

Article

Not peer-reviewed version

Relationships Between Health Behaviors and Weight Status Among Nigerian Immigrants in the United States

[Samuel Adefisayo Ayeni](#) ^{*}, [Philip Esposito](#), [Meena Shah](#)

Posted Date: 27 June 2025

doi: [10.20944/preprints202506.2306.v1](https://doi.org/10.20944/preprints202506.2306.v1)

Keywords: lifestyle; overweight; obesity; physical activity; dietary intake; sleep duration; immigrants



Preprints.org is a free multidisciplinary platform providing preprint service that is dedicated to making early versions of research outputs permanently available and citable. Preprints posted at Preprints.org appear in Web of Science, Crossref, Google Scholar, Scilit, Europe PMC.

Copyright: This open access article is published under a Creative Commons CC BY 4.0 license, which permit the free download, distribution, and reuse, provided that the author and preprint are cited in any reuse.

Disclaimer/Publisher's Note: The statements, opinions, and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions, or products referred to in the content.

Article

Relationships Between Health Behaviors and Weight Status among Nigerian Immigrants in the United States

Samuel Ayeni *, Philip Esposito and Meena Shah

Department of Kinesiology, Texas Christian University, Fort Worth, TX 76129, USA

* Correspondence: adefisayo.ayeni@tcu.edu; Tel.: +19453288112

Abstract

The Nigerian immigrant population in the United States (U.S.) has increased substantially over the past three decades. However, there is limited research on how acculturation and lifestyle behaviors impact their health. Thus, the study examined the relationships between demographic factors, health behaviors, and weight status among U.S. foreign-born Nigerians. Data were obtained from 70 participants using the Bioelectric Impedance Analysis, the International Physical Activity Questionnaire, and the Automated Self-Administered 24-hour Dietary Assessment Tool. Binomial regression analysis showed no significant association between demographic factors (age, sex, and length of stay), health behaviors (physical activity, dietary intake, and sleep duration) and body fat percentage. Nonetheless, females were found twice as likely to be overweight/obese compared to males (OR = 2.06, 95%CI [0.72-5.91]), and individuals with low physical activity levels and poor sleep duration had greater odds (OR = 4.25, 95%CI [0.57-31.94]) and (OR = 1.54 95%CI [0.27-8.82]), respectively) of being overweight/obese. Additionally, the results indicated an insufficient daily intake of fruits (0.74 cups equivalent) and vegetables (2.37 cups equivalent), but daily consumption of red meat (4.73 ounces equivalent) exceeded U.S. dietary guidelines. These findings provide evidence to inform behavior change interventions for preventing unhealthy weight gain and reducing obesity prevalence among Nigerian immigrants.

Keywords: lifestyle; overweight; obesity; physical activity; dietary intake; sleep duration; immigrants

1. Introduction

The number of Nigerian immigrants to the United States (U.S.) has grown rapidly over the past few decades. According to the most recent statistics from the American Community Survey by the U.S. Census Bureau (USCB), the population of Nigerian immigrants residing in the U.S. has increased from 25,000 in 1980 to 448,000 in 2022 [1]. Very little is known about the health or predictors of health of Nigerian immigrants residing in the U.S. Moving to the U.S. may have negative health consequences. Several studies [2-4] have found that acculturation (determined by length of stay or dietary intake) may be linked to weight gain among African immigrants (including Nigerians) to the U.S. Moreover, a high rate of adverse sleep health has been observed among U.S. immigrant population compared native-born adult population, with acculturation likely contributing to the disparity [5]. According to one study [6], the prevalence of overweight and obesity in the Nigerian immigrant population in the U.S. is 26% and 32.1%, respectively. Although the rate of obesity among Nigerians residing in the U.S. is lower than the corresponding values among non-Hispanic Black or White Americans (49.6% and 42.2%, respectively) [7], a dearth of knowledge on health determinants among Nigerian immigrants warrants examining the factors that predict body weight among this population.

To date, only two studies have assessed the behavioral and non-behavioral determinants of weight status in U.S. foreign-born Nigerians. Obisesan et al. [8] observed a significant relationship

between alcohol consumption, female sex, and obesity, but did not demonstrate a link with well-established predictors such as acculturation (defined by length of stay), socio-economic status, and physical activity level among Nigerian immigrants residing in Minnesota. A study conducted by Duru [6] among Nigerian Igbo immigrants living in Georgia, found that there was a positive association between female sex, daily fruit and meat/burger consumption, and obesity while no relationship was noted between acculturation (defined by length of stay), smoking, physical activity level, socioeconomic status, stress, and obesity. A few limitations have been identified in the studies reviewed above. Both studies used BMI as a reference to determine obesity. However, BMI may not be an accurate indicator of obesity, especially in men [9]. Obisesan et al. [8] limited the diet assessment to alcohol consumption alone, so the connection between food intake and obesity was not fully assessed. Both studies did not also investigate the effect of sleep quality or duration on obesity.

The above introduction demonstrates that despite a growing Nigerian immigrant population in the U.S., there is very little knowledge on factors that affect the health of this population. Therefore, the aims of the study were to examine the prevalence of overweight and obesity among U.S. Nigerian immigrants, and to evaluate whether demographic factors and health behaviors predict overweight and obesity among this population. This information will be helpful in implementing appropriate interventions for health promotion and disease prevention among this population.

2. Materials and Methods

2.1. Participants

Seventy participants (44 males and 26 females) were recruited for this study. The inclusion criteria included Nigerian immigrants, aged 18 years and older, who could write and speak English. The participants had also been residing in the US for at least two years. Individuals who were non-Nigerian immigrants, did not meet age and language requirements, and black individuals who are Nigerians by marriage but not by birth were excluded from the study. Also excluded were pregnant and lactating women, individuals who were dieting to lose weight, and amputees.

Participants were recruited from churches (parishes of The Redeemed Christian Church of God), Texas Christian University's African students' organization, and local social clubs in the Dallas-Fort Worth metroplex. After local club and church leaders were contacted, recruitment fliers for the study were shared on their onsite or online meeting platforms. Flyers about the study were also posted on African students' social media channels. After a potential participant indicated interest in the study, their eligibility to participate was determined through an online screening survey. They were then recruited into the study if they met the eligibility criteria. Individuals who did not pass the screening process were excluded from the study.

The study was approved by the TCU Institutional Review Board, and data collection was done between October 2024 and February 2025.

2.2. Measures

2.2.1. Demographics, Anthropometry, and Body Composition

Demographic information, including sex, age, length of stay (years residing in the U.S.), education, annual family income, and occupation, was obtained using a questionnaire. Height was measured using a stadiometer. Body Mass Index (BMI) was calculated as weight (kg)/height (m²). Body composition was evaluated using a bioelectric impedance analysis (BIA) device. BIA is a well-established method for examining body composition and is a reliable and valid method for estimating fluid status and body composition [10,11]. The Tanita® BC-1000 Plus (Tanita Corp., Tokyo, Japan), a foot-to-foot BIA analyzer, was used to measure weight and body composition. It has a validity of 0.93 and a reliability of 0.89 [12]. Before measurement, participants were instructed to drink a certain amount of water to account for hydration levels. Body fat percentage was calculated

through pre-established body fat predictive algorithms included in the device [13]. The BIA instrument determined the classification of body fat percentage as healthy, overweight, or obese.

2.2.2. Physical Activity Level

Physical activity was assessed using the International Physical Activity Questionnaire-Short Form (IPAQ-SF). IPAQ-SF has been used to evaluate physical activity participation in various populations, with a reliability of 0.80 and a validity of 0.30 [14,15]. It is a self-report measure, that assesses the types of physical activity and sitting time that people do in the previous seven days, to estimate total physical activity in MET-min/week and time spent sitting. Per the IPAQ protocol, physical activity level is categorized as low (<600 MET-min/week), moderate (600-3000 MET-min/week), and high (>3000 MET-min/week).

2.2.3. Dietary Intake

Dietary intake was assessed using the Automated Self-Administered 24-hour (ASA24) Dietary Assessment Tool (version 2024). ASA24 is a free, web-based self-report tool that enables multiple, automatically coded, self-administered 24-hour diet recalls and/or single or multi-day food records [16], with a reliability score of 0.67 [17]. The dietary recall method collects information on the types and amounts of food and beverages consumed the previous day. Two weekday recalls and a weekend day recall were collected. The output files were obtained from the ASA24 researcher website, and the average of the 3-day dietary intake was calculated.

2.2.4. Sleep Duration

Sleep duration was evaluated using the Sleep module of the Automatic Self- Administered 24-hour Dietary Assessment Tool. The sleep module is a self-report tool for obtaining information on participants' sleep health, including timing, duration, and quality. The duration of sleep was calculated as the difference between sleep onset and wake-up time, after excluding the amount of time spent awake after falling asleep. The output files were retrieved from the ASA24 researcher website, and the average of the 3-day sleep duration was calculated. Sleep duration was classified as short sleep duration (<7 hrs.), normal sleep duration (7 – 9 hrs.), and long sleep duration (>9 hours) according to the National Sleep Foundation [18].

2.3. Procedures

On the day of data collection, participants were instructed to sign the informed consent document after the study process was explained. Afterward, the participants completed the demographic questionnaire using Qualtrics. Following this, anthropometric measurements were taken. Height was measured using a stadiometer, and it was entered into the BIA computer software. Then weight and body composition were evaluated using the BIA analyzer. The participants were asked to stand on the scale with feet shoulder-width apart, barefoot, and wearing light clothing. Arms and legs were equally distributed on the scale. The device then generated data on BMI, body fat percentage, and weight category. These procedures took place onsite either in the laboratory, workplaces, or designated churches.

Next, participants completed the dietary recall. The dietary recalls were done at the participants' convenience, such as in their homes. On the website, participants were instructed to accurately recall and record the kinds and quantities of all the foods and beverages they had the day before. The diet entry was done in five stages. In the first stage, participants were questioned on the occasion and time they consumed the items. During the second stage, they were prompted to select all the food and drinks they consumed. In the third stage, participants were instructed to report the food's preparation methods and estimate the portion sizes in grams, pounds, ounces, cups, teaspoons, or slices. The participants also included processed food brands, names of restaurants visited when dining out, and recipes for home-cooked meals. In the fourth stage, participants were probed about

any frequently overlooked foods they might have missed, including drinks, snacks, breads, fruits, and vegetables. In the fifth stage, they were instructed to review and submit the dietary recall. After completing the dietary assessment, the website asked the participants to provide information on sleep timing, duration, and quality. Overall, the participants performed two weekday recalls and a weekend day recall, totaling three diet and sleep recalls. Finally, the participants completed the IPAQ-SF using Qualtrics, which they were allowed to fill out at their convenience.

2.4. Statistical Analysis

Descriptive statistics were used to summarize demographics, body fat percentage, anthropometrics, and health behaviors. The independent variables are demographic factors (age, sex, and length of stay) and health behaviors [physical activity level, dietary intake (fruits, vegetables, whole grains, red meat, alcohol, and added sugars), and sleep duration].

Binomial logistic regression was used to assess the predictive relationship between the independent variables (age, sex, length of stay, physical activity level, dietary intake, and sleep duration) and body fat percentage (dichotomized into healthy and overweight/obese). A p-value of ≤ 0.05 was used to denote statistical significance. Data was analyzed using SPSS 29.0 (SPSS Inc., Chicago, IL).

3. Results

3.1. Demographic Characteristics

Table 1 shows the demographic characteristics of the study sample. A total of 70 foreign-born Nigerians participated in the study. About two-thirds of the participants (63.86%) were males, and less than one-third (27.17%) were females. The mean age and mean length of stay were 38.80 years and 9.89 years, respectively. Most of the participants reported holding either a bachelor's degree (40%) or a master's degree (32.86%). The largest occupation group was professionals (27.14%), followed by students (22.86%), and business/craftsmen (14.29%). One-third reported earning \$75,000 or more annually, 26.57% makes between \$50,000 and \$75,000, and 29 individuals (41.43%) earn below \$50,000.

Table 1. Demographic Characteristics .

	Total (n = 70)
Sex	
Male, n (%)	44 (62.86)
Female, n (%)	26 (37.14)
Age (years), mean (SD)	38.80 (11.27)
Length of stay (years), mean (SD)	9.89 (5.55)
Education, n (%)	
High school diploma	12 (17.14)
Vocational training	1 (1.43)
Associate degree	5 (7.14)
Bachelor's degree	28 (40.00)
Master's degree	23 (32.86)
Doctoral degree	1 (1.43)
Occupation, n (%)	
Professional (doctor, teacher, lawyer, engineer)	19 (27.14)
Management/Consulting	3 (4.29)
Business/Crafts	10 (14.29)
Technical support	9 (12.86)
Sales/Marketing	3 (4.29)
Security agencies (police, fire service, military)	2 (2.86)

Academic (professor, postdoc researcher)	1 (1.43)
Student (undergraduate, graduate)	16 (22.86)
Other	7 (10.00)
Annual family income, n (%)	
\$10,000-19,999	10 (14.29)
\$20,000-29,999	6 (8.57)
\$30,000-39,999	6 (8.57)
\$40,000-49,999	7 (10.00)
\$50,000-59,999	12 (17.14)
\$60,000-74,999	8 (11.43)
\$75,000 or more	21 (30.00)

3.2. Weight Status Indices

Table 2 presents the weight status indices of the participants. The mean body fat percentage and mean BMI were 28.80% and 27.05 kg/m², respectively. Of the 70 participants, about 37% were healthy, 24% were overweight, and 29% were obese. Nearly 63% were either overweight or obese.

Table 2. Weight Status Indices.

	Total (n = 70)
Body Fat Percentage, mean (SD)	28.80 (9.44)
BMI (kg/m ²), mean (SD)	27.05 (4.49)
Body Fat Percentage, n (%)	
Healthy	26 (37.14)
Overweight	24 (24.29)
Obese	20 (28.57)

Note. BMI = Body Mass Index.

3.3. Health Behaviors

Table 3 shows the distribution of health behaviors. The mean energy expenditure was 1188.64 MET-min/week. More than one-third (32.86%) of the participants reported a low level of physical activity. Forty-two individuals (60%) were moderately active, and less than one-tenth (7.14%) had a high level of physical activity.

The average daily intake of fruits and vegetables was 0.74 cups equivalent and 2.47 cups equivalent, respectively. The participants consumed an average of 0.65 ounces equivalent of whole grain and 4.73 ounces equivalent of red meat daily. The daily mean alcohol and added sugar intake was 1.85 grams and 7.69 teaspoons equivalent, respectively.

The mean sleep duration was 7.28 hrs. About half of the participants (51.43%) reported short sleep duration (< 7 hrs.), 40% had normal sleep duration (7-9 hrs.), and 6 people (8.57%) reported long sleep duration (> 9 hrs.).

Table 3. Distribution of Health Behaviors.

	Total (n = 70)
Physical Activity Level	
PAL (MET-min/week), mean (SD)	1188.64 (1206.48)
Low PAL (<600 MET-min/week), n (%)	23 (32.86)
Moderate PAL (600- 3000 MET-min/week), n (%)	42 (60.00)
High PAL (>3000 MET-min/week), n (%)	5 (7.14)
Dietary Intake, mean (SD)	
Fruits (cups eq.)	0.74 (0.78)
Vegetables (cups eq.)	2.37 (1.10)
Whole grains (oz. eq.)	0.65 (1.29)

Red meat (oz. eq.)	4.73 (4.56)
Alcohol (g)	1.85 (6.00)
Added sugars (tsp. eq.)	7.69 (9.69)
Sleep Duration	
Sleep duration (hrs.), mean (SD)	7.28 (1.18)
Short sleep duration (< 7 hrs.), n (%)	36 (51.43%)
Normal sleep duration (7-9 hrs.), n (%)	28 (40.00%)
Long sleep duration (> 9 hrs.), n (%)	6 (8.57%)

Note. PAL = Physical Activity Level .

3.4. Demographics, Health Behaviors, and Body Fat Percentage

Table 4 presents the binomial logistic regression analysis of demographics, health behaviors, and body fat percentage. There was a statistically non-significant association between age and body fat percentage ($p = 0.43$, OR = 1.02, 95%CI [0.97-1.06]), with the odds of being overweight/obese increasing by 1.02 times for an additional year of age. The association between female sex and body fat percentage was not statistically significant ($p = 0.18$, OR = 2.06, 95%CI [0.72-5.91]). Still, females are 2.06 times more likely to be overweight/obese compared to males. The relationship between length of stay and body fat percentage was not statistically significant ($p = 0.40$, OR = 0.96, 95%CI [0.88-1.05]).

Moreover, the analysis revealed no statistically significant association between low physical activity level and body fat percentage ($p = 0.16$, OR = 2.25, 95%CI [0.57-31.94]). However, the odds of being overweight or obese are 4.25 times as likely with low physical activity levels compared to high physical activity levels. There was no statistically significant relationship between moderate physical activity level and body fat percentage ($p = 0.41$, OR = 2.21, 95%CI [0.33-14.64]). Having moderate physical activity levels increase the likelihood of being overweight or obese by 2.21 times compared to high physical activity levels (Table 13).

Additionally, the analysis indicated no statistically significant association between fruit intake and body fat percentage ($p = 0.92$, OR = 2.27, 95%CI [0.89-5.02]), with an extra intake of one cup of fruit increasing the likelihood of being overweight or obese by 2.27 times. No statistically significant relationship was found between vegetable intake and body fat percentage ($p = 0.56$, OR = 1.18, 95%CI [0.67-2.07]), suggesting that one cup more of vegetables raises the risk of being overweight or obese by 1.04 times. There was no statistically significant association between whole grain intake and body fat percentage ($p = 0.43$, OR = 0.79, 95%CI [0.54-1.30]), with the risk of being overweight or obese increasing only by 0.79 with an additional intake of one cup of whole grains. Also, there was no statistically significant relationship between red meat intake and body fat percentage ($p = 0.48$, OR = 1.09, 95%CI [0.91-1.21]), with an extra consumption of one gram of red meat increasing the likelihood of being overweight or obese by 1.09 times. No statistically significant association was observed between alcohol intake and body fat percentage ($p = 0.82$, OR = 1.01, 95%CI [0.92-1.11]), indicating that the risk of being overweight or obese increases by 1.01 times for every consumption of one gram of alcohol. The relationship between added sugar intake and body fat percentage was not statistically significant ($p = 0.16$, OR = 0.95, 95%CI [0.90-1.02]), suggesting that a one-gram increase in added sugar intake raises the odds of being overweight or obese by 0.95 times.

Further, no statistically significant association was found between short sleep duration and body fat percentage ($p = 0.63$, OR = 1.54, 95%CI [0.27-8.82]), demonstrating that the likelihood of being overweight or obese increases by 1.54 times with short sleep duration compared with long sleep duration. There was a statistically non-significant relationship between normal sleep duration and overweight or obesity ($p = 0.41$, OR = 2.10, 95%CI [0.33-12.31]), indicating that normal sleep duration increases the odds of being overweight or obese by 2.1 times compared to long sleep duration.

Table 4. Binomial Logistic Regression Analysis of Demographics, Health Behaviors, and Body Fat Percentage.

β	S.E.	z	p	Odds Ratio	95% CI
---------	------	---	---	------------	--------

Age	0.02	0.02	0.79	0.43	1.02	0.97 - 1.06
Sex (Female)	0.72	0.54	1.35	0.18	2.06	0.72 - 5.91
LOS	-0.04	0.04	0.85	0.40	0.96	0.88 - 1.05
Low PAL	1.45	1.03	1.41	0.16	4.25	0.57 - 31.94
Moderate PAL	0.79	0.97	0.82	0.41	2.21	0.33 - 14.64
Fruits	0.82	0.44	1.69	0.92	2.27	0.89 - 5.02
Vegetables	0.04	0.29	0.58	0.56	1.04	0.67 - 2.07
Whole grains	-0.24	0.22	0.80	0.43	0.79	0.54 - 1.30
Red meat	0.08	0.07	0.70	0.48	1.09	0.91 - 1.21
Alcohol	0.01	0.05	0.23	0.82	1.01	0.92 - 1.11
Added sugars	-0.06	0.03	1.41	0.16	0.95	0.90 - 1.02
Short sleep duration	0.43	0.89	0.38	0.63	1.54	0.27 - 8.82
Normal sleep duration	0.74	0.90	1.00	0.41	2.10	0.33 - 12.31

Note. Variables entered: Age, Female sex, LOS (length of stay), Low PAL, Moderate PAL, Fruit intake, Vegetable intake, Whole grain intake, Red meat intake, Alcohol intake, Added sugar intake, Short sleep duration, and Normal sleep duration. Reference category for Sex: Male; for PAL: High PAL; for Sleep Duration: Long sleep duration; for Body Fat Percentage: Overweight/obese .

4. Discussion

This study investigated the relationships between demographic factors, health behaviors, and weight status among Nigerian immigrants in the U.S. The overweight and obesity prevalence in the sample population was found to be 32% and 28%, respectively, with the rate of obesity lower than that of the Texan adult population (34.4%) [19]. The obesity rate is also lower than the rate observed among the general U.S. non-Hispanic black (49.6%), Hispanic (44.8%), and non-Hispanic white (42.2%) populations [7]. However, the overweight and obesity prevalence in the sample is higher than the corresponding estimated prevalence (27% and 14.5%, respectively) seen among indigenous Nigerians [20]. This may indicate a transition in lifestyle and environmental influences that lead to an increased risk of weight gain and obesity

The present study observed no relationship between age and overweight/obesity, but the likelihood of being overweight/obese increases by 1.02 for every year. The results are consistent with Duru [6], who found no association between age and obesity among foreign-born Nigerians in the U.S, but an increased odds of obesity with increasing age. Byiringiro et al. [2] also noted that the relative risk of maintaining an unhealthy BMI increased by 7% for every year of age at immigration among Africans in the U.S. Moreover, obesity risk tends to increase with age, particularly during middle adulthood, but may stabilize or decrease in older age in the general U.S. population [21]. This underscores the importance of early and sustained obesity prevention efforts, particularly targeting foreign-born Nigerians as they age in the U.S.

The study found that sex was not associated with overweight/obesity, although females were twice as likely as males to be overweight/obese. This is partially in line with Choi et al. [22], who found a higher prevalence of obesity in female immigrants, but a higher overweight prevalence in male immigrants. Another study reported that females displayed a higher prevalence of obesity than males among U.S.- and foreign-born blacks [23]. Comparably, Hurston et al. [24] observed that females were more likely to be overweight or obese than men among Africans in the U.S. Hence, there is consensus from these studies that female immigrants are more likely to be obese than their male counterparts. Moreover, the National Heart, Lung, and Blood Institute [25], stated that females are more likely (40%) than males (35%) to have obesity among the broad U.S. population, supporting the findings of the current study that females overall are more likely to be overweight or obese.

There was no link between length of stay in the United States and overweight/obesity in this study, agreeing with previous studies [6,8], which indicated no association between length of stay and obesity in Nigerian immigrants in the U.S. Additionally, Ade et al. [26] noted there was no

relationship between duration of residence and obesity in African immigrants overall. However, Onuoha-Obilor [27] reported that length of stay had a relationship with prevalence of obesity among African foreign-born adults in the U.S. This suggests that **aggregating African immigrants into one category may mask important subgroup differences** regarding the impact of length of stay on weight status

The study demonstrated no relationship between physical activity level and overweight/obesity, which is consistent with findings of studies showing that physical activity participation was not linked to overweight/obesity in populations of foreign-born Nigerians in the U.S. [6,8] and foreign-born Africans in the U.S [28]. Alese and Alese [29] also demonstrated that immigrants were more likely to engage in moderate-intensity physical activity at least once a week and seemed to have healthier lifestyles related to physical activity behaviors compared to native-born U.S. adults. Interestingly, our study findings showed that individuals with low levels of physical activity (<600 MET-min/week) are four times more likely to be overweight/obese than those who are moderately active (600-3000 MET-min/week) or highly active (>3000 MET-min/week). This aligns with the results of a study in the United Kingdom, a western country like the U.S., showing that overweight/obese people were more likely to report low physical activity levels compared to those with normal weight [30]. This highlights the necessity of promoting regular, moderate-to-vigorous physical activity as a key strategy in obesity prevention, particularly among the Nigerian immigrant population who may appear active but still fall below optimal activity thresholds.

Fruit and vegetable intake showed no relationship with overweight/obesity in the current study. Similar results were reported in a previous study in which Klabunde et al. [31] observed no correlation between daily and weekly consumption of fruits and vegetables and overweight/obesity in Brazilian immigrants living in Massachusetts. Another study indicated that Latino immigrants, who reported eating fruits and vegetables more in the past month, showed no association with increased BMI [32]. Studies have also shown that U.S immigrants are more likely to consume some quantity of fruits [33] and fruits and vegetables overall [34] compared to native-born individuals. A qualitative study by Ukaegumaoha [35] revealed that African immigrants in California preferred eating fresh produce, including vegetables, due to the beneficial effects on reducing the risk of obesity and other chronic conditions. Additionally, the mean intakes of fruits and vegetables in the study were 0.74 and 2.37 cups equivalent, respectively. These are below the daily recommendation of 2 cups equivalent for fruits and 2.5 cups equivalent for vegetables [36], implying that foreign-born Nigerians in the U.S need to increase vegetable and fruit consumption to meet the U.S dietary guidelines.

The study found that higher whole-grain intake is associated with lower odds of being overweight/obese. This agrees with studies, concluding that higher whole-grain intake is associated with lower odds of abdominal and general obesity among the broad U.S. population [37,38]. Similarly, a recent meta-analysis of 12 cross-sectional studies showed an inverse correlation between whole-grain intake and BMI [39]. The USDA 2020-2025 dietary guidelines recommended that adults consume at least half of their daily grains as whole grains, translating to a minimum of 3-ounce equivalents of whole grains per day [36]. However, the average daily whole-grain intake noted in the present study was 0.65-ounce equivalents, indicating that they did not meet the daily requirement and highlighting the significance of promoting whole-grain consumption in Nigerian immigrants.

Red meat intake exhibited no relationship with overweight and obesity in this study, contrasting with Duru [6], which showed that daily consumption of meat/burger was significantly linked with overweight/obesity in U.S. foreign-born Nigerians. These disparate findings may be because Duru [6] focused on more processed meats, which are typically higher in calories, sodium, and unhealthy fats, strongly contributing to obesity, compared to the current study, which had more reporting of unprocessed meats. Moreover, several studies [33,34] have observed that U.S. immigrants are less likely than native-born to eat meat overall. Although the 2020-2025 dietary guidelines advise consuming no more than 18 ounces of red meat per week or 2.57 ounces per day [36], the sampled population had an average daily intake of 4.73 ounces of red meat, demonstrating that Nigerian immigrants need to limit red meat intake.

The study found no relationship between alcohol consumption and overweight/obesity. The finding aligns with a study by Akinsola [28], which revealed no association between alcohol use and obesity among U.S. African immigrants. A systematic review and meta-analysis of 31 studies showed lower odds of obesity with alcohol use among immigrants than natives [40]. However, the result of the current study is inconsistent with previous relevant study showing that weekly consumption of alcohol was associated with all types of obesity in U.S. Nigerian immigrants [8]. Likewise, Ade et al. [26] demonstrated a relationship between alcohol intake and morbid obesity among Africans and Black-Americans in the U.S. Furthermore, the daily mean intake of alcohol in our study was 1.85 grams, which is far below the recommendation limit of 28 grams per day for men and 14 grams per day for women [36]. These findings imply that low alcohol consumption levels in the study population may explain the lack of association with overweight/obesity. They also highlighted that the relationship between alcohol and overweight/obesity may vary across populations and contexts, suggesting that cultural, behavioral, and environmental factors may influence how alcohol intake affect obesity risk.

An inverse relationship was noted between added sugar intake and overweight/obesity in the study, revealing that as added sugar intake increases, the likelihood of being overweight or obese decreases. This contrasts with the findings of several studies [41–43], indicating that the consumption of added sugars is associated with increased risk of weight gain and obesity. This discrepancy in results could be because Nigerian immigrants adopt Western dietary habits selectively, potentially consuming more added sugars while still maintaining some traditional nutrition practices that mitigate overweight/obesity risk. Alternatively, individuals in this group who reported higher sugar intake may also engage in behaviors, including higher physical activity participation or healthier eating patterns, that offset the associated risk. Importantly, the sampled population consumed 7.94 teaspoons of added sugars daily, which is significantly lower than the recommended intake of about 12 teaspoons per day [36].

The study found that short sleep duration was associated with a 58% likelihood of being overweight/obese. This is supported by a study of US-born and foreign-born black adults, indicating that short sleep duration was associated with a higher prevalence of obesity among immigrants [44]. Obi [45] concluded that short sleep duration is common among African immigrants residing in the U.S., with sleep duration decreasing upon immigration. In a recent systematic review, Aqua et al. [5] revealed that there is a high prevalence of poor sleep health among immigrant populations compared to US-born adult populations. The result of the current study imply that short sleep duration may be a significant contributor to overweight and obesity among African and Nigerian immigrants in the U.S.

Limitations

A limitation in the current study was the use of self-reported physical activity, dietary intake, and sleep measures, potentially leading to recall and social desirability bias. Participants might have forgotten to report some foods consumed, provided an inaccurate estimation of portion sizes, or alter responses to appear healthier [46]. IPAQ-SF also tends to overestimate activity levels and does not provide a comprehensive assessment of other domains of physical activity, including occupation, transport, yard, household, and leisure [47]. Additionally, participants could have equated time in bed with time asleep, neglecting sleep onset latency or nighttime awakenings, leading to systematic overestimation of actual sleep duration or could have inflated sleep duration to align with perceived health norms [48].

Furthermore, the generalization of the study findings to the wider population is limited due to a convenient and small sample size. The sampling method and sample size may not be representative of the entire population of foreign-born Nigerians in the Dallas-Fort Worth metroplex, which holds the fifth-largest Nigerian immigrant population (18,000) in the U.S. [49], hence the results should be explicated with caution. Despite these limitations, this is the first study conducted among Nigerian immigrants in the U.S. that assessed weight status using body fat percentage and its relationship with

demographic factors and health behaviors. Body fat percentage is a more accurate measure of weight status because it distinguishes between fat and muscle mass [50].

Future Research

Researchers should conduct longitudinal studies to track weight status relative to various predictive factors that may influence variable clusters. Since length of stay and health behaviors are time factors, these studies would enable repeated observations of the same variables over a period, enabling researchers to examine how they influence weight status. Future studies could objectively assess physical activity using accelerometers in combination with the long form of IPAQ. Accelerometers tend to give more reliable results than self-report PA questionnaire [51,52]. Researchers should consider evaluating dietary intake using food records, such as ASA24 food records as they involve real-time reporting of food consumption, reducing reliance on memory and potential for inaccuracies [53]. Additionally, sleep duration can be objectively measured using actigraphy, which uses wrist-worn monitors to detect movement and estimate sleep/wake status. This method provides more reliable data compared to subjective methods like sleep recalls/questionnaires [54]. Further research should also assess the impact of health behaviors on body fat percentage change rather than body fat percentage overall to rule out the possibility of cases in which overweight/obesity had already developed prior to the immigrant's arrival in the U.S.

5. Conclusions

This study examined the relationship between demographic factors, health behaviors, and weight status among Nigerian immigrants living in the U.S. Although the outcomes showed that there was no significant association between demographic factors, lifestyle behaviors, and body fat percentage, it was observed that the prevalence of overweight/obesity in the study population is lower than in most U.S. ethnic groups but higher than in indigenous Nigerians. The study also demonstrated that females are twice as likely to become overweight/obese compared to men. Moreover, the study population ate excessive amounts of red meat each day while consuming inadequate fruits and vegetables. Lastly, individuals with energy expenditure of <600 MET-min/week and those with less than seven hours of sleep had greater odds of being overweight/obese. The findings of the study suggest that researchers and public health professionals should design and implement female-tailored initiatives and behavior change interventions to prevent unhealthy weight gain and reduce the rate of overweight/obesity among foreign-born Nigerians in the U.S.

Author Contributions: Conceptualization, S.A. and M.S.; methodology, S.A., E.P. and M.S.; software, S.A., M.S.; validation, S.A., E.P. and M.S.; formal analysis, S.A. and E.P.; investigation, S.A. and E.P.; resources, S.A. and E.P.; data curation, S.A. and E.P.; writing—original draft preparation, S.A.; writing—review and editing, S.A. and E.P. and M.S.; visualization, S.A. and E.P. and M.S.; supervision, M.S. and E.P.; project administration, S.A. and E.P.; funding acquisition, S.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Harris College of Nursing & Health Sciences Graduate Student Research Grant, and the APC was funded by Texas Christian University Open Access Fund

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of Texas Christian University (IRB#2024-083, approved on April 25, 2024).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available upon reasonable request from the corresponding author.

Acknowledgments: We appreciate the participants for completing the study.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. US Census Bureau. Place of birth for the foreign-born population in the United States. <https://data.census.gov/table/acsd1y2019.b05006?q=b05006&g=010xx00us> (accessed on October 28, 2023)
2. Byiringiro, S.; Koirala, B.; Ajibewa, T.; Broni, E.K.; Liu, X.; Adeleye, K.; Turkson-Ocran, R.A.N.; Baptiste, D.; Ogungbe, O.; Himmelfarb, C.D.; Gbaba, S. Migration-related weight changes among African immigrants in the United States. *International journal of environmental research and public health.* **2022**, *19*, 15501. <https://doi.org/10.3390/ijerph192315501>
3. Grey, S. Health risks, nutrition assessments and disease prevalence among African immigrant Groups in Atlanta Georgia. Master's Thesis. Georgia State University. Atlanta. 2013.
4. Paxton, A.; Pillai, A.; Phelan, K. P.; Cevette, N.; Bah, F.; Akabas, S. Dietary acculturation of recent immigrants from West Africa to New York City. *Face à face. Regards sur la santé.* **2016**, *13*. <http://journals.openedition.org/faceaface/1023>
5. Aqua, J. K.; White, K.; Johnson, D. A. A systematic review of acculturation and sleep health among adult immigrants in the United States. *Sleep health.* **2023**, *9*, 288–305. <https://doi.org/10.1016/j.sleh.2023.01.007>
6. Duru, A. A. Demographic, lifestyle, and psychosocial predictors of obesity among Nigerian Igbo Immigrants Doctoral dissertation, Walden University. Minneapolis. 2020.
7. Hales, C. M.; Carroll, M. D.; Fryar, C. D.; Ogden, C. L. Prevalence of obesity and severe obesity among Adults: United States, 2017-2018. *NCHS data brief*, (360), **2020**, 1-8.
8. Obisesan, O.; Kuo, W. H.; Brunet, M.; Obisesan, A.; Akinola, O.; Commodore-Mensah, Y. Predictors of obesity among Nigerian immigrants in the United States. *Journal of immigrant and minority health.* **2017**, *19*, 328-332. <https://doi.org/10.1007/s10903-016-0404-4>
9. Humphreys, S. The unethical use of BMI in contemporary general practice. *British Journal of General Practice.* **2010**, *60*, 696–697. <https://doi.org/10.3399/bjgp10X515548>
10. Aldobali, M.; Pal, K. Bioelectrical impedance analysis for evaluation of body composition: A review. In *2021 International Congress of Advanced Technology and Engineering (ICOTEN).* **2021**, 1-10, IEEE. <https://doi.org/10.1109/icoten52080.2021.9493494>
11. Franco-Villoria, M.; Wright, C. M.; McColl, J. H.; Sherriff, A.; Pearce, M. S.; Gateshead Millennium Study core team. Assessment of adult body composition using bioelectrical impedance: comparison of researcher calculated to machine outputted values. *BMJ open.* **2016**, *6*, e008922. <https://doi.org/10.1136/bmjopen-2015-008922>
12. Vasold, K. L.; Parks, A. C.; Phelan, D. M. L.; Pontifex, M. B.; Pivarnik, J. M. Reliability and Validity of Commercially Available Low-Cost Bioelectrical Impedance Analysis. *International journal of sport nutrition and exercise metabolism.* **2019**, *29*, 406– 410. <https://doi.org/10.1123/ijsnem.2018-0283>
13. Kreissl, A.; Jorda, A.; Truschner, K.; Skacel, G.; Greber-Platzer, S. Clinically relevant body composition methods for obese pediatric patients. *BMC pediatrics.* **2019**, *19*, 1-8. <https://doi.org/10.1186/s12887-019-1454-2>
14. Craig C.L.; Marshall A.L.; Sjöström M.; Bauman A.E.; Booth M.L.; Ainsworth B.E.; Pratt M.; Ekelund U.; Yngve A.; Sallis J.F.; Oja P. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc.* 2003, *35*, 1381-95. <https://doi.org/10.1249/01.mss.0000078924.61453.f>
15. van Poppel, M. N.; Chinapaw, M. J.; Mokkink, L. B.; Van Mechelen, W.; Terwee, C. B. Physical activity questionnaires for adults: a systematic review of measurement properties. *Sports medicine.* **2010**, *40*, 565-600. <https://doi.org/10.2165/11531930-00000000-00000>
16. National Cancer Institute. Automated Self-Administered 24-Hour Dietary Assessment Tool (ASA24). National Institute of Health. <https://epi.grants.cancer.gov/asa24/> (accessed on 14 March 2025)
17. Mitchell, D. C.; Cheng, F. W.; Still, C. D.; Jensen, G. L. A Validation of Automated Self-Administered 24-Hour Dietary Recalls (ASA24) relative to Interviewer- Administered Recalls using the Nutrition Data System for Research (NDSR). *The FASEB Journal.* **2016**, *30*, 43-3. https://doi.org/10.1096/fasebj.30.1_supplement.43.3
18. Hirshkowitz M.; Whiton K.; Albert SM.; Alessi C.; Bruni O.; DonCarlos L.; Hazen N.; Herman J.; Adams Hillard PJ.; Katz ES.; Kheirandish-Gozal L.; Neubauer DN.; O'Donnell A.; Ohayon M.; Peever J.; Rawding

R.; Sachdeva RC.; Setters B.; Vitiello MV.; Ware JC. National Sleep Foundation's updated sleep duration recommendations: final report. *Sleep Health*. 2015, 1, 233-243. <https://doi:10.1016/j.sleh.2015.10.004>

19. Centers for Disease Control and Prevention. National Health and Nutrition Examination Survey, 2017–2018. National Center for Health Statistics. <https://www.cdc.gov/nchs/nhanes/continuousnhanes/overview.aspx?BeginYear=2017> (accessed on 25 February 2025)

20. Chukwuonye, I. I.; Chuku, A.; John, C.; Ohagwu, K. A.; Imoh, M. E.; Isa, S. E.; Ogah, O.S.; Oviasu, E. Prevalence of overweight and obesity in adult Nigerians—a systematic review. *Diabetes, metabolic syndrome, and obesity: targets and therapy*. 2013, 6, 43- 47. <https://doi.org/10.2147/dmso.s38626>

21. Emmerich, S. D.; Fryar, C. D.; Stierman, B.; Ogden, C. L. Obesity and severe obesity prevalence in Adults: United States, August 2021-August 2023. *NCHS data brief*, (508). 2024. 10.15620/cdc/159281. <https://doi.org/10.15620/cdc/159281>

22. Choi J. Y. Prevalence of overweight and obesity among US immigrants: results of the 2003 New Immigrant Survey. *Journal of immigrant and minority health*. 2012, 14, 1112–1118. <https://doi.org/10.1007/s10903-011-9560-8>

23. Mehta, N. K.; Elo, I. T.; Ford, N. D.; Siegel, K. R. Obesity among U.S.- and foreign-born blacks by region of birth. *American journal of preventive medicine*. 2015, 49, 269–273. <https://doi.org/10.1016/j.amepre.2015.02.014>

24. Hurston, J. S.; Worthy, C. C.; Huefner, E. A.; Sayed, M. S.; Dubose, C. W.; Mabundo, L. S.; Horlyck-Romanovsky, M. F.; Younger-Coleman, N.; Sumner, A. E. An overview of body size preference, perception and dissatisfaction in sub-Saharan Africans living in the United States. *Diabetes, metabolic syndrome and obesity: targets and therapy*. 2024, 17, 3279–3293. <https://doi.org/10.2147/dmso.s474956>

25. National Heart, Lung, and Blood Institute. Obesity and women's health. National Institute of Health. <https://www.nhlbi.nih.gov/health/overweight-and-obesity/women> (accessed on 14 March 2025).

26. Ade, J. N.; Rohrer, J.; Rea, N. K. Immigration, income, drinking and obesity in African American adults. *Journal of immigrant and minority health*. 2011, 13, 659–663. <https://doi.org/10.1007/s10903-010-9431-8>

27. Onuoha-Obilor, S. Dietary acculturation and obesity in African immigrant adults. Doctoral dissertation. Walden University. Minneapolis. 2017.

28. Akinsola, W. D. Associations of stress, health behaviors, and obesity among African American immigrants. Doctoral dissertation. Walden University. Minneapolis. 2023

29. Alese, J. T.; Alese, O. B. Comparison of physical activity as an obesity-related behavior between immigrants and native-born US adults. *Palgrave Communications*. 2020, 6, 1-7. <https://doi.org/10.1057/s41599-020-0441-4>

30. Cassidy, S.; Chau, J. Y.; Catt, M.; Bauman, A.; Trenell, M. I. Low physical activity, high television viewing and poor sleep duration cluster in overweight and obese adults; a cross-sectional study of 398,984 participants from the UK Biobank. *The international journal of behavioral nutrition and physical activity*. 2017, 14, 57. <https://doi.org/10.1186/s12966-017-0514-y>

31. Klabunde, R. A.; Lazar Neto, F.; Louzada, A.; de Moura, R. F.; Calixto, F. M.; Danaei, G.; Castro, M. C. Prevalence and predictors of overweight and obesity in Brazilian immigrants in Massachusetts. *BMC public health*. 2020, 20, 42. <https://doi.org/10.1186/s12889-020-8144-8>

32. Kepka, D.; Ayala, G. X.; Cherrington, A. Do Latino immigrants link self-rated health with BMI and health behaviors? *American journal of health behavior*. 2007, 31, 535–544. <https://doi.org/10.5555/ajhb.2007.31.5.535>

33. Dong, D.; Stewart, H. Racial and ethnic diversification will likely shape US food demand and diet quality. *Amber Waves: Racial and Ethnic Diversification Will Likely Shape US Food Demand and Diet Quality*. 2022, 2022, 1-9. <https://doi.org/10.22004/ag.econ.324120>

34. Rickertsen, K.; Gustavsen, G. W.; Nayga, R. M.; Dong, D. Acculturation in food choices among US immigrants. 2018. <https://doi.org/10.22004/ag.econ.277041>

35. Ukagumaoha, J. The Cultural Diet Behaviors of African Immigrants in California for Preventing Chronic Health Conditions including Obesity. Doctoral dissertation. Walden University. Minneapolis. 2023

36. United States Department of Agriculture. *Dietary Guidelines for Americans 2020-2025*. https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf (accessed on 13 March 2025)

37. Wang, Y.; Feng, J.; Liu, T.; Gong, Z.; Zhuo, Q. Association between whole-grain intake and obesity defined by different anthropometric indicators and dose-response relationship analysis among U.S. adults: A Population-Based Study. *Nutrients*. **2024**, *16*, 2373. <https://doi.org/10.3390/nu16142373>

38. Maki, K. C.; Palacios, O. M.; Koecher, K.; Sawicki, C. M.; Livingston, K. A.; Bell, M.; Nelson Cortes, H.; McKeown, N. M. The Relationship between whole grain intake and body weight: Results of meta-analyses of observational studies and randomized controlled trials. *Nutrients*. **2019**, *11*, 1245. <https://doi.org/10.3390/nu11061245>

39. Albertson, A. M.; Reicks, M.; Joshi, N.; Gugger, C. K. Whole grain consumption trends and associations with body weight measures in the United States: results from the cross-sectional National Health and Nutrition Examination Survey 2001-2012. *Nutrition journal*. **2018**, *15*, 8. <https://doi.org/10.1186/s12937-016-0126-4>

40. Juárez, S. P.; Honkaniemi, H.; Gustafsson, N. K.; Rostila, M.; Berg, L. Health risk behaviors by immigrants' duration of residence: A Systematic Review and Meta- Analysis. *International journal of public health*. **2022**, *67*, 1604437. <https://doi.org/10.3389/ijph.2022.1604437>

41. Endy, E. J.; Yi, S. Y.; Steffen, B. T.; Shikany, J. M.; Jacobs, D. R. Jr.; Goins, R. K.; Steffen, L. M. Added sugar intake is associated with weight gain and risk of developing obesity over 30 years: The CARDIA study. *Nutrition, metabolism, and cardiovascular diseases: NMCD*. **2024**, *34*, 466–474. <https://doi.org/10.1016/j.numecd.2023.10.022>

42. Malik, V. S.; Popkin, B. M.; Bray, G. A.; Després, J. P.; Hu, F. B. Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. *Circulation*. **2010**, *121*, 1356–1364. <https://doi.org/10.1161/circulationaha.109.876185>

43. Olsen, N. J.; Heitmann, B. L. Intake of calorically sweetened beverages and obesity. *Obesity reviews: an official journal of the International Association for the Study of Obesity*. **2009**, *10*, 68–75. <https://doi.org/10.1111/j.1467-789x.2008.00523.x>

44. Johnson, S.; Labaran, R.; Johnson, D. A. Associations of self-reported sleep duration and sleep difficulties with cardiometabolic risk factors among US-born and foreign-born black adults in the United States: NHANES 2005-2016. *Sleep Epidemiology*. **2022**, *2*, 100025. <https://doi.org/10.1016/j.sleepe.2022.100025>

45. Obi, J. I. Sleep patterns of African immigrants in the United States. *Sleep*. **2017**, *40*. <https://doi.org/10.1093/sleep/zsx050.839>

46. Subar, A. F.; Freedman, L. S.; Tooze, J. A.; Kirkpatrick, S. I.; Boushey, C.; Neuhouser, M. L.; Thompson, F. E.; Potischman, N.; Guenther, P. M.; Tarasuk, V.; Reedy, J.; Krebs-Smith, S. M. Addressing Current Criticism Regarding the Value of Self-Report Dietary Data. *The Journal of nutrition*. **2015**, *145*, 2639–2645. <https://doi.org/10.3945/jn.115.219634>

47. Lee, P. H.; Macfarlane, D. J.; Lam, T. H.; Stewart, S. M. Validity of the International Physical Activity Questionnaire Short Form (IPAQ-SF): a systematic review. *The international journal of behavioral nutrition and physical activity*. **2011**, *8*, 115. <https://doi.org/10.1186/1479-5868-8-115>

48. Lauderdale, D. S.; Knutson, K. L.; Yan, L. L.; Liu, K.; Rathouz, P. J. Self-reported and measured sleep duration: how similar are they? *Epidemiology (Cambridge, Mass.)*. **2008**, *19*, 838–845. <https://doi.org/10.1097/ede.0b013e318187a7b0>

49. Saenz, R. African migrants to North Texas defy Trump's disparaging depiction. *Dallas News*. <https://www.dallasnews.com/opinion/commentary/2018/02/01/african-migrants-to-north-texas-defy-trumps-disparaging-depiction/> (accessed 21 March 2025).

50. Liu, P.; Ma, F.; Lou, H.; Liu, Y. The utility of fat mass index vs. body mass index and percentage of body fat in the screening of metabolic syndrome. *BMC public health*. **2013**, *13*, 629. <https://doi.org/10.1186/1471-2458-13-629>

51. Garriguet, D.; Tremblay, S.; Colley, R. C. Comparison of Physical Activity Adult Questionnaire results with accelerometer data. *Health reports*. **2015**, *26*, 11.

52. Skender, S.; Ose, J.; Chang-Claude, J.; Paskow, M.; Brühmann, B.; Siegel, E. M.; Steindorf, K.; Ulrich, C. M. Accelerometry and physical activity questionnaires - a systematic review. *BMC public health*. **2016**, *16*, 515. <https://doi.org/10.1186/s12889-016-3172-0>

53. Park, Y.; Dodd, K. W.; Kipnis, V.; Thompson, F. E.; Potischman, N.; Schoeller, D. A.; Baer, D. J.; Midthune, D.; Troiano, R. P.; Bowles, H.; Subar, A. F. Comparison of self-reported dietary intakes from the Automated Self-Administered 24-h recall, 4-d food records, and food-frequency questionnaires against recovery biomarkers. *The American journal of clinical nutrition*. 2018, 107, 80–93. <https://doi.org/10.1093/ajcn/nqx002>
54. Cudney, L. E.; Frey, B. N.; McCabe, R. E.; Green, S. M. Investigating the relationship between objective measures of sleep and self-report sleep quality in healthy adults: a review. *Journal of clinical sleep medicine: JCSM: official publication of the American Academy of Sleep Medicine*. 2022, 18, 927–936. <https://doi.org/10.5664/jcsm.9708>

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.