

Knowledge and Practice of Infants Exposure to Sunlight Among Lactating Mothers Attending at Yirgalem Hospital, Sidama Regional State

Clinical Medicine Insights: Pediatrics
Volume 15: 1–8
© The Author(s) 2021
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/11795565211041348



Addisu Seneshaw Bezabih¹, Daniel Eshetu¹, Nigussie Yohanis¹ and Agete Tadewos Hirigo²

¹Yirgalem Hospital Medical College, Yirgalem, Sidama Regional State, Southern-Ethiopia.

²Hawassa University, College of Medicine and Health Science, School of Medical Laboratory Sciences, Hawassa, Sidama Regional State, Southern-Ethiopia.

ABSTRACT

BACKGROUND: Exposure to sunlight is vital for the synthesis of vitamin-D and vitamin D plays an important role in growth and bones strength. Therefore, this study aimed to assess the knowledge and practice of infants exposure to sunlight among lactating women.

METHODS: A cross-sectional study was conducted from May 01 to 30, 2019 among 327 infant coupled lactating mothers attended at Yirgalem General Hospital. An interviewer-administered questionnaire was used to collect relevant data through a convenient sampling technique.

RESULTS: A total of 84.7% of respondents exposed infants to sunlight. More than 94% knew the benefit of exposing infants to sunlight. About 20.9%, 25.6%, and 19.9% of mothers exposed infants to sunlight within 15, 16 to 30, and 31 to 45 days of birth, respectively. In addition, 59.9% of respondents exposed infants to sunshine daily and 72.2% exposed without clothing the infants' body. Moreover, 63.5% of mothers have applied lubricants and overall 54.5% of mothers exposed infants to sunlight in good practice. Unemployed women were 4.7 times more likely (aOR; 95%CI: 4.7; 2.0-11.4) to expose infants to sunlight when compared to those employed, while women whose husbands have at least secondary education level were 5.1 times more likely (aOR; 95%CI: 5.1; 1.6-16.1) to expose infants to sunlight when compared to those unable to read and write.

CONCLUSION: More than 45% and more than one-third of lactating mothers had poor practice and exposed infants to sunlight for inadequate time, respectively. Therefore, the finding indicates a need for awareness creation to increase women's knowledge and practice toward the exposure of infants to sunlight.

KEYWORDS: Infants, mothers, sunlight exposure, knowledge, practice

RECEIVED: October 24, 2020. **ACCEPTED:** July 28, 2021.

TYPE: Original Research

FUNDING: The author(s) received no financial support for the research, authorship, and/or publication of this article.

DECLARATION OF CONFLICTING INTERESTS: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

CORRESPONDING AUTHOR: Agete Tadewos Hirigo, Hawassa University College of Medicine and Health Science, School of Medical Laboratory Sciences, Hawassa 1560, Southern-Ethiopia. Emails: agetetadewos@yahoo.com; tadewosa@gmail.com

Introduction

Vitamin D is a fat-soluble vitamin that generally refers to 2 pro-hormones: ergocalciferol (vitamin D₂) and cholecalciferol (vitamin D₃).¹ It is synthesized primarily in humans through the exposure of sunlight on the skin and converted to its active form of 1 α ,25-dihydroxyvitamin D₃ [1 α ,25(OH)₂D₃] in the kidney by 25-hydroxyvitamin D-1 alpha hydroxylase.^{1,2} Approximately 90% of vitamin-D requirement comes from sunlight exposure and the residual from dietary source and/or supplementation.³ Vitamin D plays an important role in the regulation of calcium level and bone metabolism in the body, its active metabolite 1,25(OH)₂D (calcitriol) facilitate the innate and adaptive immune systems and triggers effective antimicrobial pathways against bacterial, viral, and fungal pathogens in the cells of the innate immune system.⁴ Moreover, it helps for brain development and function, including neuronal differentiation, proliferation, and apoptosis, regulating synaptic plasticity, the ontogeny of the dopaminergic system, immunomodulation, reduces the risk of asthma and reducing oxidative burden.⁵ Over 40% of infants/adults' skin should be

exposed to sunshine daily for twenty minutes in order to synthesize a sufficient amount of 25(OH)D₃ or to prevent its deficiency.⁶

However, 25(OH)D₃ deficiency in infants can lead to abnormalities like bone malformation, seizures, and difficulty breathing. Severe vitamin D deficiency (<10 ng/mL) in children may lead to overt skeletal abnormalities, typically defined as rickets.⁷ Healthy breast milk contains an insufficient amount of 25(OH)D₃, leading to a poor source of 25(OH)D₃ for exclusive breastfeeding.^{8,9} Exclusively breastfed infants depend on sunlight exposure and 25(OH)D₃ intake from breast milk in order to maintain its concentration. However, the report indicated that breast milk 25(OH)D₃ content is low, which may rise the risk of vitamin D deficiency (VDD) in infants living in areas with insufficient sunlight.¹⁰ Besides the exposure status of sunlight, vitamin D nutritional status can also affect neonatal anthropometrics, bone development, electrolyte balance, immune function, and cognitive function.¹¹ Further, VDD during pregnancy may affect neonatal outcomes, thereby increasing the risk of preterm birth, low



Creative Commons Non Commercial CC BY-NC: This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits non-commercial use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE and Open Access pages (<https://us.sagepub.com/en-us/nam/open-access-at-sage>).

birth weight (LBW), small for gestational age (SGA), and poor offspring health.¹²

Globally, vitamin D deficiency is a health problem in both children and adults; and considered as an epidemic.¹³ Rickets disease is common in children particularly in Sub-Saharan Africa including Ethiopia.¹⁴ Lack of sunlight exposure, maternal VDD, and lack of vitamin D supplements were the risk factors for developing VDD rickets in children.¹⁵ Regarding 25(OH)D3 deficiency in children, it was found that 42% in Adama, east Ethiopia,¹⁶ while the prevalence of rickets was 10.5% in Jimma, Southwest Ethiopia¹⁷ and 7.8% in Haramya, eastern Ethiopia.¹⁸ Further duration of sun exposure status, application of baby oil, skin color of the baby, and occupational status of the mother was significantly associated with rickets.¹⁷ While, dressing fully during sun exposure, being sick 1 month prior to the study, and being under the care of caregivers were positively associated with rickets.¹⁸ Therefore, prophylactic vitamin D supplementation for infants is recommended however, considering the side effects of intoxication, the real need for use of supplementation should be evaluated.¹⁹ Ethiopia is known as a country with 13 months of sunlight (365 or 366 days or 12 months of 30 days each and 13th month of 5 days, which will be 6 days every leap year). However, lack of awareness on the benefits and suitable habits of sunlight exposure and also unaccepted traditional beliefs are possible reasons for avoiding sunlight exposure for infants. Data are still scarce in Ethiopia, therefore this study aimed to assess the knowledge and practice of lactating women about infants' sunlight exposure status.

Methods Study Settings, Study Population, and Sampling

This institution based cross-sectional study was conducted from 01 to 30 May 2019 at Yirgalem General Hospital, Yirgalem, Sidama Regional State, Southern-Ethiopia. Yirgalem town has a latitude and longitude of 6°45'N 38°25'E/6.75°N 38.417°E/6.75; 38.417 and an elevation of 1776 m above the sea level. In total, 327 mothers who had a child <12 months of age and visited the Pediatrics and Child Health Department were eligible for study enrollment. Besides, data on socio-demographic, education, knowledge level about sunlight exposure, frequency of sunlight exposure, time of sunlight exposure, and clothing status during sunlight exposure, utilization, and duration of lubricant application were collected by a pre-tested structured questionnaire through a convenient sampling technique. An interviewer-administered questionnaire was used by trained nurses who were working in the pediatrics and child health department. Lactating women who attend pediatrics and child health department under 12 months of children for healthcare were included in the study and the interview was directly forwarded to the lactating mothers. However, those lactating mothers who came with children

aged \geq 12 months, and those who unable to communicate properly were not considered for inclusion in the study.

Data Collection Procedure

Before going to the data collection, a pretest was done on 5% of similar mothers in the health center. Data was collected through the face-to-face interview method. The interview was conducted during the day both in the morning and in the afternoon in a place where the interviewee feels free and can express her feelings without any hesitation after taking informed consent. All interviews was conducted alone with the respondents.

Operational Definitions

Lubricants: The type of lubricants utilized by lactating mothers to keep their infants' skin soft and massaging was butter (fresh dairy product) and/or baby oil (a petroleum-based mineral oil) only but not sunscreens.

Sufficient sunlight exposure time: Sufficient sunlight exposure was mentioned as those infants/children exposed to sunlight daily in the morning session a minimum of 15 to 30 minutes.^{6,20}

The practice of sunlight exposure: Lactating mothers were asked about their experience of sunlight exposure using practice-related questions in different aspects like frequency of exposure, condition of closing during exposure, adequacy of exposure time, utilization of lubricants, and duration of lubricant application. The *sunlight exposure* status of infants was assessed by practice-related indicators (questions) and presented using a 5-point Likert scale approach (1-not at all/never; 2-sometimes/insufficient; 3- fair/sufficient; 4-most of the time/very sufficient; and 5-always/extremely sufficient). Hence lactating mothers who responded more than or equal to the median value of the overall practice indicator items were categorized under a group of *good practice*; otherwise, they were categorized under a group of *poor practice* of sunlight exposure.

Sample Size Determination

The sample size was calculated using a single population proportion formula and considering 32.6% prevalence from the study conducted in Aleta Wondo Health Center.²¹ With a 5% marginal error and 95% confidence interval (CI) level, the final sample size was calculated to be 338.

Statistical Analysis

Each questionnaire was visually checked, coded, and entered into SPSS version 20 for statistical analysis. To explain the study population with relevant variables, descriptive statistics were used. Bivariate and multivariate logistic regressions model was used to assess the association between the practice of sunlight exposure and independent variables. The adjusted odds ratios (aOR) with 95%CI was used to determine the association of explanatory variable with the practice of sunlight

exposure. In addition, the model fitness was checked by the Hosmer-Lemeshow goodness of fit test. Finally P -value $<.05$ was accepted as statistically significance at a 95%CI.

Results

Socio-demographic and other characteristics of the study subjects

Of 338 lactating mothers approached, 327 were recruited in the study, giving a response rate of 96.7%. One hundred (30.6%) women were aged between 21 and 26 years and more than half of the children (54.4%) were under 7 months old (Table 1).

Majorities, 310 (94.8%) of lactating mothers had information on infants exposure to sunlight and of them, 26.8% (83/310) were accessed information from midwives/nurses, while 53.5% (166/310) were received information from their neighbors. Moreover, 4.5% of lactating mothers have received information from health extension workers (HEWs) on sunlight exposure (Figure 1). The HEWs are mobilizing the community, and by acting as community role models to form more model households (1-in-5 network). HEWs provide health post-based basic services, including preventive health services such as immunizations and injectable contraceptives, and limited basic curative services such as first aid and treatment of malaria, intestinal parasites, and other ailments.

Knowledge of Lactating Mothers on the Infants' Exposure to Sunlight

Totally 310 (94.8%) knew about the benefit of infants sunning. More than 53% of women were responded that sunlight is important for the strengthening of body. While the rest 22.2% (69/310) and 7.4% (69/310) were responded that exposing infants to sunlight is required for bone strength and vitamin-D synthesis, respectively. More than 94% of the respondents did not know about the harmful effects of sunlight exposure. Moreover, 18 respondents who had known the harmful effects of sunlight exposure, 9 of them responded that it can cause blindness, while 3 of them responded that it can cause skin cancer and 6 of them responded that it can cause other risks (Table 2).

Lactating Mothers Practice on Infants Exposure to Sunlight

More than 84% of lactating mothers exposed their infants to sunshine. One-third (33.6%) of the mothers began sunning of infants after 45 days of birth, while 20.9%, 25.6%, and 19.9% of them exposed within 15, 16 to 30, and 31 to 45 days of birth, respectively. A total 166 (59.9%) mothers exposed infants to sunlight daily and 72.2% exposed without clothing of infants' body. Regarding the application of lubricant, 63.5% (176/310) of mothers applied lubricants, and of these, 25% (44/176), 45.5% (80/176), and 29.5% (52/176) applied lubricant before, during, and after the sunning of infants, respectively. Overall

54.5% (151/277) of lactating women adequately practiced infants' exposure to sunlight, whereas the rest 45.5% (126/277) practiced inadequately (Table 3).

Factors Associated With the Practice of Infants Sunlight Exposure

In bivariate analysis, mothers aged between 21 and 26 years were 2.4 times more likely to practice infants exposure to sunlight compared to those mothers aged between 15 to 20 years, the crude odds ratio (cOR; 95%CI: 2.42; 1.2-4.9). Mothers educated from grade 11 to 12 were 3.3 times more likely to practice infants exposure to sunlight when compared to mothers who were unable to read and write (cOR; 95%CI: 3.3; 1.49-7.5). In addition, unemployed women were 1.8 times more likely to practice infants exposure to sunlight when compared to those employed women (cOR; 95%CI: 1.7; 1.0-3.1). When using a multivariate logistic regression analysis, only maternal occupation and husband's education remained as the significant independent predictors of good practice of sunlight exposure. Unemployed women were 4.7 times more likely (aOR; 95%CI: 4.7; 2.0-11.4) to expose infants to sunlight when compared to those who were employed, while women whose husbands had at least a secondary education level were 5.1 times more likely (aOR; 95%CI: 5.1; 1.6-16.1) to expose infants to sunlight when compared to those unable to read and write. (Table 4).

Discussion

In this study, 94.8% of lactating mothers had information on infants exposure to sunlight. However, the inconsistent rate was reported in different studies like 86.1% in Gojjam,²² 53.98% in Gondar,²³ 64% in Saudi,²⁴ 40% in Saudi.²⁵ The variations might be attributed to socio-demographic, maternal education, cultural differences, geographical contributions, and beliefs/fear regarding early infants sunning.

In this study, 94.8% of lactating mothers responded affirmatively about the importance of infants exposure to sunlight. This finding was nearly comparable with the study conducted in Debre Markos (91.1%),²² and Jimma town (99.68%).¹⁶ However, it was higher than the report from Aleta Wondo²¹ and Gondar,²³ which were 84.9% and 75.98%, respectively. The level of awareness and adequacy of health extension workers between regions/zones for the proper home to home delivery of health education might be possible factors for the variations.

Regarding the harmful effects of solar UV radiation, only 5.5% of lactating mothers responded that sunning had side effects, irrespective of its benefits such as blindness, skin cancer, and others. Their knowledge level was significantly lower than the studies done in other parts of Ethiopia like Aleta Wondo,²¹ and Debre Markos,²² which were 48.7% and 26.8%, respectively. This indicates that most lactating mothers do not have enough information about sunning and its drawbacks since sunning might be useful for reducing neonatal jaundice and boosts vitamin D for different physiological functions in the body.²⁶

Table 1. Socio-demographic characteristics of the study subjects.

VARIABLES	CATEGORY	FREQUENCY	PERCENT (%)
Mother's age	15-20	93	28.4
	21-26	100	30.6
	27-32	88	26.9
	>32	46	14.1
Infant's age	0-6 mo	178	54.4
	7-12 mo	149	45.6
Religion (Mother)	Protestant	277	84.7
	Orthodox	36	11.1
	Muslim	8	2.4
	Others	6	1.8
Ethnicity	Sidama	293	89.6
	Oromo	8	2.4
	Amhara	17	5.2
	Others	9	2.8
Marital status	Single	12	3.7
	Married	310	94.8
	Divorced	5	1.5
Mother's educational status	Unable to read and write	91	27.8
	Grade 1-6	100	30.6
	Grade 7-10	75	22.9
	Grade 11-12	12	3.7
	Diploma and above	49	15
Mother's occupation	Student	11	3.4
	House wife	214	65.4
	Government employee	44	13.5
	Self-employed	25	7.6
	Daily laborer	11	3.4
	Merchant	22	6.7
Family size	1-3	124	37.9
	4-6	177	54.1
	>6	26	8
Husband's educational status	Unable to read and write	69	21.1
	Able to read and write	7	2.1
	Grade 1-6	58	17.7
	Grade 7-10	79	24.2
	Grade 11-12	11	3.4
	Diploma and above	86	26.3
	Missing	17	5.2

In the present study, 54.5% of lactating mothers exposed infants to sunlight adequately time appropriately. This finding is in line with the study conducted in Gondar (54.4%).²³ However, variable rates of sunlight exposure practice were reported by several studies conducted in Ethiopia, such as 32.6% in Aleta Wondo,²¹ and 44.6% in Debre Markos.²² Seasonal differences between the studies might cause variation in sunlight exposure status due to rain, cloudy weather conditions, and variation in the number of sunny days. In addition, in this study, 84.7% of lactating women exposed infants to sunning irrespective of time adequacy. The finding was comparable with studies conducted in Aleta Wondo, Ethiopia²¹ in which 80.1% of mothers exposed infants to sunlight. However, the finding was higher than the studies conducted in Debre Markos,²² and Gondar,²³ which were 40% and 51.98%, respectively. Differences in socio-cultural conditions between the regions might affect early exposure of infants to sunlight.

In this study, 20.9% of mothers exposed babies to sunlight within 0 to 15 days of birth. The finding was nearly comparable

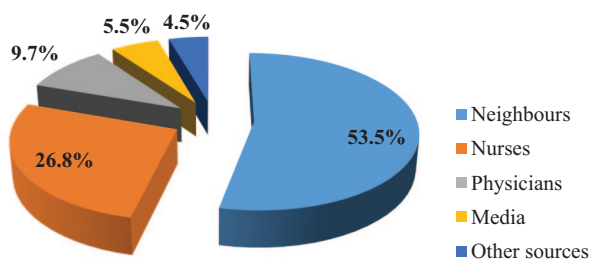


Figure 1. Source of information for mothers on infants exposure to sunlight.

with the study conducted in Debre Markos, Ethiopia, in which 17.6% of lactating mothers exposed their babies to sunlight within 0 to 15 days of birth.²² However, it was inconsistent with the report of several studies conducted in other parts of Ethiopia like 23.4% in Debre Markos,²² 15.7% in Gondar,²³ 42.0% in Jimma.¹⁶ Individual perception, fear of disease, fear of attack, and fear of witchcraft might be reasons for the variability in periods of sunlight exposure after birth in different communities.

The current study indicated that 59.9% of mothers exposed their infants to sunshine daily and this is in line with the study conducted in Debre Markos, which indicated that 57.9% of mothers exposed infants to sunshine.²² However, the finding was inconsistent with the reports of other studies, such as 67.6% in Aleta Wondo,²¹ 40% in Gondar,²³ and 49.4% in Southern Ethiopia.²⁷ Regarding the time of exposure, majority (83%) of mothers exposed their babies to sunlight between 8:00 and 10:00 AM. However, different studies reported variable rates about the exposure of infants to sunlight in the depicted period: e.g. 90% in Aleta Wondo,²¹ 99.1% in Debre Markos,²² and 73.2% in Gondar.²³ Even though the exposure of infants to sunlight is important for growth, excess exposure to UV rays (both natural and artificial tanning sources) in children and adolescents may lead to an increased risk of skin cancers – some of which may be fatal.^{28,29}

Moreover, unemployed women were 4.7 times more likely to expose their infants to sunlight than those who were employed. This might be attributed to unemployed women have sufficient time to expose their infants to sunlight when compared to those women with employed women. Furthermore, the odds of practice among women who had a husband education \geq secondary level were 5.1 times higher in exposing of children to sunlight than those women whose husband education was below the

Table 2. Knowledge of mothers on infants exposure to sunlight.

VARIABLE	CATEGORY	FREQUENCY	PERCENT (%)
Information on sunlight exposure (n=327)	Yes	310	94.8
	No	17	5.2
Benefits of sunlight exposure (n=310)	Bone strength	69	22.3
	Keep warm	46	14.8
	Produce vitamin D	23	7.4
	Body strength	167	53.9
	Others	5	1.6
Harmful effects (n=327)	Yes	18	5.5
	No	309	94.5
What harmful effect (n=18)	Skin cancer	3	16.6
	Blindness	9	50
	Others	6	33.3

Table 3. The practice of mothers on infants exposure to sunlight.

VARIABLE	CATEGORY	FREQUENCY	PERCENTAGE (%)
Expose to sunlight	Yes	277	84.7
	No	50	15.3
Age of exposure to sunlight (n=277)	0-15 d	58	20.9
	16-30 d	71	25.6
	31-45 d	55	19.9
	>45 d	93	33.6
Frequency of exposure (n=277)	Daily	166	59.9
	Sometimes	111	40.1
Time of exposure (n=277)	8:00-10:00 AM	230	83
	11:00 AM-1:00 PM	30	10.8
	2:00-4:00 PM	17	6.2
Condition of clothing (n=277)	Unclothed	200	72.2
	Diapers and eye protection only	5	1.8
	Partly covered	58	21
	Completely covered	14	5
Minutes to expose (n=277)	5-10 min	25	9
	10-14 min	101	36.5
	15-30 min	143	51.6
	>30 min	8	2.9
Application of lubricant (n=277)	Yes	176	63.5
	No	101	36.5
When to apply (n=176)	Before exposure	44	25.0
	During exposure	80	45.5
	After exposure	52	29.5
Sunlight exposure status (n=277)	Adequately exposed	151	54.5
	Poor	121	45.5

secondary level. This indicates husbands' education level has an impact to create awareness of their wives to expose their children to sunlight.

Limitations of the Study

Since the study design was cross-sectional, it referenced only a single point and suggesting the evidence of dependent variable and its causal risk factors sufficiently is impossible. In addition the vitamin D status from infants blood was not determined and the study was only focused on maternal knowledge and practice regarding sunlight exposure status of the infants. The lack of vitamin D status assessment in our study, do not allow to proof that good practice of sunlight exposure has any

benefits for breastfeeding infants' vitamin D status. Regardless of these limits, this study ultimately adds helpful information in the limited data settings.

Conclusion

More than 45% of lactating mothers had inadequate practice concerning the exposure of infants to sunlight. Besides, more than one-third of lactating mothers exposed their infants to sunlight for inadequately time (<15 minutes). Therefore, the finding indicates a need for awareness creation during HEWs visit, antenatal care follow-up, and infants' vaccination visit to increase women's knowledge and practice toward the exposure of infants to sunlight.

Table 4. Factors associated with mothers practice on infants exposure to sunlight.

VARIABLES	THE PRACTICE OF SUNLIGHT EXPOSURE (N=277)					
	POOR 126 (%)	GOOD 151 (%)	COR (95%CI)	P-VALUE	AOR (95%CI)	P-VALUE
Maternal age (y)						
<26y	68 (24.5)	88 (31.8)	0.94 (0.61-1.5)	.8	1.3 (0.75-2.4)	.32
≥26y	58 (20.9)	63 (22.7)	1.00		1.00	
Marital status						
Unmarried	2 (0.7)	8 (2.9)	1.00		1.00	
Married	124 (44.8)	143 (51.6)	0.96 (0.36-2.6)	.94	0.2 (0.04-1.1)	.06
Maternal education						
Unable to read and write	36 (13.0)	46 (16.6)	1.00		1.00	
Primary	34 (12.3)	40 (14.4)	0.65 (0.37-1.2)	.14	0.7 (0.31-1.6)	.38
≥Secondary	56 (20.2)	65 (23.5)	0.89 (0.53-1.5)	.68	0.64 (0.26-1.6)	.34
Maternal occupation						
Employed	38 (13.7)	24 (8.7)	1.00		1.00	
Unemployed	88 (31.8)	127 (45.8)	1.7 (1.0-3.1)	.045	4.7 (2.0-11.4)	.001
Husband's education						
Unable to read write	33 (11.9)	36 (13.0)	1.00		1.00	
Primary level	52 (18.8)	67 (24.2)	1.2 (0.71-2.1)	.49	1.7 (0.83-3.6)	.14
≥Secondary level	41 (14.8)	48 (17.3)	1.4 (0.76-2.4)	.30	5.1 (1.6-16.1)	.006

Acknowledgements

We want to acknowledge the Yirgalem Hospital pediatrics outpatient department staffs for their great provision during data collection. Further, our gratefulness is also extended to the study mothers for their keen contribution to the study.

Author Contributions

All stated authors were participated in the research. AS and DE conceptualized and designed the study including data collection and analysis; NY assisted in advising throughout the project and ATH did manuscript drafting, required data analysis and appraisal. All authors read the manuscript and approved the final version.

Availability of Data

The dataset of this article is accessible on reasonable request from the corresponding author

Informed Consent

Written informed consent was obtained from study participants before collecting data

Ethics Approval and Consent to Participate

This study ethically approved by the Ethics committee of Yirgalem Hospital Medical College and it was done in

accordance with the codes of the declaration of Helsinki for ethical principles for medical research involving human subjects. All the study subjects were well informed about the protocol of the study. Besides, written informed consent was provided from study participants. Further, the confidentiality of individual information was strictly kept.

ORCID iD

Agete Tadewos Hirigo  <https://orcid.org/0000-0003-4122-8151>

REFERENCES

- Holick MF. Vitamin D and sunlight: strategies for cancer prevention and other health benefits. *Clin J Am Soc Nephrol.* 2008;3:1548-1554.
- Schuster I. Cytochromes P450 are essential players in the vitamin D signaling system. *Biochim Biophys Acta.* 2011;1814:186-199.
- Holick MF. Vitamin D deficiency. *N Engl J Med.* 2007;357:266-281.
- Omar N, Mosaad Y. Vitamin D and immune system. *Vitam Miner.* 2017;6:151.
- Bivona G, Gambino CM, Iacolino G, Ciaccio M. Vitamin D and the nervous system. *Neurol Res.* 2019;41:827-835.
- Naeem Z. Vitamin D deficiency—an ignored epidemic. *Int J Health Sci (Qassim).* 2010;4:V-VI.
- Zerofsky M, Ryder M, Bhatia S, Stephensen CB, King J, Fung EB. Effects of early vitamin D deficiency rickets on bone and dental health, growth and immunity. *Matern Child Nutr.* 2016;12:898-907.
- Jan Mohamed HJ, Rowan A, Fong B, Loy S-L. Maternal serum and breast milk vitamin D levels: findings from the Universiti Sains Malaysia Pregnancy Cohort Study. *PLoS One.* 2014;9:e100705.

9. Pilz S, Zittermann A, Obeid R, et al. The role of vitamin D in fertility and during pregnancy and lactation: a review of clinical data. *Int J Environ Res Public Health*. 2018;15:2241.
10. við Streyms S, Højskov CS, Møller UK, et al. Vitamin D content in human breast milk: a 9-mo follow-up study. *Am J Clin Nutr*. 2016;103:107-114.
11. Martin CR, Ling PR, Blackburn GL. Review of infant feeding: key features of breast milk and infant formula. *Nutrients*. 2016;8:279.
12. Harvey NC, Holroyd C, Ntani G, et al. Vitamin D supplementation in pregnancy: a systematic review. *Health Technol Assess*. 2014;18:1-190.
13. Wahl DA, Cooper C, Ebeling PR, et al. A global representation of vitamin D status in healthy populations. *Arch Osteoporos*. 2012;7:155-172.
14. Prentice A. Nutritional rickets around the world. *J Steroid Biochem Mol Biol*. 2013;136:201-206.
15. Hollis BW, Johnson D, Hulsey TC, Ebeling M, Wagner CL. Vitamin D supplementation during pregnancy: double blind, randomized clinical trial of safety and effectiveness. *J Bone Miner Res*. 2011;26:2341-2357.
16. Ewnetu H. Retrospective analysis of prevalence of rickets and associated factors among children admitted to pediatric ward in Jimma University specialized hospital. *J Pediatr Neonatal Care*. 2014;1:00044.
17. Tsehay M, Ayantu Kebede TB, Getachew F. Determinants of rickets among under five children in Yekatit 12 Hospital, Case Control Study Addis Ababa, Ethiopia. *J Community Med Health Educ*. 2020;10:692.
18. Sisay K, Mesfin F, Gobena T, Gebremichael B. Rickets and its associated factors among under-five children in selected public hospitals in eastern Ethiopia. *East Afr J Health Biomed Sci*. 2019;3:23-34.
19. Almeida ACF, de Paula FJA, Monteiro JP, et al. Do all infants need vitamin D supplementation? *PLoS One*. 2018;13:e0195368.
20. The uncensored family guide to vitamin D. Accessed September 1, 2019. <https://tancanada.org/index.php?wlmfile=2012/12/30MinutesSunshine.pdf>
21. Bedaso A, Gebrie M, Deribe B, Ayalew M, Duko B. Knowledge and practice on adequate sunlight exposure of infants among mothers attending EPI unit of Aleta Wondo Health Center, SNNPR, Ethiopia. *BMC Res Notes*. 2019;12:183.
22. Abate A. Assessment of practice and factors affecting sunlight exposure of infants among mothers attending governmental health facilities in Debre Markos town, East Gojjam, Ethiopia, 2015. *Am J Nurs Sci*. 2016;5:30-36.
23. Gedamu H, Tafere Y. Assessment of knowledge, attitude, and practice of sunlight exposure of infants among mothers attending in governmental health facilities in Farta district, South Gondar Zone, North West Ethiopia, 2018. *Int J Reprod Med*. 2019;2019:2638190.
24. Alshamsan FM, Bin-Abbas BS. Knowledge, awareness, attitudes and sources of vitamin D deficiency and sufficiency in Saudi children. *Saudi Med J*. 2016;37:579-583.
25. Alramdhan AM, El-Zubair AG. Poor vitamin D supplementation in infants. Cross-sectional study of maternal practices and awareness of vitamin D supplementation in infants in Al-Ahsa, Eastern Saudi Arabia. *Saudi Med J*. 2014;35:67-71.
26. Zhang X, Ding F, Li H, et al. Low serum levels of vitamins A, D, and E are associated with recurrent respiratory tract infections in children living in northern China: a case control study. *PLoS One*. 2016;11:e0167689.
27. Tezera F, Whiting S, Gebremedhin S. Dietary calcium intake and sunlight exposure among children aged 6-23 months in Dale woreda, southern Ethiopia. *Afr J Food Agric Nutr Dev*. 2017;17:12427-12440.
28. Jindal AK, Gupta A, Vinay K, Bishnoi A. Sun exposure in children: balancing the benefits and harms. *Indian Dermatol Online J*. 2020;11:94-98.
29. Balk SJ; Council on Environmental Health; Section on Dermatology. Ultraviolet radiation: a hazard to children and adolescents. *Pediatrics*. 2011;127:e791-e817.