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Assessment of the Practice of Exposing Infants to Sunlight and Associated Factors Among Caregivers Attending Asella Teaching and Referral Hospital, South East Ethiopia

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Abstract

Background: A study done in Debre Berhan town in 2021, shows that 34.3% of participants have poor practice in sunlight exposure of infants. Mothers who are either housewives or government employees with a maternal age of 33 and above perceive that sunlight strengthen their infant bones and makes them healthier. Those mothers who were got information from health-care professionals significantly associated with good practice in sunning of their infant. Lack of appreciation for the importance of sensible sunlight exposure to meet vitamin D requirements of children and adults has led to a worldwide Vitamin D deficiency pandemic. Daily exposure to sunshine remains the cheapest, safest and most effective method to avert the disease.

Objectives: To assess the practice of exposing infants to sunlight and associated factors among caregivers attending at Asella Teaching and Referral Hospital from June 1/2022 to August 31/2022.

Methods: Facility based cross-sectional study design was employed at Arsi University, College of Health Sciences Asella teaching and referral hospital. Data was collected using structured questioners which were designed to assess the practice of exposing infants to sunlight and associated factors. Trained nurses and medical interns collected the data and analysis was done using SPSS version 21, the results were presented in the form of text, tables and graphs.

Results: All the caregivers were interviewed and 50.8% of them had good practice in sunning of their infants. In multi-variable analysis, caregiver and husbands' educational status, a caregivers' perception, and sources of information were significantly associated with the practice of exposing infant to sunlight.

Conclusions and recommendation: Finding of this study indicated that nearly half of participants have poor practice in sunning of infants. This is a pointer that sunlight exposure of infants still needs attention from the health professionals and other concerned bodies.

Keywords: Rickets; Sunlight exposure; Ultraviolet index; Vitamin; VDD

Introduction

Background of study

The healing power of the sun and its use in medical treatment (heliotherapy) has extended back into ancient times starting from about 1400 BC [1,2]. In 1919, the first scientifically established health benefit of sun exposure was that sunlight can be used to prevent and cure rickets [3]. Recently being exposed to ultraviolet radiation has been a subject of epidemiological interest due to both its beneficial and detrimental effects. Excessive ultraviolet radiation (UVR) is associated with skin cancer, sunburn, accelerated skin aging, and cataracts and it also reduces the effectiveness of the immune system. Contrary to the adverse effect, the exposure to solar UVR is an essential step for the

production of Vitamin D, and also the main source of vitamin D in human body [4-8]. Ultraviolet B (UVB) rays in the solar UVR spectrum produce vitamin D in the human body. UVB rays penetrate uncovered skin and converts cutaneous 7-dehydrocholesterol to pre-vitamin D3, which in turn becomes vitamin D3 [9,10]. Sunlight exposure also still has inadequately explored benefits, which include release of nitric oxide, production of beta endorphin, and regulation of circadian rhythms [11]. Vitamin D is used for maintaining the plasma concentration of calcium and phosphate in normal physiologic range and it interacts with parathyroid hormone to maintain bone mineralization [12]. Around 80–90% of vitamin D in humans is sunlight-derived production in the skin and the residual from dietary source and/or supplementation [13]. But, to get such amount of vitamin D there are different factors to considered. Such factors are time spent outdoors, skin pigmentation, degree of latitude, season, the amount of cloud cover, the extent of air pollution, the amount of skin exposed, and the extent of ultra-violet B (UVB) protection, including clothing and sunscreens[14-16]. For efficient production of vitamin D regular exposure of unprotected skin (without use of sunscreen and/or without clothing) to the available UVB radiation is recommended [17]. UVB (short-wave ultraviolet rays) is found maximum in the midday sun. Thus, the best time of day for vitamin D production is near to solar noon from 10 a.m. to 2 p.m [11,17,18]. Below latitudes of approximately 35° north, UVB radiation is sufficient for vitamin D3 synthesis throughout the year, however, at higher latitudes (above 35° north) vitamin D3 is not produced during the winter months and people may be predisposed to vitamin D deficiency unless taking vitamin D supplementation [19]. Vitamin D deficiency (VDD), which is serum 25- hydroxyl vitamin D (25OHD) level less than 30 nmol/l, is a worldwide major public health problem with numerous health consequences in many countries of the world [20]. Around 1 billion people worldwide, across all age groups, have a VDD. Epidemiological studies in different countries revealed that VDD is highly prevalent among infants, regardless of age, ethnicity, geographic location and climatic conditions and is believed to range from 2.7% to 45% [21,22]. Ethiopia is not an exception from this burden. A study done in Addis Ababa revealed that 41% of children below three years of age visiting an out-patient department had vitamin D deficiency rickets and the frequency was higher in infants [23]. Another study done in Jimma town also found that the prevalence of vitamin D deficiency rickets in infants was 11% [24].Studies worldwide identify lack of sun exposure as the main cause of rickets [14,25]. In many rich industrialized countries, the prevalence of rickets in the general population diminished after the introduction of dietary supplementation. However, in such countries, vitamin-D deficiency rickets has re-emerged in recent years, particularly among groups with limited exposure to UVB containing sunshine. Infants at risk of rickets are those whose mothers had poor vitamin D status during pregnancy and those exclusively breast-fed for a prolonged period with little skin exposure to UVB. Contrary to general belief, rickets is widely prevalent in many tropical and subtropical regions despite abundant sunshine. A study conducted in Kenyatta National Hospital showed 58.8% of premature infants develop rickets by the age of 6 months [26]. A recent study conducted in Kiambu District Hospital states that the prevalence of rickets in children 0–59 months to be 3.4% [27]. In Ethiopia, a review of rickets stated that the prevalence of rickets was highly as 40%, making it one of the highest in the world. Vitamin D deficiency rickets is also common in Ethiopian children [28].

Statement of the Problem

Decades have now elapsed since the pioneering studies on rickets in Ethiopia [23,29-31]. Showed that lack of exposure to sunshine was the single most important cause of rickets in Ethiopian children. Some pioneering studies as well as more recent work [24,32] suggested that daily exposure to sunshine remains the cheapest, safest and most effective method of preventing the disease(30). Although Ethiopia is a country with 13 months of sunshine, prevalence of Rickets remains high in Ethiopia this probably due to the poor mothers' practice status as shown in different study.A study done in Debre Markos showed 93% of mothers exposed their infants to sunlight but only 57.9% of them exposed daily and 55.4% of them had poor practice about sunlight exposure. Mothers' age, mothers' educational status, mothers' occupation, fathers' educational status, evil eye, cold, and pneumonia had statistically significant association with sunlight exposure practice [33].A study done in Aleta Wondo Health Center, 62.2% are knowledgeable about sunlight exposure and only 32.6% of mothers had good practice of exposing their infants to sunlight [34]. A study done in Yirgalem hospital shows more than 45% and more than one-third of lactating mothers had poor practice and exposed infants to sunlight for inadequate time, respectively. Unemployed women and husbands' education level were associated with poor practice [35], a study done in Debre Berhan, shows that 34.3% of participants have poor practice in sunlight exposure of infants. Mothers who are housewives or government employees, have a maternal age of 33 and above, perceive that sunlight strengthen infant bones, perceive that sunlight makes their infants healthier, and who got information from health-care professionals were significantly associated with good practice in sunning of their infant [36]. Although it is fairly simple to obtain vitamin D, lack of appreciation for the importance of sensible sunlight exposure to meet vitamin D requirements of children and adults has led to a worldwide VDD pandemic [16]. Furthermore social, religious norms and health practice of mothers might lead to vitamin D deficiency by

preventing infants from sunlight exposure. Previous study revealed that maternal age, maternal educational status, maternal occupation, family size and fathers' educational status were significantly associated with practice of sunlight exposure [33]. Efforts to prevent VDD with supplementation of vitamin D, fortification of milk or other foods with vitamin D and/or adequate sunlight exposure are recommended worldwide [21]. Guidelines in Ethiopia recommend sunning of neonates starting from 2 weeks old for 15–20 minutes per day. Although health education to change maternal behavior to expose infants to sunshine was adopted as the main strategy to combat rickets in the early 1960s, the implementation of this strategy is inconsistent [27]. Despite all these efforts, lack of sunlight exposure continues to be the major risk factor of VDD rickets in Ethiopian children [37,38]. It contributes to infant mortality and morbidity and carries long-term consequences. Caregivers plays a key role in prevention of rickets by exposing their infants to sunlight adequately. There is an abundance of sunlight in Ethiopia throughout the year, but studies indicating the practice of mothers on sunning of their infants and factors barring infants from getting adequate sunshine are insufficient and especially no evidence is available in the study area.

Significance of study

This study provides evidences for prevention of Rickets in infants by identifying factors affecting practices and by promoting good caregivers' practice of infants' sunlight exposure. Specifically, this study benefits the following:

Community - community directly benefit from this study as its finding may encourage them to have a good practice of infants' sunlight exposure so that they can avoid Rickets.

Health professionals - this study inform health professional that how important is counselling about good practice of sunlight exposure at every encounter of caregivers including during ANC and PNC follow up.

Policy makers - this study may help policy makers to plan and deliver information about practices of sunlight exposure through various media.

Researcher - It would also be a baseline for other researcher to do prospective study in the future study to assess practice of sunlight exposure.

Methods and Materials

Study setting

The study was conducted at Arsi University, COHS, ATRH which is located in Asella town, 175 kilometers from Addis Ababa. Arsi University is one of the young universities established in 2014, whereas ATRH has been serving over 3.5 million populations in Arsi and the nearby zones since 1964 G.C. The hospital is well equipped and has 321 beds with more than 6 departments of which 102 beds for the pediatric ward (42 NICU, 54 Pediatric medical ward and 10 for emergency pediatric ward). The hospital is involved in training undergraduate and postgraduate trainees in various departments. The pediatric ward further segregated into 5 units. These are EPI clinics, regular OPD, emergency OPD, ward, NICU. In the pediatrics and child health unit there have been 8 paediatricians and 21 residents.

Study period and design

Facility based cross-sectional study was conducted among caregivers of infants attending Asella teaching and referral hospital from June 1/2022 to August 31/2022.

Source Population

All caregivers who had a child <12months of age and visited the Pediatrics and Child Health Department at Asella teaching and referral hospital.

Study population

Caregivers who had a child <12months of age and visited the Pediatrics and Child Health Department at Asella teaching and referral hospital at the time of data collection and who fulfilled the inclusion criteria.

Inclusion Criteria and Exclusion Criteria

Inclusion Criteria

- Caregivers with infants who attended Pediatrics and Child Health Department at Asella teaching and referral hospital during the study period.
- Those caregivers with infants and volunteer to participate in the study

Exclusion Criteria

- Caregivers with infants, and who were not mentally and physically capable of responding during the study period.

Sample Size Determination

The sample size for the study determined by using single population formula.According to the study done in Debre Berhan in 2021, 34.3% of mothers had poor practice about sunlight exposure of infants. And the Level of significance to be 5% (α=0.05), so α/2=1.96 by assuming 95% confidence interval, margin of error to be 5%.

$$ni = \frac{\left(z\alpha/_2\right)^2 * p(1-p)}{d^2}$$

Where, ni=initial sample size
p= proportion of poor practice; 34.3%=0.343
a= confidence interval (95%)

d= is the margin of sampling error tolerated (5%) = 0.05

ni= (1.96)2 (0.343) (1-0.343)/ (0.05)2 =3.8416(0.343) (0.657)/.0025 =346

For possible dropout rate 10% (34) is added to sample size.

Sample size = 346 + 34 =380

Sampling procedure

Systematic random sampling technique was used to select among caregivers of infants attending at ATRH during the study period. Using a formula K= N/n where N is the total numbers infants visited ATRH over 3 months and n is the sample size. There are 740 infants visited ATRH over the past 3 months. (Between January 01/2022 to March 31/ 2022.). So, K=740/380 = 1.9 ~ 2

Every 2nd Caregiver of infants visiting ATRH was selected until the required sample achieved.

Study Variables

Independent Variables

- Socio-demographic factors (Caregiver age group, Infant's age group, Caregiver religion, Marital status, Caregiver' educational status, Occupational status, Family size, Husband's educational level)
- Perception of Caregivers (benefit or harms)
- Caregiver's Source of Information ((physician, nurse/midwife, TV/Radio, neighbors/elders)
- Health service utilization of mother during ANC, Delivery and PNC

Dependent Variables

- The practice of exposing infants to sunlight

Key Words and Operational Definitions

Good practice: Caregivers that responded to practice questions and scored above median values

Poor practice: Caregivers responded to practice questions and scored below median values

Completely covered: Infant wearing clothes that cover the whole body except the face [33,36] (Figure 1).

Unclothed: Infant wearing no clothes except pants

Partly covered: Infant wearing minimal clothing (pants and vest) and not long shorts such that legs, arms and face are not covered.

Got antenatal care: Caregivers who had at least one visit in health facility prior to onset of labor.

Got postnatal care: Caregivers who had at least one return visit of health facility for postnatal care within six weeks of postpartum period.

Data Collection Instrument

A structured interviewer administered questionnaire were adopted from a study done in Jimma [24], Debre Berhan [36] and Turkey [47] and it was modified. The questionnaire included ten questions related to socio-demographic characteristics; seven questions to evaluate practice of mother on sunning of infants; one question about sources of information; and four questions related to perceived consequence of sunlight exposure and six questions linked to health service utilization.

Data Quality Assurance

The questionnaire was prepared in English and then translated in to Amharic and Afan Oromo and back translated. The supervisor checked the collected data on daily bases for completeness and the principal investigator monitored the overall quality of data collection.

Data processing and analysis

The completed questionnaires were checked for their completeness and consistency, then data were coded and entered to Epi-Data version 4.6 software and exported to SPSS statistical software version 21 for analysis. Categorical and continuous variables was summarized as proportions and means respectively. Cross-tabulations comparing cases versus controls was performed. Chi-square (Fischer's exact test was used to see the association between groups where statistical significance defined as alpha less than 0.05 (two-sided). The crude regression model was adjusted for known confounders, and then variables whose p-value is < 0.25 in bivariate analysis and a prior selected key variable were fitted into a multivariate logistic regression model. The Hosmer-Lemeshow test was used to check model fitness. Then, a p-value < 0.05 in multivariate logistic regression was considered as statistically significant and the strength of associations was determined using the adjusted odds ratio (AOR) with the corresponding 95% confidence interval

Ethical considerations

Ethical clearance was obtained from the research unit of Arsi University. Letter of permission was obtained from college of medicine and health science. Prior to administering the questionnaire, the objectives of the study was clearly explained to the participants and oral informed consent was obtained. Participants was informed that their participation is voluntary and they have the right not to participate and this will not affect any service or benefit that they will get from the institution.

Results of Study

Socio-Demographic characteristics of the respondent

A total of 380 caregivers were interviewed. 185(48.7%) infants are aged below 6 months while 195 (51.3%) infants are above 6 months. 213(56.1%) infants were male while 167(43.9%) were female infants. Those caregivers aged 27-32 years and above 33

years are equally contributed about 31.8% of all. 37.1% of caregivers were housewife, whereas 1.6% was daily laborer. Those caregivers who have no any formal education were 31.3% of all caregiver. 338(88.9%) of caregivers were married, 4.5% were single, 3.4% were divorced and 3.2% were widowed. Regarding ethnicity the majority70.3% and 22.9% were Oromo and Amhara, respectively. In terms of religion 50.3% and 41.3% were Muslim and Orthodox respectively. Concerning husbands' educational status of 363, 35.8% of them had at least a Diploma (Table 1).

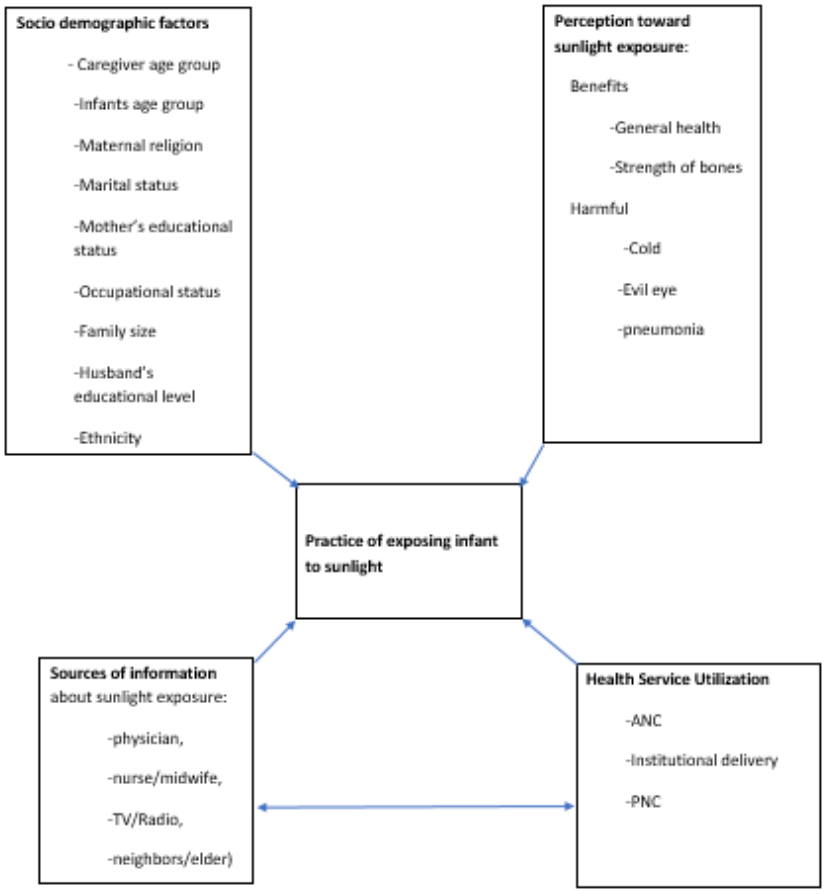

***Figure 1*:** *Conceptual framework shows the linkage between practice and its associated factors of infants' sunlight exposure among caregivers attending at ATRH. (33,36)*

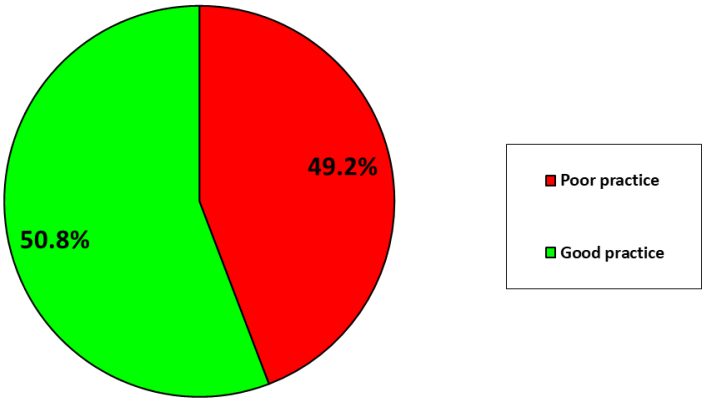

***Figure 2**: A pie chart showing Caregiver's Level of Practice about Sunlight Exposure of Their Infants.*

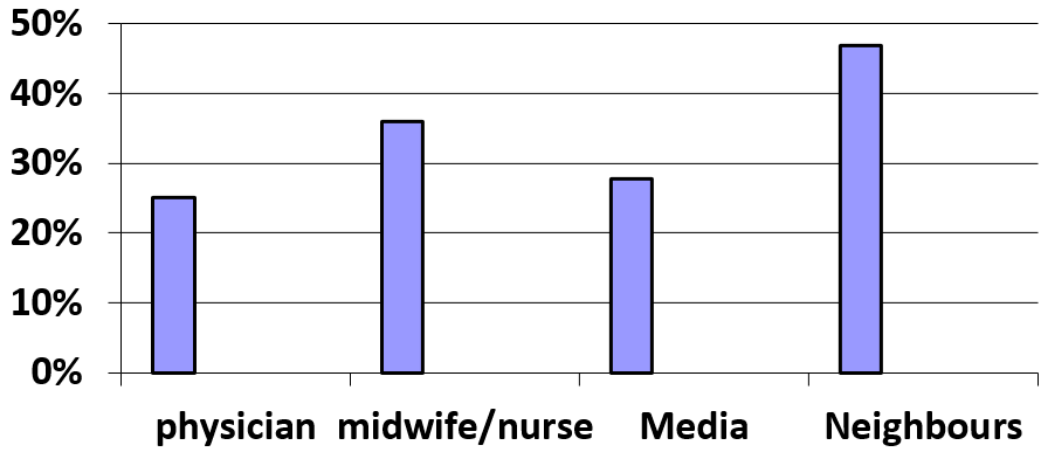

***Figure 3**: Distribution of mothers by their source of information about sunlight exposure of infants in ARTH, Arsi zone, Ethiopia, 2022 (n = 380 to each).*

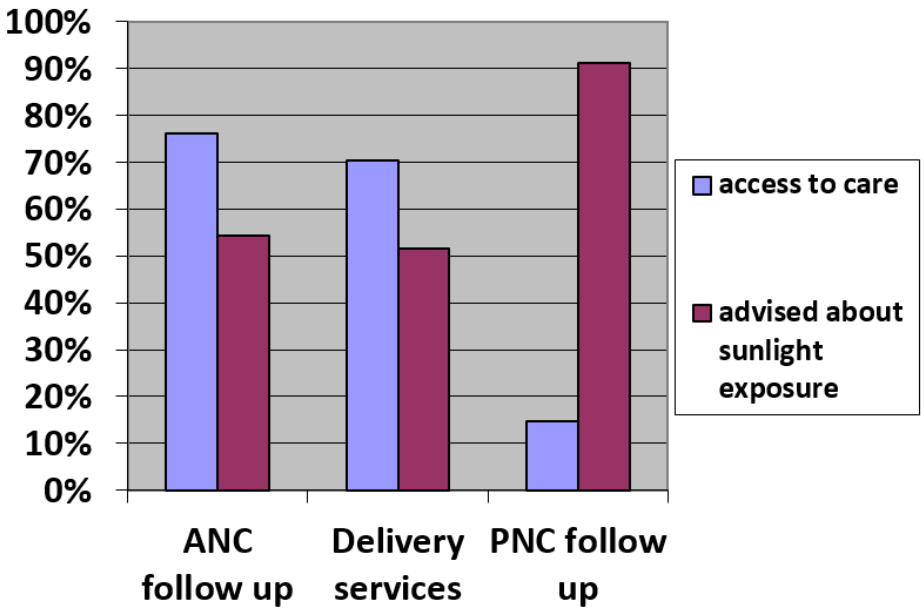

***Figure 4**: Distribution of caregiver by health service utilization in ARTH, Arsi zone, Ethiopia, 2022.*

***Table 1:** Distribution of Socio-Demographic Characteristics of Study Participants in ARTH, Arsi Zone, Ethiopia, 2022 (n=380).*

Variables	Categories	Frequency	Percent
Caregivers age group	15-20 years	35	9.2
	21-26 years	103	27.1
	27-32 years	121	31.8
	33 and above years	121	31.8
Infants age group	0-180 days	185	48.7

	181-365 days	195	51.3
Occupational status	Student	28	7.4
	Housewife	141	37.1
	Private employee	66	17.4
	Daily laborer	6	1.6
	Government employee	61	16.1
	Farmer	44	11.6
	Merchant	34	8.9
Educational background of caregiver?	No formal education	119	31.3
	Grade 1-8	107	28.2
	Grade 9-12	57	15.0
	Diploma and above	97	25.5
Family size	<3	176	46.3
	3-4	123	32.4
	>=5	81	21.3
Ethnicity	Oromo	272	71.6
	Amhara	92	24.2
	Others	16	4.2
Religion	Muslim	191	50.3
	Orthodox	157	41.3
	Protestant	22	5.8
	Catholic	10	2.6
Marital status	Single	17	4.5
	Married	338	95.5
Husband's educational level	No formal education	81	22.3
	Grade 1-8	98	27.0
	Grade 9-12	54	14.9
	Diploma and above	130	35.8

Practice of caregivers about sunlight exposure of their infants

The majority of respondents 264(69.5%) intentionally expose infants to direct sunlight. Of them 94(35.6%) expose daily and 101(38.3%) started exposing infants to sunlight since the age of 45 days of life. Furthermore, 251 (95.1%) caregivers were exposing in the morning before 10 a.m. and 118 (44.7%) caregivers exposing their infants for duration of 15-20 minutes. Regarding the condition of clothing during sunning of infant, 113

(42.8%) caregivers expose by only putting diaper or naked. Only 17(17%) of respondents did not apply any lubricant/body lotion during sunning of their infant (Table 2).

Caregiver's level of practice about sunlight exposure of their infants

For the above seven practices questions the median value is 3. Out of 380 respondents 187 (49.2%) scored less than the median value. Therefore, depending on the operational definition 49.2% of mothers had poor practice (Figure 2).

***Table 2**: Distribution of Caregivers by Their Practice Concerning Sunlight Exposure of Infants in ARTH, Arsi zone, Ethiopia, 2022*.

Variables	Categories	Frequency	Percent
Caregiver who intentionally expose infant to direct sunlight(n=380)	YES	264	69.5
	NO	116	30.5
Age of infant at the time of starting sunlight exposure(n=264)	0-15 days	43	16.3
	16-30 days	47	17.8
	31-45 days	73	27.7
	45 days and above	101	38.3
Frequency of sunlight exposure(n=264)	Daily	94	35.6
	1-3 days/week	93	35.2
	4-5 days /week	77	29.2
Time of the day you expose the infant outdoors(n=264)	Morning before 10:00 am	251	95.1
	Mid-day 10:00am-2:00pm	13	4.9
Condition of clothing during sunlight exposure (n=264)	Completely covered	54	20.5
	Only Diapers/naked	113	42.8
	Partly covered	97	36.7
Duration of exposure to sunlight (n=264)	5-10 minutes	21	8.0
	10-15 minutes	70	26.5
	15-20 minutes	118	44.7
	Above 20 minutes	55	20.8
Apply lubricants/lotion on infant's body during sunlight exposure	YES	219	83.0
	NO	45	17.0

***Table 3:** Distribution of caregivers by Their Perception Related to Sunlight Exposure of Infants in ARTH, Arsi zone, Ethiopia, 2022*.

Variables	Categories	Frequency	Percent
Sunlight exposure is beneficial for infants(n=380)	Yes	313	82.4
	NO	18	4.7
	Not sure	49	12.9
perceived benefit(n=313)	To strengthen infant bones	158	32.1
	To get good sleep	92	18.6
	To be healthier infant	102	20.7
	To grow faster	104	21.1
	Other benefit (Closure of fontanels, prevent blurring of vision)	36	7.3
Sunlight exposure has harmful effect	Yes	131	34.5
	No	249	65.5
perceived harm (n=131)	Predispose to pneumonia	73	55.7
	Predispose to blindness	32	24.4

	Other harm (fever, crossed eye)	33	25.1
Notes: *Each caregiver did perceive two or more benefits, **Each caregiver did perceive two or more harms			

Table 4: *Bivariable and Multivariable Analysis of Caregivers' Practice towards Sunlight Exposure of Their Infants in ATRH, Arsi zone, Ethiopia, 2022.*

Variables		**Practice**		**95%CI(COR)**	**95%CI(AOR)**
		Good No.(%)	**Poor No.(%)**		
Infants age group	1-180 days	86(46.5)	99(53.5)	1	1
	181-365 days	107(54.9)	88(45.1)	1.40.(0.93,2.09) *	2.68(1.49,4.81) ****
Sex	Male	93(43.7)	120(56.3)	1	1
	Female	100(59.9)	67(40.1)	1.92(1.27, 2.90) *	2.44(1.43,4.16) ****
Educational status	No formal education	29(24.4)	90(75.6)	1	1
	Grade 1-8	51(47.7)	56(52.3)	2.82(1.60,4.97) *	3.07(1.41, 6.68) ****
	Grade 9-12	32(56.1)	25(43.9)	3.97(203,7.76) *	3.33(1.15, 9.60) ****
	Diploma and above	81(83.5)	16(16.5)	15.7(7.95,31.01) *	11.38(3.47,37.32) ****
Occupational status	Student	20(71.4)	8(28.6)	1	1
	Housewife	60(42.6)	81(57.4)	0.29(0.12,0.71) *	.37(.11, 1.29)
	Private employee	38(57.6)	28(42.4)	0.54(0.20,1.41)	.35(.10,1.24)
	Daily laborer	2(33.3)	4(66.7)	0.20(0.03,1.31)	.05(.003,0.83) *
	Government employee	51(83.6)	10(16.4)	2.04(0.70,5.91)	.37(.08,1.60)
	Farmer	10(22.7)	34(77.3)	0.11(0.04,0.34) *	.11(.02,0.53) *
	Merchant	12(35.3)	22(64.7)	0.21(0.07,0.64) *	.17(.04,0.72) ****
Husband's educational status	No formal education	20(24.7)	61(75.3)		
	Grade 1-8	38(38.8)	60(61.2)	1.93(1.01,3.69) *	2.46(1.14,5.28) ****
	Grade 9-12	31(57.4)	23(42.6)	4.11(1.96,8.60) *	1.40(.54,3.67)
	Diploma and above	98(75.4)	32(24.6)	4.90(4.90,17.77)*	1.95(.71,5.37)
Sunlight exposure is beneficial	Yes	172(55)	141(45)	2.67(1.52,4.68) *	
	No/not sure	21(31.3)	46(68.7)	1	

Perceived to be healthier infant	Yes	36(70.6)	15(29.4)	2.22(1.16,4.25) *	2.11(1.02,4.35) *****
	No	136(51.9)	126(48.1%)	1	
Perceived to grow faster infant	Yes	20(43.5)	26(56.5)	0.58(0.31,1.09)	.52(.24,1.09)
	No	152(56.9)	115(43.1)	1	
Sunlight exposure is harmful	Yes	60(45.8)	71(54.2)	1	
	No	133(53.4)	116(46.6)	1.35(0.88,2.07)	
Sources of information about sunlight exposure	Physician	62(72.9)	23(27.1)	6.22(3.38,11.43) *	2.85(1.37,5.94) *****
	Nurses/Midwifes	70(60.9)	45(39.1)	3.59(2.11,6.10) *	1.60(.84, 3.05)
	Media	22(43.1)	29(56.9)	1.75(0.89,3.42)	.71(.30,1.63)
	Neighbors	39(30.2)	90(69.8)	1	
Those who had ANC follow up	Yes	172(59.5)	117(40.5)	4.90(2.85,8.42) *****	.71(.29,1.74)
	No	21(23.1)	70(76.9)	1	
Delivered at health institution	Yes	166(62.2)	101(37.8)	5.23(3.18,8.61) *	4.92(2.25, 10.76) *****
	No	27(23.9)	86(76.1)	1	
Had PNC follow up	Yes	42(75)	14(25)	3.43(1.80,6.53) *	1.99(.94, 4.21)
	No	151(46.6)	173(53.4)	1	

Note: *p-value<0.05 for multivariate analysis; p-value<0.25 for bivariate analysis
Abbreviations: COR, crude odds ratio; AOR, adjusted odds ratio; CI, confidence interval.

Associated factors of practice of exposing Infants to Sunlight among caregivers

Caregiver's source of information for intentional exposure of their infant to sunlight

Regarding the source of information for sunlight exposure of infants, 178(46.8%) caregivers got information from neighbors whereas 138(36%) of them got the information from the midwife/nurses (Figure 3).

Perception of caregiver's towards sunlight exposure of infant

The majority 313(82.4 %) of caregivers perceived that sunlight exposure is beneficial but 4.7% of them is not, while the rest 12.9% were not sure of it. Out of 313 caregivers 35.8% believed that it strengthens infant bones, 13.4% for healthier infant, 12.1% for fast growth and 8.9% for other benefit (Table 3).

Health service utilization of caregivers

Of all caregivers 267(70.3%) delivered in a health facility, of them 138 (51.5%) were advised to expose their child to sunlight while 289(76.1%) caregivers had ANC follow up, of them 157 (54.3%) were advised about sunning of their infant. Though only 56 (14.7%) caregivers had PNC follow up, 52 (91.2%) were advised about sunning of their infant (Figure 4).

Bivariable and Multivariable Analysis of Practice of exposing infants to sunlight among caregivers

In this study infant age, sex, family size, occupational status, caregiver's and husband's educational status, religion, source of information, caregiver's perception related to the benefit of sunning specifically to being healthier and to grow faster, and regarding harmful effect of sunlight exposure, ANC, health facility delivery and PNC follow-up were found candidate variables on bivariable analysis at p-value < 0.25 for multivariable analysis.In multivariable analysis factors such as: infant age, sex, occupational status, caregivers' and husband's educational status, delivery at health institution and source of information from physician were found to be significantly associated with maternal practice of infant sunlight exposure. Caregiver whose educational status grade 1-8 (AOR = 3.07, 95% CI: 1.41, 6.68), and grade 9-12(AOR = 3.33, 95% CI: 1.15, 9.60) were 3 times while whose educational status Diploma and above

(AOR = 11.38, 95% CI: 3.47, 37.32,3.3) were 11 times more likely at having good practice in sunlight exposure of infant compared with caregivers that had no formal education. Caregiver whose occupational status was daily laborer (AOR= .05, 95% CI:.003,0.83), farmer AOR=.11, 95% CI:.02,0.53), and merchant (AOR =.17, 95% CI:.04,0.72) were 0.05 times (94.8%), 0.11 times (89%) and 0.17 times (83%) less likely to practice good sunning of infant compared with students respectively. Caregiver whose husband's educational status Grade 1-8 (AOR = 2.46, 95% CI: 1.14, 5.28) were 2.4 times more likely at having good practice in sunlight exposure of infant compared with caregivers that had husband with no formal education. Furthermore, caregiver perception of sunlight exposure as beneficial to make the infant healthier (AOR = 2.11, 95% CI: 1.02, 4.35) caregiver's source information for sunning being physician (AOR = 2.85, 95% CI: 1.37, 5.94) and those who delivered at health institution (AOR=4.92, 95% CI: 2.25, 10.76) showed statistically significant association with maternal practice of sunlight exposure of infant. Infants age group of less than 6mos (AOR=2.68, CI: 1.49, 4.81) and female sex (AOR=2.44, CI=1.43, 4.16) showed statistically significant association with caregiver practice.

Discussion

A systematic review of nutritional rickets in Ethiopia done in 2005 GC shows the major cause of nutritional rickets in Ethiopian children is lack of exposure to sunshine and/or inadequate intake of vitamin D [38].Though Ethiopia is a 13months of sunshine, Rickets is still prevalent this is probably due to the poor practice of sunlight exposure. This study was carried out to assess practice of caregivers and associated factors concerning sunlight exposure of their infant in ATRH, southeast Ethiopia in the study period. The finding of this study indicated that 49.2% of participants have poor practice in sunlight exposure of infants. This finding fosters the fact that inadequate sun exposure is a major public health concern, and health education with particular attention for mothers and caregivers of young children should be provided [3,48]. The finding of this study showed that 69.5%% of caregivers did intentionally expose their infant to direct sunlight. This is slightly higher in a study done at Debre Tabor town which was 61.5% but lower than a study done in Debre Berhan town which was 99.1%, Debre Markos town which was 93%, and Jimma town which was 100% [33,36,42,45]. This difference might be due to sociodemographic differences of respondents. In addition, in a study done at Townsville, Australia showed that only 20% of mothers intentionally expose their baby, which was lower than the finding of this study [49]. The possible reason behind this may be that the Australian cancer prevention society does not recommend infant sunlight exposure because of the high prevalence of skin cancer there and hence fear of skin cancer. In this study only 16.3% of respondents started to expose their infants to sunlight by the time they were 15 days old. This finding was not in agreement with a study of Debre Berhan that showed 85.7% started within 15 days [36].This discrepancy might be the study participants' source of information. In this study the majority of respondents got information from neighbor which has insignificant association with practice level of sunning of infant. Source of information for majority of participants in that study was health-care professionals and source of information from health-care professionals was significantly associated with the practice level of mothers. This study also revealed that 35.6% of caregivers were sunning their infant on daily basis. This finding is lower than a study done in Debre Markos town which was 57.9%, a study done in Debre Berhan town which was 60.8% and a study done in Jimma town which was 92% [33,36,42]. This study showed that 95.1% of respondents exposed their infant to sunlight in the morning before 10 a.m. This implies almost all respondents did not expose their infant at the best time of day for vitamin D production, the time near to solar noon from 10 a.m. to 2 p.m [11,17,18]. Evidence from 2015 of Ethiopian IMNCI showed that babies need to be exposed to sunlight for 15–20 minutes per day. Moreover evidence cited that regular exposure of unprotected skin (without use of sunscreen and/or without clothing) to the available UVB radiation is efficient for the production of vitamin D [17]. In the current study only 42.8% and 44.7% of respondents were sunning their infant with only diaper/naked and for a duration of 15-20 minutes/day, respectively. Moreover, 87% of respondent in this study applied body lotion/lubricants at the time of sunning their infant. This implies that it is vital to increase the awareness of communities regarding the appropriate practice of sunning of infants for optimal cutaneous vitamin D production. Finding of this study revealed that Caregiver whose educational status Grade 1-8 and Grade 9-12 were 3 times while Diploma and above were 11 times more likely at having good practice in exposing infant to sunlight compared with caregivers that had no formal education. Caregiver whose husband's educational status Grade 1-8 were 2.4 times more likely at having good practice in sunlight exposure of infant compared with caregivers that had husband with no formal education. Caregiver whose occupational status was daily laborer, farmer, and merchant were 94.8%,89% and 83% respectively less likely to practice good sunning of infant compared with students. Similarly in the study done in Debre Berhan town maternal educational status and occupational status were statistically significant associated factors. Furthermore, caregiver perception of sunlight exposure as beneficial to make the infant healthier, caregiver's source information for sunning being physician and those who delivered at health institution showed statistically significant association with maternal practice of sunlight exposure of infant.

Conclusions and Recommendations

Conclusions

The finding of this study revealed that nearly half of participants have poor practice in sunlight exposure of their infant. This low practice level is an indicator that the federal ministry of health, health care professionals and other concerned body did not give as much attention as is necessary to provide detailed information about the importance of infant sunlight exposure. Caregiver's educational status, Husband's educational status, perceived benefit by caregivers on infant sunlight exposure for the health of their infants, and source of information from physicians were positively associated with caregivers' practice of exposing infant to sunlight.

Recommendations

Majority of sources of information were from neighbors which is an indicator that the federal ministry of health along with health care professionals did not give as much attention. Since a major gab is observed on the practices the demonstration of sunlight exposure by health extension workers and professionals is necessary. Providing detailed information about the importance of infant sunlight exposure by health professional is indispensable for the good practice of exposing infants. The federal ministry of health should encourage the professional especially nurses/midwifes to advise caregivers at every health encounter and also providing various trainings. Hence, the federal ministry of health should coordinate concerned bodies for preparing a detail counselling steps on the appropriate practice of sunning of infants and incorporate these in the other health service guidelines. Nurses/Midwifes should provide appropriate information about sunlight exposure and appropriate practices for caregivers since they had a direct relationship with caregivers in different circumstances e.g., during ANC, delivery, integrated management of new-born and childhood illness service. Furthermore, the government should try best to improve at least primary educational coverage so that they can get information from reading. Fellow researchers should do further study to determine the most appropriate way of sunning infants to maintain adequate serum vitamin D based on a study area's ultra-violet index.

Declarations

Ethics approval and consent to participate

This research was approved by Institutional Review Board of Arsi University College of Health Sciences

Consent for publication

This section is not applicable because the research does not include individuals' image or videos.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

AK=Original draft preparation, Conceptualization, Methodology, Investigation, data curation,
MTA= Conceptualization, Methodology, Analysis, data curation,
AD=Original draft preparation, Conceptualization, Methodology, Review and editing MA=Analysis, Methodology, Review and editing

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