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Obesity in Nigerian Adults and the Associated Cause and Impact on the Population

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ABSTRACT

Background: Obesity has been on the rise in developed and developing countries such as Nigeria. Data from the WHO demonstrated the prevalence of obesity increased by 15% between 2002 and 2016 in Nigeria. Here, we examine the rate of obesity in Nigerian adults and the associated cause and impact on the population.

Methods: An electronic search was conducted from November 2020 to October 2022 across PubMed, PMC, Science Direct and NU search. A formal search strategy was used to combine the keywords. The retrieved studies were filtered through inclusion and exclusion criteria. Fifteen studies were included in this systematic review. The data of the included studies were extracted using the Critical Appraisal Skills Programme (CASP) checklist and results analysed with Revman meta-analysis.

Results: Three key themes were identified across the 15 studies: socio-economic status, sedentary lifestyle and diet-associated obesity. Obesity was found in an average of 22% (n=1042) and 34% (n=2361) females and males, respectively. As such, the rate of obesity was overall significantly higher in Nigerian females than males.

Conclusion: The prevalence of obesity in Nigeria was high with Nigerian adult females more affected. The high rate of obesity was associated with non-communicable diseases (NCDs) such as gestational diabetes, diabetes mellitus, stroke, cardiovascular disease and cancer. Support from health care professionals, nursing practitioners and governmental interventions are required to reduce the burden on and the deterioration in Nigerian adults' health and wellbeing.

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Introduction

According to the World Health Organisation (WHO) (2016), since 1975, global obesity defined as a non-communicable disease has tripled, with an estimated 650 million adults worldwide. During that period, the rate has increased from 21.5% to 38.9% with over 3 million people dying globally every year with no signs of a decline (WHO, 2016).

Obesity arises as a result of accumulated excess body fat in individuals caused by high consumption of unhealthy energy dense foods, sugar and saturated fats (junk foods) and beverage drinks (beer, coca cola) (WHO, 2016). An unhealthy dietary pattern combined with reduced physical activity (sedentary lifestyle) enhanced the risk of an individual gaining weight and becoming obese [1]. Consequently, according to a previous study by Sola et al. (2011), unhealthy lifestyles led to obesity associated with adverse effects on health such as hypertension, cardiovascular disease (CVD), dyslipidaemia, stroke, cancer and diabetes mellitus [2]. For this reason, WHO (2015) described obesity as a complex disease (WHO, 2015) with other factors, such as genetics and social-economic status, also having an influence on the prevalence of obesity in individuals [2, 3].

To assess the prevalence of obesity, various measurement tools, such as the waist- hips ratio (WHR) could be used. The WHR measured the waist-hip circumference determines the amount of fat stores in the waist, hips and buttocks of an obese individual [4]. However, Lear et al. (2010) stated there are ethical issues associated with WHR. For example, WHR cut-off points varies among ethnic groups. There are specific cut-off points for populations in South-America, Europe, Asia and Africa as body compositions differ. Thus, according to the body mass index (BMI) is the most reliable measurement tool [5].

The BMI measures individuals' body fat based on the weight in kilograms (kg) and height in meters (m^2). As such, the BMI is subdivided in criteria [5]. A normal BMI is between 18.5 - 24.9 kg/m^2 . A BMI of 30.0 - 34.9 kg/m^2 is classified as class I obesity (low- risk), whereas class II (moderate- risk) is a BMI of 35.0 - 39.9 kg/m^2. A BMI greater than 40.0 kg/m^2 is seen as high-risk and classified as class III obesity (Pletcher, 2016). WHO (2017) predicted over 1 billion adults worldwide would have a high BMI by 2025 [6].

Globally, obesity is seen in children and adults and the rise in obesity has resulted in a major public health concern in numerous high-income countries including North America and Europe. Countries in the Middle East (e.g., Pakistan) and Latin America (e.g., Brazil) also reported a similar effect with obesity with increased female prevalence. In 2016, more than 20% of females were obese in 14 Latin American countries and in the Middle East over 30% of females. The high percentage of obesity has resulted in a regional shift in many countries, a shift also seen in Sub-Saharan African countries, where more than 1.9 billion adults were either overweight or obese in 2017 [6,7]. Countries in the Sub-Saharan Africa were slowly transitioning from a traditional diet, that contained high amounts of fibre and carbohydrate and low amounts of sugar and fat, to a diet high in saturated fat, energy, sugar and sodium as compared to Western countries. Despite this slow nutritional transition, the rate of obesity appears to have significantly increased in Nigeria [5].

Nigeria, a country located on the western coast of Africa is a federal republic and comprises 36 states, with the official language being English as a result of colonisation, which started in 1901 and ended in 1960 [8].

Since Nigerian independence, it has endured decades of political instability and economic inequality, which has had a negative impact on the country's education, nutrition, health care system and the entire country. For example, most of the Nigerian population live in deprived areas [9]. A previous report by the National Bureau of Statistics in 2020, stated more than 40% (84.8 million people) of the total population (212 million people) in Nigeria live in poverty (National Bureau of Statistics, 2020). However, people living in larger Nigerian cities such as Lagos and Abuja where there is rapid economic development, are more likely to find a job (e.g., office job, roadside trading). As such, they are financially capable to consume varieties of foods and have more accessible facilities (e.g., healthcare) to improve their living condition. Thus, the inequality in the economic status impacts greatly the health of many Nigerians, where obesity has been on the rise. Data from WHO between 2002 and 2016 illustrated the prevalence of obesity in Nigeria with an increase of approximately 15%. The highest rate of obesity was reported in the South- East and North-East Nigeria. Nearly 40% (n= 364) of the people who lived in the South-East were obese with approximately 30% (n= 209) in the North-East. In 2020, an estimated 12 million individuals presented with obesity in Nigeria. The high rate of obesity led to an increase in non-communicable diseases (NCDs) such as diabetes mellitus (WHO, 2020). Estimated 5.8% (n= 6 million) of Nigerians adults were diagnosed with diabetes mellitus in 2018 with a consequential impact on the mortality rate [10]. According to the WHO (2021), NCDs accounted for nearly 30% of all deaths in Nigeria of which 3% related to diabetes and 12% CVD [11].

Ezeigwe et al. (2020) explained demographic changes, growing income, and sedentary lifestyles, cultural perceptions, lack of education, fertility and the intake of highly processed diets were the drivers for nutritional, socio-economic and western inequity attributing to obesity in Nigeria [12]. Moreover, analysed the obesity prevalence data and stated it was higher in females than males, a possible reason that Nigerian males were likely to be taller than the female counterparts [13].

The high prevalence of Nigerian obesity also impacts on the quality of life (QoL), self- esteem, productivity and the health of Nigerian individuals [13]. This negatively impacts health care costs in treating obesity with medical care, mediation and physician consultation costs for obese individuals with NCDs nearly three times higher (£172) than the cost for non-obese Nigerian individuals (£69) [14, 15].

Also stated there were more obese individuals admitted to the hospitals than non-obese individuals. This increase in obese patients increased the pressure and burden on health care professionals. For example, not all hospitals had suitable facilities [15]. With the potential high medical bills or expensive medication requirements, medical treatment was not always immediately sought among most Nigerians and as such late disease diagnosis impacted mortality rates associated with obesity [16].

Here, we examine the associated cause and impact of obesity in Nigerian adults.

Methods

Pubmed, PMC, ScienceDirect, NUsearch and British Medical Journal were searched from 2011 to 2019 using a broad search strategy to identify all potentially relevant publications. The text words contained in the titles and abstracts of relevant articles and the index terms used to describe the articles were used to develop a full search strategy. The search strategy, including all identified keywords and index terms, was adapted for each database source included. Initial keywords used in this review were "obesity", "Nigerian", "adults", "cause" and "impact" together with the Boolean operator "AND" or "OR". Finally, additional studies were searched for in the reference lists of all identified reports and articles. 150 studies identified and removed as duplicates. The titles and abstracts of remaining 126 articles read and 60 studies excluded using the pre-determined inclusion and exclusion criteria. Sixty-six articles further screened and full-text assessed for eligibility. A total of 15 papers met the inclusion criteria and 51 articles were added to the excluded studies. The overview of the search result was presented using a PRISMA flow diagram. A Critical Appraisal Skills Programme (CASP) checklist was used to assess, evaluate and critique the included papers.

Inclusion and Exclusion Criteria

Studies were included if they met the following criteria: 1) subjects were Nigerian population diagnosed with obesity and $\geq$ 18 years old; 2) studies of obesity interventions that measured the BMI (body mass index), waist- hip ratio, dietary measurements and questionnaires; 3) studies that reported the rate of obesity between Nigerian males and females; 4) the onset of obesity class I, II and III were reported as outcomes; 5) studies: descriptive and cross-sectional studies. Studies were excluded if they were in a language other than English, published before 2000, case studies and systematic or narrative reviews.

Study Selection

A process of screening and supplementary search parameters were used to ensure relevance to the topic and duplicate articles were removed. Following abstract review, studies were excluded if they were not primary research, unrelated to obesity, excluded

non- Nigerian ≥ 18 years old and young Nigerian ≤ 18 years old as participants, non-English language or did not have full text available for the review. The full text of selected studies was assessed in detail against the inclusion criteria by two independent reviewers. Reasons for exclusion of full-text studies that did not meet the inclusion criteria were recorded and reported. The results of the search were reported in full in the final report and presented in a Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram.

Quality Assessment

The selected studies were critically appraised for methodological quality using the Critical Appraisal Skills Programme (CASP) checklist and checked with the second reviewer.

Data Extraction

Data from the selected studies were extracted using standardised data tables to bring all data together for easy reference. These included author/year/country, sample size, age range, intervention, clinical and study outcomes.

Data Analysis

Data analysis was conducted using the RevMan meta-analysis Review Manager 5.4.1. Tabulated data of the mean difference and standard deviation between obesity in females and males were extracted from the included studies at three criteria (socio-economic status, sedentary lifestyle and diet). Meta-analyses were performed separately according to each criterion to estimate the rate of obesity by using random effect models depending on the level of heterogeneity. Outcomes were reported as mean difference with 95% confidence intervals (CIs). Heterogeneity was measured using the I2 index. A p-value less than 0.05 was considered statistically significant.

Results

Socio-Economic Status and Obesity

Five studies comprising 5495 participants used the BMI to measure how low socio- economic status in Nigeria influenced the prevalence of obesity. A combined effect of the results demonstrated that 1196 (21.8%) Nigerian females and 519 (9.4%) Nigerian males were obese. The effect size indicated a statistically significant mean difference of 17.17 (95% CI, 12.64, 21.70) between the obese Nigerian females and males (figure 2). Although obesity was more common among Nigerian females, the number of Nigerians with class I and class III obesity were higher in the males. Approximately 70% (n= 369) of the Nigerian males had a BMI of 30.0- 34.9 kg/m2 (class I obesity) and nearly 9% (n= 43) were severe obese. However, among the Nigerian females, the percentage was slightly lower. Nigerian females that were diagnosed with class I obesity was 64.5% (n=772) and 8% (n= 96) had class III obesity. Class II obesity was more common among the Nigerian females (27.4%, n= 328) compared to the males (20.6%, n= 107) (Table 1 and 2).

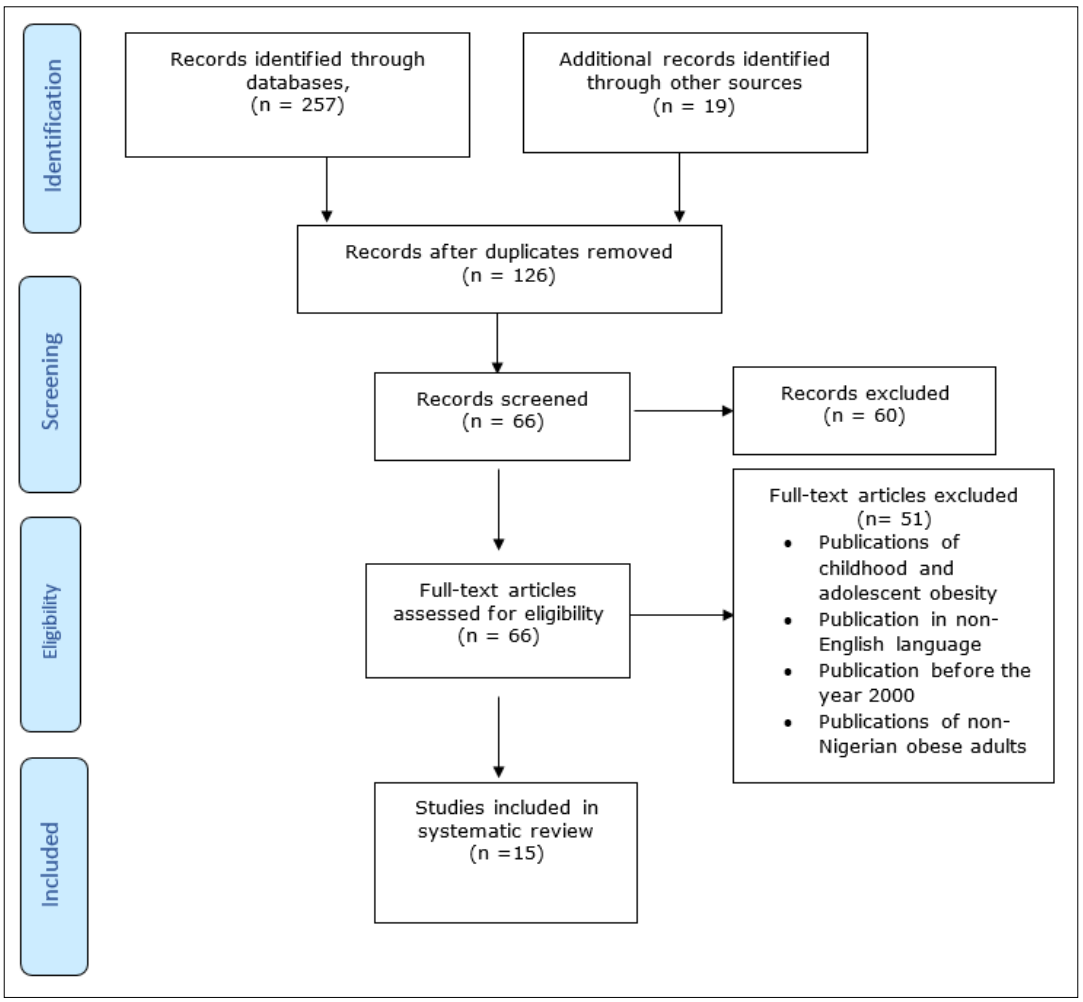

Figure 1: PRISMA Flow Diagram Identifying Studies Included [17]

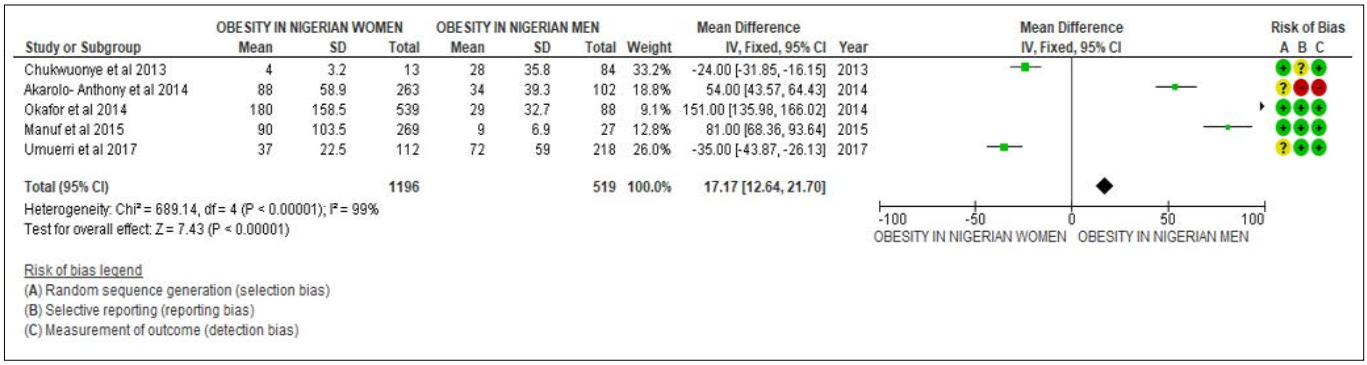

Figure 2: Forest Plot of Comparison: Association between Socio- Economic Status and Prevalence of Obesity in Nigerian Women and Men Outcome: Women were More Likely to Become Obese Affected by Low Socio- Economic Status

Table 1. Characteristics of included studies

							Males (%)			Females (%)			END OF DISCUSSION CHAPTER
		Location	Total sample size adults (males/ females)	Age range (years)			I	II	III	I	II	III	
1.Iloh et al. (2011)	Descriptive	Imo state, Nigeria	429 (308/121)	18- 90	BMI (kg/m²)	Nearly 35% of the participants were obese. Obesity was likely to be seen among the males (84/ 308) than the females (45/121). Although, there were more male participants than females, which may have caused the difference.	42	3	0	69	12	3	Nigerian males who were living in Imo state presented a higher rate of obesity compared to the females. The prevalence of obesity was associated with hypertension and dyslipidaemia among the population. The study only used BMI measurement for obesity, which was one of the study's limitations.
							T: 84 (27)			T: 45 (37)			
2.Sola et al. (2011)	Cross-sectional	Benin state, Nigeria	435 (137/ 298)	18-45	BMI (kg/m2) Waist- hip ratio (cm)	Obesity was seen among 34% (102/ 298) females whiles less than 15% (15/ 137) of the males were obese. The males were only diagnosed with class I obesity. Females were diagnosed with class I and class II obesity.	15	0	0	77	25	0	There was a high prevalence of obesity in females from Benin state. Only a small number of males were diagnosed with obesity. Severe obesity was not presented in both genders. The females were either diagnosed with class I and II obesity whereas males presented only class I obesity. The study was limited by the selection of participants. More females in the rural and urban communities were included than males.
							T: 15 (11)			102 (34)			
3.Wahab et al. (2011)	Cross-sectional	Katsina, Nigeria	300 (129/ 171)	25- 55	BMI (kg/m²)	Less than 10% (12/ 129) of the males were diagnosed with obesity. Thirty percent (51/ 171) of the females were obese. Severe obesity was only seen among the females (7).	10	2	0	32	12	7	Reduced physical activity contributed to the prevalence of obesity in Katsina. The females were less likely to participate in doing physical activity compared to the males. For this reason, a higher rate of obesity was seen among the females. The participants recruited for the study were only public and hospital staff. Not the entire Northern population. Therefore, the rate of obesity could have been higher.
							T: 12 (9)			51 (30)			

4.Adienbo et al. (2012)	Cross-sectional	Kalabari, Nigeria	304 (117/187)	20- 70	BMI (kg/m2) Waist- hip ratio (cm)	The prevalence of generalised obesity was more seen in females (47%, 88/187) than males (42%, 49/117). In both genders, class III obesity was the lowest.	30	14	2	67	12	9	There was a high prevalence of obesity among the indigenous residents of Kalabari, predominantly among the females. Diet was the most contributing factor. Government agencies had organised campaigns to raise awareness about the health complications related to obesity and to reduce intake of high caloric food. A limitation of the study was that only indigenous residents living in Kalabari were examined to conclude the rate of obesity.
							T: 49 (42)			88 (47)			
*M= men, F= women, BMI= body mass index, T= total participants obese, Obesity classification- I= 30- 34.9 kg/m2, II=35- 39.9 kg/m2, III= > 40 kg/m2													
													conclude the rate of obesity.
5.Ngwogu et al. (2012)	Cross-sectional	Abia State, Nigeria	1818 (725/ 1093)	18- 55	BMI (kg/m2)	Nearly twice as many females (34%, 372/ 1093) were obese compared to the males (19%, 138/ 725).	76	62	0	282	90	0	More female citizens from Abia state were diagnosed with obesity. Class I and II obesity was predominantly seen in both genders whereas class III obesity was not common among the population. More results could have been obtained for the study if additional measurements were used besides the BMI.
							T: 138 (19)			372 (34)			
6. Oyeyemi et al. [21]	Cross-sectional	Maiduguri, Nigeria	310 (148/162)	20- 65	BMI (kg/m2) Sociodemographic characteristics	There was a slight difference in obesity rate between the females (17%, 27/162) and males (18%, 26/148). Severe obesity was not seen in both genders.	19	7	0	21	6	0	A similar number of females and males living in Maiduguri were diagnosed with obesity. Class I and II obesity was presented in both genders. Lack of physical activity contributed to the prevalence of obesity. Measures to analyse food intake among the participants were not included in the study to further explain the rate of obesity.
							T: 26 (18)			27 (17)			
7. Chukwuo nye et al. (2013)	Cross sectional	Umuahia, Nigeria	375 (225/150)	20-65	BMI (kg/m2)	The prevalence of obesity was more seen among the males (37%, 84/ 225) than females (9%, 13/ 150). All three classifications of obesity were more seen among the males.	69	12	3	8	3	2	A small number of females were diagnosed with obesity. Higher levels of obesity were more seen among the males. The rate of obesity was influenced by the socio-economic status. The study only used BMI measurement to investigate the rate of obesity. The reliability of the result could have been enhanced if the study used additional measurements such as waist circumference.
							T: 84 (37)			13 (9)			
8.Adebayo et al. (2014)	Cross-sectional	Ife, Southwest-Nigeria	227 (145/82)	20- 90	BMI (kg/m2) Waist- hip ratio (cm)	Only a small percentage (15%) of participants had normal weight. More males (39) appeared to be obese than females (27).	30	6	3	17	5	5	The prevalence of obesity in Ife state was more seen among the males than the females. Obesity class I was more common among the population. The study only included participants living in three rural communities, not the entire southwest Nigeria. Therefore, the rate of obesity could have been higher.
							T: 39 (27)			T: 27 (33)			
9.Akarolo- Anthony et al. [22]	Cross-sectional	Abuja, Nigeria	1041 (416/ 625)	30- 50	BMI (kg/m2) Physical activity questionnaire Dietary measurement (FFQ)	A higher rate of females (263/ 625) appeared to be obese compared to the males (102/ 416). Class III obesity was only seen among the females (33/ 625).	77	25	0	150	80	33	Nigerian females living in the capital of Nigeria, Abuja, presented a higher rate of obesity compared to the males. Obesity class I was more common in both genders. The study was limited by excluding participants living in the rural areas. Therefore, the prevalence of obesity could have been higher if both rural and urban areas were investigated.
							T: 102 (25)			263 (42)			

10.Idung et al. [23]	Cross-sectional descriptive	Uyo, Nigeria	584 (196/ 388)	18- 65	Waist- hip ratio BMI (kg/m2)	Obesity was predominantly seen more in females (52%, 202/388). More than half (108/ 202) of the females that were obese appeared to be diagnosed with class I obesity, whereas less than 7% (25/ 202) were diagnosed with class 3 obesity.	44	9	2	108	69	25	Sedentary lifestyle contributed to the prevalence of obesity in Uyo. Higher rate of obesity was seen among the females. The population used in the study derived only from patients attending an outpatient clinic. The entire population was not included, which may have limited the results.
							T: 55 (28)			202 (52)			
11.Okafor et al. [25]	Cross-sectional community based descriptive survey	Enugu state, Nigeria	2392 (937/ 1455)	24- 74	BMI (kg/m2)	Obesity was presented among approximately 1/3 of the total participants. More females (539) were diagnosed with obesity than males (88).	67	12	9	356	134	49	The prevalence of obesity was high among the females living in Enugu. This was attributed to the low socio- economic status. Most of the females had low- educational level and thereby lacked nutritional awareness and the complications associated with obesity. The use of only one measurement (BMI) limited the study in obtaining more results. Also, more females participated in the study compared to males, which had resulted in the prevalence of obesity to be higher in Nigerian females.
							T: 88 (9)			539 (37)			
12.Chukwuonye et al. [1]	Cross-sectional	Abia state, Nigeria	1035 (500/ 535)	25- 65	BMI (kg/m2)	Nearly half (41%, 218/ 535) of the females that participated in the study were obese. Obesity among the males was less than 20% (95/ 500). Only 4 males were severe obese whiles among the females there were 26.	78	13	4	139	53	26	Obesity class I was more common in the citizens in Abia state. More females appeared to be obese compared to the males. Additional measurements to investigate the rate of obesity were excluded, which limited the study results.
							T: 95 (19)			218 (41)			
13.Manuf et al. [26]	Cross-sectional survey	Nnewi, Nigeria	821 (275/ 546)	18- 85	BMI Socio- economic assessment	Approximately 50% (269/ 546) of the females were diagnosed with obesity. More females were diagnosed with class I obesity while severe obesity was not seen among the females.	17	5	5	203	66	0	The prevalence of obesity was significantly more seen among the females. A small number of males living in Nnewi were obese. The socio- economic status influenced the prevalence of obesity. The study reported the use of BMI as measurement was not a suitable method for all the participants. BMI was unable to differentiate participants with pronounced muscular build. This had resulted in the level of obesity appearing higher in females.
							T: 27 (10)			269 (49)			
14.Raimi et al. [5]	Cross-sectional	Ogun state, Nigeria	412 (206/ 206)	20- 60	Waist- hip ratio Waist- to- height ratio	Nearly 1/5 (33/206) of the females were diagnosed with obesity. Only 5% (10/ 206) of the males were obese. All three classifications of obesity were more seen among the females.	8	2	0	18	9	6	Obesity was seen in a small number of females and males living in Ogun state. Higher rates of obesity were more present in females. The study recommended health education on healthy lifestyle to be implemented in Ogun state to tackle obesity. The cross- sectional study limited the study to establish causal relationship between obesity and the predictors.
							T: 10 (5)			33 (16)			

15.Umuerri et al. (2017)	Cross-sectional descriptive	Delta state, Nigeria	866 (581/ 285)	18- 65	BMI (kg/m2)	Males were more likely to be obese (218/ 581) than the females (112/ 285). Class I, II and III obesities were higher seen in males than females.	139	53	26	55	45	12	More males from the Delta state were diagnosed with obesity compared to the females. Obesity in Delta state was influenced by low socio- economic status. The citizens had a low level of education and therefore, lacked sufficient knowledge on obesity and the health complications. More male participants were included in the study compared to females. This had resulted for the prevalence of obesity to appear higher in males than females. The result would have been more accurate if the same number of females and males were examined.
							T: 218 (39)			112 (38)			

Table 2: Percentage of Nigerian Females and Males Diagnosed with Class I, II and III Obesity Influenced by Socio- Economic Status, Sedentary Lifestyle and Diet

Obesity Classification						
	Class I (BMI 30.0- 34.9 kg/m²)		Class II (BMI 35.0- 39.9 kg/m²)		Class III (BMI > 40.0 kg/m²)	
	% Females	% Males	% Females	% Males	% Females	% Males
Socio- economic Status	64.5	71.1	27.4	20.6	8	8.7
Sedentary Lifestyle	67.3	65.1	27.6	34.0	5.1	0.8
Diet	71.1	80.2	20.6	16.1	8.3	3.7

BMI: Body Mass Index

Sedentary Lifestyle and Obesity

Five studies with 3424 participants reported the association of sedentary lifestyle and obesity in Nigeria. A combined effect of 685 (20%) Nigerian females and 241 (7%) males were either diagnosed with class I, II or III obesity. The effect size indicated a non-statistical significance between obese Nigerian women and men with an effect size of 27.92 (95% CI, 11.41, 44. 44) (see figure 3). The result showed obesity was more common in Nigerian females than males. Furthermore, class I obesity was found among 67.3% (n= 461) of the 685 Nigerian females, whereas class II was seen in 27.6% (n= 186) females. Less than 10% (n= 38) of the females were severe obese (BMI >40 kg/m2). Class I obesity was also higher among Nigerian males (65.1%, n= 157), whereas 34% (n= 82) of the males were diagnosed with class II obesity. Only 0.8% (n= 2) of the males appeared to have class III obesity (Table 1 and 2).

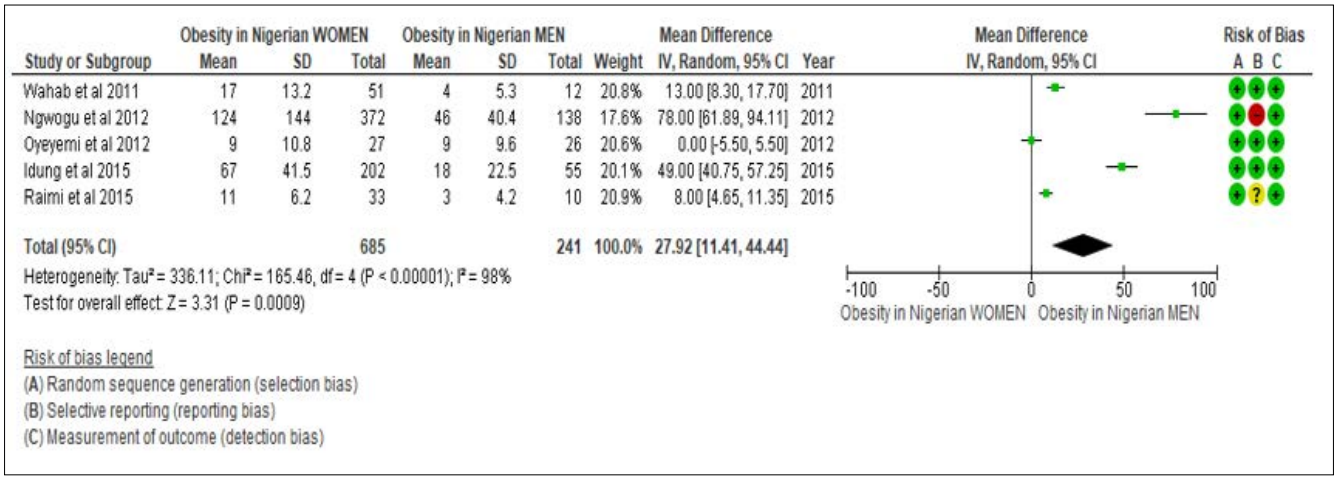

Figure 3: Forest plot of comparison: Association between sedentary lifestyle and prevalence of obesity in Nigerian Women and Men outcome: Significantly, a higher number of Nigerian women became diagnosed with obesity as result of sedentary lifestyle compared to Nigerian men

Diet and Obesity

Five studies with 2430 participants investigated how diet increased the risk of obesity in Nigeria. A combined effect of 519 (21.4%) Nigerian females and 243 (10%) males were either diagnosed with class I, II or III obesity. This indicated the prevalence of obesity was more common in Nigerian females than males when diet influenced the obesity rate. More so, the effect size indicated a non-statistical significance between obese Nigerian women and men with an effect size of 15.59 (95% CI, 11.83, 19.35) as shown in figure

4. Class III obesity was the least seen among the participants. Nearly 50 (8.3%) of Nigerian females and only 10 (3.7%) Nigerian males were severe obese due to unhealthy dietary pattern. Approximately 400 and 200, Nigerian females and males respectively, had a BMI of 30.0- 34.9 kg/m2. More so, the difference in the number of Nigerian females and males with class II obesity was nihil. One fifth (n=107) of the females and 16.1% (n=39) of the males were moderate (class II) obese as shown in table 1 and 2.

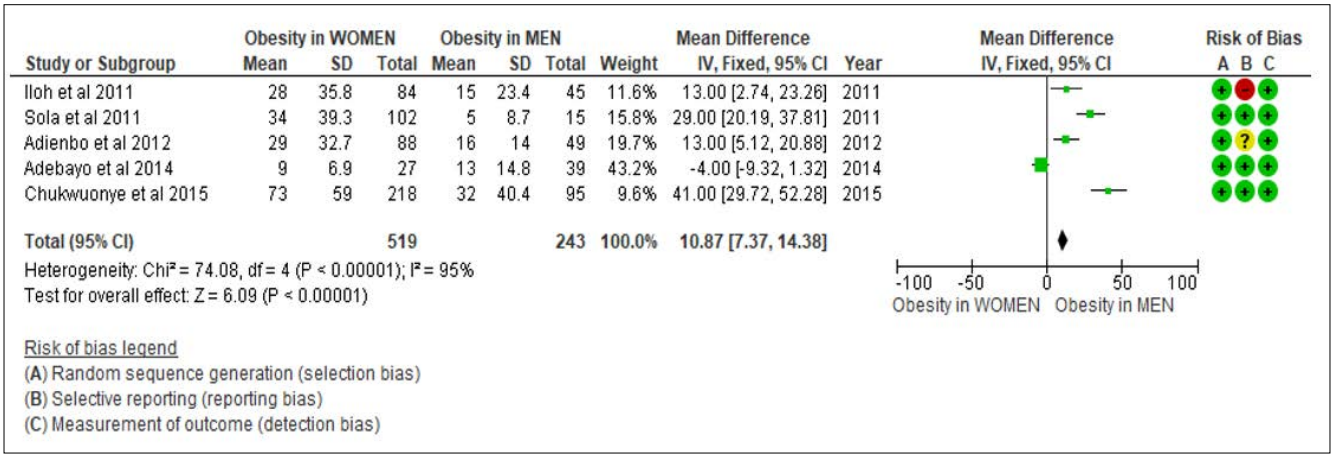

Figure 4: Forest plot of comparison: Association between diet and the prevalence of obesity in Nigerian Women and Men outcome: more Nigerian women were obese compared to Nigerian men as result of their diet

Discussion

This study examined the prevalence of obesity in Nigerian females and males. The first theme of this review investigated the association between socio- economic status and the prevalence of obesity among Nigerian adults. Five included studies found there is a significant association between the socio-economic status and obesity in Nigeria. According to 4 of the studies, higher rates of obesity levels were seen more in Nigerian females than males. The studies explained that low socio-economic status such as low educational levels among Nigerian adults contributed to the prevalence of obesity [22, 24-26]. Advocated that there was an increased number of Nigerian adults who only completed primary school or did not have any formal education during their younger years. This prevented those adults, especially Nigerian females, to have sufficient knowledge on healthy lifestyle whiles growing and may had contributed to become obese [22].

Also, the study by Maruf et al. (2014) stated that there were more Nigerian females than males that did not attend school due to their parents' financial instability or supported the parents by selling food products from an early age to sustain the family [26]. A recent article published by Unicef (2021) analysed only 47.7% (n= 2.5 million) of Nigerian females attended primary school in the Northern part of Nigeria in 2019. This meant that more than half of the females did not have education from a young age [27]. As a result, those females did not have the opportunity to learn how to read and found it difficult to understand or were unaware of the importance of a healthy lifestyle when they became adults [26]. According to Carlisle (2012), the disadvantage of being unable to read reduced the knowledge of an individual. For example, it prevented an individual from educating and increasing their awareness on obesity by reading books related to health or leaflets provided in hospitals. It also resulted in fundamental life skills and enhanced knowledge on aspects surrounding unhealthy lifestyle that led to the development of obesity to narrow [28].

More so, Vermon (2013) explained low literacy made it difficult for an individual to understand and follow health instructions given by health professionals. The findings showed low literacy contributed to nearly one third (n=189) of individuals experiencing health complications as a result of poor understanding to adapt to a healthier lifestyle (Vermon, 2013). However, Arena et al. (2018) recommended the government in Nigeria to organise health events to increase obesity awareness among Nigerian adults. Health events provided the opportunity for individuals to ask questions and have information explained in- depth to enhance their understanding [29].

High socio-economic status was associated with great odds for obesity to develop in Nigerians as well. The study by Chukwonye et al. (2013) investigated the rate of obesity in Lagos [24]. Chukwonye et al. (2013) found that among the 97 participants, nearly 87% (n= 84) were obese males. Unlike the other included studies (Umuerri et al. 2018) where the findings demonstrated higher rate of obesity was seen in females, study showed obesity appeared more in males [22, 24-26]. According to Amira et al. (2011), Lagos is one of the largest cities in Nigeria and the fourth wealthiest city in Africa. The presence of universities provided most Nigerian males who were living in Lagos the opportunity to achieve a high educational level, which secured a lucrative career and became financially more stable. The stability supported those males to adapt to a lifestyle they preferred, which was often adapted from the western lifestyle [30]. For example, Ayodele et al. (2019) analysed some Nigerian males tended to eat more outdoors. They consumed take- away foods (high in carbohydrates and saturated fats) purchased from international food chains sited in Lagos such as Domino's Pizza and Kentucky Fried Chicken. As those Nigerian males adapted to such eating patterns, their energy intake increased and they gained weight easily [31]. Although, Renzaho (2014) insinuated that Nigerian males deliberately adapted to such eating patterns as a large body size symbolised high social status in Nigeria. Nigerian males who had a normal body size or a slim figure 1 showed signs of poverty and deprivation. Therefore, regardless of their awareness of health complications associated with obesity, the perception of large body image was usually accepted positively. It was characterised as having a status, being rich and culturally powerful [16].

On the contrary, Agha (2017) suggested highly educated Nigerian females' perspective on obesity differed from the males. Most

females experienced low self- esteem when they were obese and rather desired having a normal weight according to the BMI [32]. For this reason, high socio- economic status contributed for the likelihood of obesity to be higher in Nigerian males than females as shown in the findings. The study reported only 13 out of 150 females were obese [24].

The second theme for this systematic review examined the association between sedentary lifestyle and obesity. Based on the included five studies (Idung et al., 2014; Ngwogu et al., 2012; Oyeyemi et al., 2012; Raimi et al., 2015; Wahab et al., 2011), Nigerian adults gained weight as result of reduced physical activity [5, 19-21, 23]. Idung et al. (2014) found that among the 584 participants were living in Uyo, South- Nigeria, 257 were obese [23]. The rate of obesity was higher in females (n= 202) than males (n= 55). According to Idung et al. (2014), there were several socio-cultural barriers for Nigerian females to participate in doing physical activities, which resulted in the high prevalence of obesity [23]. For example, Nigerian females who exercised were often perceived as a persistent myth. Some Nigerians believed females became muscular and gained a posture of a male when actively involved in exercise. Such body shape appeared unattractive and often intimidated men [23]. Therefore, most Nigerian males preferred females with curvy hips and thick thighs, also known as a pear-shaped body. As such, the societal stereotyping of the gender role caused physical exercise and sports to appear more appropriate for Nigerian males than females. Nigerian females were therefore frequently excluded from participating in exercise, which promoted weight gain [33].

To eliminate the gender discrimination surrounding physical activity in Nigeria, several interventions and policies such as the National Gender Policy, were implemented. The National Gender Policy was established by the Government of Nigeria in 2006. The policy focused on promoting gender equality between females and males in Nigeria. One of the objectives of the policy was to adopt gender mainstreaming as an important value and practiced in social transformation, organisational cultures and in the general polity in Nigeria. The target of the objective was to develop and strengthen appropriate educational, training and institutional frameworks that connected the macro- policy environment with the micro level where females, males and communities experienced gender inequality. This supported the minimisation of the traditions, customs and sexual stereotyping of social roles and cultural prejudice in Nigeria. Some Nigerian females enjoyed their rights and fully participated on an equal basis with the males in national development. Those Nigerian females felt empowered and motivated to participate in different life activities, which positively influenced their health. However, not all Nigerians were familiar with the policy. As a result, gender inequality was still present among Nigerians (Ajayi, 2021).

Research conducted by Arslan et al. (2017) coincided with the National Gender Policy. Arslan et al. (2017) agreed promoting gender equality changed the perception and cultural beliefs of people. Such intervention increased the awareness of males of the importance of allowing females to participate in physical activities and sport. Arslan et al (2017) highlighted females who were more physically active were for example less likely to experience gestational diabetes during pregnancy. It reduced the risk of females to encounter diabetes mellitus later in life or death of the baby before or after the birth. As such, less medical attention was needed during pregnancy [34]. Therefore, promoting gender equality had a positive effect on the health of predominantly females (Ajayi, 2021).

Besides socio-economic status and sedentary lifestyle, diet influenced the obesity rate among Nigerian adults as well. Traditional food in Nigeria contained high starch and saturated fats. For example, the most common local food in Nigeria, pounded yams and garri, were both rich sources of starch (Okeke, 2018). According to Raman (2017), consuming an adequate amount of starchy food stimulated weight gain. Starchy food contains a high number of calories. It added bulk to meals and thereby boosted the risk of an individual to become obese (Raman, 2017).

The findings of the included study by Sola et al. (2011) illustrated 34% (n=102) Nigerian females living in Benue state were diagnosed with obesity, whereas among the males only 11% (n=15). Sola et al. (2011) implied as Nigerian females were mostly home, they consumed high calorie snacks or an adequate number of meals in a day that were high in starch. This contributed to weight gain in Nigerian females especially if they were also less physically active during the day, unlike Nigerian males. Sola et al. (2011) suggested the low percentage (11%, n= 15) of Nigerian males being obese was due to the males usually being the breadwinners in the home [2]. Nigerian males were more occupied with work during the day and consumed less meals. Also, the work stimulated the males being physically active, burned calories effectively and thereby prevented weight gain [10]. For those reasons, the study showed the number of Nigerian males diagnosed with obesity was lower than in females [2].

More so, Adienbo et al. (2012) analysed besides starchy food, Nigerian adults, predominately the females, consumed meat in large quantities. Both studies found the rate of obesity was significantly higher among Nigerian females than males [18]. Obesity class I, II and III were seen in both genders. There were 47% (n=88) Nigerian females and 42% (n= 49) Nigerian males obese in the findings by Adienbo et al. (2012). It Found a difference of 10% (n= 39) more Nigerian females obese compared to males who lived in Imo state [18]. According to Etukumana et al. (2012), traditional Nigerian dishes were prepared with a variety of meat (e.g., beef and goat meat) as Nigerian adults enjoyed the tenderness of meat flavour. Those dishes contained high amounts of saturated fats and low- density lipoprotein (LDL) cholesterol and thereby increased fat deposits in the body system. This resulted for Nigerian adults to become obese and at higher risk of experiencing chronic diseases like CVD and stroke (Etukumana et al., 2012). However, Ikunjenlola (2020) argued not all Nigerian adults were able to afford buying meat to include in their meals. There were other factors such as the eating patterns that contributed to the prevalence of obesity in Nigeria. Ikunjenlola (2020) explained Nigerian adults often consumed more than 2 large meals a day. They tended to overeat and consumed more calories than they burned daily (Ikunjenlola, 2020). However, advocated Nigerian adults would have a better understanding of calorie consumption if they received nutritional advice. Nutritional advice increased the awareness and advantages of consuming a healthy diet, including portion size, in individuals. This promoted a healthy lifestyle behaviour and changed patterns of obesity, health and quality of life [32].

According to interventions such as self- behaviour management, weight loss programmes and providing health professionals like nurses with nutrition programmes could also support tackling obesity in Nigeria. For example, nutrition programmes could further enhance nurse practitioners understanding about malnourishment. As such, nurse practitioners would be able to provide effective nutritional advice to obese Nigerian adults to control their weight and dietary behaviour [35]. Therefore, Huang

et al. (2021) suggested without a suitable intervention, obesity will continue to be a public burden in Nigeria. The high number of patients with obesity and the severity (e.g., associated medical conditions) could further put pressure on nurses in Nigeria. For example, nursing workload may increase, which affects the nursing time required to deliver patients' care. Nurses would be responsible to look after more patients as well. This could result in nurses feeling burned- out, stressed and unable to clinically perform well. Also, a higher demand of nursing practitioners specialised in obesity may be required on the ward or in the community to meet up with the needs of the patients (Huang et al., 2021).

There were several limitations to consider in this study. The variety of measurement tools to investigate the prevalence of obesity was not used in all studies. Some studies only used the BMI whereas other studies also included additional measurements such as questionnaires and waist- hip ratio. Despite not all studies used questionnaires due to its reliability, the use of additional measurements would have supported a variety of results being obtained. More so, not all the studies mentioned the duration to monitor the prevalence of obesity. This could have provided information about the length of the experiment and a better understanding of how it was undertaken. However, overall, the studies included a high number of participants, which supported more findings to be obtained. Also, the findings of the studies provided useful information about obesity among Nigerian adults in different states, the cause and associated significant long- term health complications. The studies also provided information about potential interventions that could be used to tackle obesity in Nigeria.

In conclusion, socio- economic status, sedentary lifestyle and diet were factors that stimulated the high obesity rate in Nigeria. Low educational level, which reflects socio- economic status, appeared to be the most associated factor with obesity in Nigeria [26]. Most of the studies reviewed indicated obesity was higher in Nigerian females compared to males.

Several interventions implemented by the government may cause the obesity rate to decline. For example, raising the awareness of health consequences associated with obesity among the Nigerian population. More so, nurses in Nigeria could be provided with additional training to enhance their knowledge about obesity to stimulate Nigerians adapting to a healthier lifestyle. As such, this may reduce the burden on the public health and lower the mortality rate in Nigeria.

Conflict of Interest

The authors declare no conflict of interest

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