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POLYUNSATURATED FATTY ACIDS (PUFAS) AND DEPRESSION IN ADOLESCENTS: A CROSS-SECTIONAL STUDY IN SOKOTO, NIGERIA

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Abstract

A cross-sectional study was conducted to investigate the relationship between polyunsaturated fatty acid (PUFA) intake and depression among adolescents attending Federal Neuropsychiatric Hospital Kware, Sokoto, Nigeria. Sixty participants were randomly selected and their dietary habits were assessed using a validated food frequency questionnaire (FFQ). Depression scores were evaluated using a standardized tool. Results showed that participants had low levels of PUFAs, and the common diets include palm oil being the lowest (1.65 ± 0.71%) content of PUFAs and coconut having the highest concentration (22.3 ± 8.6%). The prevalence of depression was high among participants, and it was linked to lower levels of PUFAs. The study suggests that poor dietary habits, particularly low intake of PUFAs, may contribute to depression among adolescents in Sokoto, Nigeria. This signifies the need for health education, counseling, and awareness regarding healthy dietary habits especially in adolescents.

Keywords:

Polyunsaturated Fatty Acids, adolescents, Sokoto, depression, palm oil, Kware.

Introduction

Healthy diet is a major pillar to maintain healthy wellbeing through the lifespan. Healthy diet is required in healthy eating behavior and shall be maintained at every level of life for growth, health, and development (Alaba & Adewunmi, 2017; Hamish & Angus, 2019). The youngsters including the adolescents are greater part of every society because they are supposedly the incoming leaders that steer and foster growth and development of "self" and nations or populations (Kumari & Manral, 2021).

Adolescents dietary patter and problems are being studied. Adolescents are being reported for taking poor diets, poor nutritional status, mostly because of socioecological problems such as personal behaviors of snacking, meal skipping, addiction to obesogenic foods (empty calories), etc (Arya & Mishra, 2013; Bondi et al., 2014; Falahan et al., 2023). Among the resultant effects of poor eating among adolescents were the poor behavior and depression (Bondi et al., 2014; Falahan et al., 2018; Faranzago et al., 2023). Depression is encouraged because of stressful societies, poor eating, poor diets and other reasons (Bondi et al., 2014). Indeed, there are a lot of concerns on the rise of poor PUFAs in diets in developing and developed societies nowadays (Bondi et al., 2014). Poor intake of PUFAs is associated with diverse array of negative outcomes in adolescents. The problem can also persist or transcends (Oliveira et al., 2012; Faranzago et al., 2023). Depression is a major and serious mental issue that nearly affects 280 million people worldwide. Depression is known for mental disorder, low mood, feeling guilty, low human pleasure, and suicide thought (Yousef et al., 2018). Depression is the 4th cause of human disability in the year 2018, and in 2020 it remained the 2nd among the 10 leading causes of disability. Several determinants such as gender, genetics, educational level, economics, etc are risk factors of depression (Yousef et al., 2018). There is strong connection between depression and dietary pattern (Yousef et al., 2018; Zhang, 2022). Poor intake of PUFAs is a dietary pattern that links to depression (Yousef et al., 2018). For instance, Eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and others are relevant in proper or improper mental patter (Wang et al., 2024). It was speculated that the EPA and the likes act by relieving the brain from oxidative stress, therefore relevant in mental disorders. They are also acting as anti-inflammatory agents (Dwarkanath et al., 2009; Zhang, 2022). The objectives of this study are as enumerated below:

- To assess the dietary intake of polyunsaturated fatty acids (PUFAs) among adolescents with depression in Sokoto, Nigeria.
- To determine the prevalence of depression among adolescents attending Federal Neuropsychiatric Hospital Kware, Sokoto
- To examine the relationship between PUFA intake and depression among adolescents in Sokoto, Nigeria.
- To identify the socio-demographic factors influencing PUFA intake among adolescents with depression in Sokoto, Nigeria.
- To evaluate the levels of PUFAs in commonly consumed foods in Sokoto, Nigeria, and their potential impact on adolescent mental health.

MATERIALS AND METHODS

Study Design

A cross-sectional study design was employed in the course of this study.

Study Population and Sample size

Adolescents diagnosed with depression and attending Federal Neuropsychiatric Hospital Kware, Sokoto were the subjects or participants in this study. The sample size utilized was 60 participants through simple random sampling to recruit participants.

Data Collection Tools and Techniques

Data collections tools are as follows:

1. **Dietary Assessment**: A validated food frequency questionnaire (FFQ) was used to estimate PUFA intake.
2. **Depression Assessment**: Depression scores were evaluated using a standardized tool specifically the Zung Self-rating depression scale (Zung, 1965).

Sources of foods

Foods for the analysis of PUFAs in Sokoto were purchased in Sokoto City and Kware. The categories of foods involved in the study are: Coconut, palm oil, groundnut oil, and soy beans.

Fatty acids profile (FAP)

FAP in foods was determined by following the details in Halfen et al. (2016) using chemicals and solvents of analytical grade, and gas chromatography. PUFA levels were analyzed using gas chromatography. Equally, in humans the FAP (or PUFAs) were determined according to protocols stated by Wang et al. (2024) that capitalized on gas chromatography.

Statistical Analysis

Data in the study had to be expressed as mean ± standard deviation, descriptive statistics (where necessary) was calculated, differences between values were tested ($P<0.05$) using t test in a statistical tool (SPSS, version 20).

Ethical approval

Ethical approval was sought from the relevant ethics committee, and informed consent was obtained from participants and guardians. The management of Federal Neuropsychiatric Hospital Kware, Sokoto has approved this work with the tag number as follows: FNPHK/ADM/SUB/809/VOL.I/P.104.

RESULTS AND DISCUSSION

The results for this study are shown in Tables 1-5.

Table 1: Demographic characteristics of participants in Sokoto, Nigeria

S/N	Demographic characteristics	Prevalence	Frequency(N:60)	Percentage
1	Putative level of income	Worker Unemployed Farmer Business	9 32 8 11	15.0 53.3 13.3 18.3
2	Marital status	Single Married	42 18	70.0 30.0
3	Education	Less than 15 years More than 15 years	32 28	53.3 46.7
4	Gender	Male Female	37 23	61.7 38.3

Table 1 shows the demographic characteristics of the participants in this study. The occupation of parents is: 53.3% unemployed, 18.3% businessman, and 13.3% farmer, and 15.0 worker. The marital status of the participants is 70.0% single, and 30.0% married. In terms of educational level, 53.3% are educated in less than 15 years (which may be below secondary school), and 46.7% were educated above 15 years (an indication of more than a secondary school education). In terms of gender, 61.7% are males and 38.3% are females.

Table 2: Levels or concentrations of some polyunsaturated fatty acids (PUFAs) in adolescents attending Federal Neuropsychiatric Hospital Kware, Sokoto

S/N	Fatty acids (μmol/L)	10-12 years old (mean ± Standard deviation)	13-15 years old (mean ± Standard deviation)	16-19 years old (mean ± Standard deviation)
1	C20:4n-6 (AA)	4.2 ± 1.0	3.9 ± 1.2	5.6 ± 1.2
2	C20:5 n-3 (EPA)	1.6 ± 0.2	0.7 ± 0.1	3.1 ± 0.1
3	C20:6 n-3 (DHA)	2.1 ± 0.4	1.9 ± 0.3	2.1 ± 0.2
4	22:5n-3 DPAnH3	5.2 ± 0.5	6.9 ± 0.2	5.12± 0.1
	Total	13.1	13.4	15.92
	Average	3.28 ± 0.53	3.35 ± 0.45	3.98 ± 0.52

Table 2 shows the serum concentrations of PUFAs in different categories of adolescents attending the Federal Neuropsychiatric Hospital Kware (FNHK). The results indicate that there is difference in concentrations of the distinct PUFAs assessed in the participants, there with, the total concentration of

PUFAs is increasing towards the borderline of adolescence. This might be because the adolescents are getting more exposed to sociological factors (such as peers, more education, and ability to earn money) that are in turn important in facilitating ability to have access to healthy and desirable amounts of foods, since majority of the parents are unemployed (as revealed on Table 1). Unemployment is a major factor that causes food insecurity, and in turn malnutrition in its various forms (Barth et al., 2021). Equally, the low levels of PUFAs in the adolescents could be due to personal poor dietary habits.

The concentrations of PUFAs determined in this study are generally lower than the findings of Wang et al. (2024) among adults in US. The difference could be due to differences in demographics and settings. Majority of the United States of America citizens live in the cities and US dwellers have more access to healthy foods and health literacy (or health care that encourage healthy eating) (Barth et al., 2021). Adults have more ability to make healthy eating choices more than the adolescents due examined in this study (adolescents attending Federal Neuropsychiatric Hospital Kware, FNHK) (Barth et al., 2021). Equally, the findings of this study is in agreement with that of Yousef et al. (2018) that revealed an administration of 300 mg of different PUFAs in adults is linked to reduced prevalence of depression in patients attending a university hospital in Pakistan. The role of PUFAs in aiding or abetting depression in human nutrition is enormous (Wang et al., 2024).

Table 3: Levels or concentrations of some polyunsaturated fatty acids (PUFAs) in different foods in Sokoto, Nigeria

S/N	**Fatty acids**	**Groundnut (mean** ± Standard deviation)	**Palm oil (mean** ± Standard deviation)	**Soy beans (mean** ± Standard deviation)	**Coconut (mean** ± Standard deviation)
1	C20:4n-6 (AA)	5.0 ± 0.1	0.16 ± 0.05	2.1 ± 0.6	6.0 ± 1.6
2	C20:5 n-3 (EPA)	9.0 ± 0.5	1.2 ± 0.6	13.6 ± 5.0	10.6 ± 5.0
3	C20:6 n-3 (DHA)	3.11 ± 0.6	0.13 ± 0.01	1.0 ± 0.5	3.7 ± 1.0
4	22:5n-3 DPAnH3	1.6 ± 0.1	0.16 ± 0.1	2.5 ± 0.6	2.0 ± 1.6
	Total	18.71 ± 1.3	1.65 ± 0.71	19.2 ± 6.7	22.3 ± 8.6

Table 3 shows the levels (concentrations) of different PUFAs in foods in Sokoto, Nigeria. Accordingly, the palm oil was the food with the lowest level of PUFAs (1.65 ± 0.71%) and equally the highest concentration (level) was recorded in coconut (22.3 ± 8.6%), then soy beans (19.2 ± 6.7%), and lastly followed by groundnut oil (18.71 ± 1.3%). The nutritional implications of these concentrations are many. The consumers should usually consume varieties and mixtures of food sources in order to get balanced diet (Al-Fatlawy et al.., 2023; Li et al., 2024). The coconut oil or coconut is not readily accessible in Sokoto, because of the farming environment and the scarcity of technology to tap coconut oil. Additionally, consumption of coconut may expose the consumers to saturated fats, therewith, ultra-processed coconut products are unhealthy (being empty calories with little nutrients, and laden with

harmful preservatives) (Lalnunthara & Kumar, 2020). The palm oil is common in Sokoto, but contain low level of PUFAs and high levels of saturated fats (that increased the risk of having elevated cholesterol level and consequently heart problems) (Das, 2015). Soybeans oil is uncommon (largely inaccessible) in Sokoto, therefore, these factors may be among the determinants of poor (low level in) PUFAs in the participants in this study.

Table 4: Prevalence of polyunsaturated fatty acids (PUFAs) intake among participants in Sokoto, Nigeria

S/N	**Source of fatty acid**	**Prevalence**		**Frequency**	**Percentage**
1	Palm oil	Often	Yes	47	28.3
			No	13	71..7
2	Groundnut oil	Often	Yes	32	38.3
			No	37	61.7
3	Coconut	Rarely	Yes	14	23.3
			No	46	76.7
4	Soy beans	Rarely	Yes	16	26.7
			No	44	73.3
5	Junk foods	Frequently	Yes	47	78.3
			No	13	21.7

As shown in Table 4, the consumption of palm oil and groundnut oil was a minor trend among the study participants. This is unhealthy and may be due to the adolescents improve behaviors regards to foods (such as empty calories consumption, snacking, bulimia, etc). The participants stated that they take empty calories (junk foods) frequently, which is a trend that is being experienced across various parts of the world especially among the adolescents or young people (Das, 2015; Michigan WIC Program, 2022).

Poor consumption of sources of PUFAs is witnessed by responses of the participants in this study may be due to high intake of empty calories. Resultantly, empty calories are non-nutritious, and are readily addictive in nature (Ayed et al., 2019). In turn could easily spur malnutrition forms such as hidden hunger. However, the pattern or trend of consumption is in line with that reported in pregnant women in India by Dwarkanath et al. (2009).

Table 5: Prevalence of depression among study participants

Fatty acid	With depression F(%)	Without depression F(%)
C20:4n-6 (AA)	47 (78.3)	13 (21.7)
C20:5 n-3 (EPA)	42 (70.0)	78 (30.0)
C20:6 n-3 (DHA)	41 (68.3)	19 (31.7)
22:5n-3 DPAnH3	52 (86.6)	8 (13.4)

Table 5 shows the levels of depression among the participants. It was evident that there is major prevalence of depression among the participants. This could be speculated to the lower levels of PUFAs in the participants, and also linked to lower accessibilities to sources of PUFAs due to several reasons (Dymytrenko, 2009). The majority of the participants submitted to the facts that, they do not often consume palm oil (a lower source of PUFAs), groundnut oil, coconut, and soy beans. But the participants

are more inclined to empty calories. Noteworthy, PUFAs are significant in nutritional health (Oliveira et al., 2012; Adubiara et al., 2018; Falahan et al., 2018; Wang et al., 2024). EPA and DHA are significant in human brain. The EPA and DHA, along with other PUFAs serve as antioxidants and anti-inflammatory agents in the brain, thereby reducing the chances of mental disorders (like depression). Therefore, people who consume less of the PUFAs may be speculated to experience mental issues such as depression as submitted by participants in this work (Yousef et al., 2018; Flanagan et al., 2020).

CONCLUSION

The study highlights a significant connection between poor dietary habits, particularly low intake of polyunsaturated fatty acids (PUFAs), and depression among adolescents in Sokoto, Nigeria. The research involved 60 adolescents diagnosed with depression, revealing that most participants had low levels of PUFAs, likely due to factors like unemployment among parents, limited access to healthy food options, and a preference for junk food. In this study, indeed participants had lower concentrations of PUFAs, which are essential for brain health and mental well-being. Additionally, adolescents consumed more empty calories and less PUFA-rich foods like palm oil, groundnut oil, coconut, and soybeans. There was a significant prevalence of depression among participants, potentially linked to their low PUFA intake. PUFAs levels in food sources are as follows: Coconut (22.3 ± 8.6%), soybeans (19.2 ± 6.7%), groundnut oil (18.71 ± 1.3%), palm and oil (1.65 ± 0.71%). Increasing PUFAs consumption through dietary changes or supplements could help alleviate depressive symptoms in adolescents. Omega-3 fatty acids, particularly EPA and DHA, play a crucial role in brain health and may reduce depression risk.

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