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Original Article

ASSESSING THE CORRELATION BETWEEN MATHEMATICAL LITERACY AND ANTIOXIDANT KNOWLEDGE AMONG NIGERIANS

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ABSTRACT

Background: Mathematical literacy and health literacy are essential components of an individual's overall literacy. Mathematical literacy refers to the ability to apply mathematical concepts and skills to solve real-world problems. On the other hand, health literacy encompasses the knowledge, skills, and abilities required to navigate the healthcare system and make informed decisions about one's health. The ability to understand and apply mathematical concepts is crucial in health literacy, particularly in comprehending health-related numerical information. Individuals with higher mathematical literacy levels are better equipped to understand health statistics, treatment options, and medication instructions. Antioxidants play a vital role in maintaining overall health and well-being. They help prevent or reduce cell damage caused by free radicals, which can contribute to the development of chronic diseases. A diet rich in antioxidants, such as vitamins C and E, beta-carotene, and other phytochemicals, has been linked to a reduced risk of chronic diseases, including cancer, cardiovascular disease, and neurodegenerative disorders. Oxidative stress related diseases, including cancer, diabetes, and cardiovascular issues, poses significant public health challenges globally. Antioxidant supplements have been promoted as a potential preventive measure against these conditions, yet their effectiveness and safety remain contentious. Despite the importance of antioxidants, many Nigerians lack adequate knowledge about these substances. This knowledge gap may be attributed to various factors, including limited access to health education, low health literacy levels, and inadequate mathematical literacy skills. Therefore, assessing the correlation between mathematical literacy and antioxidant knowledge among

Nigerians is essential to identify areas for improvement in health education and literacy. This study aims to assess the relationship between mathematical literacy and antioxidant knowledge among Nigerians, providing insights into the development of effective health education strategies.

Methodology: A study was a cross sectional study conducted to assess the correlation between mathematical literacy and antioxidant knowledge among Nigerians involving 100 study participants that were selected using multistage sampling method. Data was collected using semi structured questionnaire and analyzed with SPSS version 26 to show frequencies and proportions.

Results: Assessing the correlation between mathematical literacy and antioxidant knowledge among Nigerians, it was observed that majority of the respondents had good knowledge about the antioxidants.

Conclusion: This investigation is particularly relevant given the prevalence of such diseases and the increasing interest in antioxidants, which are believed to mitigate oxidative damage and enhance overall health. Despite this interest, there is a notable lack of research on public knowledge surrounding the use of antioxidant supplements for preventing oxidative stress related diseases. This scoping review seeks to address this knowledge gap by exploring the current literature on assessing the correlation between mathematical literacy and antioxidant knowledge among Nigerians

KEYWORDS: knowledge, Antioxidants, mathematical literacy

INTRODUCTION

Mathematical literacy and health literacy are essential components of an individual's overall literacy (OECD, 2016). Mathematical literacy refers to the ability to apply mathematical concepts and skills to solve real-world problems (OECD, 2013). On the other hand, health literacy encompasses the knowledge, skills, and abilities required to navigate the healthcare system and make informed decisions about one's health (WHO, 2013).

Research has shown that mathematical literacy plays a crucial role in health literacy, particularly in understanding health-related numerical information (Golbeck *et al.,* 2005). Individuals with higher mathematical literacy levels are better equipped to comprehend health statistics, treatment options, and medication instructions (Rebacz *et al.,* 2017). Antioxidants are substances that help prevent or reduce cell damage caused by free radicals (Halliwell, 2007). A diet rich in antioxidants, such as vitamins C and E, beta-carotene, and other phytochemicals, has been linked to a reduced risk of chronic diseases, including cancer, cardiovascular disease, and neurodegenerative disorders (Liu, 2013). Despite the importance of antioxidants, many Nigerians lack adequate knowledge

about these substances (Omemu *et al.,* 2013). This knowledge gap may be attributed to various factors, including limited access to health education, low health literacy levels, and inadequate mathematical literacy skills (Akpabio *et al.,* 2016).

Therefore, assessing the correlation between mathematical literacy and antioxidant knowledge among Nigerians is essential to identify areas for improvement in health education and literacy. This study aims to investigate the relationship between mathematical literacy and antioxidant knowledge among Nigerians, providing insights into the development of effective health education strategies. Oxidative stress/ problem is a crucial factor in the carcinogenesis process and while cancer therapy outcomes have improved, cancer remains a systemic sickness after a certain point. Because the complete recovery of cancer patients following a particular treatment is challenging, a multidisciplinary strategy including surgery, chemotherapy, radiation, and immunotherapy is commonly employed· (Ali SS, *et al*). The severity of oxidative stress in public health is worrying and has been on the increase. Antioxidants, such as vitamins A, C, E, selenium, zinc, copper, and manganese, help reduce the detrimental effects of oxidative related stress in nutrition and human health by trapping and counteracting free radicals. Studies have shown that the public has a limited understanding of antioxidant supplements and their role in preventing oxidative stress-related diseases. A survey conducted in the United States found that only 22% of respondents had heard of antioxidant supplements, and only 12% reported using them. Another study conducted in Australia found that 70% of respondents believed that antioxidant supplements were effective in preventing chronic diseases, but only 30% reported using them.

Oxidative stress has an important role in the onset and in the progression of several diseases, and in particular, in cardiovascular diseases. Oxidative stress is caused by the overproduction of reactive oxygen species (ROS), which include both the free radicals and their non-radical intermediates, such as superoxide anion ($O_2^{\bullet -}$), hydroxyl ion ($OH^{\bullet}$), hydrogen peroxide (H_2O_2), and peroxyl radicals ($ROO^{\bullet}$), alkoxyl ($RO^{\bullet}$), singlet oxygen ($^1O_2$), and ozone (O_3).The burst of ROS is associated with an imbalance between the generated ROS and the antioxidant defense systems. Evidence shows that oxidative stress plays an important role in the progression of various cardiovascular diseases, such as atherosclerosis, heart failure (HF), cardiac arrhythmia, and myocardial ischemia-reperfusion (I/R) injury. A lot of work has been devoted to the studies of antioxidants therapies in the prevention and treatment of these cardiovascular diseases. While some clinical trials have shown positive results, others are controversial.

Green tea, strawberries, eggplant, garlic, ginger, and other foods are essential and have anti-oxidative properties in food, which have been showed to have a variety of pharmacological actions too, as well as the treatment of lipid metabolic anomalies. Obesity being a disease of body mass index more than 25kg/m^2 is widely recognized to produce oxidative stress via several methods and in different ways. The first procedure is mitochondrial and peroxisomal fatty acid disintegration, which can produce reactive oxygen species (ROS) in oxidation reactions, while another is oxygen overconsumption, which produces free radicals in the mitochondrial respiring chain and guides oxidative phosphorylation in mitochondria.

Reversing the impact of corpulence on oxidative stress and swelling is essential to lessening the disastrous impacts of corpulence. The pretended designs of antioxidants differ, and they may be classified as hydrophilic (dissolved in water) or hydrophobic (soluble in fat). While fat-dissolved antioxidants are more inclined insulate cell membranes from ROS-mediated lipid peroxidation, water-dissolved antioxidants usually respond with ROS inside cells or body fluids (blood antitoxin, extracellular fluid, seminal plasma) Polyphenols contained in pigmented rice may play a crucial role in focusing certain therapeutic pathways in obesity-related oxidative stress and inflammation, Like every other location in Nigeria, the population in this study area may lack enough knowledge and could perceived substances regarding the antioxidant supplements at low rate, thus Preventing Oxidative Stress-Related Diseases; consequently, knowing the antioxidants and the supplements helps in successful health treatments (Garvin, T., & Szostak, R).

Oxidative Stress and Its Implications: Oxidative stress has been powerfully implicated in the pathogenesis of traumatic brain injury (TBI). Mitochondrial ferritin (Ftmt) is reported to be closely related to oxidative stress. However, whether Ftmt is involved in TBI-induced oxidative stress and neurological deficits remains unknown. Increasing evidence shows that oxidative stress induced by abnormal accumulation of reactive oxygen species (ROS) plays an main role in the pathogenesis of TBI, in accordance with Wang, Excessive levels of oxidative stress can cause protein, nucleic acids and lipids damage, leading to neurological dysfunction, additionally, [17] stated that Vascular calcification is closely related to cardiovascular morbidity and mortality and also indicated that oxidative stress is associated with dysfunction of differing organs, along with cardiovascular ailments in incessant kidney ailment (CKD), Excessive production of oxidative stress results in various deleterious occurrences by irrevocable modification of biomolecules,

including lipids, proteins, and DNA. Regarding diabetes raised ROS and hyperglycemia damage the pancreatic β-cells and consequently induce type 1 DM

Antioxidants: Excessive oxygen free radicals can lead to ageing, cancer, and other ailments. Therefore, searching for productive antioxidants to scavenge oxygen-free radicals has become the focus of modern medicine stated that natural antioxidants in ingested foods include tocopherols, ascorbic acid, carotenoids, flavonoids, amino acids, phospholipids, and sterols. They serve a main function in scavenging free radicals and non-radical oxidants and protecting cells from oxidative stress and damage. The evidence that oxidative damage is immediately linked to various disorders, including cancer, neuro-degeneration, and diabetes, stresses the need for antioxidants. (Callcott E. T., Blanchard C. L., Snell P., and Santhakumar A. B)

Several ways to improve human health and lifespan incorporate dietary antioxidants into diets and fortified foods. Antioxidants also help to hold food fresher for longer. Fortified or designer meals that are enhanced with antioxidant nutrients and the exercise of microorganisms as probiotics are suitable and more accessible in the market as fitness foods., According to a study, antioxidants are classified into two types established by their method of operation: (i) deterrent antioxidants, which interfere with the start process by delaying or staying the formation of radical class, and (ii) chain-breaking antioxidants, that hinder autoxidation by playing with propagation reactions; that is, they respond with radicals faster than the oxidizable substrate. In addition to these direct antioxidants, substances that do not hold antioxidant activity but can advance and boost the efficiency of the endogenous antioxidant defences in biological systems, are usually categorized as indirect antioxidant. The term "antioxidants" defines chemical substances that slow down the damage caused by oxygen to organisms. Antioxidants are one of the mechanisms that the body uses to fight against oxidative stress with the role to balance the negative effects of oxidant agents and protect cells from oxidative damage. We can identify two macro groups of antioxidants: Those who are produced by the body itself (i.e., endogenous antioxidants) and those that derive from dietary sources (i.e., exogenous antioxidants). Endogenous antioxidants can be divided into two classes: Enzymatic and non-enzymatic antioxidants. Some enzymatic antioxidants are catalase (CAT) that degrades hydrogen peroxide (H_2O_2) to water and oxygen, glutathione reductase (GRx), glutathione peroxidase (GPx) that catalyzes the reduction of H_2O_2 by the reduced form of glutathione (GSH), creating a glutathione bridge with another glutathione molecule (GSSG), and superoxide

dismutase (SOD) that catalyzes the dismutation of superoxide anion radical (O_2^-) into H_2O_2 and oxygen (O_2)

The non-enzymatic antioxidants include nutrients that are not produced by the body, and thus need, to be included through the diet. Nutrient antioxidants are found in fruits, vegetables, and fish, and are extremely important because each one of them has a role in oxidative stress neutralization. According to their role in reducing oxidative stress-mediated cardiovascular risk, these exogenous molecules can represent a useful tool in clinical practice. Specifically, natural extracts, such as polyphenols, exert an antioxidant activity that includes suppression of ROS formation by either inhibition of enzymes involved in their production, like NOX2, scavenging of ROS, or up-regulation or protection of antioxidant defenses.

The most widely used antioxidants include: Vitamins E and C

Vitamin E is a strong antioxidant, is dissoluble in fat, and presents eight stereoisomers. Just one, α-tocopherol, is bioactive in humans. The main function of vitamin E is to protect the body against lipid peroxidation. It has been shown that high-dosages (≥400 IU/day or more for at least 1 year) can be dangerous and can increase the risk of death. Moreover, a dose-response analysis showed a statistically significant relationship between vitamin E dosage and all-cause mortality, with an increased risk of dosages greater than 150 IU/day. (Fernández-Sánchez A., Madrigal-Santillán E., Bautista M) The effect of Vitamin E supplementation in the prevention of cardiovascular diseases is controversial. The analyses of sixteen randomized controlled trials of vitamin E treatment showed that, compared to controls, vitamin E given alone significantly decreased myocardial infarction (R.R.: 0.82; 95% C.I., 0.70–0.96; p = 0.01). Supplements containing vitamin E significantly reduced cardiovascular mortality risk (RR: 0.88; 95% CI: 0.80, 0.96). However, the analyses of 15 trials reporting data on 188,209 participants showed that antioxidant vitamin supplementation (vitamin E, β-carotene, and vitamin C) has no effect on the incidence of major cardiovascular events, myocardial infarction, stroke, total death, and cardiac death. Vitamin C, or ascorbic acid, is a water-soluble antioxidant with a fundamental role in quenching various ROS and reactive nitrogen species (RNS). The antioxidant activity of vitamin C supplementation resulted in positive effects when administrated in concentrations that ranged from 500 to 2.000 mg/day. In the case of high consumption, vitamin C and its metabolites, such as dehydroascorbic acid, 2,3-diketogulonic acid, and oxalic acid, are excreted via the kidneys in humans. Vitamin C

is generally non-toxic, but at high doses (2–6 g/day) it can cause gastrointestinal disturbances or diarrhea. However, these side effects are generally not serious and can be easily reversed by reducing its intake. Several lines of evidence suggest that Vitamin C may be associated with a favorable impact on the risk of cardiovascular disease. Vitamin C dose greater than 500 mg/day was associated with beneficial effects on endothelial function with stronger effects in those at higher cardiovascular disease risk, such as in atherosclerotic, diabetic, and heart failure patients. (Evans, J. A., Shim, J., & Ioannidis, J. P)

The analyses of thirteen trials involving 1956 patients after cardiac surgery showed that vitamin C significantly reduced the incidence of postoperative atrial fibrillation (RR: 0.68, 95% CI: 0.54, 0.87, p = 0.002) and the risk of adverse events (RR: 0.45, 95% CI: 0.21, 0.96, p = 0.039).

Finally, the effects of Vitamins E and C are strictly correlated. Indeed, in patients with coronary artery disease, supplementation with 2 g of vitamin C with 600 mg of vitamin E orally significantly enhanced endothelium-dependent vasodilatation in the radial circulation.

METHODOLOGY:

Study area: This study was carried out in Edo south senatorial district of Edo State. The state is one of the states in the south south, Niger Delta region of Nigeria with 3 senatorial district, (Edo south, Edo central and Edo north). It lies between latitude $48^{o}32N$ and $5^{o}25E$ and longitude $7^{0}25N$ and $8^{0}25E$. The people of Edo State are majorly Christians and the main economic activities of the people are fishing for riverine and coastal dwellers, farming mostly for upland dwellers, trading, artisanship and civil services. Edo south senatorial district is vast and blessed with rich foods and cultural heritage.

Study Design: The study was a descriptive cross-sectional study.

Study Population: The target respondents are from a variety of demographic backgrounds in three senatorial district of the state (Edo south, Edo central and Edo north) 18 years old and above.

Sample size determination:

Sample size was estimated using William Cochran's method for cross sectional survey

Sample size $n = \frac{Z^2PQ}{D^2} \ldots 13$

n = Sample size

Z = Standard normal deviate set at 1.96 to correspond to 95% confidence interval.

P = Prevalence of the condition under study from related studies.

Q = 1-P

D = Degree of precision at a confidence level of 95% (Error margin)

Z = 1.96

P = 20.5 = 0.25

d = 0.05

From the formula; $n = \frac{Z^2PQ}{D^2}$

$n = \frac{(1.96)^2 \times 0.25 \times 0.3)}{(0.05)^2}$

$n = \frac{3.8416 \times 0.059}{0.0025} = \frac{}{0.0025} = 0.6592$

Minimum sample size, n = 92.10

Adding a non-response rate of 10%, the study sample size would be 101, approximately 100 participants.

Study Sample size used in this study = 100

Sampling technique:

Multistage sampling technique was used for this survey.

Stage I: Selection of LGA. Oredo, Igueben and Afuze LGA was selected using simple random sampling balloting method

Stage II: Selection of wards and villages. Wards and villages were selected using simple random sampling technique (balloting method).

Stage 111: Selection of participant. Participants were selected using simple random sampling technique (balloting method).

Study Instruments:

An adapted paper-based, semi-structured questionnaire was used for data collection. The questions were in simple English language, short and direct to prevent misunderstanding. The questionnaire

was divided into four sections: Section A; Socio-demographic characteristics of the participants. Section B; Knowledge of antioxidant supplements in preventing oxidative stress-related diseases.

Pretesting: A pretest study was done with 10% of the study sample size to establish reliability, clarity, inclusion of relevant information and good consistency in the words. Modifications were made on the questionnaire based on feedback received from the pretest.

Data Collection Techniques:

The semi- structured questionnaire was used to collect data to assess the correlation between mathematical literacy and antioxidant knowledge among Nigerians. Respondents were contacted and asked where they obtained the antioxidant information and other relevant questions. The data collection lasted for a period of 2 months. A research assistant was trained for 2 days on how to administer consent form, collect data. An information sheet, ethics approval and written consent form (which was read out) was provided to each respondent. There was confidentiality and anonymity of data collected.

Statistical Analysis: Responses gotten from respondents was check for errors and omission on daily basis. It was fed into electronic database using the software Statistical Package for Social Sciences (SPSS) software version 26.0 [SPSS Inc; Chicago, IL, USA] and presented in the form of numerical, tabular presentations. Descriptive statistics were employed to characterize the demographic characteristics of the respondents and their level of knowledge. Percentages and frequencies were determined.

Ethical Considerations: Ethical approval for the study was obtained from Ministry of Health Research and Ethics Committee, Edo State. A written informed consent was obtained from the respondents before questionnaires were administered. Information given was treated with utmost confidentiality. There was also provision for translation of consent form for participants who can't read or write. Before administering the questionnaire to respondents, demographic information such as educational level, age, gender, and socioeconomic position were assessed and their confidentiality was maintained.

Limitation of the study: self-reporting could pose limitation as respondents may overestimate their knowledge. More elaborate study with interviewer administered may reduce such limitation

RESULTS:

One hundred (100) respondents participated in the study and provided responses to all the questions. The results obtained are shown below:

Table 1: Demographic Characteristics of respondents

Demographic variable	Frequency(n =100	Percentage (%)
Age Group		
18-25 years	20	20.0
26-35 years	25	25.0
36-45 years	30	30.0
46 years and above	25	25.0
Gender		
Male	45	45.0
Female	55	55.0
Education Level		
No formal education	10	10.0
Primary education	25	25.0
Secondary education	35	35.0
Tertiary education	30	30.0
Occupation		
Student	20	20.0
Employed	50	50.0
Unemployed	30	30.0

Table 1 show demographic characteristics of respondents**.** Their ages ranged from 18-46 years. Majority of the respondents were females 55%, Greater percentage, 35%, of the respondents had educational status (Secondary education)

Table 2: Awareness/ knowledge of Antioxidants among respondents

Awareness Level	Frequency (n)	Percentage (%)
	43	43.0

Awareness Level	Frequency (n)	Percentage (%)
Aware of Antioxidants		
Not Aware of Antioxidants	57	57.0
Misconceptions about Antioxidants	47	47.0
Correct Understanding	53	53.0

Table 2 shows knowledge of Antioxidants among respondents. 43% of participants were aware of the possible health advantages of antioxidants. Majority of respondents (47%) had false beliefs about the contribution of antioxidants to the prevention of illness. The overall level of knowledge was graded as Good/Poor

Table 3: Sources of Information on Antioxidants

Source of Information	Frequency (n)	Percentage (%)
Professional Health Sources	37	37.0
Non-Professional Sources	63	63.0
Social Media	40	40.0
Friends and Family	23	23.0

Table 3 shows sources of Information on Antioxidants**.** The findings showed that although just 37% of respondents looked for information from reputable health sources like doctors and dietitians, the majority (63%) relied on non-professional sources

DISCUSSION

The study's findings provide vital insights into public understanding to assess the correlation between mathematical literacy and antioxidant knowledge among Nigerians viz in Oredo, Igueben and Afuze LGA of Edo State, Nigeria. A sizable proportion of respondents (43%) were aware of antioxidants; yet, an alarming 47% had misunderstandings about their function in disease prevention. The modest level of awareness about antioxidants is similar to earlier research, which found various degrees of public understanding about dietary supplements. The significant amount of misunderstandings (47%), indicates that many people may not completely comprehend the scientific foundation for antioxidant health claims.

This has proof to illustrate how false information is frequently spread by relying on uncertain sources, such as social media and conversations among peers. The majority of facts on antioxidants emanate from non-professional sources (63%) which raise questions about the veracity and integrity of the facts being shared. It is exclusively troubling when people depend on deceptive sources for health facts because this might bring about the proliferation of myths and deception regarding antioxidant supplements. According to earlier studies, those who get their health facts from informal sources are more likely to misunderstand dietary supplements. The study's findings highlighted the need for increased health literacy campaigns that emphasize the significance of seeking reliable information on dietary supplements from certified health providers. The survey also found that the vast majority of respondents (80%) wanted more precise health information on antioxidants. Furthermore, 65% of respondents believe antioxidant supplements might help avoid illnesses, indicating a potential market for educational programs aiming at explaining their function in health promotion. There is an obvious need for focused teaching campaigns that dispel myths about antioxidants and give evidence-based information on their efficacy and safety. To reach a larger audience, such programs might be delivered through community workshops, health fairs, and online platforms. Furthermore, healthcare practitioners should be encouraged to engage in talks with patients about dietary supplements, therefore dispelling myths and providing factual information. While this study provides useful information, it is important to recognize its limitations.

The use of a convenience sample strategy may reduce the findings' generalizability to the larger population. Future studies should investigate using a more representative sample technique and investigating qualitative methodologies to acquire a better understanding of public views and attitudes about antioxidants. Longitudinal studies might also assist examine changes in knowledge and attitudes over time, especially after educational interventions

CONCLUSION

The ability to understand and apply mathematical concepts is crucial in health literacy, particularly in comprehending health-related numerical information. Individuals with higher mathematical literacy levels are better equipped to understand health statistics, treatment options, and medication instructions. Antioxidants play a vital role in maintaining overall health and well-being. They help prevent or reduce cell damage caused by free radicals, which can contribute to the development of

chronic diseases. A diet rich in antioxidants, such as vitamins C and E, beta-carotene, and other phytochemicals, has been linked to a reduced risk of chronic diseases, including cancer, cardiovascular disease, and neurodegenerative disorders. Oxidative stress related diseases, including cancer, diabetes, and cardiovascular issues, poses significant public health challenges globally. This study contributes to the broader discourse on public health nutrition and emphasizes the importance of integrating reliable information into community health initiatives and fostering a better understanding of antioxidants and their role in health, it is possible to mitigate the risks associated with oxidative stress-related diseases and promote overall well-being in the state and beyond.

CONFLICT OF INTEREST: Author hereby declare zero conflict of interest in the study

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