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ORIGINAL ARTICLE

Association of nutrition, physical activity, and morbidity among older adults

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Abstract

Aim Globally, the burden of non-communicable diseases is increasing rapidly, but little is known about the interactive effects of nutrition, physical activity (PA), and morbidity in older adults in Nigeria. This study examined the associations among nutrition, PA, and morbidity among older adults in Nigeria.

Subject and methods A cross-sectional design was adopted, and a multistage sampling technique was used to survey 330 older adult residents of a town in Nigeria. Nutritional status and physical activity levels were assessed using the full Mini-Nutritional Assessment (MNA) and International Physical Activity Questionnaire, respectively. It also included questions about the presence of health problems when diagnosed and respondents' perceptions of their health.

Results About 62% of the respondents had at least one chronic illness, and the prevalent conditions included musculoskeletal (25.6%), heart conditions (16.6%), and ear/eye problems (9.7%). Findings further showed that 21.4% were at risk of malnutrition and 1.9% were malnourished. Also, 31.6% reported low PA participation. Morbidity was significantly associated with age ($p < 0.000$), level of education ($p < 0.000$), income ($p < 0.000$), PA ($p < 0.000$), and nutrition ($p = 0.045$). In addition, factors that predicted the presence or absence of chronic illness included nutrition (OR = 0.395, $p = 0.016$), high PA (OR = 0.077, $p = 0.000$), age (OR = 1.063, $p = 0.006$), BMI overweight (OR = 0.127, $p < .000$), education (OR = 1.835, $p = 0.001$), artisan occupation (OR = 3.382, $p = 0.006$), and income of 10,000–20,000 Nigerian naira per month (OR = 0.363, $p = 0.023$).

Conclusion Chronic illness is prevalent among older adults and is associated with poor nutrition, physical inactivity, and certain demographic characteristics.

Keywords Morbidity · Nutrition · Older adults · Physical activity

Introduction

The population of older adults (age 65+ years) in Nigeria is on the increase as crude mortality rates are gradually decreasing (Tanyi et al. 2018; National Prevention Council 2016). Tanyi et al. (2018) further reported that ageing in Nigeria is occurring against a background of socio-economic hardship, widespread poverty, the HIV/AIDS pandemic, and the rapid transformation of the traditional extended family structure. Senior citizens in society play a significant role in nation-building at the various stages of their life. They are indisputably the custodians of a society's culture and tradition, especially in Africa; they also mediate during conflict resolution and are contributors to enforcing peace in their various communities (Abidemi 2005).

Physical activity and nutrition are known determinants of health and have been recognized as behavioural risk factors for non-communicable diseases (Bouchard et al. 2012). Physical activity and diet play a significant role in health, both together and separately. According to a previous study, there are additional health benefits to be gained from physical activity, and there are significant nutritional risks that are unrelated to obesity (Jakicic and Otto 2005). In addition, physical activity is pivotal in improving the physical and mental health of an individual. Also, physical activity

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reduces the risk of developing or dying from some leading causes of illness and death.

According to the World Health Organization (WHO) Global Strategy on Diet, Physical Activity and Health (World Health Organization 2004), unhealthy diet and physical inactivity are among the leading causes of major non-communicable diseases, and some of the risk factors that account for much of the mortality and morbidity have been closely related to diet and physical activity. These include high concentrations of cholesterol in the blood, inadequate intake of fruits and vegetables, overweight or obesity, and physical inactivity. Nutritional health reflects a balance between food intake and the body's needs for nutrients. More often, the focus of nutrition in older adults is a healthy diet and physical activity to reduce the chances of developing chronic diseases due to poor lifestyle (Amarya et al. 2015).

According to Milanović et al. (2013), physical activity generally tends to decrease with ageing. Many factors have been associated with the age-related decline in physical activity, including personal, social, and environmental features. Features of this decline include decreased functional fitness and decreased muscle mass and strength, agility, flexibility, and maximal aerobic capacity characterizing the old age period. In the absence of physical activity, the older adults expose themselves to the risk of a reduction in muscle mass and joint motion by 40%, while a loss of muscle strength (~30%) is related to a decrease in muscle mass (Kostić et al. 2011). Previous studies have examined the effect of chronic conditions and physical activity among older people. Little has been done to establish the interactive effect of nutrition, physical activity, and morbidity in the older adults in Nigeria. Thus, this study may provide knowledge about the interrelationship between nutrition, physical activity, and morbidity in older people living in Nigeria.

This study sought to determine the level of physical activity, assess the presence of any non-communicable diseases, and examine the association of nutritional status, level of physical activity, and morbidity among the older adults.

Methodology

Design

A cross-sectional design was used to examine the association between nutrition, physical activity, and morbidity among the older adults in the community.

Setting

The study was conducted in the community of Ile-Ife, Osun State, Nigeria, which is an ancient Yoruba city in south-western Nigeria. Administratively, xx has two local government areas (LGAs), A and B. It has an area of 111 km^2, according to the 2006 census (National Population Commission 2015). The map obtained from the National Population Commission indicated a population of about 450,000 people living in 100,000 households in the community (National Population Commission 2015).

Sample size

The sample size was derived using the formula $n = z^2pq/d^2$ (Armitage et al. 1987), where n = sample size, $q = 1 - p$, p = prevalence of a chronic conditions among the older adults (Agrawal 2013), z = standard normal variance where the confidence level is 1.96 at 95%, d = maximum allowable margin error = 0.05, and n = 318.8 (approximated to 330) respondents.

Sampling technique

The study adopted a multi-stage sampling technique. Three wards each were randomly selected from two LGAs (A and B). The selected wards were divided into enumeration areas (EAs). We selected five EAs from the six selected wards, giving a total of 30 EAs through a simple random sampling procedure. All the constituent households in the selected EAs were listed. Furthermore, systematic random sampling was used to select 11 households from the selected EAs. This was done until 11 older adults from each EA had been interviewed. In each household, we interviewed one consenting male or female older adult. In any visited household, the eligibility for participation was the presence of older adults (aged 60 years and above, residents in the study area for at least 1 year, and cognitively intact). In the case of more than one eligible participant in the dwelling, we enrolled only one by a lottery method.

Instruments

The instruments for data collection included a weighing scale, a stadiometer, the full Mini-Nutritional Assessment (MNA®) questionnaire, the International Physical Activity Questionnaire (IPAQ), and a section asking respondents to describe the characteristics of health problems. The full MNA® is a validated screening tool that identifies older adults persons who are malnourished or at risk for malnutrition (Guigoz 1994). The MNA two-step procedure includes a nutritional screening (items 1–6) and an assessment (the remaining 12 questions) for those at risk of malnutrition. A score of 12 or higher indicates that the person is well nourished and needs no further intervention (Guigoz 1994). A score of 8–11 indicates that the person is at risk of malnutrition, and a score of 7 or less indicates that the person

is malnourished (Guigoz 1994). We assessed the physical activity of the respondents using the IPAQ. The IPAQ assesses physical activity undertaken across a comprehensive set of domains, including leisure-time physical activity, domestic and gardening (yard) activities, work-related physical activity, and transport-related physical activity. The IPAQ uses two scoring protocols, (i) continuous score and (ii) category score. Data collected with the IPAQ long form were reported as a continuous measure, and median values and interquartile ranges were computed for walking (W), moderate-intensity activities (M), and vigorous-intensity activities (V). Physical activities were categorized as low, moderate, and high for each domain. Body weight was measured using a standard weighing scale, and height was measured using a stadiometer; these were used to compute the body mass index (BMI), and it was classified according to the WHO standard (Dwyer et al. 2015). Similarly, respondents were asked about the presence and characteristics of health problems, which included when they were diagnosed, their perception of their health, and their perception of their health compared with others of their age.

Validity and reliability

The MNA and IPAQ have been validated in previous studies. The MNA has a positive predictive value of 97% to detect under-nutrition in the older adults. It has 96% sensitivity and 98% specificity (Guigoz 1994), while the Cronbach alpha for the IPAQ was established in a previous study as 0.714 (Ayvat et al. 2017). The validity of the structured questionnaire was also established through face and content validity criteria. The instrument was subjected to scrutiny by experts in the fields of geriatrics, education, psychology, and sociology. Each item on the instrument was examined for content, clarity, scope, and relevance to the study. In addition, the Cronbach alpha of the instrument yielded 0.65, and thus it was deemed fit to be used in its present form.

Data analysis

Descriptive statistics (frequency, percentage, mean, standard deviation) were used to describe the socio-demographic characteristics and illness conditions of older adults. The chi-square statistic was used to assess the associations between morbidity and nutrition status, physical activity, and socio-demographic characteristics of the older adults. Similarly, correlation analysis was conducted to assess the relationship between the different variables of older adults. The chi-square test was used to evaluate the differences in sample characteristics, and multivariable logistic regression analysis was used to assess the association between age, gender, marital status, occupation, level of education, income, nutrition, physical activity (independent variables), and chronic illness (outcome variable). All analysis was conducted using Stata 12 statistical software (StataCorp LLC 2011).

Results

Characteristics of respondents

The age of the respondents ranged from 60 to 100 years, with a mean of 71.37 ± 8.87 years. Adults aged 60–70 years constituted the largest group (56.3%). A total of 56.3% of respondents were men, 62.2% were married, 31.6% had no formal education, and 33.4% were retired. In addition, 33.4% of the respondents earned 10,000–20,000 Nigerian naira per month (see Table 1).

Table 1 Socio-demographic profile of the study population ($n = 330$)

Variable	Frequency	Percent (%)
Age (years)		
60–70	186	56.3
71–80	84	25.3
81–90	59	17.8
91–100	2	0.6
Sex		
Male	186	56.3
Female	144	43.8
Marital status		
Single	6	1.9
Married	205	62.2
Divorced	6	1.9
Widow	112	34.1
Education		
Primary	75	22.8
Secondary	51	15.3
Tertiary	100	30.3
No formal education	104	31.6
Occupation		
Artisans	14	4.4
Civil servant	13	4.1
Farming	41	12.5
None	43	13.1
Clergy	6	1.9
Retiree	110	33.4
Trading	101	30.6
Income (naira, ₦)		
Less than 10,000	80	24.4
10,000–20,000	110	33.4
20,000–30,000	60	18.1
30,000 and above	79	24.1

Table 2 Nutritional status and level of physical activity of the respondents

Variable	Frequency	Percent (%)
Nutritional status		
Normal	245	74.1
Risk of malnutrition	79	24
Malnourished	6	1.9
Level of physical activity		
Low	104	31.6
Moderate	138	41.8
High	88	26.6

Table 2 shows the nutritional status and level of physical activity of the respondents. The results indicated that 74.1% of the respondents had normal nutritional status and 24.0% were at risk of malnutrition, while 1.9% of the respondents were malnourished. Also, 31.6% of the respondents had low physical activity and 41.9% had moderate physical activity, while 26.6% had high physical activity.

The results from this study showed that a majority (64.4%) of the respondents were living with at least one chronic condition, and musculoskeletal (25.6%), heart diseases (16.6%), and ear/eye problems (9.7%) were the leading chronic conditions among them (Table 3).

A bivariate analysis of associations between chronic illness and socio-demographic variables of the older adults revealed that age, level of education, income, physical activity (all at $p < 0.001$), and nutrition ($p = 0.045$) were significantly associated with chronic illness (see Table 4). Similarly, age, marital status, level of education, BMI, level of income (all at $p < 0.001$), and occupation ($p = 0.013$) were significantly associated with nutritional practices (see Table 5).

Table 3 Presence of morbidity in the respondents

Presence of chronic condition	Frequency	Percent (%)
No	118	35.6
Yes	212	64.4
Total	330	100.0
Chronic condition		
BPH	6	1.9
Ear/eye problem	32	9.7
Heart diseases	55	16.6
GIT	29	8.8
Musculoskeletal	85	25.6
Respiratory	6	1.9
None	118	35.6
Total	330	100.0

BPH = benign prostatic hypertrophy, GIT = gastrointestinal tract

A binary logistic regression analysis was performed to assess the impact of a number of factors on the likelihood that respondents would develop chronic illness. The model contained nine independent variables (nutrition, physical activity, BMI, age, gender, marital status, education, occupation, and income). The full model containing all predictors was statistically significant [χ^2 (18, $N = 326$) = 146.46, $p < 0.001$], indicating that the model was able to distinguish between respondents who reported and did not report a chronic illness. The model as a whole explained 35% of the variance in the

Table 4 Bivariate analysis of associations between chronic illness and socio-demographic variables of the older adults

	Illness				
Variable	Yes	No	Total	χ^2	p
Age (years)					
60–70	99	87	186	41.25	0.000*
71–80	14	69	83		
81–90	11	47	58		
91–100	1	1	2		
Gender					
Male	71	114	185	0.01	0.931
Female	55	90	145		
Marital status					
Single	6	6	12	5.68	0.059
Married	87	119	206		
Widow	33	79	112		
Occupation					
Retiree	65	108	173	0.17	0.918
Artisan	21	35	56		
Trading	40	61	101		
Level of education					
No formal education	19	86	105		
Primary	47	28	75	44.24	0.000*
Secondary	12	38	50		
Tertiary	47	53	100		
Income					
Less than 10,000	13	67	80	20.42	0.000*
10,000–20,000	52	59	111		
20,000–30,000	27	33	60		
30,000 and above	34	45	79		
Nutrition					
Good	101	143	244	4.02	0.045*
Poor	25	61	86		
Physical activity					
Low	26	78	104	48.35	0.000*
Moderate	39	99	138		
High	61	27	88		

*Indicates significance at $p < 0.05$

Table 5 Bivariate analysis of associations between nutrition and social-demographic variables of the older adults

Variable	Nutrition				
Age (years)	Normal (%)	Poor (%)	Total (%)	χ^2	*p*
60–70	161 (48.8)	25 (7.6)	186 (56.4)	69.9875	0.000
71–80	65 (19.7)	17 (5.2)	82 (24.8)		
81–90	20 (6.1)	40 (12.1)	60 (18.2)		
91–100	1 (0.3)	1 (0.3)	2 (0.6)		
Total	247 (74.8)	83 (25.2)	330 (100.0)		
Marital					
Single	14 (4.2)	0 (0.0)	14 (4.2)	36.3133	0.000
Married	169 (51.2)	32 (9.7)	201 (60.9)		
Widow	64 (19.4)	51 (15.5)	115 (34.8)		
Total	247 (74.8)	83 (25.2)	330 (100.0)		
Level of education					
No formal education	42 (12.7)	65 (19.7)	10,732.4	112.9579	0.000
Primary	63 (19.1)	12 (3.6)	7522.7		
Secondary	43 (13.0)	6 (1.8)	4914.8		
Tertiary	99 (30.0)	0 (0.0)	9930.0		
Total	247 (74.8)	83 (25.2)	330 (100.0)		
Level of income					
Less than 10,000	38 (11.5)	46 (13.9)	84 (25.5)	57.8982	0.000
10,000–20,000	85 (25.8)	24 (7.3)	109 (33.0)		
20,000–30,000	51 (15.5)	7 (2.1)	58 (17.6)		
30,000 and above	73 (22.1)	6 (1.8)	79 (23.9)		
Total	247 (74.8)	83 (25.2)	330 (100.0)		
BMI					
Below 18.5 (underweight)	0 (0.0)	31 (9.4)	31 (9.4)	120.0299	0.000
18.5–24.9 (normal weight)	90 (27.3)	27 (8.2)	117 (35.5)		
25.0–29.9 (pre-obesity)	138 (41.8)	12 (3.6)	150 (45.5)		
30.0–34.9 (obesity)	19 (5.8)	13 (3.9)	32 (9.7)		
Total	247 (74.8)	83 (25.2)	330 (100.0)		
Occupation					
Retiree	47 (14.2)	7 (2.1)	54 (16.4)	8.6897	0.013
Artisan	107 (32.4)	50 (15.2)	15,747.6		
Trading	93 (28.2)	26 (7.9)	11,936.1		
Total	247 (74.8)	83 (25.2)	330 (100.0)		

BMI = body mass index

dependent variable. The independent variables nutrition (OR = 0.11, $p = 0.001$), high physical activity (OR = 0.13, $p < 0.001$), BMI overweight (OR = 0.127, $p < 0.000$), obesity (OR = 0.366, $p = 0.172$), age 71–80 (OR = 6.27, $p < 0.001$), primary education (OR = 0.02, $p < 0.000$), tertiary education (OR = 0.13, $p = 0.02$), artisan occupation (OR = 0.18, $p = 0.002$), trading occupation (OR = 0.088, $p < 0.001$), and income N10,000–20,000 (OR = 0.178, $p = 0.002$) made unique statistically significant contributions to the model. However, age (71–80) was the strongest predictor of chronic illness, while the least predictive was primary school education (see Table 6).

Discussion

Findings from the study showed that there is a high prevalence of chronic conditions among older adults in this population. This finding is similar to a previous study by Faronbi et al. (2019), which revealed that chronic illness is prevalent among the Nigerian older adult population. The high prevalence might be attributed to the global ageing population, where people are living longer, and the increasing opportunity to live with chronic conditions. Also, a significant proportion of the population may be living in a disadvantaged area where access to preventive care may

Table 6 Logistic regression analysis to predict the specific condition/disease or no disease

Illness	OR	SE	*z*	*p* > *z*	95% CI	
Nutrition						
Risk for malnutrition	0.100	0.069	−3.33	0.001	0.026	0.388
Malnourished	1.000	(empty)				
Physical activity						
Moderate	1.053	0.467	0.12	0.907	0.442	2.512
High	0.130	0.074	−3.6	< 0.000	0.043	0.395
BMI						
Normal	Ref					
Under-nourished	1.000	(empty)				
Overweight	0.127	0.066	−3.98	< 0.000	0.046	0.351
Obesity	0.366	0.269	−1.37	0.172	0.087	1.548
Age category						
60–70	Ref					
71–80	6.273	2.987	3.86	< 0.000	2.467	15.953
81–90	2.565	1.502	1.61	0.108	0.814	8.082
91–100	0.279	0.478	−0.75	0.456	0.010	8.004
Gender						
Male	Ref					
Female	1.087	0.340	0.27	0.789	0.589	2.008
Marital status						
Single	Ref					
Married	2.662	1.917	1.36	0.174	0.649	10.917
Widow	1.609	1.468	0.52	0.602	0.269	9.625
Education						
No formal education	Ref					
Primary	0.019	0.015	−4.99	< 0.000	0.004	0.090
Secondary	0.370	0.306	−1.2	0.229	0.073	1.871
Tertiary	0.132	0.115	−2.32	0.02	0.024	0.731
Occupation						
Retiree	Ref					
Artisan	0.163	0.094	−3.14	0.002	0.053	0.506
Trading	0.117	0.066	−3.81	< 0.000	0.039	0.353
Income						
< 10,000	Ref					
10,000–20,000	0.178	0.099	−3.09	0.002	0.059	0.532
20,000–30,000	0.088	0.063	−3.39	0.001	0.022	0.360
30,000 and above	0.158	0.112	−2.59	0.01	0.039	0.638

BMI = body mass index

be highly limited, thereby increasing their vulnerability to chronic illness.

It is worth mentioning that more than a quarter of the population is at risk for nutrition problems. This is similar to that reported by Nurizky et al. (2017), who found that 37% of their study population were at risk of malnutrition. An urgent intervention in this regard might have brought about a better outcome and prevented irreparable damage that may exacerbate the progression of malnutrition among older adults. Furthermore, findings showed that 1.9% were malnourished; this agrees with the study conducted by Ribeiro et al. (2011), who observed a prevalence of malnutrition of 1.3% among community-dwelling older adults in Brazil. This finding is also lower than that obtained by Ghani et al. (2013), who reported that 5.53% of their subjects were suffering from malnutrition. The respondents within the group aged 81–90 years had the highest proportion (40 respondents) at risk of malnutrition. Also, at this age, there may have been significant loss of muscle mass as compared to the middle-aged older adults (60–70 years). This supports

the assertion that malnutrition is most common in the upper geriatric age group (80 years and above) (Ghani et al. 2013). This finding also correlates with the results by Lahiri et al. (2015), where older age was associated with lower MNA scores. Baweja et al. (2008) similarly found that as age increases, malnutrition and risk of malnutrition increase. It can be concluded that this age group is more dependent, less mobile, and more isolated than those 60–70 years of age.

Furthermore, Baweja et al. (2008) established that age alone had a significant and independent effect on important anthropometric and biochemical nutritional assessment variables. They argued that increasing age was independently associated with poor nutritional status.

Findings from this study also revealed a significant relationship between gender and nutritional status of the older people ($p < 0.05$). This agrees with the findings of Ghani et al. (2013), where malnutrition was prominent in males (23.16%) as compared to females (18.95%) of the same age group based on the MNA score. Also, nutrition was significantly associated with chronic illness (OR = 0.11, $p = 0.001$). Experts have suggested that nutrition is a major modifiable determinant of chronic disease, and scientific evidence has been released to support the role of diet in altering the impact, both positive and negative, on health throughout life (WHO Joint Consultation 2003). Similarly, other scholars have suggested that consuming high-quality foods was associated with a lower risk of chronic disease and mortality over 20 years of follow-up (Hay et al. 2017). Furthermore, findings from this study revealed an association between chronic illness and overweight (OR = 0.127, $p < 0.000$). Kearns et al. (2014) identified overweight and obesity as significant contributors to the burden of chronic disease in the population. They, therefore, suggested that a relatively modest reduction in average BMI in the population could result in a significant impact on the burden of chronic disease.

High physical activity was significantly associated with chronic illness, as high physical activity reduced the odds for chronic illness (OR = 0.13, $p < 0.001$). Regarding the relationship of age with physical activity, of the 81 respondents (25.3%) in the71–80 age group, 36 (11.3%) reported low physical activity, while 11 (3.4%) reported high physical activity. Of the 57 respondents (17.8%) in the 81–90 age group, 29 (9.1%) reported low physical activity, while only 2 (0.6%) reported high physical activity. This result suggests that increased age is associated with reduced physical activity.

Similarly, in a study by Babatsikou et al. (2012), people of both sexes aged 65–79 years showed a significantly higher rate of physical activity than those aged 80–90 years. The findings also agreed with Milanović et al. (2013), who reported that both men and women became progressively less active with increasing age, and hence this negatively affected their muscle strength, endurance, and body structure. Also, findings from this study agree with Murtagh et al. (2015), who showed a significant difference in physical activity levels between all age groups (60–64, 65–69, 70–74, 75+), with physical activity levels declining with age also supporting this study. Moderate physical activity was dominant compared to low and high physical activity, and this is because most physical activity by the respondents occurred incidentally, i.e. from activities of daily living (ADLs), and not from any planned exercise or leisure-time activity. The result is also consistent with the report by Milanović et al. (2013), where energy consumption estimated by the IPAQ showed that moderate physical activity, as compared with walking and heavy physical activity, accounted for almost half the energy consumed by both men and women, regardless of age category. The job status of the respondents can be said to have influenced their level of physical activity. Those who had no job, the retirees, and traders had lower physical activity than those with an active job. The physical activity level of the respondents was influenced by duties at work, gardening activity, or household chores but not by leisure-time activity. This suggests that respondents' tasks at work are associated with their level of physical activity. A recent study by Gudnadottir et al. (2019) found that occupational activity (OA) was associated with self-reported physical activity. They observed that a higher proportion of individuals in high-OA jobs (e.g. construction workers and farm workers) met the physical activity guidelines than those in medium-OA (e.g. clerks and fabricators) and low-OA jobs (e.g. administrators and engineers).

Non-communicable disease is highly prevalent in this population, as evidenced by the presence of non-communicable disease reported by 61.9% of the respondents. The findings of this study agree with the findings by Clausen et al. (2000) and Mahesh et al. (2013), where major geriatric problems such as visual problems and hypertension were reported among their population.

Furthermore, a significant association was observed between nutrition and physical activity (p-value of 0.000, $r = -0.274$) at a 0.05 level; the direction of the correlation may mean that increased BMI (for obese people) may hinder their ability to engage in high levels of physical activity. Also, a significant association was found between nutrition and morbidity (p-value of 0.019, $r = -0.131$) at a 0.05 level; the direction of the correlation may mean that underweight older adults are more prone to having a prolonged period of the disease condition. There was a significant association between physical activity and morbidity as well (p-value of 0.000, $r = 0.339$) at a 0.05 level. Staying physically active and engaging in regular exercise can produce long-term health benefits and even improve health for some older people who already have diseases and disabilities. A systematic review evaluating the benefits of physical activity by Windle et al. (2010) confirmed that being physically active was associated with improved physical functioning in activities

such as walking. A population-based study by Chen (2010) confirmed the importance of physical activity in the prevention of progressive functional decline. Improvements in muscle strength in old age have been observed in response to physical activities (Taylor et al. 2004).

Implications

Health workers play a vital role in health promotion, including helping clients to make responsible, informed decisions on how to maintain or improve their health as they age. Despite the burden of increased non-communicable disease that is likely to occur as an individual grows old, with proper education on the importance of good nutrition and physical activity by health workers, an individual could experience minimal morbidity as they age.

Also, health workers can develop an individual plan for the promotion of activities for older people. This is useful in planning activities that fit the old people's condition and provide advice on the possible benefits of increased physical activity and adequate nutrition for the health condition of the older adult as a routine part of care. Strategies for the implementation and maintenance of individual and structured activities should be developed, and the benefits of good and adequate nutrition and physical activity among older adults should be emphasized.

Limitations

There are several limitations of this study. First, because of the self-reported nature of all the variables explored in the study, the information was not objectively verified by clinicians or with the use of laboratory parameters. This introduced the possibility of recall bias. In addition, the possibility of denial or misinterpretation of certain health conditions by some older adults could not be ruled out. However, the use of objectively validated instruments gives strength to the study, and therefore the results can be generalized with respect to the significant findings.

Recommendations

The following recommendations are proposed based on the findings of this study:

- There should be an increased focus on geriatric care, as this promotes health education and follow-up for the older adults.
- People aged 60 years and above should be encouraged to develop an exercise plan inside and outside the house, as this motivates them to maintain a high level of physical activity that helps improve their muscle mass.
- The physical activity plan for each older person should be tailored to their state of health in a way that improves any existing non-communicable diseases or maintains their health status for those who are healthy.
- The health care provider should become involved in nutrition monitoring for early detection of malnutrition and nutrition-related diseases.
- Provision of financial grants and monthly welfare packages to the older adults helps them provide for their nutritional needs to combat malnutrition.
- There should be regular payment of pensions and gratuity to retirees.
- Financial empowerment for middle-aged older adults should be provided to enhance their income.

Conclusion

This study showed that there is a significant association between nutrition, physical activity, and morbidity among the older adults, and a majority of older adults did not achieve a high level of physical activity.

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Authors' contributions FJO made substantial contributions to conception and design, made the statistical analyses, drafted the manuscript, gave final approval of the version to be published, and agreed to be accountable for all aspects of the work. TEA, OAI, and OMO made substantial contributions to conception and design, revised the manuscript critically for intellectual content, gave final approval of the version to be published, and agreed to be accountable for all aspects of the work.

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Data Availability The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval Ethical clearance for the study was obtained from the Human Research Ethics Committee, Institute of Public Health, Obafemi Awolowo University, Ile-Ife, Nigeria.

Consent to participate All the participants gave informed consent before participation in the research, and they were assured of the confidentiality of any information provided.

Consent for publication All the participants gave informed consent regarding publishing of anonymous data collected for the study.

Conflicts of interest/Competing interests The authors declare that they have no conflict of interests.

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