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ORIGINAL ARTICLE

Prevalence and Predictors of Vitamin D Deficiency Among Children Attending Makongoro Reproductive and Child Health Clinic in Mwanza, Tanzania

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ABSTRACT

Background: Vitamin D deficiency (VDD) is a global public health problem which affects all age groups and it is prevalent even in countries with adequate sunlight due to inadequate sunlight exposure and consumption of diet poor in vitamin D. The effects of VDD peak between 3 to 18 months due to increased requirement of vitamin D. This study was done in order to determine the prevalence and predictors of VDD among children attending Makongoro reproductive and child health (RCH) in Mwanza, Tanzania

Methods: This was a cross sectional study involving children aged 1 month and 2 weeks to 24 months attending Makongoro RCH clinic in Mwanza Tanzania. The sample size for prevalence was estimated using Kish Leslie formula while double proportion formula was used for calculations of predictors of low serum vitamin D levels. Convenient sampling was therefore used to recruit 305 children who met the inclusion criteria. Social demographic and clinical data were obtained using data collection tool. Rapid vitamin D (25-hydroxy-vitamin-D [25(OH)D]) test was done followed by serum 25(OH)D and calcium levels in all children with positive rapid 25(OH)D test results. Vitamin D deficiency was defined as serum levels <20ng/ml and Vitamin D insufficiency (VDI) when levels were between 20 and 30ng/ml. Hypocalcaemia was defined as serum ionized calcium <1.17mmol/l. Data was analyzed using STATA version 13.

Results: A total of 305 children were enrolled in this study. While normal serum vitamin D levels were observed in 80% of the studied children, 9% had VDI and 11% had VDD. Low serum vitamin D levels were independently associated with prematurity (OR 6.9, 95% CI; 2.28-20.69,P=.001), delayed milestones (OR 3.3, 95% CI; 1.38-28.57, *P* =.03), inadequate sun exposure (OR 12, 95% CI; 4.14-35.49, *P*<.001) and malnutrition (OR= 7.9, 95% CI; 1.91-32.96, *P*=.004). Hypocalcaemia was observed in 24% of children with low serum vitamin D levels.

Conclusion: Substantial proportion of children attending Makongoro RCH clinic have VDD. Prematurity, inadequate sun exposure, malnutrition and delayed milestones significantly predicted low serum vitamin D levels hence screening should be prioritized in children with these conditions.

BACKGROUND

Vitamin D deficiency (VDD) is a global public health problem affecting both children and adults even in countries with adequate sunlight exposure enough to prevent VDD.[1,2] Globally, 1 billion people have low serum vitamin D levels across all age groups.[3] In Europe, studies have reported the prevalence of VDD in infants and toddlers to be 32% and 38.9% respectively.[4,5]

Despite adequate sunlight in most African countries, VDD has been reported in different age groups with lowest levels of 25 hydroxyvitamin D (25(OH) D) having been reported in the Middle, East and North Africa.[6] A study done in Nigeria, among children under 2 years reported prevalence of VDD to be 24.6%.[7] In East Africa, studies have reported the prevalence of VDD ranging from 20% to 83.7% with exclusive breastfeeding, prematurity, chronic illnesses and malnutrition being the recognized risk factors.[8-10] In Tanzania, the study done at Muhimbili National hospital revealed the prevalence of VDD among malnourished children under five years to be 30.6% and among them, 80% were under 2 years of age.[8]

Vitamin D has been reported to play an important role in stimulating intestinal absorption of calcium and phosphorus, stimulating bone calcium mobilization and increasing re-absorption of calcium in the kidney to maintain serum calcium levels for bone

mineralization and skeletal health.[11,12] Calcium is important for building strong bones and teeth and its requirement is increased during childhood due to rapid skeletal growth.[13] Therefore, vitamin D is very important for the child's growth and development during the very early stages of growth.

Vitamin D deficiency causes rickets, impaired growth and development in children[14,15] and it is linked to increased risk of developing infectious diseases, respiratory diseases, asthma, allergies, autoimmune diseases such as type 1 diabetes, oncological and cardiovascular diseases.[16,17] Individuals with higher risk of VDD include children, pregnant women, individuals with dark skin living in moderate climates and those with poor exposure to sunlight due to personal, cultural or religious reasons.[18] Dietary sources of Vitamin D include the flesh of fatty fish, fish liver oils, beef liver, egg yolk, sardines and fortified foods such as milk and breakfast cereals.[19] Moreover, despite having food sources containing vitamin D in this study setting, most of our children are routinely fed on food which are rich in starch with poor sources of vitamin D.

The effects of VDD appear when levels of vitamin D are extremely low with peak incidence between 3 and 18 months of age.[20,21] Susceptibility to VDD in early life is commonly due to increased micronutrient requirements for child growth especially bone development coupled with inadequate nutrient intake or limited exposure to sunlight.[17]

Understanding the magnitude of VDD and associated factors in children is key to prevention of VDD and related complications.[21] American Association of pediatrics recommends that all infants and children should have a minimum intake of 400IU of vitamin D per day beginning soon after birth until the age of 1 year.[22] In Tanzania, our national neonatal care guideline recommends vitamin D supplementation (400-1,000IU daily for 6 months) among babies with low birth weight until 6 months of age.[23] However, this is not the usual practice in many places in Tanzania. Additionally, screening for symptoms of VDD and measurement of serum vitamin D levels are not routinely done at reproductive and child healthcare (RCH) clinics in Tanzania. Hence, the magnitude of VDD and predictors of low serum vitamin D levels in our setting are unknown. Therefore, this study aimed at determining the prevalence of VDD and predictors of low serum vitamin D among children attending Makongoro RCH clinic in Mwanza, Tanzania.

MATERIALS AND METHODS

Study Design and Area

This was a cross sectional study done at Makongoro RCH clinic from November 2022 to February 2023. Makongoro RCH clinic is located in Nyamagana district in Mwanza city, Tanzania where antenatal and postnatal care services are provided to pregnant women before and after delivery (https://mapy.com/s/bohabadeco). About 250 children receive RCH services such as vaccinations, growth and development monitoring monthly at this clinic. During our study period, about 10 to 40 children received RCH services every day at Makongoro RCH clinic. Other health services which are provided at Makongoro RCH include outpatient clinic, HIV care and treatment, prevention of mother to child transmission of HIV (PMTCT) and nutritional counselling for malnourished children.

Study Population

All children aged 1 month and 2 weeks old to 2 years of age attending Makongoro RCH clinic were invited to participate in this study. The study population comprised of 422 children who attended RCH services at Makongoro RCH clinic with an average of 10 to 40 children per day. We excluded those who were receiving vitamin D supplements, anticonvulsant drugs such as phenytoin, phenobarbitone, carbamazepine and sodium valproate as well as those with confirmed chronic diseases such as severe liver disease, renal failure and chronic malabsorption.

Sample Size Estimation and Sampling Procedures

The sample for the prevalence was estimated by using Kish Leslie formula for prevalence studies where Z= Standard normal deviate corresponding to 95% confidence interval (1.96), P= prevalence of Vitamin D deficiency in infants 6 weeks to 12months of 22%[9] and E= margin of error 5% (0.05). Therefore;

$N = Z^2 P(1-P)/E^2 = 1.96^2 \times 0.22(1-0.22)/0.05^2 = 263.$

For the calculations of predictors of low serum vitamin D levels, double proportion formula ($N = (Z_{\alpha/2}+Z_\beta)^2 \times (p_1(1-p_1) + p_2(1-p_2)) / (p_1-p_2)^2$) was used to calculate the sample size, in which prematurity was used as the predictor of low serum vitamin D levels,

where:

$Z_{\alpha/2}$= the value from the normal standard distribution holding 1-α/2 below it =1.96, Zβ=is the value from the normal standard distribution holding 1-β below it=0.84, P_1=proportion of vitamin D deficiency to children born premature =23.1% and P_2=proportion of vitamin D deficient children born at term =21.9%. Thus; $N= (1.96+0.84)^2 \times (0.231(1-0.231) +0.219(1-0.219)) / (0.231-0.219)^2 = 225.$

Therefore, the calculated minimum sample size opted was 263. However, we managed to recruit a sample size of 305 children. Convenient sampling was used to recruit all children aged 1 month and 2 weeks to 24 months who met the inclusion criteria.

Study Procedures

Upon arrival at Makongoro RCH clinic, all children aged 1 month and 2 weeks old to 2 years were screened for eligibility. An informed written consent was obtained from the parents/caretakers of those who met the inclusion criteria. Children whose parents/caretakers consented, were enrolled into the study until the sample size was reached. A pre-tested questionnaire was used to obtain the socio-demographic and clinical data, anthropometric measurements (weight, Mid Upper Arm Circumference (MUAC) and length or height) as well as signs of rickets. Blood samples were drawn for laboratory tests and the results were recorded in the questionnaire. Sunlight exposure was regarded as adequate when the face, arms, hands and feet of a child were exposed for at least 30 minutes per day for 3 or more days per week. Exclusive breastfeeding (EBF) was defined as the practice whereby an infant received only breastmilk for 6 months while

mixed feeding when an infant was given other liquids and/or foods together with breast milk in infants under 6 months of age. Human Immunodeficiency Virus (HIV) status of both the mother and child was acquired from interviewing the mother and verification from the RCH card was done. However, for children who were reported to be negative, HIV rapid test was done by using Tanzania national HIV testing algorithm.[24]

Physical examination was done from head to toe followed by systemic examination. Physical signs of VDD which include rachitic rosary, bent legs, Harrison's groove, delayed dentition, delayed fontanelle closure, hair loss and craniotabes[25] were evaluated for during complete physical examination.

Length was measured by length board with a headboard and sliding foot piece.[26] Children under 2 years of age were weighed using a 25kg Salter hanging scale (CMS Weighing equipment, High Holborn, London). The scales were adjusted to zero before each measurement was taken. The child's weight was recorded to the nearest 100 grams. We used WHO Z-score charts in order to determine the weight for length (WFL) or weight for height (WFH) in order to grade the nutritional status of the child. Mid-Upper Arm Circumference (MUAC) was measured using a standard MUAC tape (S0145620 MUAC tape, child 11.5 Red/PAC-50). Tip of the shoulder and of the elbow were identified and thereafter the MUAC tape was placed at the tip of the shoulder and pulled past the tip of the bent elbow. Midpoint was marked and then the arm circumference was measured in centimeters and interpreted based on WHO MUAC chart.

Laboratory Procedures

Under aseptic technique, middle left finger was wiped using an alcohol swab and then a finger prick was done using a sterile lancet. A capillary dropper was used to draw 20 microliters of whole blood. Two drops of buffer were added on the Citest vitamin D rapid test cassette (All Test Biotech Co, Hangzhou) and reading was done at 10 minutes. A positive test was marked by the appearance of two lines on the test cassette.[27]

For those with the positive vitamin D rapid test, 3 to 5mls of whole blood was collected in a sterile red top vacutainer tube containing coagulation activator. It was then stored in a storage box at 8°C and then transported to the laboratory within 4 hours of collection where centrifugation was done to obtain 1 to 2mls of serum. Serum 25(OH)D was estimated using Maglumi-800 chemiluminescent immunoassay biochemical analyzer (Snibe Diagnostics, Shenzhen) while serum calcium was estimated using COBAS C111 machine (Roche Diagnostics, Rotkreuz). All children with vitamin D levels between 20 to 30ng/dl were regarded as vitamin D insufficient (VDI) while those with serum vitamin D levels less than 20ng/ml were regarded as vitamin D deficient (VDD).[28] Children with serum vitamin D levels below 30ng/ml were considered to have low serum vitamin D levels. Hypocalcemia was defined as ionized serum calcium of less than 1.17mmol/l.[29] All those with VDD and VDI were referred to the medical doctor for further management.

Data Management and Statistical Analysis

Data was entered into a Microsoft excel and analyzed using STATA version 13 (StataCorp LP, Texas). Dependent variable was low serum vitamin D level while independent variables were child factors (age, sex, gestational age at birth, birth weight, duration of exclusive breastfeeding, current feeding type, nutritional status, HIV, Sickle cell disease and cardiac diseases) and maternal factors (age, parity, religion, HIV status, sun exposure, vitamin D supplementation and diet). Categorical variables were summarized by proportions and percentage while continuous variables were summarized as median and interquartile range. To determine factors associated with low serum vitamin D, univariate logistic regression was done and factors with *P* value <.05 were subjected to multivariate logistic regression model. All factors with a *P* value less than .05 on multivariate logistic regression were considered statistically significant.

Ethical Consideration

Ethical clearance and approval to conduct this study was granted by the joint BMC/CUHAS research ethics and review committee with ethical clearance certificate number CREC/623/2022. Permission to conduct the study was obtained from Nyamagana council health management team and Makongoro RCH administration. Before enrollment of the participants, study procedures were explained to the parents/guardians and thereafter, they were requested to sign a consent form. Confidentiality was ensured. Feedback of the results was given to the parents/guardians as soon as they were available. Children with VDI and VDD were referred to the medical doctor and they were managed according to the Tanzania's standard treatment guidelines.

RESULTS

Study Participants' Sociodemographic Characteristics

About 73% of children who attended Makongoro RCH clinic during the study period were studied. However, 5.3% of the studied children were excluded in the analysis due to absence of complete information from their caretakers and refusal to participate in this study. Among the enrolled children, 169 (55%) were males and 180 (59%) were aged between 7 and12 months with median age of 9 (IQR 6-15) months. Children who were born at term were 274 (89.8%) while the median birth weight of 3kg (IQR 2.7-3.5). Two hundred and eighteen children (71.5%) were exclusively breastfed for 6 months. During the study period, 244 (80%) children were on complementary feeding and only 61(20%) were still on exclusive breastfeeding (Table 1).

Mother's Baseline Characteristics

Two hundred and seventy-four (89.8%) mothers were under the age of 35 years with median age of 27 years (IQR 22-30). Among mothers of the study participants, 281(92%) had fewer than 5 children and median parity was 2 children (IQR 1-3). Out of 305 mothers whose children were enrolled, 16 (5.2%) were HIV positive and 262 (85.9%) women had adequate sun exposure (Table 2).

Children's Clinical and Laboratory Findings

Chronic illnesses were found in 10 (3.3%) participants which included 4 children with cerebral palsy, 5 children

with sickle cell disease and 1 child had osteogenesis imperfecta. Majority of children (94.8%) were HIV negative and (91.5%) had normal developmental milestones. Only 26(8.5%) had features of rickets and 23(7.5%) had malnutrition. (Table 3).

TABLE 1: Social Demographic and Baseline Characteristics of the Study Participants

Characteristic	Number or Median	Percentage (%) or IQR
Gender		
Female	136	45
Male	169	55
Age in months	9	6—15
≤6 months	73	24
7-12 months	180	59
>12 – 24 months	52	17
Gestation age		
Term	274	89.8
Preterm	31	10.2
Birth weight in kg	3	2.7—3.5
<2.5	120	39.3
2.5-4	165	54.1
>4	20	6.6
Duration of exclusive breast feeding		
6 months	218	71.5
<6 months	87	28.5
Type of feeding		
Breastfeeding	61	20
Complementary feeding	244	80
Chronic illness		
Yes	10	3.3
No	295	96.7
Sun exposure		
Yes	238	78
No	67	22

TABLE 2: Mother's Baseline Characteristics

Characteristic	Number/Median	Percentage (%)/IQR
Age in years	27	22-30
<35	274	89.8
≥35	31	10.2
Parity (children)		
<5 children	281	92
>5 children	24	8
Sun exposure		
Yes	262	85.9
No	43	14.1
HIV status		
Negative	289	94.8
Positive	16	5.2
Religion		
Christian	227	74.4
Muslim	78	25.6

Children's Vitamin D and Calcium Levels

The prevalence of low serum vitamin D levels was 20% and that of vitamin D insuffiency was 9%. High proportion of children with low serum levels of vitamin D (45%) had VDI (Figure 1). Severe VDD was observed in one child (3%) who presented with serum vitamin D of less than 10ng/ml). The median serum vitamin D levels among children with VDD and VDI was found to be 19.2ng/ml (IQR 15.6-24.6ng/ml). Serum ionized calcium levels were tested among the 33 children with VDD, whereby 8 (24%) were found to have hypocalcemia with the mean serum ionized calcium level of 1.21mmol/l (IQR 1.14mmol/l-1.27mmol/l).

FIGURE 1: Children's Vitamin D Status

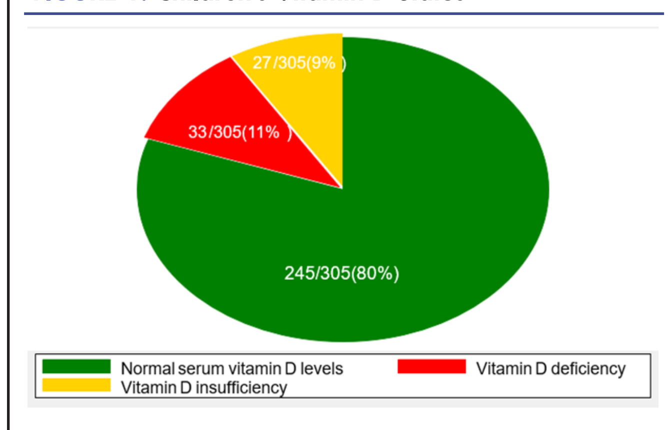

TABLE 3: Clinical and Laboratory Characteristics of 305 Children Who Attended RCH Clinic at Makongoro

Characteristic	Number	Percentage (%)
Chronic illness		
Yes	10	3.3
No	295	96.7
HIV status		
Negative	289	94.8
Exposed	15	4.9
Positive	1	0.3
Developmental milestones		
Normal	287	94.1
Delayed	18	5.9
Nutritional status		
Normal	282	92.5
Malnutrition*	23	7.5
Features of Rickets		
Yes	26	8.5
No	279	91.5

*Weight for Length or Height Z score < -2SD

Predictors of Low Serum Vitamin D Levels

In multivariate logistic regression model, low serum vitamin D levels was independently associated with prematurity (OR 6.9, 95% CI; 2.28-20.69, *P* value=.001), delayed milestones (OR 3.3, 95% CI; 1.38-28.57, *P* value=.03), inadequate sunlight exposure (OR 12, 95% CI; 4.14-35.49, P value <.001) and malnutrition (OR 7.9, 95% CI; 1.91-32.96, *P* value=.004) (Table 4).

TABLE 4: Predictors of Low Serum Vitamin D Among Children Attending Makongoro RCH Clinic

Variable	Serum Vitamin D levels Low (n=60) n%	Normal (n=245) n%	Univariate OR (95%CI)	*P-value*	Multivariate OR (95%CI)	*P-value*
Age in month						
1.5-6	9(12.30)	64(87.70)	1.0			
7-12	19(10.60)	161(89.40)	0.84(0.36-1.95)	.68	-	-
13-24	5(9.60)	47(90.40)	0.76(0.24-2.40)	.64	-	-
Gender						
Female	15(11.00)	121(89.00)	1.0			
Male	18(10.65)	151(89.35)	0.96(0.47-1.99)	.92	-	-
Gestation age						
≥9months	21(7.66)	253(92.34)	1.0			
<9months	12(38.71)	19(61.29)	7.6(3.26-17.78)	<.001	6.9(2.28-20.69)	.001
Birth weight						
<2.5kg	18(15.00)	102(85.00)	1.0			
2.5-4kg	10(6.06)	155(93.94)	0.81(0.43-1.50)	.50	-	-
>4kg	5(25.00)	15(75.00)	0.34(0.19-2.29)	.21	-	-
EBF* in months						
<6	23(10.55)	195(89.45)	1.0			
≥6	10(11.49)	77(89.51)	1.1(0.50-2.42)	.81	-	-
Feeding method						
Complementary	26(10.66)	218(89.34)	1.0			
Breastfeed	7(11.48)	54(88.52)	1.1(0.45-2.64)	.85	-	-
Religion						
Christian	19(8.40)	208(91.60)	1.0			
Muslim	14(17.95)	64(82.05)	2.4(1.14-5.05)	.02	3.9(0.46-10.41)	.07
Chronic illness						
Yes	4(40.00)	6(60.00)	1.0			
No	29(9.83)	266(90.17)	0.2(0.04-0.61)	.007	0.2(0.01-3.09)	.24
Milestones						
Normal	23(8.01)	264(91.99)	1.0			
Delayed	10(55.56)	8(44.44)	14(5.16-39.9)	<.001	3.3(1.38-28.57)	.03
Sun exposure						
Adequate	10(4.20)	288(95.80)	1.0			
Inadequate	23(34.33)	44(65.67)	12(5.30-26.8)	<.001	12(4.14-35.49)	<.001
Nutrition status						
Normal	24(8.51)	258(91.49)	1.0			
Malnourished*	9(39.13)	14(60.87)	6.9(2.71-17.62)	<.001	7.9(1.91-32.96)	.004
Mother's age (year)						
<35	30(10.95)	244(89.05)	1.0			
≥35	3(9.68)	28(90.32)	0.87(0.25-3.04)	.83	-	-
Parity of the mother						
<5children	31(11.03)	250(88.97)	1.0			
≥5children	2(8.33)	22(91.67)	0.73(0.16-3.27)	.68	-	-
Mother's sun exposure						
Yes	23(8.78)	239(91.22)	1.0			
No	10(23.26)	33 (76.74)	12(5.30-26.78)	<.001	0.7(0.15-3.61)	.71
Mother's HIV status						
Negative	31(10.73)	258(89.27)	1.0			
Positive	2(12.50)	14(87.50)	1.2(0.26-5.48)	.82	-	-

*Exclusive breastfeeding

DISCUSSION

The observed high prevalence of vitamin D deficiency (11%) among children aged 6 weeks to 24 months attending RCH services at Makongoro clinic was similar to the prevalence reported by Said *et al* who reported a prevalence of 11.2%.[30] Despite adequate sunlight and food sources rich in vitamin D in our setting, this high prevalence can be attributed by inadequate sunlight exposure to children due to lack of knowledge on when, how long and which body parts to be exposed to the sunlight for adequate cutaneous vitamin D synthesis. Additionally, poor knowledge on dietary sources of vitamin D which are needed to feed these children in order to prevent VDD may have contributed to high VDD prevalence.

However, the reported prevalence in our study is lower compared to the prevalence reported by Urio *et al* (22%),[8] Hoevenerr *et al* (32%)[4] and that of two previous studies which were done in Dar es salaam - Tanzania, which reported the prevalence of 30.6% and 53.7%.[9,10] The difference in the prevalence compared to that reported by Urio *et al* and Hoevenerr *et al* can be explained by the differences in weather in our study area which has adequate sunlight as compared to the weather in study area by Urio *et al* and Hoevenerr *et al*l which is relatively cold with few episodes of sunshine. Moreover, the lower prevalence in our study as compared to that reported in the two studies which were done in Dar es salaam can be explained by differences in study population as our study was carried out in healthy children attending RCH clinic while the two previous studies were done in admitted children. Hence the high prevalence of vitamin D deficiency found in studies done in Dar es salaam can be attributed by the disease state of those children and inadequate sun exposure resulting from being admitted to the hospital.

In our study, VDD was independently associated with prematurity, delayed milestones, inadequate sunlight exposure and malnutrition. In the current study, children who were born preterm had 7 times higher odds of having VDD compared to those who were born at term. This can be explained by the low transplacental transfer of vitamin D from the mother to the infant during the third trimester, prolonged hospital stays, delayed initiation of breastfeeding and delayed sunlight exposure resulting from complications of prematurity. Burris *et al* found that prematurity with the gestation age less than 32 weeks had increased odds of having VDD compared to more mature infants.[31]

Our study found that children with delayed milestones were 3 times more likely to have VDD as compared to those with normal milestones. Previous study by Kumar *et al* found that more than 60% of children who were not walking to be vitamin D deficient.[32] These findings can be explained by the role of vitamin D on muscle and bone metabolism where by in addition to its role in bone mineralization, vitamin D has been shown to influence muscle calcium transport and stimulation of muscle cell proliferation and growth.[33]

Furthermore, we found that inadequate sunlight exposure was associated with VDD. The odds of developing VDD in children with inadequate sunlight exposure were 12 folds higher compared to those with adequate sunlight exposure. Similar findings have been reported by other previous studies done in and out of Africa.[30,34,35] For instance, Said *et al* reported a five times higher odds of VDD in infants on exclusive breastfeeding receiving less than 30 minutes of sunlight exposure as compared to those receiving more than 30 minutes of sunlight exposure per day.[30] Similar results were reported by Alqahtani *et al* where by children aged less than 2 years who were exposed to sunlight for less than 3 days per week were five times more likely to be vitamin D deficient compared to those exposed to sunlight for more than 3 days in a week.[34] Our findings are in keeping with the known literature of the major role of ultraviolet light on production of vitamin D.[15]

Furthermore, our study found the association between malnutrition and VDD. Children whose weight for length Z-score was <-2SD had 8 times higher odds of developing VDD as compared to those with normal weight for length. Similar findings have been reported in previous studies which reported increased risk of VDD in malnourished children.[35, 36] These findings can be explained by reduced intake of nutrients in malnourished children, including vitamin D.

Lastly, we found that 9% of enrolled children had VDI. This finding is an alarming call for possible interventions in such children in order to prevent them from being vitamin D deficient. Additionally, among the 33 children with VDD, only 8(24%) had hypocalcemia and were referred for further evaluation and management. However, we could not establish an association between VDD and hypocalcemia due to lack of a comparable group as serum calcium was measured only in children with VDD.

The authors would like to acknowledge the following study limitations. Some of the information such as sunlight exposure was obtained from mothers and caregivers which could have been affected by recall bias. Serum calcium levels were obtained only in those who were found to have VDD hence failure to establish an association between VDD and serum calcium levels due to absence of the comparable group.

CONCLUSION AND RECOMMENDATIONS

Prevalence of low serum vitamin D levels is 20% and vitamin D deficiency accounts for 11% of children attending Makongoro RCH clinic in Mwanza, Tanzania. Predictors of low serum vitamin D levels in these children include prematurity, delayed milestones, inadequate sunlight exposure and malnutrition. Children with these conditions should be thoroughly evaluated for symptoms and signs of VDD and parents/caregivers of children attending RCH clinics should be educated on prevention of VDD through adequate sunlight exposure, dietary recommendations and vitamin D supplementation.

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