Scientific Research Publishing

Open Journal of Pediatrics, 2025, 15(1), 101-110
https://www.scirp.org/journal/ojped
ISSN Online: 2160-8776
ISSN Print: 2160-8741

Vitamin D Status in Healthy Children Aged 6 to 59 Months at the Pikine-Guediawaye Institute of Social Pediatrics, Dakar Suburbs (Senegal)

Babacar Niang[1*], Aliou Ndongo[2], Aminata Mbaye[1], Serigne Saliou Mbacke[3], Ablaye Ndiaye[1], Khadidatou Diouf[1], Abou Ba[4], Abdallah Diallo[5], Djibril Boiro[2], Oulimata Ndiaye[1], Ousmane Ndiaye[1]

[1]Centre Hospitalier National d'Enfants Albert Royer, Dakar, Senegal
[2]Centre Hospitalier Abass Ndao, Dakar, Senegal
[3]Laboratoire Biochimie, Dakar, Senegal
[4]Hôpital Dalal Jam, Guediawaye, Senegal
[5]Institut de Pédiatrie Sociale, Pikine, Senegal
Email: *drrniangbacar@mail.com

How to cite this paper: Niang, B., Ndongo, A., Mbaye, A., Mbacke, S.S., Ndiaye, A., Diouf, K., Ba, A., Diallo, A., Boiro, D., Ndiaye, O. and Ndiaye, O. (2025) Vitamin D Status in Healthy Children Aged 6 to 59 Months at the Pikine-Guediawaye Institute of Social Pediatrics, Dakar Suburbs (Senegal). *Open Journal of Pediatrics*, **15**, 101-110.
https://doi.org/10.4236/ojped.2025.151010

Received: December 3, 2024
Accepted: January 17, 2025
Published: January 20, 2025

Abstract

Introduction: Vitamin D plays a key role in phosphocalcic metabolism, in normal functioning of the immune system and in the prevention of certain forms of cancer. Systematic vitamin D supplementation has been implemented in most Western countries, which has drastically reduced the prevalence of rickets. In Senegal, a country with enough sunshine, no large-scale data exists on vitamin D deficiency in children. In addition, there are no guidelines from the Ministry of Health and Social Action (MoHSA) on vitamin D supplementation. Our objective was to determine the prevalence of vitamin D deficiency in children aged 6 to 59 months and to analyze the factors associated with it at the Institute of Social Pediatrics in Pikine-Guédiawaye, a suburb of Dakar. **Patients and Methods:** This was a prospective, descriptive and analytical cross-sectional study over a 3-month period (from January to March 2024) at the Institute of Social Pediatric (IPS) of Pikine-Guédiawaye. The study population consisted of all children aged 6 to 59 months free from any acute or chronic pathology, whose parents had agreed to answer the questionnaires after having consented and signed the consent and children who had had a sample taken for vitamin D dosage. **Results:** We included 102 children, 35 of whom had vitamin D deficiency, *i.e.* a prevalence of 34.31% with a slight male predominance (sex ratio 1.05). Infants aged 13 - 24 months were more affected (41.67%), but the difference was not statistically significant (p-value = 0.385). Patients with acute malnutrition had a significantly higher prevalence

of vitamin D deficiency (54.17% of cases versus 28.38%) in those without acute malnutrition (p = 0.02). On the other hand, chronic malnutrition, underweight and diversification foods were not significantly associated with vitamin D deficiency (p of 0.60, 0.42 and 0.09 respectively). **Conclusion:** Vitamin deficiency affects one-third of apparently healthy children under 5 and this deficiency has no significant relationship with diversification foods. This suggests that the observed vitamin D deficiencies are less related to diet than to lack of sun exposure.

Keywords

Vitamin D Deficiency, Children, Supplementation

1. Introduction

Vitamin D plays a major role in phosphocalcic metabolism, in the normal functioning of the immune system and in the prevention of certain forms of cancer [1]. It exists in several forms that belong to the sterol family [2] [3]. Vitamin D deficiency is a global health problem and affects a billion children and adults worldwide [4]. Although cases of rickets remain uncommon, pediatricians are often confronted with vitamin D deficiency, clinically symptomatic and more or less severe [1]. Risk factors have been identified, such as exclusive breastfeeding without vitamin D supplementation, insufficient exposure to the sun (clothing habits, customs), hyperpigmented and thick skin, low levels of maternal vitamin D during pregnancy, chronic diseases associated with fat malabsorption, etc. [2] [3] [5]. Systematic vitamin D supplementation has been implemented in most Western countries, which has drastically reduced the prevalence of this condition [6] [7]. In developing countries, such as Senegal, micronutrient deficiencies are a major public health issue. According to the Senegalese Committee for the Fortification of Foods with Micronutrients (COSFAM), in 2018, 71% of children under 5 years of age suffered from iron deficiency, 50.2% from folate deficiency and 12.1% from vitamin A deficiency [8]. In Senegal, no large-scale factual data exist on vitamin D deficiency in children. Despite the permanent sunshine throughout the year in Senegal, where the population is predominantly pigmented and thick skin, studies show that rickets due to vitamin D deficiency still poses serious health problems. Thus, in a study carried out in 2022 on rickets at the Dakar University Hospital, vitamin D deficiency represented 46.2% of the causes of rickets [9]. In addition, there are no guidelines from the Ministry of Health and Social Action (MoHSA) on vitamin D supplementation and few studies on rickets have been carried out. In this context that we carried out this study to determine the prevalence of vitamin D deficiency in children aged 6 to 59 months and to analyze factors associated with it at the Institute of Social Pediatrics in Pikine-Guédiawaye, a suburb of Dakar.

2. Patients and Methods

2.1. Type, Period and Study Population

This was a prospective, descriptive and analytical cross-sectional study that took place from January 9 to March 18, 2024 at the Pediatric and Social Institute (IPS) of Pikine-Guédiawaye. All children aged 6 to 59 months who consulted during the study period and without any acute or chronic pathology were concerned. The IPS is a university institute created on June 26, 1964 and oriented towards training and research with a view to improving the health of mothers and children living in disadvantaged areas. It contributes in Senegal to the development and implementation of community health care and primary health care, through operational research and training.

2.2. Inclusion Criteria

These were children whose parents had agreed to answer the questionnaires after having consented and signed the consent; and children who had a sample taken for vitamin D testing.

2.3. Non-Inclusion Criteria

Children whose parents did not sign the consent and those who did not have a vitamin D test were not included.

2.4. Exclusion Criteria

All children with acute infectious or non-infectious pathology and all children with underlying pathology were excluded from the study.

2.5. Parameters Studied and Definition of Operational Variables

The parameters studied were:

- Sociodemographic: age, sex, socioeconomic level, type of breastfeeding, dietary diversification, family environment;
- Clinical: weight and height were expressed in standard derivations, brachial perimeter (MUAC) in cm;
- Paraclinical: vitamin D testing. Vitamin D levels were considered normal if >30 ng/ml, deficient between 10 and 30 ng/ml and vitamin D deficiency < 10 ng/ml.

2.6. Data Entry and Statistical Analysis

Data entry and analysis as well as graphs were carried out using Microsoft Office Excel 2019 and Epi info 7.6.2.0 software. The description of qualitative variables was done with the calculation of frequencies (percentages) and quantitative variables were presented as means or medians with their ranges. Bivariate analysis was carried out using the Chi-square test. The significant threshold was set at 0.05.

3. Results

Of the 338 children surveyed, 229 were sampled and 102 analyses were received.

Among them, 35 had vitamin D deficiency, representing a prevalence of 34.31%. The median age was 27.59 months [6 - 60 months]. The age group [13 - 24 months] was the most representative (Figure 1). The sex ratio, in favor of boys, was 1.17.

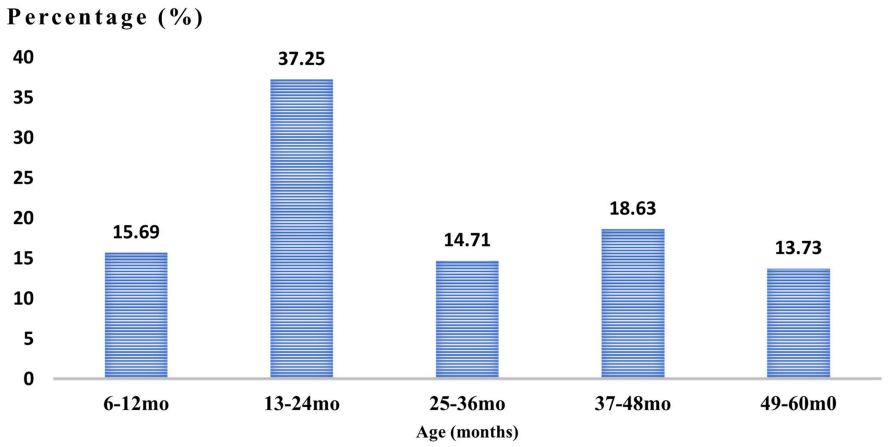

Figure 1. Population distribution by age group.

Within the study population, 83 children (81.37%) lived in the large family home. The majority of the study population had access to water and electricity (Figure 2). The family environment was unfavorable in 15.30% of cases.

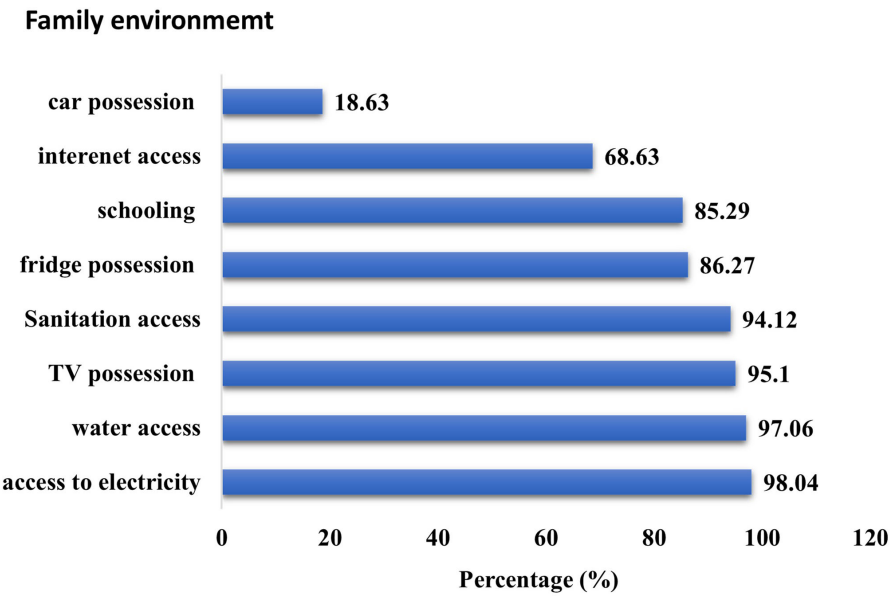

Figure 2. Distribution of the population according to their family environment.

The socioeconomic level was low in 44% of children and very low in 26% of children.

Before 6 months of life, 31% of children were exclusively breastfed and 51.96% were predominantly breastfed (Table 1).

Table 1. Distribution of children according to type of breastfeeding.

Breastfeeding mode	Frequency	Percentage (%)
Breastfeeding predominant	53	51.96
Exclusive breastfeeding	31	30.39
Mixed breastfeeding	18	17.65
Total	102	100.00

Mean age of diversification was 5.93 months [3 - 17 months]. Early and late dietary diversification was noted in 7.01% and 18% of children, respectively.

In the study population, 29 children (28.43%) of the population had less than 3 meals per day.

Animal proteins represented the lowest proportion of diversification foods with a rate of 7.84% (Table 2).

Table 2. Diversification products.

Diversification products	Frequency	Percentage (%)
Cereals	102	100
Dairy products	93	91.18
Fruits	86	84.31
Tubers	80	78.43
Vegetables	78	76.47
Legumes	61	59.80
Animal proteins	8	7.84

In our study, 32.65% of children had good dietary diversification (Table 3).

Table 3. Distribution of children according to food diversity.

Food diversity	Frequency	Percentage (%)
Good	32	32.65
Moderate	40	40.82
Poor	26	26.53
Total	98	100.00

Mean age of weaning was 18.75 months [6 - 27 months]. Nearly half of the children (47.43%) were weaned before 16 months (Figure 3).

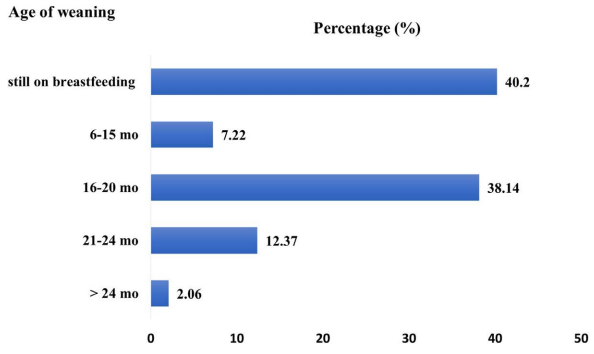

Figure 3. Population distribution by age of weaning.

The different forms of malnutrition, chronic or acute, and underweight were present respectively in 23.53%, 22.55% and 18.63% of children (Table 4).

Table 4. Distribution according to nutritional status.

Nutritional status	Modalities	Frequency	Percentage (%)
Acute malnutrition	Yes	24	23.53
	No	78	76.47
Chronic malnutrition	Yes	23	22.55
	No	79	77.45
Underweiht	Yes	19	18.63
	No	83	81.37

Vitamin D deficiency was statistically associated with the presence of acute malnutrition (p = 0.02) (Table 5).

Table 5. Factors associated with vitamin D deficiency.

Factors	Vitamin D deficiency		p-value
	Yes	No	
Age (months)			0.38
6 - 12	6 (37.50)	10 (62.50)	
13 - 24	15 (41.67)	21 (58.33)	
>24	13 (27.66)	34 (72.34)	
Socio-economic level			0.79
Low	24 (35.29)	44 (64.1)	
Medium	8 (33.33)	16 (66.67)	
High	3 (50)	3 (50)	
Acute malnutrition			0.02*
Yes	13 (54.17)	11 (45.83)	
No	21 (28.38)	53 (71.62)	
Chronic malnutrition			0.60
Yes	7 (30.43)	16 (69.57)	
No	28 (36.36)	49 (63.64)	
Underweight			0.42
Yes	26 (32.50)	54 (67.50)	
No	8 (42.11)	11 (57.89)	
Consumption of dairy products			0.53
Yes	31 (34.07)	60 (65.93)	
No	4 (44.44)	5 (55.56)	
Consumption of vegetables			
Yes	29 (38.16)	47 (61.84)	0.29
No	6 (26.09)	17 (73.91)	
Consumption of tubers			0.53
Yes	28 (35.90)	50 (64.10)	
No	6 (28.57)	15 (71.43)	
Consumption of legumes			0.09
Yes	17 (28.81)	42 (71.19)	
No	18 (45)	22 (55)	
Consumption of fruits			0.57

Continued

Yes	28 (33.33)	56 (66.67)	
No	5 (41.67)	7 (58.33)	
Consumption of animals proteins			0.33
Yes	4 (50)	4 (50)	
No	30 (32.97)	61 (67.03)	

*p-value < 0.05 the significance threshold set.

4. Discussion

In our study, more than one-third of apparently healthy children aged 6 to 59 months had vitamin D deficiency. Permanent sunshine did not prevent the occurrence of vitamin D deficiency in these children. This may be explained by the fact that thick, pigmented skin opposes good vitamin D synthesis. Indeed, patients with dark skin are also at risk of vitamin D deficiency because photosynthesis by ultraviolet rays is hindered by melanin. The role of melanin as a protective screen against the harmful effects of ultraviolet rays is not in favor of vitamin D synthesis [10]. People with light skin synthesize up to six times more vitamin D than those with dark skin, with the same sun exposure. A case-control study conducted in Nigeria found higher vitamin D levels in albino patients than in those with pigmented skin [11]. This high prevalence of vitamin D deficiency is reported in other similar studies conducted in Africa, particularly in Tanzania with a rate of 30% [12]. A literature review conducted in Africa highlighted a prevalence of 58.54% of vitamin D insufficiency, 34.18% of vitamin D deficiency and 17.31% of severe vitamin D deficiency [13].

Lower prevalences of vitamin D levels below 50 nmol/L and below 30 nmol/L, respectively, of 7.8 and 0.6%, were found in another study conducted in Kenya, Uganda, Burkina Faso, Gambia and South Africa [14].

This high prevalence of vitamin D deficiency in Africa and particularly in Senegal could be explained by the lack of vitamin D supplementation in children and the consumption of foods that are not fortified or deficient in vitamin D. Foods rich in vitamin D are fish such as salmon, horse mackerel, tuna, liver and eggs. In our study, only 7.84% of children consumed products of animal origin. Improving the vitamin D status of these children through systematic screening and supplementation if necessary, or even systematic, could have beneficial effects far beyond the skeletal sphere.

However, it is not certain that the levels of 25(OH)D considered "optimal" for bone and mineral metabolism in Westerners are the same as those in African populations. A cross-sectional study in the United States examined the relationships between 25(OH)D and parathyroid hormone and bone mineral density (BMD) showed that blacks and Mexican Americans had significantly lower 25(OH)D concentrations and higher PTH concentrations than whites. BMD decreased significantly when serum 25(OH)D and calcium intake decreased in whites and Mexican Americans, but not in blacks. The impact of vitamin D deficiency (25(OH)D ≤ 20 ng/ml) on PTH levels was modified by race/ethnicity [15]. Blacks have been

reported to have lower serum 25(OH)D concentrations than whites [16]-[20], primarily because increased skin pigmentation inhibits cutaneous synthesis of cholecalciferol, the metabolic precursor of 25(OH)D [10]. This has led many researchers to conclude that blacks are at higher risk of vitamin D deficiency than whites [16]-[20] and, therefore, may also be at increased risk of developing associated chronic diseases such as hypertension, diabetes, and cancer [21] [22].

It seems desirable to take into account the ethnic origin of children to better assess vitamin D status.

Our study showed that vitamin D deficiency mainly affects infants aged 13 to 24 months with a prevalence of 41.67%. This age group corresponds to the weaning age where the majority of infants have prolonged breastfeeding and without vitamin D supplementation. In addition, breastfeeding was predominant, which, coupled with the poverty of breast milk in vitamin D, promotes vitamin D deficiency. In Senegal, supplementation is not systematic, neither in the mother nor in the infant. The ANJE (Infant and Young Child Feeding) policy recommends exclusive breastfeeding for six months then appropriate food diversification taking into account all micronutrients, including vitamin D [23]. Indeed, during diversification only 7.84% of children consumed animal proteins. However, we did not find a significant relationship between vitamin D deficiency and diversification foods. This suggests that the vitamin D deficiencies observed in this group are less related to diet than to lack of sun exposure. Indeed, we are in a society undergoing transformation where the lifestyle is becoming more Westernized with lives in poorly lit, sun-soaked apartments; children go out less and less, are transported to school by car.

Children with acute malnutrition had a higher risk of vitamin D compared to non-malnourished children (54.17% vs. 28.38%). Ba, in his work, had found that acute malnutrition was a risk factor associated with vitamin deficiency with an OR = 3.36, 95% CI (1.28 to 8.80). On the other hand, chronic malnutrition and underweight were not associated. Further studies are needed to study the relationship between the different forms of malnutrition and vitamin D deficiency [24].

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Adorini, L. (2002) Immunomodulatory Effects of Vitamin D Receptor Ligands in Autoimmune Diseases. *International Immunopharmacology*, **2**, 1017-1028. https://doi.org/10.1016/s1567-5769(02)00049-8

[2] Brown, A.J., Dusso, A. and Slatopolsky, E. (1999) Vitamin D. *American Journal of Physiology-Renal Physiology*, **277**, F157-F175. https://doi.org/10.1152/ajprenal.1999.277.2.f157

[3] Vidailhet, M., Mallet, E., Bocquet, A., Briend, A., *et al.* (2012) Vitamin D: Still a Topical Matter in Children and Adolescents. a Position Paper by the Committee on Nutrition of the French Society of Paediatrics. *Archives de Pédiatrie*, **19**, 316-328. https://doi.org/10.1016/j.arcped.2011.12.015

[4] Holick, M.F. (2007) Vitamin D Deficiency. *New England Journal of Medicine*, **357**, 266-281. https://doi.org/10.1056/nejmra070553

[5] Souberbielle, J. (2016) Epidemiology of Vitamin-D Deficiency. *Gériatrie et Psychologie Neuropsychiatrie du Viellissement*, **14**, 7-15. https://doi.org/10.1684/pnv.2016.0589

[6] Bacchetta, J., Edouard, T., Laverny, G., *et al*. (2022) Vitamin D and Calcium Intakes in General Pediatric Populations: A French Expert Consensus Paper. *Archives de Pédiatrie*, **21**, 1-14.

[7] Irvine, J. and Ward, L.M. (2022) La prévention de la carence en vitamine D symptomatique et du rachitisme chez les nourrissons et les enfants autochtones du Canada. *Paediatrics & Child Health*, **27**, 128-128. https://doi.org/10.1093/pch/pxac004

[8] ANDS (2024) COSFAM: Rapport d'enquête Évaluation de l'enrichissement des aliments sur le statut nutritionnel des enfants de 6 à 59 mois et des femmes en âge de procréer: Analyse détaillé de l'enquête nutritionnelle de 2018 et analyse comparative avec l'enquête nutritionnelle de 2010. https://groundworkhealth.org/wp-content/uploads/2023/03/Rapport_-Etude-sur-les-Micronutrients-2018_COSFAM_Senegal_170122_FINAL.pdf

[9] Niang, B., Ndongo, A.A., Sow, A., *et al*. (2022) Les rachitismes de l'enfant au Centre Hospitalier Universitaire de Dakar. *Médecine Thérapeutique/Pédiatrie*, **24**, 56-60.

[10] Clemens, T.L., Henderson, S.L., Adams, J.S. and Holick, M.F. (1982) Increased Skin Pigment Reduces the Capacity of Skin to Synthesise Vitamin D3. *The Lancet*, **319**, 74-76. https://doi.org/10.1016/s0140-6736(82)90214-8

[11] Enechukwu, N., Cockburn, M., Ogun, G., Ezejiofor, O.I., George, A. and Ogunbiyi, A. (2019) Higher Vitamin D Levels in Nigerian Albinos Compared with Pigmented Controls. *International Journal of Dermatology*, **58**, 1148-1152. https://doi.org/10.1111/ijd.14611

[12] Walli, N.Z., Munubhi, E.K., Aboud, S. and Manji, K.P. (2016) Vitamin D Levels in Malnourished Children under 5 Years in a Tertiary Care Center at Muhimbili National Hospital, Dar Es Salaam, Tanzania—A Cross-Sectional Study. *Journal of Tropical Pediatrics*, **63**, fmw081. https://doi.org/10.1093/tropej/fmw081

[13] Mogire, R.M., Mutua, A., Kimita, W., Kamau, A., Bejon, P., Pettifor, J.M., *et al*. (2020) Prevalence of Vitamin D Deficiency in Africa: A Systematic Review and Meta-Analysis. *The Lancet Global Health*, **8**, e134-e142. https://doi.org/10.1016/s2214-109x(19)30457-7

[14] Mogire, R.M., Morovat, A., Muriuki, J.M., Mentzer, A.J., Webb, E.L., Kimita, W., *et al*. (2021) Prevalence and Predictors of Vitamin D Deficiency in Young African Children. *BMC Medicine*, **19**, 115-129. https://doi.org/10.1186/s12916-021-01985-8

[15] Gutiérrez, O.M., Farwell, W.R., Kermah, D. and Taylor, E.N. (2010) Racial Differences in the Relationship between Vitamin D, Bone Mineral Density, and Parathyroid Hormone in the National Health and Nutrition Examination Survey. *Osteoporosis International*, **22**, 1745-1753. https://doi.org/10.1007/s00198-010-1383-2

[16] Harris, S. and Dawson-Hughes, B. (1998) Seasonal Changes in Plasma 25-Hydroxyvitamin D Concentrations of Young American Black and White Women. *The American Journal of Clinical Nutrition*, **67**, 1232-1236. https://doi.org/10.1093/ajcn/67.6.1232

[17] Harris, S.S., Soteriades, E., Coolidge, J.A.S., Mudgal, S. and Dawson-Hughes, B. (2000) Vitamin D Insufficiency and Hyperparathyroidism in a Low Income, Multiracial, Elderly Population1. *The Journal of Clinical Endocrinology & Metabolism*, **85**, 4125-4130. https://doi.org/10.1210/jcem.85.11.6962

[18] Looker, A.C., Dawson-Hughes, B., Calvo, M.S., Gunter, E.W. and Sahyoun, N.R. (2002) Serum 25-Hydroxyvitamin D Status of Adolescents and Adults in Two Seasonal Subpopulations from NHANES III. *Bone*, **30**, 771-777. https://doi.org/10.1016/s8756-3282(02)00692-0

[19] Nesby-O'Dell, S., Scanlon, K.S., Cogswell, M.E., Gillespie, C., Hollis, B.W., Looker, A.C., *et al*. (2002) Hypovitaminosis D Prevalence and Determinants among African American and White Women of Reproductive Age: Third National Health and Nutrition Examination Survey, 1988-1994. *The American Journal of Clinical Nutrition*, **76**, 187-192. https://doi.org/10.1093/ajcn/76.1.187

[20] Zadshir, A., Tareen, N., Pan, D., *et al*. (2005) The Prevalence of Hypovitaminosis D among US Adults: Data from the NHANES III. *Ethnicity and Disease*, **15**, 97-101.

[21] Harris, S.S. (2006) Vitamin D and African Americans. *The Journal of Nutrition*, **136**, 1126-1129. https://doi.org/10.1093/jn/136.4.1126

[22] Giovannucci, E., Liu, Y. and Willett, W.C. (2006) Cancer Incidence and Mortality and Vitamin D in Black and White Male Health Professionals. *Cancer Epidemiology, Biomarkers & Prevention*, **15**, 2467-2472. https://doi.org/10.1158/1055-9965.epi-06-0357

[23] Diatta, A.D., Casu, L., *et al*. (2021) La politique nutritionnelle au Sénégal. Transform Nutrition West Africa, 2021; Note Factuelle No. 6 (Juillet). Dakar, Sénégal: Institut international de recherche sur les politiques alimentaires. https://cgspace.cgiar.org/server/api/core/bitstreams/6e4d3e59-05f1-43b3-9557-7458f5f56ea2/content

[24] Abou, B., Najah, F.C., Idrissa, B., El, H.I.K., Penda, A.K., Mamadou, S., *et al*. (2022) Prevalence and Associated Risk Factors of Vitamin D Deficiency in Children under Five Years of Age, at the Diamniadio Childrens Hospital in Senegal. *African Journal of Biochemistry Research*, **16**, 47-54. https://doi.org/10.5897/ajbr2022.1152