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Kertas Asli/*Original Articles*

Food Intake in Relation to Obesity and Subjective Cognitive Complaints: A Cross-sectional Study from Nigeria

(Pengambilan makanan dan kaitannya dengan obesiti dan aduan kognitif subjektif: Kajian keratan rentas di Nigeria)

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ABSTRACT

There is evidence from research that dietary lifestyle influences health and mental well-being but there is limited understanding of the mechanism in Nigerian adult population. This study evaluated association of food intake with obesity and subjective cognitive complaints (SCCs) in Nigerian adults. We carried out a cross-sectional study of 1338 random samples aged 18-87 years who were visiting six different public hospitals in the southwest Nigeria between March 2016 and April 2016. Standard food frequency questionnaire (FFQ) and SCC questionnaire were used while anthropometric data were measured using standard clinical procedures. Associations were determined by linear and unconditional logistic regressions, after adjustment for age, ethnicity, education, gender, marital status, family type, alcohol and smoking status. Consumption of four different foods was significantly associated with SCC while one food intake was significantly associated with obesity measure (i.e., body mass index): meat product (Adjusted Odds Ratio (AOR), 1.002; 95% Confidence Interval (CI), 1.001-1.004; P <.0001), and sugary snacks (AOR, 1.007; 95% CI, 1.002-1.011; P <.01) were associated with increased SCCs whereas consumption of cereal products (AOR, 0.999; 95% CI, 0.998-1.000; P <.01) and potatoes (AOR, 0.998; 95% CI, 0.996-1.000; P <.05) were associated with decreased levels of SCCs. Consumption of non-alcoholic beverages was associated with decreased BMI levels (AOR, 0.998; 95%CI, 0.997-1.00; P <.05). Linear regression analyses on these data largely recapitulated the results. In conclusion, consumption of cereals, potatoes and non-alcoholic beverages appear beneficial to health and the findings could serve as an intervention strategy for tackling SCCs and obesity.

Keywords: Food intake; subjective cognitive complaints; BMI, obesity; Nigeria

ABSTRAK

Terdapat bukti daripada penyelidikan bahawa gaya hidup berkaitan pemakanan mempengaruhi kesihatan dan kesejahteraan mental, namun kurang pemahaman tentang mekanisme kaitan ini dalam kalangan populasi dewasa di Nigeria. Kajian ini menilai perkaitan pengambilan makanan dengan obesiti dan aduan kognitif subjektif (SCC) dalam kalangan orang dewasa Nigeria. Satu kajian keratan rentas telah dilakuan pada 1338 orang sampel rawak berumur 18-87 tahun yang melawat enam hospital awam yang berbeza di barat daya Nigeria antara Mac 2016 dan April 2016. Soal selidik kekerapan makanan yang standard (FFQ) dan soal selidik SCC telah digunakan di samping pengukuran antropometri dijalankan menggunakan prosedur klinikal standard. Perkaitan ditentukan oleh regresi logistik linear tanpa syarat, selepas pelarasan untuk umur, etnik, pendidikan, jantina, status perkahwinan, jenis keluarga, status pengambilan alkohol dan merokok. Pengambilan empat makanan berbeza mempunyai kaitan yang signifikan dikaitkan dengan SCC manakala pengambilan satu makanan berkait secara signifikan dengan ukuran obesiti (iaitu, indeks jisim tubuh, IJT): produk daging (Adjusted Odds Ratio: AOR), 1,002; 95% Selang Keyakinan (CI), 1.001-1.004; P <.0001), dan snek manis (AOR, 1.007; 95% CI, 1.002-1,011; P <.01) dikaitkan dengan peningkatan SCC manakala penggunaan produk bijirin (AOR, 0.999; 95% CI,0.998-1,000; P <.01) dan kentang (AOR, 0.998; 95% CI, 0.996-1.000; P <.05) dikaitkan dengan penurunan tahap SCC. Pengambilan minuman bukan alkohol dikaitkan dengan penurunan IJT (AOR, 0.998; 95% CI, 0.997-1.00; P <.05). Analisis regresi linear pada data ini telah mengikhtisarkan hasil kajian secara keseluruhannya. Kesimpulannya, pengambilan bijirin, kentang dan minuman bukan alkohol mampu memberi manfaat kepada kesihatan dan hasil kajian ini boleh digunakan sebagai strategi intervensi untuk menangani SCC dan obesiti.

Kata kunci: Pengambilan makanan; aduan kognitif subjektif; IJT, obesiti; Nigeria

INTRODUCTION

Human diet impacts well-being as a good balanced diet contributes significantly towards a healthy living and human performances, both physical and mental depend largely on dietary consumption (WHO 2019). For this reason, individuals are increasingly paying considerable attention to what they eat prompting more and more people to seek for nutritional information. This increase in nutritional knowledge has had a great effect on diet (Zhou et al. 2017). The general recommendation for healthy eating requires a diet that is balanced and with variety that includes fruit and vegetables, complex carbohydrates and low fat food choices (WHO 2019).

High intake of nutrient-dense foods such as cereals, fruits, vegetables, low-fat meat and dairy products have been associated with a number of favourable health outcomes in adults including a decreased prevalence of obesity and some other chronic diseases (Schulze et al. 2018). In contrast, low-nutrient dense dietary patterns with high intakes of sweets, desserts, and high-fat dairy products have been associated with higher rates of obesity and poor nutritional status in older adults (Schulze et al. 2018).

Obesity is an excess of adipose tissue capable of inducing significant increase in health risks and the instrument often used by the World Health Organisation (WHO 2012) to evaluate relationship between weight and stature in adult is the body mass index (BMI). BMI is an index for measuring weight to height; weight in kilograms divided by height in meters squared, and represents weight adjusted for height (Nuttall 2015). BMI correlates better with body fat than other indicators and it is used to classify underweight, overweight and obesity. Body weight can be a reflection of someone's nutritional intake (National Health and Medical Research Council 2013). Overweight and obesity are commonly suggestive of an incorrect energy balance and poor nutritional intake (Hill et al. 2012). Indeed, overweight and obese individuals are at higher risk of numerous health problems, including cardiovascular disease, type-2 diabetes, musculoskeletal disorders, and even some forms of cancer (WHO 2019). These individuals may exhibit deficits in multiple cognitive domains, including attention, executive function and memory (Sellbom & Gunstad 2012). Interestingly such deficits may be indicative of cognitive problems or complaints.

SCCs are reported failures in perception, memory, and motor functioning, in which the action does not match the intention (Allahyari et al. 2008). At all levels of ability, lapses of attention are clearly a part of everyone's life. Some are merely inconveniences, such as missing a familiar turn-off on the high-way and some are extremely serious, such as failure of attention that causes accidents, injury and loss of life (Robertson 2003). An association between weight status (obesity) and impaired cognitive functioning is sparingly available (Baccouche et al. 2014). However, evidence is increasingly growing that obesity is associated with adverse neurocognitive outcomes including stroke, and vascular dementia (Fitzpatrick et al. 2009) and as earlier noted, people who are obese tend to exhibit deficits in multiple cognitive abilities such as attention and memory (Gunstad et al. 2010; Sellbom & Gunstad 2012). Individuals who are obese usually suffer poor cardiovascular fitness, which in turn is associated with decreased cognitive function among different healthy and patient participants (Okonkwo et al. 2011).

While unhealthy eating habits partly contribute to the aetiology of overweight and obesity (Martyn-Nemeth et al. 2009), the underlying relationship between cognitive abilities and diet is still limited in Nigerian adults; hence further knowledge about the relationship between food and cognitive functioning is needed and the physiological mechanisms underlying this relationship could guide the development of public health policy and education. Thus, this study is aimed at improving our understanding of the relationship between food intake, obesity and SCCs in Nigerian adults.

MATERIALS AND METHODS

PARTICIPANTS

In total, 1338 randomly selected people participated in the survey. The participants consisted of 801 women and 531 men. Their age range was 18–87 years and they had a mean age of 32 years. We carried out a cross-sectional study of participants who were visiting general outpatient departments in six different public hospitals located across three states in the southwest Nigeria between March 2016 and April 2016. Permission and support were requested from the relevant units within these hospitals. Information sheets were attached to the questionnaires before being sent out. This included a description about the aims of the project. All the participants who participated in the study signed informed consent form prior to their recruitment. The inclusion criteria involved being18 years of age or older, and of good health status while the study excluded those with serious illness, severe hearing or visual impairment, persistent impairment of consciousness, and those with a history of severe head trauma or neurosurgery, and previous prolong mental retardation that may preclude a reliable assessment of cognitive complaints. This study was carried out following the Declaration of Helsinki and was approved by the Tai Solarin University of Education Institutional Review Board (IRB/2016/RP11).

PROCEDURE

The questionnaires were returned anonymously with no identifiers attached therefore no reminders or follow ups were completed.

FOOD INTAKE INFORMATION

This was measured using all the 14 food groups (i.e., alcoholic beverages, cereals and cereal products, eggs and egg dishes, fats and oils, fish & fish products, fruit, meat and meat products, milk and milk products, non-alcoholic beverages, nuts and seeds, potatoes, soups & sauces, sugars; preserves and snacks, vegetables) from a standard food frequency questionnaire with ratings involving a 10 point scale from —Never to —Everyday. The questionnaire is similar to the validated food frequency questionnaire (FFQ) (FFQ) by Mulligan and colleagues and was analysed and was analysed using feta software (Mulligan et al. 2014).

SUBJECTIVE COGNITIVE COMPLAINTS

The Subjective Cognitive Complaints Questionnaire, SCCQ was adapted from the well-established Cognitive Failure Questionnaire (Broadbent et al. 1982). Developed in 1982, the CFQ is a 25-item self-report measure of failures in attention, perception, memory, and action. Participants are required to indicate on a scale of 5, how frequent they have gone through each failure in the previous months, from 0 (never) to 5 (very often). Scores on the entire scale could range from 0 to 125 with the middle point being 62.5. Selected items from the CFQ include #7, "Do you fail to listen to people's names when you are meeting them?" and #17, "Do you forget where you put something like a newspaper or a book?" One study determined that CFQ's reliability is high, possessing an internal consistency (Cronbach's alpha) ranging from .85 to .89 (Broadbent et al. 1982). It also has high test–retest reliability. Broadbent et al. (1982) reported values of r = .82 and r = .80 over an extended period of up to 2years. They claimed that the CFQ should be used only to assess the single construct of cognitive failure. This claim was backed by stating the high internal consistency of the scale. A total score of SCCs was computed from the 25 items SCCQ, the range being 0 to 125. A score of 62.5 is the middle point so higher scores indicate high SCCs while lower scores indicate low SCCs. We validated this SCCQ in Nigerian sample (Cronbach's alpha was 0.93) and confirmed that it thus loads on a single factor using explorative and confirmatory factor analyses, respectively (Awofala & Ogundele 2018).

ANTHROPOMETRIC MEASUREMENT

Anthropometric parameters including height, weight and waist circumference were measured in all participants according to standard protocols (Cogill 2001). BMI was estimated as weight measured in kilograms divided by the square of height measured in metres. BMI was used to classify individuals into obese and normal weight (reference weight) individuals**.** A BMI $\geq$ 25 kg/m^2 indicates obesity while BMI < 25 kg/m^2 represents normal weight (Nuttall 2015).

OTHER HEALTH-RELATED BEHAVIOURS

Smoking and alcohol consumption were assessed using questionnaire and were used as covariates. Variables such as gender, ethnicity, age, marital status and education were also included in this part.

STATISTICAL ANALYSIS

Continuous variables are presented as means and standard deviations and were compared among BMI classes using

Table 1 Covariates included in the regression models

Variable	Description
Alcohol consumption	Current alcohol consumers were compared with those who did not currently consume alcohol.
Smoking	Current/ former cigarette smokers were compared to those who did not currently/formerly smoke cigarettes.
Gender	Males and females were compared.
Age	Age was compared based on a median split (18–52 years compared to 53-87 years).
Ethnicity	Three ethnic groups in Nigeria: Yoruba vs. Hausa and Yoruba vs. Ibo were compared. Yoruba being the reference.
Family type	Those from nuclear family were compared with those from polygamous or extended family.

One-way ANOVA. Backward step binary logistic regression was used to analyse the data including covariates. Regression models were used in order to examine whether dietary intake exhibit any effects on cognitive failure when other health related behaviours and demographics are taken into consideration (Table 1). Goodness of fit analysis was conducted (Hosmer-Lemeshow) together with standardized residuals (Cooks, Leverance and DFBetas). Linear regression was also used to test and possibly recapitulate this relationship and to test for evidence of collinearity. As some of the covariates are multichotomous; they were dummy coded before being added to the regression model. Unless otherwise mentioned, all of these values returned normal and did not need any further exploration.All *P*-values are two-tailed, and *P*< 0.05 was considered statistically significant. All analyses were performed using SAS software, version 9.2.1 (SAS Institute Inc., Cary, NC, USA).

RESULTS

PARTICIPANTS' CHARACTERISTICS

The study participants (N = 1338) had average age of 32 years and were more of Yoruba descent (78.3%) involving higher females (61.4%) more likely to be married (61.6%) and divorced (57.1%), and possess more university education (59.2%), with higher SCCs (58.9%) and overweight and obesity (55.4%) than their male counterparts.

The mean BMI of participants in this study was 26.09 ± 4.54 kgm^{-2} an indication that the participants were more likely to be overweight. The participants reported that they ate cereal products on an average of 307 g/day. The average amount of daily protein foods such as egg dishes, fish products, meat products and milk products consumed by participants in the past one year was 23 g/day, 92 g/day, 174 g/day and 230 ml/day, respectively. They however consumed lesser amounts of fats and oils (13 g/day), nut seed (5 g/day), sugary snacks (37 g/day) and potatoes (58 g/day) but more fruits (234 g/day) and soup sauces (393 g/day).

There were significant differences in the amount of cereal products (p =.021), non-alcoholic beverages (p =.004), soup sauces (p =.006) and fats and oil foods (p =.002) consumed across different BMI categories (i.e., underweight, normal weight, overweight and obese). Post hoc ANOVA using Scheffé test revealed that individuals who were overweight ate significantly lesser amount of cereal products than individuals with obesity; whereas consumption of non-alcoholic beverages by individuals with obesity differed significantly from those of underweight category. The quantity of soup sauces consumed by underweight participants differed significantly from quantity consumed by each of the other BMI categories. For fats and oils, the test revealed that the quantity taken by those who were underweight differed significantly from that taken by the overweight or individuals with obesity.

Table 2 Summary table of ANOVA results for food type consumption with BMI

	Under weight		Normal weight		Overweight		Obese		*F(3, 1124)*
	M	SD	M	SD	M	SD	M	SD	
Cereal products	333.82	218.2	24.34	192.9	**315.86**	**180.5**	**270.97**	**187.3**	3.26*
Non-alcoholic beverages	**168.29**	**175.7**	222.05	139.9	120.08	135.1	**88.92**	**111.4**	4.48*
Soup sauces	**602.19**	**523.5**	**61.08**	**366.7**	**374.36**	**343.5**	**367.32**	**288.5**	4.22*
Fats & oil	**19.05**	**18.6**	23.82	11.4	**13.14**	**11.04**	**11.07**	**9.0**	6.74**

*<0.01; **<0.001; Bold values indicate groups of individuals (BMI classes) showing significant differences in food type

FOOD CONSUMPTION AND SUBJECTIVE COGNITIVE COMPLAINTS

Thirty seven percent of the sample had high SCCs and this group was compared with those who had low SCCs. The consumption of several food types including cereal products, protein foods, sugary snacks, non-alcoholic beverages, and fat and oils were modelled against SCCs in the logistic regression equation. Cereal products, meat products, potatoes and sugary snacks were found to be significant in the final model (after adjustment for confounders) for the SCCs'' outcome (see Table 3).

Participants who ate cereal products were 0.1% less likely to report SCCs and people who ate potatoes were 0.2% less likely to have SCCs. Those who ate meat products and sugary snacks were 0.2% and 0.7% more likely to report SCCs respectively.

Table 3 Summary table of logistic regression results for food type consumption

Outcome N = 1205	Food type	Goodness of fita	OR	95% CI	P value
SCCs		$\chi 2(8) = 10.49$			
	Cereal products		0.999	0.998-1.000	.002
	Meat products		1.002	1.001-1.004	<.000
	Potatoes		0.998	0.996-1.000	.035
	Sugary snacks		1.007	1.002-1.011	.004

SCCs, Subjective cognitive complaints; OR, Odds Ratio; CI, Confidence Interval; a p > 0.05.

Linear regression analysis modelling these food types against SCCs as a continuous response variable recapitulated most of these results (Table 4). Reduced consumption of cereal products and potatoes as well as increased consumption of sugary snacks and soup sauces significantly increased the risk of developing SCCs. Notably, while consumption of meat product had no effect on the SCCs in this new analysis, there was a significant effect of soup sauces on the outcome variable.

FOOD CONSUMPTION AND OBESITY

Nineteen percent of the sample was obese and this group was compared with those who were not obese. Consumption of several food types including cereal products, protein foods, sugary snacks, non-alcoholic beverages, and fat and oils were modelled against obesity in the logistic regression equation. Non-alcoholic beverage was found to be significant in the final model (after controlling for

Table 4 Summary table of linear regression results for food type consumption

Outcome N = 1205	Food type	Model[b]	β	SE	*P* value
SCCs		$F_{12, 1073} = 6.83$			
	Cereal products		-0.007	.003	.026
	Potatoes		-0.017	.008	.039
	Soup sauces		0.005	.002	.002
	Sugary snacks		0.099	.020	<.000

SCCs, Subjective cognitive complaints; β, Parameter Estimate; SE, Standard Error; [b]$p < 0.0001$.

Table 5 Summary table of logistic regression results for food type consumption

Outcome N = 1097	Food type	Goodness of fit[a]	OR	95% Cis	*P* value
		$\chi^2(8) = 6.328$			
Obesity					
	Non-alcoholic beverage		0.998	0.997-1.000	.016

OR, Odds Ratios; CIs, Confidence Intervals; [a]$p > 0.05$.

Table 6 Summary table of linear regression results BMI frequency

Outcome N = 1097	Food type	Model[b; c]	*β*	SE	*P* value
BMI		$F8_{, 1096} = 20.47$			
	Fat and oil		-0.024	.012	.037

BMI, Body Mass Index; β, Parameter Estimate; SE, Standard Error; [b]$p < 0.0001$; [c]$R^2 = 0.131$

confounders) for the obesity outcome (Table 5). The effects of other food variables such as cereal products, meat products, potatoes and sugary snacks were removed from the final model by the backward elimination regression method.

Linear regression analysis modelling these food types against obesity measure (BMI) as a continuous response variable is shown in Table 6. There was a significant effect of fat and oil on BMI. The direction of effect is however surprising as we would have expected that increased consumption of food rich in fats and oils will increase BMI and thus increase the probability of being obese.

DISCUSSION

This study revealed that consumption of cereal products and potatoes had significant association with decreased SCCs while increased intake of meat products, sugary snacks and soup sauces showed significant associations with increased SCCs. In addition, increased consumption of non-alcoholic beverages and fat and oils were significantly associated with a decreased probability of being obese (BMI $\geq$ 26 kgm^{-2}) and a decreased BMI, respectively. Previous research had identified dietary factors to be strongly associated with SCCs after controlling for demographic and lifestyle factors (Chaplin & Smith 2011). In addition, studies have found obesity to be associated with cognitive impairment, irrespective of the presence of dietary factors (Dye et al. 2017; Deckers et al. 2017).

Chaplin and Smith (2011) previously observed the beneficial effect of foods, particularly breakfast, on SCCs. In our study, we went further to investigate which particular food significantly affects SCCs and found that individuals who consumed cereal products and potatoes regularly showed less likelihood of developing SCCs. Interestingly, evidence suggests that considerable healthy dietary patterns that maximize intakes of food rich in cereals and potatoes may slow down and /reduce cognitive decline (Tucker 2016).

Current evidence cannot support an exact anti-obesity role of fat and oils. To explain the indirect association between fats and oils and BMI is complicated and as such requires the separation of polysaturated fatty acids from the unsaturated ones in the present study. Notably, several studies have reported a significantly higher concentration of n-3 polyunsaturated fatty acids (PUFAs) in normal weight individuals compared with obese individuals (Karlsson et al., 2006; Micallef et al. 2009). The overweight and obese participants are also likely to benefit from reducing abdominal fat with fish oil supplementation especially when combined with life modification intervention as reported in a comprehensive meta-analysis examining the effects of fish oil on changes of body composition in overweight and obese adults (Du et al. 2015). In an investigation of the n-3 PUFAs content of perivisceral and omental adipose tissue samples of 8 obese patients, studies indicated that n-3 PUFAs were inversely related to abdominal obesity and adipocyte size (Garaulet et al. 2001; Garaulet et al. 2006). All of these studies perhaps indicate that n-3 polyunsaturated fatty acids (PUFAs) were effective not only in assisting in weight loss but also in preventing cognitive impairment and dementia (Simonettoet al. 2019).

It is particularly noteworthy that the causal relationship through which food indices and specific nutrients affect BMI and SCCs is not yet fully clear, it is a relationship which needs further attention and investigation. Although, we cannot obtain effective proof that fats and oils (even the n-3 PUFAs ones) intake may decrease body weight in overweight/obese adults, in the meantime, increasing consumption of cereal foods, potatoes and non-alcoholic beverages; and reducing consumption of sugary foods, meat products and soup sauces could be used as the basis of a simple, cost-effective and dietary intervention for maintaining healthy BMI levels and preventing SCCs. As revealed by our study regular consumers of sugary snacks and meat products were more likely to have SCCs than irregular consumers (Rippe & Angelopoulos 2016). SCCs occur when individuals show lapses in attention and concentration, both of which may be affected by one's alertness. This study confirmed the findings of Chaplin and Smith (2011) that associated breakfast cereals with increased alertness. In our study, people who consumed cereal products had less frequency of SCCs possibly because cereal consumption help increase cognitive alertness (Chaplin & Smith, 2011). It may not be possible to draw any firm conclusions about the mechanisms by which food intakes may influence SCCs and BMI in this study. One possible explanation is that sugary snacks and red meat products are generally fat-rich, and fat-rich meals have been shown to cause decrease in alertness (Wells & Read 1996) which could ultimately cause SCCs.

One strength of the present study was the setting: the CFQ and FFQ adopted have been previously validated in several studies across different populations. Moreover, the sample covered a wide age range and geographical area and the number of participants was relatively high. This study also controlled for a number of known and identifiable confounders that may distort the true association between food intake and obesity or SCCs.

LIMITATIONS

Our study has some limitations. First, this present study analysed data from a cross-sectional study and as such the temporal sequence between food intake and SCCs and/or between food intake and obesity cannot be ascertained. Since both the exposure and the outcomes in this study have already occurred, our study might suffer from not only recall bias but also interviewer bias that can affect the reliability of our results. However, the design of our study is such that the majority of our participants are generally young and healthy (i.e., with low SCCs and normal weight) and as such any recall bias will lead to an underestimation

of the true association between food types and SCCs or obesity. We also ensured reliability by the use of well-trained and professional nurses in information gathering and by performing and confirming all anthropometric measurements.

CONCLUSION

The result from the present study show that consumption of cereal products, potatoes and non-alcoholic beverages is associated with fewer cases of SCCs and obesity. In addition, the results confirm and further strengthen the direct association between sugary snacks and SCCs. Few of the confounding variables were controlled for in our study and so there is the need for further research to explore the associations of foods with SCCs and BMI. Further research must now determine the mechanisms underlying these effects.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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