	19 (95.0)	20	4.398[Y]	0.110
3 – 5	6 (27.3)	16 (72.7)	22		
> 5	0 (0.0)	13 (100.0)	13		
Time spent doing the activity (n = 55)					
< 30 minutes	4 (11.8)	30 (88.2)	34	0.536[Y]	0.764
30 - 60 minutes	1 (7.1)	13 (92.9)	14		
> 60 minutes	2 (28.6)	5 (71.4)	7		
MODERATE INTENSITY					
Number of days performed (n = 234)					
< 3	11 (12.5)	77 (87.5)	88	1.823	0.402
3 – 5	18 (17.3)	86 (82.7)	104		
> 5	9 (21.4)	33 (78.6)	42		
Time spent on activity (n = 234)					
< 30 minutes	26 (16.5)	132 (83.5)	158	2.080	0.353
30 - 60 minutes	7 (12.3)	50 (87.7)	57		
> 60 minutes	5 (26.3)	14 (73.7)	19		
LOW INTENSITY					
Number of days performed (n = 32)					
< 3	6 (35.3)	11 (64.7)	17	3.342[Y]	0.188
3 – 5	0 (0.0)	12 (100.0)	12		
> 5	1 (33.3)	2 (66.7)	3		
Time spent on activity (n = 32)					
< 30 minutes	7 (29.2)	17 (70.8)	24	1.036[Y]	0.595
30 - 60 minutes	0 (0.0)	6 (100.0)	6		
> 60 minutes	0 (0.0)	2 (100.0)	2		
Walking or using pedal bicycle for at least 10 minutes					
Yes	131 (47.1)	147 (52.9)	278	0.044	0.834
No	21 (48.8)	22 (51.2)	43		
Number of days performed (n = 278)					
< 3	6 (10.9)	49 (89.1)	55	1.301	0.522
3 – 5	21 (16.5)	106 (83.5)	127		
> 5	17 (17.7)	79 (82.3)	96		
Time spent doing the activity (n = 278)					
< 30 minutes	29 (16.1)	151 (83.9)	180	0.040	0.980
30 - 60 minutes	14 (15.2)	78 (84.8)	92		
> 60 minutes	1 (16.7)	5 (83.3)	6		

χ^2: Chi square test; Y: Yates corrected Chi square.

In this study, binary logistic regression analysis identified gender and marital status as the statistically significant predictors of obesity. Female respondents had 2.3 times the odds of obesity compared to males, while married respondents had 2.6 times the odds compared to singles. These findings are consistent with previous studies, such as Oladimeji et al, which found that female respondents were 4 times more likely to be overweight/obese compared to males.[12] Additionally, a study among bank workers in Accra, Ghana, found that physical activity, alcohol consumption, marital status, gender, and age were significantly associated with obesity and overweight. These findings suggest that gender and marital status are important factors to

consider in the prevention and management of obesity (Table 5).

Table 5: Predictors of obesity using binary logistic regression.

Variable	B	*p* value	OR (95% CI)
Age (years)			
< 45 REF			1
≥ 45	0.764	0.071	2.146 (0.937 – 4.913)
Gender			
Male REF			1
Female	0.833	**0.012***	2.300 (1.198 – 4.415)
Marital Status			
Single REF			1
Married	0.978	**0.048***	2.658 (1.007 – 7.019)
Divorced/Widowed	2.175	0.104	8.804 (0.640 – 121.077)
Average monthly income (#)			
< 20,000 REF			1
20,000 - <100,000	-0.736	0.088	0.479 (0.206 – 1.115)
100,000 - <200,000	0.579	0.283	1.785 (0.620 – 5.138)
≥ 200,000	-0.519	0.490	0.595 (0.136 – 2.600)
Days per week fruit is eaten (≤ 4)	0.259	0.439	1.296 (0.672 – 2.500)
Days per week vegetable is eaten (≥ 4)	0.582	0.080	1.789 (0.932 – 3.433)
Time spent on recreational activity			
< 30 minutes REF			1
30 - 60 minutes	-0.472	0.189	0.624 (0.309 – 1.260)
> 60 minutes	1.033	0.156	2.811 (0.674 – 11.715)

B: Coefficient of logistic regression; OR: Odds ratio; 95% CI: 95% Confidence Interval Predictive value: 70.6%

CONCLUSION:

To prevent obesity, institutions should educate staff on the importance of consuming recommended amounts of fruits and vegetables and engaging in adequate daily physical exercise, walking, and recreational activities. Structures should be put in place to facilitate these activities, such as providing opportunities for staff to engage in physical or sporting activities during and outside of working hours. This will help promote a healthy lifestyle and reduce the risk of obesity among staff.

Authors' contribution:

AMO: Concept, design, literature search, scientific studies, facts acquisition, manuscript preparation, drafted the initial manuscript, and manuscript review.
KMO (guarantor): Concept, design, literature search, scientific studies, facts analysis, statistical analysis, manuscript preparation, and manuscript review.
OJF: Design, definition of mental content, facts analysis, manuscript enhancing and manuscript review.
HAA: Design, definition of mental content, facts analysis, manuscript enhancing and manuscript review.
AOI: Design, definition of mental content, facts acquisition, facts analysis, manuscript enhancing and manuscript review.
MOA: Design, definition of mental content, facts acquisition, facts analysis, manuscript enhancing and manuscript review.
TAA: Literature search, facts acquisition, facts analysis, statistical analysis, and manuscript review.
TAS: Definition of mental content, facts acquisition, statistical analysis, manuscript enhancing and manuscript review.

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