

EFFECTIVENESS OF VITAMIN D, CALCIUM IN DIET AND PREVENTION OF OSTEOPOROSIS AMONG CHILDREN ATTENDING PRIMARY HEALTH CENTRE IN OJO LOCAL GOVERNMENT AREA, LAGOS STATE

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Abstract

The study was carried out to investigate the effectiveness of vitamin D, calcium in diet and prevention of osteoporosis among children attending Primary Health Centre in Ojo Local Government Area. Three research questions and hypotheses were raised for the study and descriptive survey research design was adopted. The sample consists of nursing mothers who attended Primary Health Centre at Ojo Local Government Area, Lagos State using the purposively sampling technique. A self-developed Questionnaire titled Vitamin D, Calcium and Osteoporosis Questionnaire (VDCOQ) and four-point likert scale was used for data collection. The face validity of the instrument was ascertained in the Department of Human Kinetics, Sports and Health Education by panel of three expert for construct related validity. The reliability of the instrument was ascertained using the Cronbach's alpha technique of SPSS. A total of Two Hundred (200) copies of the validated instrument were administered to the respondents and same were retrieved immediately to avoid loss of data with the help of research assistant. The data collected was analyzed using descriptive statistics of frequency counts and percentage for demographic data while inferential statistics of Chi-square was used to analyze all stated hypotheses at 0.05 level of significance. Findings from the study revealed that there was significant relationship between osteoporosis and the occurrence of green stick fracture among the children attending Primary Health Centre in Ojo Local Government Area, there was significant relationship between excessive vitamin D and calcium intake among children attending Primary Health Centre in Ojo Local Government Area and there was significant impact of vitamin D and calcium inclusion in diet of children attending Primary Health Centre in Ojo Local Government Area. The study recommend among other that, education and awareness should be provided to nursing mothers, caretakers and older adults about the risks associated with greenstick fractures and osteoporosis..

Keyword: Vitamin D, Calcium, Diet, Osteoporosis. Children

Introduction

The role of vitamin D in supporting the growth and maintenance of the skeletal system is robust; including immune function, cardiovascular health and cancer. Despite this, vitamin D deficiency remains a global public health issue (Benachi, et al., 2020). Scientists know this active form of the vitamin as 1, 25-Dihydroxycholecalciferol or calcitriol, but ordinarily, the name vitamin D or sunshine vitamin is accurate enough. It is a nutrient that the body needs in small amount for the bones and teeth, the immune system, brain health and for regulating inflammation (Cui, Xiao, & Ma, 2022). Vitamin D was discovered in 1920, culminating the long search for a way to cure its deficiency – rickets, a painful childhood bone disease. Solving the problems of rickets was only the beginning of research into vitamin D. One of the major reasons for the widespread spread of this deficiency has been deficient awareness about its importance, benefits on health, and prevention of deficiency state across different populations with the prevalence being high with children depending on the geographic location, skin pigmentation, and the time of the year (Fang, 2020). Vitamin D deficiency, a prevalent global health concern, arises when the body lacks sufficient vitamin D levels. This deficiency can lead to various health issues, particularly affecting bone health. (Pettifor, et al. 2018). Some

deficiencies can arise if a person does not take in enough vitamin D or their skin has an impaired ability to synthesize it from the sun. A person can also become deficient if the body is not able to absorb the vitamin or convert it to its active form in the liver and kidneys (Mendoza & Ahmed, 2019).

Vitamin D is a complex organic molecule derived from cholesterol. It is formed in human skin as a result of ultraviolet light exposure. The activation of vitamin D is subject to precise homeostatic regulation since this is a key element of the regulation of circulating calcium levels. Activated vitamin D contributes to the maintenance of serum calcium levels by increasing the absorption of calcium in the upper small bowel by stimulating osteoclastic bone resorption and also stimulates intestinal absorption of phosphate. Regulatory systems exist to prevent both hypercalcemia and hyperphosphatemia, since either could result in soft tissue calcification with consequent damage to the tissues affected (Francesco, et al, 2022). Vitamin D supplementation has also been found to reduce the risk of influenza, COVID-19 infections and deaths (Feitong, 2023). Currently, there is a global concern about the status of vitamin D and its metabolites in the population since it has been reported that insufficiency and deficiency in these vitamins in humans is linked not only to the development of bone diseases, such as rickets and osteoporosis, but also to many extra-skeletal diseases, including diabetes, hypertension, cardiovascular diseases, multiple sclerosis, psoriasis, Crohn's disease, neuropsychiatric illnesses or even breast and colon cancer. This is why increasing the consumption of foods which contain these vitamins is essential to tackle this problem, especially for the population that lives at high latitudes where the subcutaneous synthesis of vitamin D is absent during winter months. However, it should be emphasized that the recommendations for daily intake vary considerably between different population groups and advisory guidelines (Giustina, Adler, & Binkley, 2019).

Vitamin D benefits bone health by working in concert with calcium, other nutrients and hormones in the body to support healthy bone renewal and reduce risk for osteoporosis. Researchers are discovering that Vitamin D also promotes normal cell growth and differentiation throughout the body (Giovanna, 2020). Calcium is the most abundant mineral in the human body and has several important functions. Two percent of our total body weight is made of calcium, and more than 99% of total body calcium is stored in the bones and teeth, where it supports their structure. When dietary calcium intake is insufficient and blood levels of calcium drop too low, the body will obtain calcium by extracting it from the bones. Ideally, calcium that is taken from the bones will be replaced when calcium levels are replenished. The body cannot produce its own calcium, so every day the body loses calcium through the skin, nails, hair, sweat, urine and feces, and there are necessities to replace it (Giovanna, 2020). Dietary factors have been shown to be positively related to osteoporosis and hypertension, including intake of animal protein, low potassium, low magnesium, inadequate calcium, low fish fatty acid, high alcohol and high coffee consumption (Ogunbamowo and Oladipupo, 2019). Calcium is essential for many body functions, such as building and maintaining healthy bones, while vitamin D can help with the intestinal absorption of ingested calcium (Giustina, Adler, & Binkley, 2019). Calcium is a key structural component of bone minerals, which ensures skeletal health. It is ingested through diet or supplements, and is excreted in the urine (Lappe, Watson, & Gilsanz, 2015). Consuming calcium during childhood e.g., in milk can lead to higher bone mass in adulthood. This increase in bone density can reduce the risk of fractures later in life. Calcium may also have benefits in other body systems by reducing blood pressure and cholesterol levels (Jones, 2018).

Osteoporosis is a global health concern for the human population which is characterized by micro architectural deterioration of bone (LeBoff, Chou, Ratliff, Cook, Khurana & Kim, 2022). It is the most common systemic skeletal disease characterized by increased bone fragility. There lies an incongruity among research regarding combined supplementation of calcium plus vitamin D and loss of bone health. Among the studies, it has been had that calcium and vitamin D decrease bone resorption, reduce the incidence of

fractures, increase bone mineral density (BMD) and overall bone health (Manson, et al, 2019). Since bone loss remains asymptomatic and early osteoporosis is not usually diagnosed, osteoporosis is often considered a silent disease. Osteoporosis means porous bone. Viewed under a microscope, healthy bone looks like a honeycomb. When osteoporosis occurs, the holes and spaces in the honeycomb are much larger than in healthy bone. Osteoporotic bones have lost density or mass and contain abnormal tissue structure. As bones become less dense, they weaken and are more likely to break (Maria, Daniela, & Taneva, 2020). Although osteoporosis is usually diagnosed in older adults, this condition can also affect children. It weakens the bones and increases the risk of fractures. In children, it can hamper growth and cause deformity and pain (Mendoza & Ahmed, 2019). Osteoporosis in children is known as juvenile osteoporosis, it is a rare bone disorder characterized by thinning bones in childhood. It is the presence of a vertebral compression fracture in the absence of local disease or trauma (Manson, 2019). Fortunately, there are many things that people at all stages of life can do to build strong, healthy bones. Childhood and adolescence are especially important times for building bones and developing habits that support good bone health for life; thus, the prevention of osteoporosis should ideally start from this time. The human body continually breaks down old bone and replaces it but when the body breaks down more bone than it replaces, osteoporosis sets in. This causes a person's bones to become weaker, less dense and porous (Rowden, 2023). Efforts in health care should be aimed at reducing the spread of risk factors that cause osteoporosis. Due to the particularly high risk of fractures, patients need to be properly investigated (e.g., fracture risk assessment, fall risk assessment, bone density measurement), given lifestyle advice (e.g., diet, exercise and smoking) and bone protection therapy. Modern biological therapies are more prevalent in the treatment of osteoporosis. This increases the chance of treating many more post-menopausal patients who are most affected. Biological therapy is sparing and significantly reduces the risk of fractures. It is important that those receiving this treatment do not interrupt their intake of vitamin D, calcium, or stop active movement (Milic, Mikolasevic, Krznaric-Zrnic, Stanic, Poropat, Stimac, Vlahović-Palčevski, & Orlic, 2015).

The present study reviews Vitamin D and calcium, the cornerstones of bone health and prevention of osteoporosis. Even though the dietary sources of both nutrients are available, most people do not get adequate amounts for maintaining proper bone health. Both nutrients are substantial for optimal skeletal health throughout the lifecycle: calcium is the dominant mineral in bone, and vitamin D is important for the efficient absorption of calcium and for adequate functioning of bone cells (Nipith, & Michael, 2020). The inclusion of these nutrients in the diet has been found to prevent various diseases, reduce risk of cancer, cardiovascular diseases, bone loss, muscle weakness, decrease risk of leading to various health problems. As such, it is essential to ensure an adequate intake of vitamin D and calcium through diet or supplementation (Manson, 2019).

Vitamin D and calcium insufficiency increases the chances of children being susceptible to osteoporosis. Children constitute a population at risk for vitamin D and calcium deficiency because of their relatively large needs for these nutrients brought about by their high rate of skeletal growth. Breast-fed infants are particularly at risk because of the low concentrations of vitamin D in human milk. This is because breast milk is insufficient to meet the daily requirement of vitamin D for infants, especially if the mother is not obtaining significant amounts of vitamin D daily. Mothers, who do not expose their children's skin to the sun to trap vitamin D hold that exposure to sunlight could cause the baby to develop wrinkles and lines thereby increasing the child's risk of premature aging and skin cancer. They seem to abandon fruits and dairy products that contains essential nutrients needed for growth. Therefore this study aims to examine the impact of vitamin D and calcium and how it prevents the future occurrence of osteoporosis among children Primary Health Centre in Ojo Local Government Area.

Purpose of the Study

The purpose of this study is to examine the effectiveness of vitamin D, calcium in diet and prevention of osteoporosis among children attending Primary Health Centre in Ojo Local Government Area. Specifically the study determined:

- i. To assess the risk associated with osteoporosis in preventing the occurrence of greenstick fractures among children attending Primary Health Centre in Ojo Local Government Area
- ii. To examine the level of vitamin D and calcium intake among children attending Primary Health Centre in Ojo Local Government Area?
- iii. To identify inclusion of vitamin D and calcium in diet among children attending Primary Health Centre in Ojo Local Government Area?

Research Questions

The following research questions were answered for this study:

- i. Will there be any significant relationship between osteoporosis and the occurrence of green stick fracture among the children attending Primary Health Centre in Ojo Local Government Area?
- ii. Will there be any significant relationship between excessive vitamin D and calcium intake among children attending Primary Health Centre in Ojo Local Government Area?
- iii. What impact does the inclusion of vitamin D and Calcium in diet has on children attending Primary Health Centre in Ojo Local Government Area?

Research Hypotheses

The following research hypotheses were postulated for this study:

1. There is no significant relationship between osteoporosis and the occurrence of green stick fracture among the children attending Primary Health Centre in Ojo Local Government Area.
2. There is no significant relationship between excessive vitamin D and calcium intake among children attending Primary Health Centre in Ojo Local Government Area.
3. There is no significant impact of vitamin D and Calcium inclusion in diet on children attending Primary Health Centre in Ojo Local Government Area.

Methods

The descriptive survey research design was adopted for this study and the population of the study consists of nursing mothers attending Primary Health Centers in Ojo Local Government Area, Lagos State. 200 nursing mothers were selected using accidental sampling technique based on the clinic appointment and availability of nursing mothers the research instrument was self-developed questionnaire, titled Vitamin D, Calcium and Osteoporosis Questionnaire (VDCOQ). The questionnaire was divided into two sections, A and B. Section A consist of demographic information of respondents, while Section B was generated based on purpose of the study. The questionnaire adopted a four (4) point-Likert modified scale ranging from Strongly agree (SA), Agree (A), Disagree (D) and Strongly disagree (SD). The face validity of the questionnaire was ascertained by three experts in the Department of Human Kinetics, Sports and Health Education, Lagos State University, Ojo. This required the researcher to administer ten (10) copies of validated questionnaires to 10 respondents from Oto Local Area. The reliability of the instrument was tested using the Cronbach's Alpha techniques of SPSS, with an overall coefficient value is 0.82. Data collected was analyzed using descriptive statistics of frequency count and percentage for demographic data while inferential statistics of Chi-square was used to analyze all stated hypotheses at 0.05 level significance. The statistical package for social science (SPSS) version 23 was used for analyzing the data collected.

Data Presentation

Table 4.1: Distribution of respondents by mother's age

Mother's Age	Frequency	Percent (%)
Below 20	40	20.0%
21 – 30	116	58.0%
31 – 40	40	20.0%
41 & above	4	2.0%
Total	200	100
Marital Status	Frequency	Percent (%)
Single Mother	36	18.0%
Married	156	78.0%
Divorced	8	4.0%
Widowed	0	0%
Total	200	100
Ethnicity	Frequency	Percent (%)
Igbo	84	42.0
Hausa	16	8.0
Yoruba	92	46.0
Others	8	4.0
Total	200	100
Religion	Frequency	Percent (%)
Christianity	136	45.3
Islam	164	54.7
Traditional worshippers	16	8.0
Others	4	2.0
Total	200	100

The table presents the mother's age distribution of the respondents. From the table, 40 (20%) of the respondents for this study were below the mother's age of 20, 116 (58%) were within the age bracket 21-30, 40 (20%) were within the mother's age bracket 31-40 and 4 (2%) of the respondents were within the age bracket of 41 and above. Concerning the marital status distribution of the respondents. From the table, 36 (18%) respondents were single mothers, 156 (78%) were married, 8 (4%) were divorced and none 0 (0%) of the respondents were widowed. In the ethnicity distribution of the respondents, 84 (42%) were Igbos, 16 (8%) were Hausas, 92 (46%) were Yoruba, and 8 (4%) of respondents had a different ethnicity. This implies that the Yoruba took the highest percentage while the lowest percentage of the respondents were from different ethnicity. In the religion distribution of the respondents, the table shows that 120 (60%) were Christians, 60 (30%) were Muslims, 16 (8%) were Traditional worshippers while 4 (2%) were of other religion.

Hypothesis One

Hypothesis one states that there will be no significant relationship between osteoporosis and the occurrence of green stick fracture among the children attending Primary Health Centre in Ojo Local Government Area.

Table 4.2: Chi-Square Analysis of Relationship between Osteoporosis and the Occurrence of Greenstick Fracture

Responses	FRQ	%	DF	LS	CAL X ²	P value	RMK
SA	156	19.5	9	0.05	207.99	<.001	SIG
A	216	27					
D	224	28					
SD	204	25.5					
Total	800	100					

Table 4.2 which projected the data collected from the respondents on hypothesis one reveals a calculated X^2 value of 207.99 which is statistically significant at $p = 0.001 < 0.05$ at 9⁰ of freedom hence the rejection of the null hypothesis. It therefore implies that there is significant relationship between osteoporosis and the occurrence of green stick fracture among the children attending Primary Health Centre in Ojo Local Government Area.

Hypothesis Two

Hypothesis two states that there will be no significant relationship between excessive vitamin D and calcium intake among children attending Primary Health Centre in Ojo Local Government Area.

Table 4.3: Chi-square Analysis of Relationship between Excessive Vitamin D and Calcium Intake

Responses	FRQ	%	DF	LS	CAL X^2	P value	RMK
SA	210	26.3	9	0.05	502.43	<.001	SIG
A	205	25.6					
D	194	24.3					
SD	191	23.8					
Total	800	100					

Table 4.3 which projected the data collected from the respondents on hypothesis two reveals a calculated X^2 value of 502.43 which is statistically significant at $p = 0.001 < 0.05$ at 9⁰ of freedom hence the rejection of the null hypothesis. It therefore implies that there is significant relationship between excessive vitamin D and calcium intake among children attending Primary Health Centre in Ojo Local Government Area.

Hypothesis Three

Hypothesis three states that there will be no significant impact of vitamin D and Calcium inclusion in diet on children attending Primary Health Centre in Ojo Local Government Area.

Table 4.4: Chi-Square Analysis of Significant Impact of Vitamin D and Calcium in Diet

Responses	FRQ	%	DF	LS	CAL X^2	P value	RMK
SA	368	46	9	0.05	51.26	<.001	SIG
A	412	51.5					
D	9	1.1					
SD	11	1.4					
Total	800	100					

Table 4.4 which projected the data collected from the respondents on hypothesis three reveals a calculated X^2 value of 51.26 which is statistically significant at $p = 0.001 < 0.05$ at 9⁰ of freedom hence the rejection of the null hypothesis. It therefore implies that there is significant impact of vitamin D and Calcium inclusion in diet of children attending Primary Health Centre in Ojo Local Government Area.

Discussions

Hypothesis one states that "there will be no significant relationship between osteoporosis and the occurrence of greenstick fractures." However, Chi-square analysis showed that this relationship is significant ($\chi^2 = 207.99$, $p = 0.001$). This finding suggests that osteoporosis significantly influences the occurrence of greenstick fractures among children attending the Primary Health Centre in Ojo Local Government Area. This result is in line with research by Milic (2015), who found that vitamin D deficiency leads to increased bone turnover, elevating fracture risks in children. Thus, a deficiency in bone health could explain the occurrence of greenstick fractures among children with osteoporosis. Comparatively, Zhang (2020) reported that vitamin D supplementation significantly improves bone mineral density, which supports the prevention of fractures. Similarly, Feitong, (2023) noted that vitamin D supplementation improves bone health in children regardless of their baseline vitamin D levels. These studies affirm the importance of addressing osteoporosis in children through improved nutritional intake, particularly in regions where vitamin D and calcium intake may be

suboptimal. Hence, the findings highlight the importance of dietary management in preventing fractures among vulnerable populations. It could therefore be inferred that osteoporosis significantly increases the risk of fractures in children, and addressing this condition through nutritional interventions is crucial to improving bone health and preventing fracture occurrences.

Hypothesis Two states that "there will be no significant relationship between excessive vitamin D and calcium intake." However, Chi-square analysis showed a statistically significant relationship ($\chi^2 = 502.43$, $p = 0.001$). This finding suggests that excessive intake of vitamin D and calcium significantly impacts children's health attending the Primary Health Centre in Ojo Local Government Area. According to Nirupama, Divyashree, Janhavi, Muthukumar, & Ravindra, (2021) calcium and vitamin D supplementation are often recommended for osteoporosis prevention, but the effect of excessive intake on health requires careful evaluation. The result contrasts with Pankova, Vasileva, & Petkova, (2015) findings, which concluded that calcium intake has a clinically insignificant impact on peak bone mass density. Although calcium is essential for bone health, excessive intake may not provide additional benefits and could pose health risks. As suggested by Kevin, (2020), there is a need for balanced nutrition strategies that avoid excessive intake while preventing deficiencies in crucial nutrients such as vitamin D and calcium. It could therefore be inferred that while vitamin D and calcium intake are vital for bone health, excessive consumption may not yield further benefits and could potentially harm children's overall health.

Hypothesis Three states that "there is no significant impact of vitamin D and calcium inclusion in the diet." However, Chi-square analysis showed that this relationship is significant ($\chi^2 = 51.26$, $p = 0.001$). This finding implies that the inclusion of vitamin D and calcium in children's diets positively impacts their health outcomes. This aligns with studies by Roger, Despoina & Brent (2021), who found that vitamin D and calcium inclusion in the diet reduces the risk of fractures and treats nutritional rickets in children with poor vitamin D status. This finding also supports the recommendations by the Pawel, William, Spyridon, Armin, & Stefan, (2024), which prescribes 600-800 IU of vitamin D per day for children to ensure adequate bone development and prevent deficiencies. Furthermore, the fortification of common foods such as milk, cereals, and orange juice with vitamin D has been shown to improve children's vitamin D status, particularly in high-risk populations (Weaver, 2020). These studies emphasize the role of dietary interventions in promoting health. It could therefore be inferred that the inclusion of vitamin D and calcium in children's diets is essential for enhancing bone health and preventing conditions such as rickets and fractures.

Conclusion

Based on the findings of this study, it was concluded that:

1. There was significant relationship between osteoporosis and the occurrence of green stick fracture among the children attending Primary Health Centre in Ojo Local Government Area.
2. There was significant relationship between excessive vitamin D and calcium intake among children attending Primary Health Centre in Ojo Local Government Area.
3. There was significant impact of vitamin D and calcium inclusion in diet of children attending Primary Health Centre in Ojo Local Government Area.

Recommendations

Based on the conclusion of the study, it was recommended that:

1. Education and awareness should be provided to nursing mothers, caretakers and older adults about the risks associated with greenstick fractures and osteoporosis. Most adults ignore the signs and symptoms of these bone diseases until a bone is broken or a fracture occurs.
2. Vitamin D and calcium should be consumed accurately. Children should consume these food sources moderately so as to prevent solving a problem while creating a new

one i.e. when fractures and osteoporosis are being prevented, hypercalcemia and formation of calcium stones could be created through over consumption of vitamin D and calcium.

3. Assessment of proper knowledge on these nutrients should be enabled. Some adults, especially nursing mothers do not have due knowledge on the food sources that contains required vitamin D and calcium for their children. Hence, Health Education and nutritionist have a crucial role to play in disseminating health information about these essential nutrients.
4. Regular checkups of the bone mineral density should be encouraged. This will enable individuals to know the level of their bone density and enhance them take proper actions to fight against an upcoming bone deformity especially greenstick fracture and osteoporosis.

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