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Practice and factors associated with neonatal sunlight exposure among mothers attending governmental hospitals in Addis Ababa, Ethiopia, 2020. Cross-sectional study.

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Practice and factors associated with neonatal sunlight exposure among mothers attending governmental hospitals in Addis Ababa, Ethiopia, 2020. Cross-sectional study.

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Short Title: Practice of neonatal sunlight exposure among mothers

Abstract

Background: Sunlight exposure helps the body to produce vitamin D, prevents rickets, and is used for neonatal jaundice treatment. However, little is known about the practice of neonatal sunlight exposure among mothers in Ethiopia. Thus, the study aimed to assess the practice and factors associated with neonatal sunlight exposure among mothers attending governmental hospitals in Addis Ababa, Ethiopia, 2020.

Methods: An institution-based cross-sectional study was conducted among 420 mothers attending governmental hospitals in Addis Ababa. The participants of the study were selected by a systematic
random sampling method. The collected data was entered into Epi-data version 4.6 and transported to SPSS version 26 for analysis. Descriptive and logistic regression analyses were performed.

**Results:** The practice of neonatal sunlight exposure among mothers was 27.1%. Neonatal age of 16-28 days (AOR=1.99, 95%CI: 1.15-3.44), family member 4-6 (AOR=1.86, 95%CI: 1.08-3.21) and ≥7 (AOR=4.43, 95%CI: 11.54-12.78), lived in compound/villa houses (AOR=2.59, 95%CI: 1.26-5.33), complete ANC follow-up (AOR=2.79, 95%CI: 1.49-5.22), delivered at term (AOR=2.54, 95%CI: 1.06-6.07), poor knowledge of sunlight exposure (AOR=0.40, 95%CI: 0.23-0.71), and did not have fear of sunlight exposure (AOR=1.83, 95%CI: 1.08-3.12) were factors associated with the practice of neonatal sunlight exposure.

**Conclusion:** This study revealed that 27.1% of participants had good practice of neonatal sunlight exposure. Advanced neonatal age, higher family size, living in compound/villa houses, complete ANC visit, and term delivery result in good practice, whereas poor knowledge and fear of sunlight exposure result in poor practice. Therefore, targeted interventions are required to improve the practice of neonatal sunlight exposure.

**Strength and limitations of the study**

This study had a 100% response rate. The results of these might be generalized to mothers who were attending follow-up and immunization clinics in governmental hospitals in Addis Ababa, Ethiopia. The study includes different maternal and neonatal-related factors which were not included in the previous study done in Ethiopia such as ANC follow-up, place of delivery, gestational age, and birth weight. The study used an interviewer-administered questionnaire for data collection and using this technique to determine the practice of neonatal sunlight exposure and factors associated among
mothers might comprise some danger, nevertheless, qualitative interviews can let mothers freely
highlight their concerns and problems regarding the practice of neonatal sunlight exposure.
The use of cross-sectional design does not allow inferring causality and prospective and
experimental studies are warranted.

Keywords: Sunlight exposure, neonate, practice, knowledge, Addis Ababa, Ethiopia

Introduction

Sunlight exposure has a lot of health benefits for newborns and infants. It helps the body to produce
vitamin D, preventing rickets in children, and is used for the treatment of neonatal jaundice during
the neonatal period. Vitamin D everyday requirements can be obtained by 30 to 60 minutes of
exposure to sunlight in the morning. Vitamin D is playing a vital role in bone metabolism through
the regulation of calcium and phosphate homeostasis. Exposure of neonatal skin to the sunlight
in the morning is significant to produce nocturnal melatonin sooner which makes them enter into
sleep simply. Morning sunlight exposure supports the neonatal physiological system to break
down indirect bilirubin.

Mothers' timely and proper practice of neonatal sunlight exposure has a lot of health benefits for
neonates, however, the inadequate practice of mothers to expose sunshine to neonates leads to
vitamin D deficiency and jaundice. Vitamin D deficiency and jaundice are common health
problems in many countries of the world and developing countries, especially in Sub-Saharan
African countries including Ethiopia.

In Middle East Asia, such as the northern parts of China, Mongolia, and Afghanistan the mother’s
practice of sunlight exposure for neonates is poor due to this problem most the neonates are
complicated with vitamin D deficiency and rickets. In Ethiopia, shortage of exposure to sunlight
and inadequate consumption of vitamin D are the main cause of rickets among children. According
to a study done in Addis Ababa Ethiopia 41% of children under 3 years had vitamin D deficiency
rickets and the incidence was higher among infants. A study done in Jimma Ethiopia showed that
10.5% of under 5 children have had rickets with the main identified causes being lack of exposure
to sunlight and inadequate intake of vitamin D and the highest rate (11%) occurred in infants.
Although daily sunlight exposure remains the cheapest, safest, and most effective method of
prevention of rickets and significant numbers of children are still starved in sunlight. According to
recent studies in done Ethiopia among mothers, 55.4% in Debre Markos town, 52% in the south
Gondar zone, and 34.3% in Debre Berhan town had a poor practice of sunlight exposure to their
neonates. A multitude of factors may associate with the practice of neonatal sunlight exposure
among mothers. These factors include sociodemographic factors such as age, marital status,
educational status, occupation of mother, neonatal age, family size, place of residence, type of
housing, educational status of the husband, and household monthly income, maternal and
neonatal related factors such as antenatal care (ANC) follow-up, place of delivery, gestational age,
and birth weight, knowledge and fear of sunlight exposure. However, little is known about the practice of neonatal sunlight exposure among mothers in
Ethiopia. Thus, the study aimed to assess the practice and factors associated with neonatal sunlight
exposure among mothers attending governmental hospitals in Addis Ababa, Ethiopia, 2020.

Methods

Study area, design, and population

This institutional-based cross-sectional study design was conducted from March 18-April 30, 2020, in three governmental hospitals in Addis Ababa town, Ethiopia: Gandhi Memorial Hospital (GMH), Tikur Anbessa Specialized Hospital (TASH), and Yekatit 12 Hospital (Y12H). All mothers having neonates and attending follow-up and immunization clinics were included, except
those who had neonates above one month of age and are unable to communicate during the study period.

Sample size determination and Sampling procedure

The single population proportion formula was used to calculate the sample size by considering the following assumptions; the prevalence of mothers' practice of neonatal sunlight exposure was 45.7%, which was done in South Gondar Zone, Ethiopia, 95% confidence level, and 5% margin of error. The final sample size including the non-response rate yielded 420 mothers. The three hospitals were selected using a lottery method. According to the recent monthly data from the three hospitals, a total of 1,621 mothers with neonates have attended follow-up and immunization clinics and this was taken as a sampling frame. Then, the total sample size for each hospital was allocated proportionally based on the sampling frame (GMH, N=650; TASH, N=536; Y12H, N=435). Therefore, 168 mothers from GMH, 139 mothers from TASH, and 113 mothers from Y12H were selected using systematic random sampling every k =3 interval.

Study variables

The dependent variable was practices of neonatal sunlight exposure and the independent variables include sociodemographic factors such as the age, marital status, educational status, occupation of the mother, neonatal age, number of families, place of residence, type of housing, and household income, maternal and neonatal related factors such as ANC follow-up, place of delivery, gestational age, and birth weight, mothers’ knowledge and fear of sunlight exposure.

Data collection tool and procedure

Data was collected by using an Amharic version of an adapted questionnaire with a face-to-face interview. This questionnaire was first written in English and translated into Amharic versions and re-translated back into English by language experts to assure its consistency. The data collection
tool was adapted after extensive reviewing of different literature done on this area.\textsuperscript{11, 13, 14, 16, 17, 22}

The sociodemographic and maternal and neonatal-related factors of the mothers were documented by 14-items. Mothers’ knowledge of sunlight exposure was measured using 7-items. Participants who scored above the median value on the mother’s knowledge of the sunlight exposure tool were categorized as having good knowledge. Practices of neonatal sunlight exposure were measured using 10 self-reported items. Participants who responded correctly to all practice questions on the practice questionnaire were classified as having good practice and those who had scored less than or equal to 9 were considered to have poor practice.

The questionnaire was given to experts to check content validity and accuracy. Data collection was carried out by four trained nurses from other units of health facilities. Also, the completeness of the questionnaire and quality of data collection was checked daily by the supervisors and detailed feedback was provided to data collectors.

**Data processing and analysis**

The data were checked, coded, and entered into Epi-Data version 4.6 and exported to SPSS Version 26 software for analysis. Descriptive data were reported using frequency and percentage. A bivariate logistic regression analysis model was used to identify factors associated with the practice of neonatal sunlight exposure. Those variables with a p-value <0.25 in the bivariate logistic regression were entered into a multivariate logistic regression analysis. A multivariate logistic regression model was used to identify the association of independent variables and the practice of neonatal sunlight exposure. In multivariable logistic regression analysis, the statistical significance of associations between independent variables and the practice of neonatal sunlight exposure was determined using odds ratios with a 95% confidence interval and p-values < 0.05.
Patient and Public Involvement

Patients or the public were not involved in the design, conduct, reporting or dissemination plan of this study.

Results

Socio-demographic characteristics of participants

A total of 420 mothers have participated with a 100% response rate. The mean age of participants was 28.8 ±5.61 years. Most of the participants were married (n=398, 94.8%), and residing in urban areas (n=398, 94.8%). More than half of them, 225 (53.6%) were housewives and 267 (63.6%) had secondary and above educational status. Half of the participants, 210 (50%) had family members of 4-6 and 334 (79.5%) mothers were living in a compound/villa house. The majority of husbands of participants, 304(72.4%) had secondary and above educational status (Table 1).

Table 1. Socio-demographic characteristics of the study participants (n=420).

| Variables                      | Category   | Frequency(n) | Percent (%) |
|--------------------------------|------------|--------------|-------------|
| Age of mothers                 | ≤24        | 93           | 22.1        |
|                                | 25-29      | 151          | 36.0        |
|                                | 30-34      | 102          | 24.3        |
|                                | ≥35        | 74           | 17.6        |
| Neonatal (postnatal) age       | <15 days   | 174          | 41.4        |
|                                | ≥15 days   | 246          | 58.6        |
| Marital status of mothers      | Unmarried  | 22           | 5.2         |
|                                | Married    | 398          | 94.8        |
| Mothers' Educational status    | No education | 41       | 9.8         |
|                                | Primary education | 112 | 26.7        |
|                                | Secondary and above | 267 | 63.6        |
| Occupation status of mothers   | Housewife  | 225          | 53.6        |
|                                | Gov’t employee | 89         | 21.2        |
|                                | Private employee | 75         | 17.9        |
|                                | Merchant    | 31           | 7.4         |
| Family size                    | 1-3        | 184          | 43.8        |
|                                | 4-6        | 210          | 50.0        |
|                                | ≥7         | 26           | 6.2         |
| Residence                      | Rural      | 22           | 5.2         |
|                                | Urban      | 398          | 94.8        |
| Type of housing                | Condominium/Apartments | 86 | 20.5        |
|                                | Compound house (villa) | 334 | 79.5        |
Maternal and neonatal related factors of participants

Most of the participants, 410 (97.6%) had ANC follow up and three-fourths of participants, 306 (72.9%) delivered their neonates in hospitals. More than two-thirds of neonates, 287(68.3%) were at term (37-42 weeks) gestational ages, and the majority of neonates, 301(71.7%) had a birth weight of ≥2.5 Kg at the time of delivery (Table 2).

| Variables                     | Category           | Frequency(n) | Percent (%) |
|-------------------------------|--------------------|--------------|-------------|
| Antenatal care visit          | Yes                | 410          | 97.6        |
|                               | No                 | 10           | 2.4         |
| Number of antenatal care visits (n=410) | 1-3              | 163          | 39.8        |
|                               | ≥4                 | 247          | 60.2        |
| Place of delivery             | Home               | 7            | 1.7         |
|                               | Health center      | 104          | 24.8        |
|                               | Hospital           | 306          | 72.9        |
|                               | Other              | 3            | 0.7         |
| Gestational age               | <37 weeks          | 107          | 25.5        |
|                               | 37-42 weeks        | 287          | 68.3        |
|                               | ≥42 weeks          | 16           | 3.8         |
|                               | Unknown            | 10           | 2.4         |
| Birth weight                  | < 2.5 Kg           | 115          | 27.4        |
|                               | ≥ 2.5 Kg           | 301          | 71.7        |
|                               | Unknown            | 4            | 1.0         |

Participants’ knowledge, fear, and practice of neonatal sunlight exposure

Most of the participants, 388 (92.4%) had information about neonatal sunlight exposure. The majority of the participants, 258 (66.49%) were heard about sunlight exposure of neonates from midwives/nurse. Most of the participants, 380 (97.9%) knew the benefit of neonatal sunlight.
exposure. The majority of the participants identified that producing vitamin D (n=235, 67.14%). Most of the participants, 365 (94.07%) reported good time to expose neonates was in the morning. More than half of the participants, 245 (58.33%) had feared exposing their neonates to sunlight. Of the total participants, 181 (43.1%) had good knowledge and 114 (27.10%) had good practice of neonatal sunlight exposure (Table 3).

**Table 3.** Knowledge, fear, and practice of neonatal sunlight exposure of the study participants (n=420).

| Variables                                      | Category          | Frequency(n) | Percent (%) |
|------------------------------------------------|-------------------|--------------|-------------|
| Had information about sunlight exposure       | Yes               | 388          | 92.4        |
|                                                | No                | 32           | 7.6         |
| Source of information about sunlight exposure (n=388) | Physician         | 173          | 44.59       |
|                                                | Midwife/nurse     | 258          | 66.49       |
|                                                | Television/radio  | 17           | 4.38        |
|                                                | Neighbors/elder people | 105  | 27.06     |
| Does sunlight exposure beneficial? (n=388)    | Yes               | 380          | 97.9        |
|                                                | No                | 8            | 2.1         |
| Benefit of sunlight exposure (n=380)          | Strengthen bone   | 252          | 66.32       |
|                                                | Strengthen teeth  | 6            | 1.58        |
|                                                | Keep child warm   | 73           | 11.32       |
|                                                | Produce vitamin D | 235          | 67.14       |
|                                                | Strengthen body   | 160          | 42.11       |
| Does sunlight exposure harmful? (n=388)       | Yes               | 190          | 49.0        |
|                                                | No                | 198          | 51.0        |
| The harmful effect of sunlight exposure (n=190) | Skin cancer       | 37           | 19.47       |
|                                                | Sterility         | 80           | 42.11       |
|                                                | Blindness         | 104          | 54.73       |
| A good time to expose neonates(n=388)         | Morning           | 365          | 94.07       |
|                                                | Afternoon         | 13           | 3.35        |
|                                                | Evening           | 66           | 17.01       |
| Mothers fear sunlight exposure                | Yes*              | 245          | 58.33       |
|                                                | No                | 175          | 41.67       |
| Knowledge                                     | Good knowledge    | 181          | 43.1        |
|                                                | Poor knowledge    | 239          | 56.9        |
| Practice                                      | Good practice     | 114          | 27.1        |
|                                                | Poor practice     | 306          | 72.9        |

* Sickness, evil eye, cold
Factors associated with the participants' practice of neonatal sunlight exposure

In bivariate logistic regression neonatal age, educational status, occupation and marital status of the mother, family size, type of housing, educational status of the husband, ANC follow-up, gestational age, birth weight, mothers’ knowledge, and fear of sunlight exposure were significantly associated with the practice. However, in multiple logistic regression analysis neonatal age, family size, type of housing, ANC follow-up, gestational age, mothers’ knowledge, and fear of sunlight exposure had a statistically significant association with practice.

Mothers who had neonates aged 16-28 days (AOR=1.99, 95% CI: 1.15-3.44) were two times more likely to have good practice compared to those mothers who had neonates aged < 15 days. Mothers who had a family member of 4-6 (AOR=1.86, 95% CI: 1.08-3.21) and greater than or equal to 7 (AOR=4.43, 95% CI: 11.54-12.78) were 1.86 and 4.43 times more likely to have good practice respectively, compared to those who had family members of 1-3. Mothers who lived in compound/villa houses (AOR=2.59, 95% CI: 1.26-5.33) were 2.6 times more likely to have good practice compared to those who lived in condominiums/apartment houses.

Mothers who had complete ANC follow-up (AOR=2.79, 95% CI: 1.49-5.22) were 2.79 times more likely to have good practice compared to those who had incomplete ANC follow-up. Mothers who delivered at term gestation (AOR=2.54, 95% CI: 1.06-6.07) were 2.54 times more likely to have good practice compared to those who delivered before term. Mothers who had poor knowledge of sunlight exposure (AOR=0.40, 95% CI: 0.23-0.71) were 60% less likely to have good practice compared to their counterparts. Mothers who did not have fear of sunlight exposure (AOR=1.83, 95% CI: 1.08-3.12) were 1.83 times more likely to have good practice compared to those who had fear of sunlight exposure in their neonates (Table 4).
Table 4. Factors associated with the practice of neonatal sunlight exposure of the study participants (n=420).

| Variables                        | Category                      | Practice | Good | Poor | COR (95%CI) | AOR (95%CI) |
|----------------------------------|-------------------------------|---------|------|------|-------------|-------------|
|                                  |                               |         |      |      |             |             |
|                                  |                               |         |      |      |             |             |
| **Neonatal age**                 |                               |         |      |      |             |             |
| 0-15 days                        |                               |         |      |      |             |             |
| 16-28 days                       |                               |         |      |      |             |             |
| **Educational status of the mother** | No formal Education         |         |      |      |             |             |
|                                 | Primary Edu.                  |         |      |      |             |             |
|                                 | Secondary & above             |         |      |      |             |             |
| **Occupation of mother**         | Housewife                     |         |      |      |             |             |
|                                 | Government employee           |         |      |      |             |             |
|                                 | Private employee              |         |      |      |             |             |
|                                 | Merchant                      |         |      |      |             |             |
| **Marital status of the mother** | Married                       |         |      |      |             |             |
|                                 | Unmarried                     |         |      |      |             |             |
| **Family size**                  | 1-3                           |         |      |      |             |             |
|                                 | 4-6                           |         |      |      |             |             |
|                                 | ≥7                            |         |      |      |             |             |
| **Type of housing**              | Condominium/apartment         |         |      |      |             |             |
|                                 | Compound/villa                |         |      |      |             |             |
| **Educational status of husband** | No formal education           |         |      |      |             |             |
|                                 | Primary education             |         |      |      |             |             |
|                                 | Secondary & above             |         |      |      |             |             |
| **ANC follows-up**               | 1-3 times                     |         |      |      |             |             |
|                                 | ≥4 times                      |         |      |      |             |             |
| **Gestational age**              | <37 weeks                     |         |      |      |             |             |
|                                 | 37-42 weeks                   |         |      |      |             |             |
|                                 | ≥42 weeks                     |         |      |      |             |             |
| **Birth weight**                 | <2.5 kg                       |         |      |      |             |             |
|                                 | ≥2.5 kg                       |         |      |      |             |             |
| **Knowledge**                    | Good                          |         |      |      |             |             |
|                                 | Poor                          |         |      |      |             |             |
| **Fear of sunlight exposure**    | Yes                           |         |      |      |             |             |
|                                 | No                            |         |      |      |             |             |

*p-value <0.05; AOR: adjusted odds ratio; COR: crude odds ratio; CI: confidence interval

Discussion

This study explored the practice and factors associated with neonatal sunlight exposure among mothers attending governmental hospitals in Addis Ababa, Ethiopia, and found that 27.1% of mothers had good practice of neonatal sunlight exposure. The finding of this study was lower than studies done in Ethiopia in the South Gondar zone (54.3%), Debre Markos town(44.6%), Debre...
196 Berhan town (34.3%),\textsuperscript{15} and Aleta Wondo town (32.6%).\textsuperscript{16} The possible reason for this might be
due to differences in housing type, family size, mothers' fear of sunlight exposure, and the cut
point of the tool used to measure practice. In this study majority of mothers were living in
condominiums/apartments, had low family size, and had fear of sunlight exposure to their neonates
the cut point of the tool in the other studies were median value, but in this study mothers who
correctly respond to all practice questionnaire was having good practice.

202 This study identified that neonatal age, family size, type of housing, ANC follow-up, gestational
age, mothers’ knowledge, and fear of sunlight exposure had an association with mothers’ practice.

204 This study revealed that mothers who had neonates with advanced age (16-28 days) had good
practice compared to those who had neonates with earlier age (≤15 days). This finding was
different from studies conducted in Debre Markos town, Aleta Wondo town, and the South Gondar
zone.\textsuperscript{13,14,16} This discrepancy might be due to differences in cultural beliefs, in those rural towns,
mothers fear to exposure neonates aged less than 15 days for different reasons such as evil eye,
cold, and other cultural reasons. Therefore, mothers who had neonatal age of ≤15 days require
special care during designing interventions aimed at increasing mothers’ practice of neonatal
sunlight exposure.

212 This study shows that mothers who had higher family sizes had had good practice compared to
those who had lower family sizes. This finding is consistent with other studies done in Ethiopia.\textsuperscript{13,14}
The scientific explanation might be due to mothers who had low family sizes, especially in
primipara mothers' lack of experience in the practice of neonatal sunlight exposure. Thus, mothers
who had lower family sizes may require educational provision during the follow-up to improve
their practice of neonatal sunlight exposure.
Our study shows that mothers who lived in compound/villa houses had had good practice compared to those who lived in condominiums/apartment houses. This might be related to the fact condominiums/apartment houses are very crowded with many populations and did not have lifts and fences and mothers might fear an evil eye and fall accidents. This study showed that mothers who had complete ANC follow-up (≥4 times) had good practice compared with those mothers who had lower ANC follow-up. This might be because when ANC visit is regular and complete, the mother would have adequate knowledge and practices of neonatal sunlight exposure. Therefore, encouraging the mothers to have regular and complete ANC follow-ups is important to improve mothers’ practices of neonatal sunlight exposure.

This study also shows that mothers who delivered at term gestation had good practice compared to those mothers who delivered before term. The scientific explanation for this might be that sunlight exposure to premature and low birth weight neonates is controversial, and most preterm babies stay at the hospital for the treatment of different preterm complications. In this study another modifiable factor associated with mothers' practice of neonatal sunlight exposure was knowledge. Those mothers who had poor knowledge about neonatal sunlight exposure had a poor practice than those who had good knowledge. This finding was similar to other studies done in Ethiopia. This might be related to the fact that mothers who know well and practice neonatal sunlight exposure may perform more practice than mothers who didn’t know. Future studies are required to identify the effects of knowledge on the practice of neonatal sunlight exposure among mothers.

In this study, we found that mothers who did not have a fear to expose their neonates had good practice compared to those who had feared. This finding is consistent with other studies conducted in Ethiopia. These mother's fear of sunlight exposure to the neonates might be related to having poor knowledge about sunlight exposure to the neonates since the majority of the
participants in this study have poor knowledge about sunlight exposure of the neonates. Knowing is very important for the practice of neonatal sunlight exposure by decreasing the fear of neonatal exposure to sunlight. Therefore, especially emphasis should be given to those mothers when preparing educational interventions during follow-up to improve the practice of neonatal sunlight exposure by increasing knowledge about neonatal sunlight exposure.

Conclusion

This study revealed that 27.1% of participants had good practice of neonatal sunlight exposure. Advanced neonatal age, having a higher family size, living in compound/villa houses, having complete ANC visits, and having term delivery result in good practice, whereas poor knowledge and fear of sunlight exposure result in poor practice. Therefore, targeted interventions are required to improve the practice of neonatal sunlight exposure.

Abbreviations

ANC: antenatal care; AOR: Adjusted Odd Ratio; COR: Crude Odd Ratio; GMH: Gandhi memorial hospital; TASH: Tikur Anbessa Specialized Hospital; VDD: Vitamin D deficiency; WHO: World Health Organization; Y12H: Yekatit 12 hospital

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from the Institutional Review Board of Addis Ababa University, College of health sciences, school of nursing, and midwifery with 011/20/SNM reference number. A formal letter was obtained from Addis Ababa public health research and emergency management to get permission to carry out the study. Written informed consent was obtained from each participant after explaining the purpose and procedure of the study. Privacy and
Confidentiality of study participants were maintained by making the questionnaire form anonymous and protecting our personal computers with a strong password.

Consent for publication

Not applicable

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 in this section. The author’s acknowledged this paper was available on the Addis Ababa University website as a thesis in June 2020.23

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Authors’ Contribution

YA conceptualized, designed the study, collected, analyzed, and interpreted the data, and also drafted the manuscript. GT, DG, and MK were involved in data analysis, drafting of the manuscript, and advising the whole research paper and also were involved in the interpretation of the data and contributed to manuscript preparation. All authors read and approved the final manuscript.

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Practice and factors associated with neonatal sunlight exposure among mothers attending governmental hospitals in Addis Ababa, Ethiopia, 2020. Cross-sectional study.

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Sample size calculation for mothers attending governmental hospitals, Addis Ababa, Ethiopia, 2020.

The sample size was calculated using the single population proportion formula considering the following assumptions; the prevalence of mothers' practice of neonatal sunlight exposure 45.7 % which was done in South Gondar Zone, North West Ethiopia among mothers, 95% confidence level, and 5% margin of error.

Sample size (n) = \( \frac{Z^2 \cdot p \cdot (1-p)}{d^2} \)

\[ n = \frac{1.96^2 \times 0.457 \times 0.543}{0.05^2} \]

\[ n = 381 \]

Where \( Z \) = critical value for normal distribution at 95% confidence level which equals to 1.96 (z value at \( \alpha =0.05 \))

\( n = \) Sample

\( p = \) prevalence of mothers practice of neonatal sunlight exposure.

\( d = \) Margin of error=5%=0.05

Adding 10% of the non-respondent rate, the final sample size was 420.
Schematic presentation of the sampling procedure for mothers attending governmental hospitals, Addis Ababa, Ethiopia, 2020.

Governmental Hospitals in Addis Ababa having follow-up clinic and EPI clinic

Simple random sampling

Three selected governmental Hospitals in Addis Ababa having follow up clinic and EPI clinic

GMH=650
Mothers with newborns attending follow up clinic and EPI Clinic

TASH=536
Mothers with newborns attending Follow up clinic and EPI Clinic

Y12HMC=435
Mothers with newborns attending follow up clinic and EPI Clinic

Proportional to size allocation formula

\[
GMH = \frac{n \times N_{GMH}}{N} = \frac{420 \times 650}{1,621} = 168
\]

\[
TASH = \frac{n \times N_{TASH}}{N} = \frac{420 \times 536}{1,621} = 139
\]

\[
Y12HMC = \frac{n \times N_{Y12HMC}}{N} = \frac{420 \times 435}{1,621} = 113
\]

Systematic sampling techniques

Total sample size = 420
### English Version Questionnaires

**Part I- Questions related to Socio-demographic information**

**Instruction:** Socio-demographic characteristics of the study participants in governmental hospitals, Addis Ababa, Ethiopia, 2020.

| No. | Questions                                      | Coding categories                                                                 |
|-----|------------------------------------------------|-----------------------------------------------------------------------------------|
| 101 | Mother’s age                                   | ________ years                                                                    |
| 102 | Neonatal/postnatal/ age                        | ________ days                                                                     |
| 103 | Marital status                                 | 1. Single                                                                         |
|     |                                                | 2. Married                                                                        |
|     |                                                | 3. Divorced                                                                       |
|     |                                                | 4. Widowed                                                                        |
|     |                                                | 5. Others __________                                                             |
| 104 | Mother’s educational status                    | 1. No formal learning                                                              |
|     |                                                | 2. Grade 1 -8                                                                    |
|     |                                                | 3. Grade 9<sup>th</sup> -12                                                       |
|     |                                                | 4. College Diploma                                                                |
|     |                                                | 5. University Degree and Above                                                    |
| 105 | Occupation                                     | 1. Student                                                                        |
|     |                                                | 2. Housewife                                                                      |
|     |                                                | 3. Government employee                                                            |
|     |                                                | 4. Private employee                                                               |
|     |                                                | 5. Daily laborer                                                                   |
|     |                                                | 6. Merchant                                                                       |
|     |                                                | 7. Others __________                                                             |
| 106 | Residency                                      | 1. Urban                                                                          |
|     |                                                | 2. Rural                                                                          |
| 107 | Type of housing designs                        | 1. Compound House (villa)                                                         |
|     |                                                | 2. Condominium/Apartments                                                         |
|     |                                                | 3. Other specify __________                                                       |
| 108 | Family size                                    | __________                                                                        |
| 109 | Monthly income                                 | __________ Ethiopian birr                                                          |
| 110 | Husband’s educational status                   | 1. No formal learning                                                              |
|     |                                                | 2. Grade 1 -8                                                                     |
|     |                                                | 3. Grade 9<sup>th</sup> -12                                                       |
|     |                                                | 4. College Diploma                                                                |
|     |                                                | 5. University Degree and Above                                                    |
### Part II: Maternal and neonatal factors related to the mothers practice of sunlight exposure of their neonates in governmental hospitals, Addis Ababa, Ethiopia, 2020.

| No. | Questions                                      | Coding categories | Skip to |
|-----|------------------------------------------------|-------------------|---------|
| 201 | ANC visit                                      | 1. Yes            |         |
|     |                                               | 2. No             |         |
| 202 | Number of visits                              | _______________number |         |
| 203 | Place of delivery                             | 1. Home           |         |
|     |                                               | 2. Health center  |         |
|     |                                               | 3. Hospital       |         |
|     |                                               | 4. Others _________ |         |
| 204 | Gestational Age                               | _______________in wks. |         |
| 205 | Birth weight                                  | ___________ in kg |         |

### Part III- Knowledge of mothers on sunlight exposure of their neonates in governmental hospitals, Addis Ababa, 2020.

| No. | Questions                                      | Coding categories | Skip to |
|-----|------------------------------------------------|-------------------|---------|
| 301 | Do you know about sunlight exposure            | 1. Yes            | 401     |
|     |                                               | 2. No             |         |
| 302 | Source of information about sunlight exposure (Circle more than one) | 1. Physician | 302     |
|     |                                               | 2. Midwife/nurse  |         |
|     |                                               | 3. Television/radio |       |
|     |                                               | 4. Neighbors/elder people |   |
|     |                                               | 5. Others _________ |       |
| 303 | Does sunlight exposure beneficial?             | 1. Yes            | 305     |
|     |                                               | 2. No             |         |
| 304 | The benefit of sunlight exposure (Circle more than one) | 1. Strengthen bone | 304     |
|     |                                               | 2. Strengthen teeth |       |
|     |                                               | 3. Keep the child warm |     |
|     |                                               | 4. Produce vitamin D |       |
|     |                                               | 5. Strengthen the body |       |
|     |                                               | 6. Others _________ |       |
| 305 | Does sunlight exposure harmful                 | 1. Yes            |         |
|     |                                               | 2. No             |         |
| 306 | Harmful effect of sunlight exposure (Circle more than one) | 1. Skin cancer | 306     |
|     |                                               | 2. Sterility      |         |
|     |                                               | 3. Blindness      |         |
|     |                                               | 4. Others _________ |         |
### Part IV - Other factors affecting the practice of mothers on sunlight exposure of their neonate among governmental hospitals, Addis Ababa, Ethiopia, 2020.

| No | Questions | Code categories | Skip to |
|----|-----------|----------------|---------|
| 501 | Do you have a fear to expose your baby to sunlight? | 1. Yes  
2. No | |
| 502 | Mother’s fear of sunlight exposure (Circle more than one) | 1. Sickness  
2. Evil eye  
3. Cold  
4. Other specify | |

### Part V - Practices of mothers on sunlight exposure of their neonates in governmental hospitals, Addis Ababa, Ethiopia, 2020.

| No | Questions | Coding categories | |
|----|-----------|-------------------|---|
| 401 | Do you expose your neonate on sunlight? | 1. Yes  
2. No | |
| 402 | Age of the newborns to start sunlight exposure | | |
| 403 | How frequently do you expose? | 1. Daily  
2. Sometimes | |
| 404 | Where do you expose your neonate on sunlight | 1. Outdoor  
2. Indoor | |
| 405 | At what time of the day do you expose your baby outdoors? (Circle more than one) | 1. Morning 8-10 AM  
2. Mid-day 11 AM-1 PM  
3. Afternoon 2-4 PM | |
| 406 | Condition of clothing during exposure | 1. Unclothed  
2. With diapers and eye protection only  
3. Partly covered  
4. Completely covered | |
| 407 | For how many minutes do you expose your neonate on sunlight? | | |
| 408 | Do you apply lubricants to your neonate body during sunlight exposure? | 1. Yes  
2. No | |
|   | If you apply, when do you apply? (Circle more than one) |   |
|---|-----------------------------------------------------|---|
| 409 | 1. Before exposure  
      | 2. During exposure  
      | 3. After exposure  |   |
| 410 | What things do you apply?  |   |
|     | 1. Baby Vaseline  
      | 2. Baby lotion  
      | 3. Butter  
      | 4. Other_____________ |   |
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Practice and factors associated with neonatal sunlight exposure among mothers attending governmental hospitals in Addis Ababa, Ethiopia, 2020. Cross-sectional study.

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Short Title: Practice of neonatal sunlight exposure among mothers

Abstract

Background: Sunlight exposure helps the body to produce vitamin D, prevents rickets, and is used for neonatal jaundice treatment. However, little is known about the practice of neonatal sunlight exposure among mothers in Ethiopia. Thus, the study aimed to assess the practice and factors associated with neonatal sunlight exposure among mothers attending governmental hospitals in Addis Ababa, Ethiopia, 2020.

Methods: An institution-based cross-sectional study was conducted among 420 mothers attending governmental hospitals in Addis Ababa. The participants of the study were selected by
a systematic random sampling method. The collected data was entered into Epi-data version 4.6 and exported to SPSS version 26 for analysis. Descriptive and logistic regression analyses were performed.

**Results:** The practice of neonatal sunlight exposure among mothers was 27.1%. Neonatal age of 16-28 days (AOR=1.99, 95%CI: 1.15-3.44), family member 4-6 (AOR=1.86, 95%CI: 1.08-3.21) and ≥7 (AOR=4.43, 95%CI: 1.54-12.78), lived in compound/villa houses (AOR=2.59, 95%CI: 1.26-5.33), complete ANC follow-up (AOR=2.79, 95%CI: 1.49-5.22), delivered at term (AOR=2.54, 95%CI: 1.06-6.07), poor knowledge of sunlight exposure (AOR=0.40, 95%CI: 0.23-0.71), and did not have fear of sunlight exposure (AOR=1.83, 95%CI: 1.08-3.12) were factors associated with the practice of neonatal sunlight exposure.

**Conclusion:** This study revealed that 27.1% of mothers expose their neonates to sunlight properly. Advanced neonatal age, higher family size, living in compound/villa houses, complete ANC visit, and term delivery result in good practice, whereas poor knowledge and fear of sunlight exposure result in poor practice. Therefore, interventions focused on these findings are required to improve the practice of neonatal sunlight exposure.

**Keywords:** Sunlight exposure, neonate, practice, knowledge, Addis Ababa, Ethiopia

**WHAT IS ALREADY KNOWN ON THIS TOPIC**

- Sunlight exposure has a lot of health benefits for newborns and infants.
- The inadequate practice of mothers to expose sunshine to neonates are its leads to vitamin D deficiency and jaundice has a common health problem in the world.

**WHAT THIS STUDY ADDS**

- Advanced neonatal age, higher family size, living in compound/villa houses, complete ANC visit, and term delivery result in good practice neonatal sunlight exposure.
• Poor knowledge and fear of sunlight exposure result in the poor practice of neonatal sunlight exposure.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE, OR POLICY

• Interventions focused on neonatal age, family size, types of housing, ANC follow-up, gestational age, mothers’ knowledge, and fear of sunlight exposure are required to improve the practice of neonatal sunlight exposure.

Introduction

Sunlight exposure has a lot of health benefits for newborns and infants. It helps the body to produce vitamin D, preventing rickets in children and is used for the treatment of neonatal jaundice during the neonatal period. Vitamin D everyday requirements can be obtained by 30 to 60 minutes of exposure to sunlight in the morning. Vitamin D is playing a vital role in bone metabolism through the regulation of calcium and phosphate homeostasis. Exposure of neonatal skin to the sunlight in the morning is significant to producing nocturnal melatonin sooner which makes them enter into sleep simply. Morning sunlight exposure supports the neonatal physiological system to break down indirect bilirubin.

Mothers’ timely and proper practice of neonatal sunlight exposure has a lot of health benefits for neonates. The inadequate practice of mothers to expose sunshine to neonates are its leads to vitamin D deficiency and jaundice has a common health problem in many countries of the world and developing countries, especially in Sub-Saharan African countries including Ethiopia.

Ultraviolet (UV) radiation weakens the immune system. Skin dendritic cells are damaged by UV-B rays, which also cause regulatory T cells to generate the immunosuppressive cytokine IL-10. Pyrimidine dimerization and DNA strand breaks are caused by UV light. Additional effects of UV radiation include the externalization of nuclear antigens on cell surfaces and the
production of neoantigens, which can exacerbate autoimmune illnesses like lupus. Another problem associated with chronic UV radiation exposure is photo-aging. Numerous epidemiological researches showed that sunlight exposure is one of the primary risk factors for the development of melanoma and nonmelanoma skin cancer (NMSC). This risk is greatest in the white population, indicating that melanin has a protective effect. It has also been discovered that exposure to UV rays during childhood increases the risk of developing skin cancer compared to exposure during an older age group.

In Middle East Asia, such as the northern parts of China, Mongolia, and Afghanistan the mother’s practice of sunlight exposure for neonates is poor. This is because most neonates are complicated with vitamin D deficiency and rickets. In Ethiopia, shortage of exposure to sunlight and inadequate consumption of vitamin D are the main cause of rickets among children. According to a study done in Addis Ababa Ethiopia 41% of children under 3 years had vitamin D deficiency rickets and the incidence was higher among infants. A study done in Jimma Ethiopia showed that 10.5% of under 5 children have had rickets with the main identified causes being lack of exposure to sunlight and inadequate intake of vitamin D and the highest rate (11%) occurred in infants.

Although daily sunlight exposure remains the cheapest, safest, and most effective method of prevention of rickets and significant numbers of children are not exposed to sunlight properly. According to recent studies in Ethiopia among mothers, 55.4% in Debre Markos town, 52% in the south Gondar zone, and 34.3% in Debre Berhan town had a poor practice of sunlight exposure to their neonates. A multitude of factors may associate with the practice of neonatal sunlight exposure among mothers. These factors include sociodemographic factors such as age, marital status, educational status, occupation of mother, neonatal age, family size, place of...
residence, type of housing, educational status of the husband, household monthly income, maternal and neonatal related factors such as antenatal care (ANC) follow-up, place of delivery, gestational age, and birth weight, mothers knowledge and fear of sunlight exposure. However, little is known about the practice of neonatal sunlight exposure among mothers in Ethiopia. Thus, the study aimed to assess the practice and factors associated with neonatal sunlight exposure among mothers attending governmental hospitals in Addis Ababa, Ethiopia, 2020.

Methods

Study area, design, and population

This institutional-based cross-sectional study design was conducted from March 18-April 30, 2020, in three governmental hospitals in Addis Ababa town, Ethiopia: Gandhi Memorial Hospital (GMH), Tikur Anbessa Specialized Hospital (TASH), and Yekatit 12 Hospital (Y12H). All mothers having neonates and attending follow-up and immunization clinics were included, except those who had neonates above one month of age and are unable to communicate during the study period.

Sample size determination and Sampling procedure

The single population proportion formula was used to calculate the sample size by considering the following assumptions; the prevalence of mothers' practice of neonatal sunlight exposure was 45.7%, which was done in South Gondar Zone, Ethiopia, 95% confidence level, and 5% margin of error. The final sample size including the non-response rate yielded 420 mothers. The three hospitals were selected using a lottery method. According to the recent monthly data from the three hospitals, a total of 1,621 mothers with neonates have attended follow-up and immunization clinics and this was taken as a sampling frame. Then, the total sample size for each
hospital was allocated proportionally based on the sampling frame (GMH, N=650; TASH, N=536; Y12H, N=435). Therefore, 168 mothers from GMH, 139 mothers from TASH, and 113 mothers from Y12H were selected using systematic random sampling every k =3 interval.

**Study variables**

The dependent variable was practices of neonatal sunlight exposure and the independent variables include sociodemographic factors such as the age, marital status, educational status, occupation of the mother, neonatal age, number of families, place of residence, type of housing, and household income, maternal and neonatal related factors such as ANC follow-up, place of delivery, gestational age, and birth weight, mothers’ knowledge and fear of sunlight exposure.

**Data collection tool and procedure**

Data was collected by using an Amharic version of an adapted questionnaire with a face-to-face interview. This questionnaire was first written in English and translated into Amharic versions and re-translated back into English by language experts to assure its consistency. The data collection tool was adapted after extensive reviewing of different literature done on this area. The sociodemographic and maternal and neonatal-related factors of the mothers were documented by 14 items. Mothers’ knowledge of sunlight exposure was measured using 7-items. Participants who scored above the median value on the mother’s knowledge of the sunlight exposure tool were categorized as having good knowledge. Practices of neonatal sunlight exposure were measured using 10 self-reported items. Participants who responded correctly to all practice questions on the practice questionnaire were classified as having good practice and those who had scored less than or equal to 9 were considered to have poor practice. The questionnaire was given to experts to check content validity and accuracy. Data collection was carried out by four trained nurses from other units of health facilities. Also, the
completeness of the questionnaire and quality of data collection was checked daily by the supervisors and detailed feedback was provided to data collectors.

**Data processing and analysis**

The data were checked, coded, and entered into Epi-Data version 4.6 and exported to SPSS Version 26 software for analysis. Descriptive data were reported using frequency and percentage. A bivariate logistic regression analysis model was used to identify factors associated with the practice of neonatal sunlight exposure. Those variables with a p-value <0.25 in the bivariate logistic regression were entered into a multivariable logistic regression analysis. A multivariate logistic regression model was used to identify the association of independent variables and the practice of neonatal sunlight exposure. In multivariable logistic regression analysis, the statistical significance of associations between independent variables and the practice of neonatal sunlight exposure was determined using odds ratios with a 95% confidence interval and p-values < 0.05.

**Patient and Public Involvement**

Patients or the public were not involved in the design, conduct, reporting, or dissemination plan of this study.

**Results**

**Socio-demographic characteristics of participants**

A total of 420 mothers have participated with a 100% response rate. The mean age of participants was 28.8 ±5.61 years. Most of the participants were married (n=398, 94.8%), and residing in urban areas (n=398, 94.8%). More than half of them, 225 (53.6%) were housewives and 267 (63.6%) had secondary and above educational status. Half of the participants, 210 (50%) had family members of 4-6 and 334 (79.5%) mothers were living in a compound/villa house. The
The majority of husbands of participants, 304 (72.4%) had secondary and above educational status (Table 1).

**Table 1.** Socio-demographic characteristics of the study participants (n=420).

| Variables                     | Category                   | Frequency(n) | Percent (%) |
|-------------------------------|----------------------------|--------------|-------------|
| Age of mothers                | ≤24                        | 93           | 22.1        |
|                               | 25-29                      | 151          | 36.0        |
|                               | 30-34                      | 102          | 24.3        |
|                               | ≥35                        | 74           | 17.6        |
| Neonatal (postnatal) age      | <15 days                   | 174          | 41.4        |
|                               | ≥15 days                   | 246          | 58.6        |
| Marital status of mothers     | Unmarried                  | 22           | 5.2         |
|                               | Married                    | 398          | 94.8        |
| Mothers' Educational status   | No education               | 41           | 9.8         |
|                               | Primary education          | 112          | 26.7        |
|                               | Secondary and above        | 267          | 63.6        |
| Occupation status of mothers  | Housewife                  | 225          | 53.6        |
|                               | Gov't employee             | 89           | 21.2        |
|                               | Private employee           | 75           | 17.9        |
|                               | Merchant                   | 31           | 7.4         |
| Family size                   | 1-3                        | 184          | 43.8        |
|                               | 4-6                        | 210          | 50.0        |
|                               | ≥7                         | 26           | 6.2         |
| Residence                     | Rural                      | 22           | 5.2         |
|                               | Urban                      | 398          | 94.8        |
| Type of housing               | Condominium/Apartments     | 86           | 20.5        |
|                               | Compound house (villa)     | 334          | 79.5        |
| Household monthly income in ETB| ≤1800                      | 90           | 21.4        |
|                               | 1801-3800                  | 102          | 24.3        |
|                               | 3801-7500                  | 122          | 29.0        |
|                               | ≥7501                      | 106          | 25.2        |
| Husband’s educational status  | No formal education        | 29           | 6.9         |
|                               | Primary education          | 87           | 20.7        |
|                               | Secondary & above          | 304          | 72.4        |

ETB; Ethiopian Birr
Maternal and neonatal related factors of participants

Most of the participants, 410 (97.6%) had ANC follow up and three-fourths of participants, 306 (72.9%) delivered their neonates in hospitals. More than two-thirds of neonates, 287 (68.3%) were at term (37-42 weeks) gestational ages, and the majority of neonates, 301 (71.7%) had a birth weight of ≥ 2.5 Kg at the time of delivery (Table 2).

Table 2. Maternal and neonatal-related factors of the study participants (n=420).

| Variables                  | Category                  | Frequency(n) | Percent (%) |
|----------------------------|---------------------------|--------------|-------------|
| Antenatal care visit       | Yes                       | 410          | 97.6        |
|                            | No                        | 10           | 2.4         |
| Number of antenatal care   | 1-3                       | 163          | 39.8        |
| visits (n=410)             | ≥4                        | 247          | 60.2        |
| Place of delivery          | Home                      | 7            | 1.7         |
|                            | Health center             | 104          | 24.8        |
|                            | Hospital                  | 306          | 72.9        |
|                            | Other                     | 3            | 0.7         |
| Gestational age            | <37 weeks                 | 107          | 25.5        |
|                            | 37-42 weeks               | 287          | 68.3        |
|                            | ≥42 weeks                 | 16           | 3.8         |
|                            | Unknown                   | 10           | 2.4         |
| Birth weight               | < 2.5 Kg                  | 115          | 27.4        |
|                            | ≥ 2.5 Kg                  | 301          | 71.7        |
|                            | Unknown                   | 4            | 1.0         |

Participants’ knowledge, fear, and practice of neonatal sunlight exposure

Most of the participants, 388 (92.4%) had information about neonatal sunlight exposure. The majority of the participants, 258 (66.49%) heard about sunlight exposure of neonates from midwives/nurse. Most of the participants, 380 (97.9%) knew the benefit of neonatal sunlight exposure. The majority of the participants identified that producing vitamin D (n=235, 67.14%). Most of the participants, 365 (94.07%) reported a good time to expose neonates was in the morning. More than half of the participants, 245 (58.33%) had feared exposing their neonates to
sunlight. Of the total participants, 181 (43.1%) had good knowledge and 114 (27.10%) had good practice of neonatal sunlight exposure (Table 3).

Table 3. Knowledge, fear, and practice of neonatal sunlight exposure of the study participants (n=420).

| Variables                                      | Category          | Frequency(n) | Percent (%) |
|------------------------------------------------|-------------------|--------------|-------------|
| Had information about sunlight exposure        | Yes               | 388          | 92.4        |
|                                                | No                | 32           | 7.6         |
| Source of information about sunlight exposure  | Physician         | 173          | 44.59       |
| (n=388)                                        | Midwife/nurse     | 258          | 66.49       |
|                                                | Television/radio  | 17           | 4.38        |
|                                                | Neighbors/elder people | 105     | 27.06       |
| Does sunlight exposure beneficial?             | Yes               | 380          | 97.9        |
| (n=388)                                        | No                | 8            | 2.1         |
| Benefit of sunlight exposure (n=380)           | Strengthen bone   | 252          | 66.32       |
|                                                | Strengthen teeth  | 6            | 1.58        |
|                                                | Keep child warm   | 73           | 11.32       |
|                                                | Produce vitamin D | 235          | 67.14       |
|                                                | Strengthen body   | 160          | 42.11       |
| Does sunlight exposure harmful?                | Yes               | 190          | 49.0        |
| (n=388)                                        | No                | 198          | 51.0        |
| The harmful effect of sunlight exposure (n=190)| Skin cancer       | 37           | 19.47       |
|                                                | Sterility         | 80           | 42.11       |
|                                                | Blindness         | 104          | 54.73       |
| A good time to expose neonates(n=388)          | Morning           | 365          | 94.07       |
|                                                | Afternoon         | 13           | 3.35        |
|                                                | Evening           | 66           | 17.01       |
| Mothers fear sunlight exposure                 | Yes*              | 245          | 58.33       |
|                                                | No                | 175          | 41.67       |
| Knowledge                                      | Good knowledge    | 181          | 43.1        |
|                                                | Poor knowledge    | 239          | 56.9        |
| Practice                                       | Good practice     | 114          | 27.1        |
|                                                | Poor practice     | 306          | 72.9        |

* Sickness, evil eye, cold

Factors associated with the participants' practice of neonatal sunlight exposure

In univariate logistic regression neonatal age, educational status, occupation and marital status of the mother, family size, type of housing, educational status of the husband, ANC follow-up, gestational age, birth weight, mothers’ knowledge, and fear of sunlight exposure were
significantly associated with the practice. However, in multiple logistic regression analysis neonatal age, family size, type of housing, ANC follow-up, gestational age, mothers’ knowledge, and fear of sunlight exposure had a statistically significant association with practice.

Mothers who had neonates aged 16-28 days (AOR=1.99, 95% CI: 1.15-3.44) were two times more likely to have good practice compared to those mothers who had neonates aged < 15 days. Mothers who had a family member of 4-6 (AOR=1.86, 95% CI: 1.08-3.21) and greater than or equal to 7 (AOR=4.43, 95% CI: 11.54-12.78) were 1.86 and 4.43 times more likely to have good practice respectively, compared to those who had family members of 1-3. Mothers who lived in compound/villa houses (AOR=2.59, 95% CI: 1.26-5.33) were 2.6 times more likely to have good practice compared to those who lived in condominiums/apartment houses.

Mothers who had complete ANC follow-up (AOR=2.79, 95% CI: 1.49-5.22) were 2.79 times more likely to have good practice compared to those who had incomplete ANC follow-up. Mothers who delivered at term gestation (AOR=2.54, 95% CI: 1.06-6.07) were 2.54 times more likely to have good practice compared to those who delivered before term. Mothers who had poor knowledge of sunlight exposure (AOR=0.40, 95% CI: 0.23-0.71) were 60% less likely to have good practice compared to their counterparts. Mothers who did not have fear of sunlight exposure (AOR=1.83, 95% CI: 1.08-3.12) were 1.83 times more likely to have good practice compared to those who had fear of sunlight exposure in their neonates (Table 4).
Table 4. Factors associated with the practice of neonatal sunlight exposure of the study participants (n=420).

| Variables                  | Practice | Category | COR (95%CI) | AOR (95%CI) |
|----------------------------|----------|----------|-------------|-------------|
|                            |          | Good     | Poor        |             |
| Neonatal age               |          | 39       | 135         | 1           |
| 0-15 days                  |          | 14       | 1           |             |
| 16-28 days                 |          | 10       | 6           |             |
| Educational status of the  |          | 0.99(0.38-2.57) | 0.61(0.20-1.86) |   |
| mother                     |          | 1         | 1           |             |
| No formal Education        |          | 0.99(0.38-2.57) | 0.61(0.20-1.86) |   |
| Primary Educ.              |          | 1         | 1           |             |
| Secondary & above          |          | 2.39(1.02-5.60) | 1.07(0.36-3.19) |   |
| Occupation of mother       |          | 1         | 1           |             |
| Housewife                  |          | 45       | 180         | 1           |
| Government employee        |          | 36       | 53          | 1           |
| Private employee           |          | 30       | 45          | 1           |
| Merchant                   |          | 3        | 28          | 1           |
| Marital status of the      |          | 112      | 286         | 1           |
| mother                     |          | 3.92(0.90-17.03) | 1.80(0.35-9.20) |   |
| Family size                |          | 1         | 1           |             |
| 1-3                        |          | 35       | 149         | 1           |
| 4-6                        |          | 65       | 145         | 1           |
| 7+                         |          | 14       | 12          | 1           |
| Type of housing            |          | 2.19(1.18-4.08) | 2.59(1.26-5.33) |   |
| Condominium/apartment      |          | 14       | 72          | 1           |
| Compound/villa             |          | 100      | 234         | 1           |
| Educational status of the  |          | 1.06(0.32-3.53) | 0.63(0.16-2.42) |   |
| husband                    |          | 1         | 1           |             |
| No formal education        |          | 4        | 25          | 1           |
| Primary education          |          | 13       | 77          | 1           |
| Secondary & above          |          | 97       | 204         | 1           |
| ANC follows-up             |          | 1         | 1           |             |
| 1-3 times                  |          | 21       | 142         | 1           |
| ≥4 times                   |          | 93       | 154         | 1           |
| Gestational age            |          | 1.31(1.83-6.01) | 2.54(1.06-6.07) |   |
| <37 weeks                  |          | 13       | 98          | 1           |
| 37-42 weeks                |          | 96       | 197         | 1           |
| ≥42 weeks                  |          | 5        | 11          | 1           |
| Birth weight               |          | 1.93(1.11-3.35) | 1.42(0.59-3.39) |   |
| <2.5 kg                    |          | 19       | 96          | 1           |
| ≥2.5 kg                    |          | 95       | 206         | 1           |
| Knowledge                  |          | 0.57(0.36-0.89) | 0.40(0.22-0.70) |   |
| Good                       |          | 38       | 143         | 1           |
| Poor                       |          | 76       | 163         | 1           |
| Fear of sunlight exposure  |          | 1.77(1.15-2.73) | 1.83(1.08-3.12) |   |
| Yes                        |          | 54       | 188         | 1           |
| No                         |          | 60       | 118         | 1           |

*p-value <0.05; AOR: adjusted odds ratio; COR: crude odds ratio; CI: confidence interval

Discussion

This study explored the practice and factors associated with neonatal sunlight exposure among mothers attending governmental hospitals in Addis Ababa, Ethiopia, and found that 27.1% of mothers had good practice of neonatal sunlight exposure. The finding of this study was lower than studies done in Ethiopia in the South Gondar zone (54.3%),19 Debre Markos town(44.6%)18
Debre Berhan town (34.3%), and Aleta Wondo town (32.6%). The possible reason might be due to differences in housing type, family size, and mothers' fear of sunlight exposure. In this study majority of mothers were living in condominiums/apartments, had low family sizes, and had fear of sunlight exposure to their neonates. In addition to this, the possible reason might be the cut point of the tool used to measure mothers' practice of neonatal sunlight exposure. The other studies used the median value as the cut point and the participants who responded correctly above the median value were classified as having good practice, but in this study participants who responded correctly to all practice questions were classified as having good practice.

This study identified that neonatal age, family size, type of housing, ANC follow-up, gestational age, mothers’ knowledge, and fear of sunlight exposure had an association with mothers’ practice. This study revealed that mothers who had neonates with advanced age (16-28 days) had good practice compared to those who had neonates with earlier age (≤15 days). This finding was different from studies conducted in Debre Markos town, Aleta Wondo town, and the South Gondar zone. This discrepancy might be due to differences in cultural beliefs, in those rural towns, mothers fear to exposure neonates aged less than 15 days for different reasons such as evil eye, cold, and other cultural reasons. Therefore, mothers who had neonatal age of ≤15 days require special care during designing interventions aimed at increasing mothers' practice of neonatal sunlight exposure.

This study shows that mothers who had higher family sizes had had good practice compared to those who had lower family sizes. This finding is consistent with other studies done in Ethiopia. The scientific explanation might be due to mothers who had low family sizes, especially in primipara mothers' lack of experience in the practice of neonatal sunlight exposure.
Thus, mothers who had lower family sizes may require educational provision during the follow-up to improve their practice of neonatal sunlight exposure.

Our study shows that mothers who lived in compound/villa houses had had good practice compared to those who lived in condominiums/ apartment houses. This might be related to the fact condominiums/apartment houses are very crowded with many populations and did not have lifts and fences and mothers might fear an evil eye and fall accidents. This study showed that mothers who had complete ANC follow-up (≥4 times) had good practice compared with those mothers who had lower ANC follow-up. This might be because when ANC visit is regular and complete, the mother would have adequate knowledge and practices of neonatal sunlight exposure. Therefore, encouraging the mothers to have regular and complete ANC follow-ups is important to improve mothers’ practices of neonatal sunlight exposure.

This study also shows that mothers who delivered at term gestation had good practice compared to those mothers who delivered before term. The scientific explanation for this might be that sunlight exposure to premature and low birth weight neonates is controversial, and most preterm babies stay at the hospital for the treatment of different preterm complications. In this study another modifiable factor associated with mothers' practice of neonatal sunlight exposure was knowledge. Those mothers who had poor knowledge about neonatal sunlight exposure had a poor practice than those who had good knowledge. This finding was similar to other studies done in Ethiopia. This might be related to the fact that mothers who know well and practice neonatal sunlight exposure may perform more practice than mothers who didn’t know. Future studies are required to identify the effects of knowledge on the practice of neonatal sunlight exposure among mothers.
In this study, we found that mothers who did not have a fear to expose their neonates had good practice compared to those who had feared. This finding is consistent with other studies conducted in Ethiopia. These mother's fear of sunlight exposure to the neonates might be related to having poor knowledge about sunlight exposure to the neonates since the majority of the participants in this study have poor knowledge about sunlight exposure of the neonates. Knowing is very important for the practice of neonatal sunlight exposure by decreasing the fear of neonatal exposure to sunlight. Therefore, especially emphasis should be given to those mothers when preparing educational interventions during follow-up to improve the practice of neonatal sunlight exposure by increasing knowledge about neonatal sunlight exposure.

Conclusion

This study revealed that 27.1% of participants had good practice of neonatal sunlight exposure. Advanced neonatal age, having a higher family size, living in compound/villa houses, having complete ANC visits, and having term delivery result in good practice, whereas poor knowledge and fear of sunlight exposure result in poor practice. Therefore, interventions focused on these findings are required to improve the practice of neonatal sunlight exposure.

Abbreviations

ANC: antenatal care; AOR: Adjusted Odd Ratio; COR: Crude Odd Ratio; GMH: Gandhi memorial hospital; NMSC: nonmelanoma skin cancer; TASH: Tikur Anbessa Specialized Hospital; UV: Ultraviolet; UV-B: Ultraviolet B; VDD: Vitamin D deficiency; WHO: World Health Organization; Y12H: Yekatit 12 hospital

Supplementary statement

Supplementary file 1. Sample size, sampling procedure, and questionnaires.
Declartions

Ethics approval and consent to participate

Ethical clearance was obtained from the Institutional Review Board of Addis Ababa University, College of health sciences, school of nursing, and midwifery with 011/20/SNM reference number. A formal letter was obtained from Addis Ababa public health research and emergency management to get permission to carry out the study. Written informed consent was obtained from each participant after explaining the purpose and procedure of the study. Privacy and confidentiality of study participants were maintained by making the questionnaire form anonymous and protecting our personal computers with a strong password.

Consent for publication

Not applicable

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 in this section. The author’s acknowledged this paper was available on the Addis Ababa University website as a thesis in June 2020.28

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Authors’ Contribution

YA conceptualized, designed the study, collected, analyzed, and interpreted the data, and also drafted the manuscript. GT, DG, and MK were involved in data analysis, drafting of the manuscript, and advising the whole research paper and also were involved in the interpretation of
the data and contributed to manuscript preparation. All authors read and approved the final manuscript.

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Practice and factors associated with neonatal sunlight exposure among mothers attending governmental hospitals in Addis Ababa, Ethiopia, 2020. Cross-sectional study.

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Sample size calculation for mothers attending governmental hospitals, Addis Ababa, Ethiopia, 2020.

The sample size was calculated using the single population proportion formula considering the following assumptions; the prevalence of mothers' practice of neonatal sunlight exposure 45.7 % which was done in South Gondar Zone, North West Ethiopia among mothers, 95% confidence level, and 5% margin of error.

\[
\text{Sample size } (n) = \frac{z^2 \times p(1-p)}{d^2}
\]

\[
n = \frac{1.96^2 \times 0.457 \times 0.543}{0.05^2}
\]

\[
n = 381
\]

Where \( Z \) = critical value for normal distribution at 95% confidence level which equals to 1.96 (\( z \) value at \( \alpha = 0.05 \))

\[
n = \text{Sample}
\]

\[
p = \text{prevalence of mothers practice of neonatal sunlight exposure.}
\]

\[
d = \text{Margin of error}=5\% = 0.05
\]

Adding 10% of the non-respondent rate, the final sample size was 420.
Schematic presentation of the sampling procedure for mothers attending governmental hospitals, Addis Ababa, Ethiopia, 2020.

Governmental Hospitals in Addis Ababa having follow-up clinic and EPI clinic

Simple random sampling

Three selected governmental Hospitals in Addis Ababa having follow up clinic and EPI clinic

GMH = 650
Mothers with newborns attending follow up clinic and EPI Clinic

TASH = 536
Mothers with newborns attending follow up clinic and EPI Clinic

Y12HMC = 435
Mothers with newborns attending follow up clinic and EPI Clinic

Proportional to size allocation formula

\[
\text{GMH} = \frac{n_f \cdot N_{GMH}}{N} = \frac{420 \cdot 650}{1,621} = 168
\]

\[
\text{TASH} = \frac{n_f \cdot N_{TASH}}{N} = \frac{420 \cdot 536}{1,621} = 139
\]

\[
\text{Y12HMC} = \frac{n_f \cdot N_{Y12HMC}}{N} = \frac{420 \cdot 435}{1,621} = 113
\]

Systematic sampling techniques

Total sample size = 420
# English Version Questionnaires

## Part I- Questions related to Socio-demographic information

**Instruction:** Socio-demographic characteristics of the study participants in governmental hospitals, Addis Ababa, Ethiopia, 2020.

| No. | Questions                                      | Coding categories                                                                 |
|-----|------------------------------------------------|----------------------------------------------------------------------------------|
| 101 | Mother’s age                                    | ________ years                                                                   |
| 102 | Neonatal/postnatal/ age                         | ________ days                                                                    |
| 103 | Marital status                                  | 1. Single<br>2. Married<br>3. Divorced<br>4. Widowed<br>5. Others ______________ |
| 104 | Mother’s educational status                     | 1. No formal learning<br>2. Grade 1 -8<br>3. Grade 9<sup>th</sup> -12<br>4. College Diploma<br>5. University Degree and Above |
| 105 | Occupation                                      | 1. Student<br>2. Housewife<br>3. Government employee<br>4. Private employee<br>5. Daily laborer<br>6. Merchant<br>7. Others ____________ |
| 106 | Residency                                      | 1. Urban<br>2. Rural                                                            |
| 107 | Type of housing designs                         | 1. Compound House (villa)<br>2. Condominium/ Apartments<br>3. Other specify ________ |
| 108 | Family size                                     | __________________________                                                        |
| 109 | Monthly income                                  | __________________________ Ethiopian birr                                         |
| 110 | Husband’s educational status                    | 1. No formal learning<br>2. Grade 1 -8<br>3. Grade 9<sup>th</sup> -12<br>4. College Diploma<br>5. University Degree and Above |
Part II: Maternal and neonatal factors related to the mothers practice of sunlight exposure of their neonates in governmental hospitals, Addis Ababa, Ethiopia, 2020.

| No. | Questions                                      | Coding categories | Skip to |
|-----|-----------------------------------------------|-------------------|---------|
| 201 | ANC visit                                     | 1. Yes            |         |
|     |                                               | 2. No             |         |
| 202 | Number of visits                              | _________________| number |
| 203 | Place of delivery                             | 1. Home           |         |
|     |                                               | 2. Health center  |         |
|     |                                               | 3. Hospital       |         |
|     |                                               | 4. Others_________|         |
| 204 | Gestational Age                               | _________________| in wks. |
| 205 | Birth weight                                  | __________       | in kg   |

Part III- Knowledge of mothers on sunlight exposure of their neonates in governmental hospitals, Addis Ababa, 2020.

| No. | Questions                                      | Coding categories | Skip to |
|-----|-----------------------------------------------|-------------------|---------|
| 301 | Do you know about sunlight exposure           | 1. Yes            | 401     |
|     |                                               | 2. No             |         |
| 302 | Source of information about sunlight exposure (Circle more than one) | 1. Physician |         |
|     |                                               | 2. Midwife/nurse  |         |
|     |                                               | 3. Television/radio|       |
|     |                                               | 4. Neighbors/elder people |       |
|     |                                               | 5. Others_________|         |
| 303 | Does sunlight exposure beneficial?            | 1. Yes            | 305     |
|     |                                               | 2. No             |         |
| 304 | The benefit of sunlight exposure (Circle more than one) | 1. Strengthen bone |         |
|     |                                               | 2. Strengthen teeth|        |
|     |                                               | 3. Keep the child warm |     |
|     |                                               | 4. Produce vitamin D|        |
|     |                                               | 5. Strengthen the body |      |
|     |                                               | 6. Others_________|         |
| 305 | Does sunlight exposure harmful                | 1. Yes            |         |
|     |                                               | 2. No             |         |
| 306 | Harmful effect of sunlight exposure (Circle more than one) | 1. Skin cancer |         |
|     |                                               | 2. Sterility      |         |
|     |                                               | 3. Blindness      |         |
|     |                                               | 4. Others_________|         |
Part IV- Other factors affecting the practice of mothers on sunlight exposure of their neonate among governmental hospitals, Addis Ababa, Ethiopia, 2020.

| No  | Questions                                                                 | Code categories                                      | Skip to |
|-----|---------------------------------------------------------------------------|------------------------------------------------------|---------|
| 501 | Do you have a fear to expose your baby to sunlight?                      | 1. Yes                                               |         |
|     |                                                                           | 2. No                                                |         |
| 502 | Mother’s fear of sunlight exposure (Circle more than one)                 | 1. Sickness                                          |         |
|     |                                                                           | 2. Evil eye                                           |         |
|     |                                                                           | 3. Cold                                               |         |
|     |                                                                           | 4. Other specify__________                             |         |

Part V- Practices of mothers on sunlight exposure of their neonates in governmental hospitals, Addis Ababa, Ethiopia, 2020.

| No. | Questions                                                                 | Coding categories                                      |
|-----|---------------------------------------------------------------------------|--------------------------------------------------------|
| 401 | Do you expose your neonate on sunlight?                                  | 1. Yes                                                  |
|     |                                                                           | 2. No                                                   |
| 402 | Age of the newborns to start sunlight exposure                            |                                                        |
| 403 | How frequently do you expose?                                            | 1. Daily                                                |
|     |                                                                           | 2. Sometimes                                            |
| 404 | Where do you expose your neonate on sunlight                              | 1. Outdoor                                              |
|     |                                                                           | 2. Indoor                                               |
| 405 | At what time of the day do you expose your baby outdoors? (Circle more than one) | 1. Morning 8-10 AM                                      |
|     |                                                                           | 2. Mid-day 11 AM-1 PM                                   |
|     |                                                                           | 3. Afternoon 2-4 PM                                     |
| 406 | Condition of clothing during exposure                                    | 1. Unclothed                                            |
|     |                                                                           | 2. With diapers and eye protection only                 |
|     |                                                                           | 3. Partly covered                                       |
|     |                                                                           | 4. Completely covered                                   |
| 407 | For how many minutes do you expose your neonate on sunlight?              |                                                        |
| 408 | Do you apply lubricants to your neonate body during sunlight exposure?    | 1. Yes                                                  |
|     |                                                                           | 2. No                                                   |
| 409 | If you apply, when do you apply? (Circle more than one) | 1. Before exposure  
2. During exposure  
3. After exposure |
|-----|-----------------------------------------------------|--------------------------------------------------|
| 410 | What things do you apply?                           | 1. Baby Vaseline  
2. Baby lotion  
3. Butter  
4. Other___________ |
Attitudes of mothers attending public hospitals in Addis Ababa, Ethiopia, to neonatal sunlight exposure among: a cross-sectional study.

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Attitudes of mothers attending public hospitals in Addis Ababa, Ethiopia, to neonatal sunlight exposure: a cross-sectional study

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ABSTRACT

Background: Sunlight exposure helps the body produce vitamin D, prevents rickets, and is used for neonatal jaundice treatment. However, little is known about the practice of neonatal sunlight exposure among mothers in Ethiopia. This study aimed to assess the practices and factors associated with neonatal sunlight exposure among mothers attending public hospitals in Addis Ababa, Ethiopia.

Methods: An institution-based cross-sectional study was conducted among 420 mothers attending public hospitals in Addis Ababa. Study participants were selected using a systematic random sampling method. The collected data were entered into Epi-data version 4.6 and exported to SPSS version 26 for analysis. Descriptive and logistic regression analyses were conducted.

Results: The practice of neonatal sunlight exposure among mothers was 27.1%. Neonatal age of 16-28 days (adjusted odds ratio [AOR]=1.99, 95% confidence interval [CI]: 1.15-3.44), family member 4-6 (AOR=1.86, 95%CI: 1.08-3.21) and ≥7 (AOR=4.43, 95%CI: 1.54-12.78), living in compound/villa houses (AOR=2.59, 95%CI: 1.26-5.33), complete antenatal care (ANC) follow-up (AOR=2.79, 95%CI: 1.49-5.22), delivery at term (AOR=2.54, 95%CI: 1.06-6.07), poor knowledge of sunlight exposure (AOR=0.40, 95%CI: 0.23-0.71), and no fear of sunlight exposure (AOR=1.83, 95%CI: 1.08-3.12) were factors associated with the practice of neonatal sunlight exposure.

Conclusion: This study revealed that 27.1% of mothers had good sunlight exposure. Advanced neonatal age, larger family, living in compound/villa houses, complete ANC visits, and term delivery were associated with good practices, whereas poor knowledge and fear of sunlight exposure were not.
exposure were associated with poor practices. Therefore, interventions focusing on these findings are required to improve the practice of neonatal sunlight exposure.

**Keywords**: Sunlight exposure, neonate, practice, knowledge, Addis Ababa, Ethiopia

**WHAT IS ALREADY KNOWN ON THIS TOPIC**

- Sunlight exposure has a lot of health benefits for newborns and infants.
- Inadequate exposure of neonates to sunshine leads to vitamin D deficiency, and jaundice are common health problems worldwide.

**WHAT THIS STUDY ADDS**

- Advanced neonatal age, higher family size, living in compound/villa houses, complete ANC visits, and term delivery were associated with good practice of neonatal sunlight exposure.
- Poor knowledge of and fear of sunlight exposure are associated with poor neonatal sunlight exposure.

**HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE, OR POLICY**

- Interventions focused on mothers’ knowledge of sunlight exposure (fear of sunlight, neonatal age, and ANC follow-up) and term delivery are required to improve the practice of neonatal sunlight exposure.
INTRODUCTION

Sunlight exposure has many health benefits for newborns and infants. It helps the body produce vitamin D, preventing rickets in children, and is used to treat neonatal jaundice during the neonatal period. Vitamin D everyday requirements can be obtained by 30 to 60 minutes of exposure to sunlight in the morning. Vitamin D plays a vital role in bone metabolism through regulation of calcium and phosphate homeostasis. Exposure of neonatal skin to sunlight in the morning is significant to producing nocturnal melatonin sooner, which helps them sleep better.

Morning sunlight exposure supports the neonatal physiological system to break down indirect bilirubin.

Timely and proper practice of neonatal sunlight exposure by mothers has many health benefits for neonates. The inadequate practice of exposure of neonates to sunshine by mothers leads to vitamin D deficiency, and jaundice is a common health problem in many developing countries, especially in sub-Saharan African countries such as Ethiopia.

Ultraviolet (UV) radiation weakens the immune system. Skin dendritic cells are damaged by UV-B rays, which also cause regulatory T cells to generate the immunosuppressive cytokine IL-10. Pyrimidine dimerization and DNA strand breaks are induced by UV light. Additional effects of UV radiation include externalization of nuclear antigens on cell surfaces and production of neoantigens, which can exacerbate autoimmune illnesses such as lupus. Another problem associated with chronic UV radiation exposure is photoaging. Numerous epidemiological research showed that sunlight exposure is one of the primary risk factors for the development of melanoma and nonmelanoma skin cancer (NMSC). This risk is greatest in the white population, indicating that melanin has a protective effect. It has also been discovered that
exposure to UV rays during childhood increases the risk of developing skin cancer compared to exposure later in life.\textsuperscript{12}

In Middle East Asia, such as the northern parts of China, Mongolia, and Afghanistan, mothers’ practice of sunlight exposure for neonates is poor. As a result, most neonates develop vitamin D deficiency and rickets.\textsuperscript{6, 13} In Ethiopia, shortage of exposure to sunlight and inadequate vitamin D consumption are the main causes of rickets among children. According to a study conducted in Addis Ababa Ethiopia, 41% of children under 3 years of age had vitamin D deficiency rickets, and the incidence was higher among infants.\textsuperscript{14} A study conducted in Jimma, Ethiopia, showed that 10.5% of children under 5 years of age had rickets, with the main identified causes being lack of exposure to sunlight and inadequate intake of vitamin D, and the highest rate (11%) occurred in infants.\textsuperscript{15-17}

Although daily sunlight exposure remains the cheapest, safest, and most effective method of prevention of rickets, significant number of children are not properly exposed to sunlight. According to recent studies in Ethiopia among mothers, 55.4% in Debre Markos town, 52% in the south Gondar zone, and 34.3% in Debre Berhan town had poor practice of exposing neonates to sunlight.\textsuperscript{18-20} Numerous factors may be associated with the practice of neonatal sunlight exposure among mothers. These factors include sociodemographic factors such as age, marital status, educational status, occupation of mother, neonatal age, family size, place of residence, type of housing, educational status of the husband, household monthly income,\textsuperscript{18-24} maternal and neonatal-related factors such as antenatal care (ANC) follow-up, place of delivery, gestational age, birth weight, mother’s knowledge \textsuperscript{13, 16, 17, 21, 23, 25} and fear of sunlight exposure.\textsuperscript{16, 18, 19, 21, 26}

However, little is known about the practice of neonatal sunlight exposure among mothers in
Ethiopia. Thus, this study aimed to assess the practices and factors associated with neonatal sunlight exposure among mothers visiting public hospitals in Addis Ababa, Ethiopia, 2020.

METHODS

Study area, design, and population

This institutional-based cross-sectional study was conducted from March 18 to April 30, 2020, in three public hospitals in Addis Ababa town, Ethiopia: Gandhi Memorial Hospital (GMH), Tikur Anbessa Specialized Hospital (TASH), and Yekatit 12 Hospital (Y12H). All mothers with neonates and those attending follow-up and immunization clinics were included, except those who had neonates above one month of age and were unable to communicate during the study period.

Sample size determination and Sampling procedure

The single population proportion formula was used to calculate the sample size based on the following assumptions: the prevalence of mothers' practice of neonatal sunlight exposure was 45.7%, as done in South Gondar Zone, Ethiopia,19 95% confidence level, and 5% margin of error. The final sample size, including the non-response rate, included 420 mothers. Three hospitals were selected, using the lottery method. According to recent monthly data from the three hospitals, a total of 1,621 mothers with neonates attended follow-up and immunization clinics, and this was taken as a sampling frame. The total sample size for each hospital was allocated proportionally based on the sampling frame (GMH, N=650; TASH, N=536; Y12H,
135 N=435). Therefore, 168 mothers from GMH, 139 mothers from TASH, and 113 mothers from Y12H were selected using systematic random sampling at k =3 intervals.

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**Study variables**

138 The study variable was sunlight exposure practice, and the independent variables included sociodemographic factors such as age, marital status, educational status, occupation of the mother, neonatal age, family size (number of individuals in the family), place of residence, type of housing, household income, maternal and neonatal-related factors such as ANC follow-up, place of delivery, gestational age, birth weight, mothers’ knowledge, and fear of sunlight exposure.

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**Data collection tool and procedure**

146 Data were collected using the Amharic version of an adapted questionnaire with face-to-face interviews. The questionnaire was first written in English, translated into Amharic versions, and re-translated into English by language experts to ensure consistency. The data collection tool was adapted after an extensive review of the literature on this area. The sociodemographic and maternal and neonatal factors of the mothers were documented using 14 items. Mothers’ knowledge of sunlight exposure was measured using 7 items. Participants who scored above the median value on the mother’s knowledge of the sunlight exposure tool were categorized as having good knowledge. Neonatal sunlight exposure was measured using 10 self-reported items. Participants who responded correctly to all practice questions on the practice questionnaire were considered as having good practice and those who had scored less than or equal to 9 were considered as having poor practice.
The questionnaire was administered to experts to check content validity and accuracy. Data were collected by four trained nurses from other health facility units. Moreover, the completeness of the questionnaire and quality of data collection were checked daily by supervisors, and detailed feedback was provided to the data collectors.

Data processing and analysis

The data were checked, coded, and entered into Epi-Data version 4.6 and exported to SPSS Version 26 software for analysis. Descriptive data were reported as frequencies and percentages. A bivariate logistic regression analysis model was used to identify factors associated with neonatal sunlight exposure. Variables with a p-value < 0.25 in the bivariate logistic regression were entered into a multivariable logistic regression analysis. A multivariate logistic regression model was used to identify the association between the independent variables and neonatal sunlight exposure. In the multivariable logistic regression analysis, the statistical significance of associations between independent variables and the practice of neonatal sunlight exposure was determined using odds ratios with a 95% confidence interval and p-values < 0.05.

Patient and Public Involvement

Patients and the public were not involved in the design, conduct, reporting, or dissemination plan of this study.

RESULTS

Socio-demographic characteristics of participants
A total of 420 mothers participated in the study, with a 100% response rate. The mean age of the participants was 28.8 ±5.61 years. Most participants were married (n=398, 94.8%) and residing in urban areas (n=398, 94.8%). More than half of them, 225 (53.6%) were housewives, and 267 (63.6%) had secondary or above educational status. Half of the participants, 210 (50%), had family members of 4-6 and 334 (79.5%) were living in a compound/villa house. The majority of husbands of participants, 304 (72.4%), had secondary or higher educational status (Table 1).

### Table 1. Socio-demographic characteristics of the study participants (n=420)

| Variables                      | Category                  | Frequency (n) | Percent (%) |
|--------------------------------|---------------------------|---------------|-------------|
| Age of mothers                 | ≤24 years                 | 93            | 22.1        |
|                                | 25-29 years               | 151           | 36.0        |
|                                | 30-34 years               | 102           | 24.3        |
|                                | ≥35 years                 | 74            | 17.6        |
| Neonatal (postnatal) age       | <15 days                  | 174           | 41.4        |
|                                | ≥15 days                  | 246           | 58.6        |
| Marital status of mothers      | Unmarried                 | 22            | 5.2         |
|                                | Married                   | 398           | 94.8        |
| Mothers' educational status    | No education              | 41            | 9.8         |
|                                | Primary education         | 112           | 26.7        |
|                                | Secondary and above       | 267           | 63.6        |
| Occupation status of mothers   | Housewife                 | 225           | 53.6        |
|                                | Govt. employee            | 89            | 21.2        |
|                                | Private employee          | 75            | 17.9        |
|                                | Merchant                  | 31            | 7.4         |
| Family size                    | 1-3                       | 184           | 43.8        |
|                                | 4-6                       | 210           | 50.0        |
|                                | ≥7                        | 26            | 6.2         |
| Residence                      | Rural                     | 22            | 5.2         |
|                                | Urban                     | 398           | 94.8        |
| Type of housing                | Condominium/Apartments    | 86            | 20.5        |
|                                | Compound house (villa)    | 334           | 79.5        |
| Household monthly income in ETB| ≤1800                     | 90            | 21.4        |
|                                | 1801-3800                 | 102           | 24.3        |
|                                | 3801-7500                 | 122           | 29.0        |
|                                | ≥7501                     | 106           | 25.2        |
| Husband’s educational status   | No formal education       | 29            | 6.9         |
|                                | Primary education         | 87            | 20.7        |
|                                | Secondary & above         | 304           | 72.4        |

ETB: Ethiopian Birr, Govt.: government
Maternal and neonatal related factors of participants

Most of the participants, 410 (97.6%), had ANC follow-up and three-fourths of the participants, and 306 (72.9%) delivered their neonates in hospitals. More than two-thirds of neonates, 287 (68.3%) were at term (37-42 weeks) gestational ages, and the majority of neonates, 301 (71.7%) had a birth weight of $\geq 2.5$ kg at the time of delivery (Table 2).

Table 2. Maternal and neonatal-related factors of the study participants (n=420)

| Variables                 | Category | Frequency (n) | Percent (%) |
|---------------------------|----------|---------------|-------------|
| Antenatal care visit      | Yes      | 410           | 97.6        |
|                           | No       | 10            | 2.4         |
| Number of antenatal care  | 1-3      | 163           | 39.8        |
| visits (n=410)            | $\geq 4$ | 247           | 60.2        |
| Place of delivery         | Home     | 7             | 1.7         |
|                           | Health center | 104 | 24.8        |
|                           | Hospital  | 306           | 72.9        |
|                           | Other     | 3             | 0.7         |
| Gestational age           | $<37$ weeks | 107  | 25.5        |
|                           | 37-42 weeks | 287 | 68.3        |
|                           | $\geq 42$ weeks | 16 | 3.8         |
|                           | Unknown   | 10            | 2.4         |
| Birth weight              | $< 2.5$ Kg | 115  | 27.4        |
|                           | $\geq 2.5$ Kg | 301 | 71.7        |
|                           | Unknown   | 4             | 1.0         |

Participants’ knowledge, fear, and practice of neonatal sunlight exposure

Most participants (388 [92.4 %]) had information about neonatal sunlight exposure. The majority of the participants, 258 (66.5%), heard about the sunlight exposure of neonates from midwives/nurses. Most participants (380 [97.9 %]) knew the benefits of neonatal sunlight exposure. The majority of the participants identified vitamin D (n=235, 67.1%). Of the participants, 365 (94.1%) reported good time to expose neonates in the morning. More than half
of the participants (245 [58.3 %]) feared exposing their neonates to sunlight. Of the total
participants, 181 (43.1%) had good knowledge and 114 (27.1%) practiced good neonatal sunlight
exposure (Table 3).

Table 3. Knowledge, fear, and practice of neonatal sunlight exposure of the study participants
(n=420)

| Variables                                      | Category                  | Frequency (n) | Percent (%) |
|------------------------------------------------|---------------------------|---------------|-------------|
| Had information about sunlight exposure        | Yes                       | 388           | 92.4        |
|                                                | No                        | 32            | 7.6         |
| Source of information about sunlight exposure  | Physician                 | 173           | 44.6        |
| (n=388)                                        | Midwife/nurse             | 258           | 66.5        |
|                                                | Television/radio          | 17            | 4.4         |
|                                                | Neighbors/elder people    | 105           | 27.1        |
| Is sunlight exposure beneficial?               | Yes                       | 380           | 97.9        |
| (n=388)                                        | No                        | 8             | 2.1         |
| The benefit of sunlight exposure (n=380)       | Strengthen bone           | 252           | 66.3        |
|                                                | Strengthen teeth          | 6             | 1.6         |
|                                                | Keep child warm           | 73            | 11.3        |
|                                                | Produce vitamin D         | 235           | 67.1        |
|                                                | Strengthen body           | 160           | 42.1        |
| Is sunlight exposure harmful?                  | Yes                       | 190           | 49.0        |
| (n=388)                                        | No                        | 198           | 51.0        |
| The harmful effect of sunlight exposure (n=190)| Skin cancer               | 37            | 19.5        |
|                                                | Sterility                 | 80            | 42.1        |
|                                                | Blindness                 | 104           | 54.7        |
| A good time to expose neonates (n=388)         | Morning                   | 365           | 94.1        |
|                                                | Afternoon                 | 13            | 3.4         |
|                                                | Evening                   | 66            | 17.0        |
| Mothers fear sunlight exposure                 | Yes*                      | 245           | 58.3        |
|                                                | No                        | 175           | 41.7        |
| Knowledge                                      | Good knowledge            | 181           | 43.1        |
|                                                | Poor knowledge            | 239           | 56.9        |
| Practice                                       | Good practice             | 114           | 27.1        |
|                                                | Poor practice             | 306           | 72.9        |

* Sickness, evil eye, cold

Factors associated with the participants' practice of neonatal sunlight exposure

In univariate logistic regression, neonatal age, educational status, occupation and marital status
of the mother, family size, type of housing, educational status of the husband, ANC follow-up,
gestational age, birth weight, mother’s knowledge, and fear of sunlight exposure were significantly associated with practice. However, in the multiple logistic regression analysis, neonatal age, family size, type of housing, ANC follow-up, gestational age, mothers’ knowledge, and fear of sunlight exposure had a statistically significant association with practice. Mothers who had neonates aged 16-28 days (AOR=1.99, 95% CI: 1.15-3.44) were two times more likely to have good practice than mothers who had neonates aged < 15 days. Mothers who had family of 4-6 members (AOR=1.86, 95% CI: 1.08-3.21) and greater than or equal to 7 (AOR=4.43, 95% CI: 11.54-12.78) were 1.86 and 4.43 times more likely to have good practices, respectively, compared to those who had family members of 1-3. Mothers who lived in compound/villa houses (AOR=2.59, 95% CI: 1.26-5.33) were 2.6 times more likely to have good practices than those who lived in condominiums/apartment houses. Mothers who had complete ANC follow-up (≥4 times) (AOR=2.79, 95% CI: 1.49-5.22) were 2.79 times more likely to have good practice compared to those who had incomplete ANC follow-up. Mothers who delivered at term (AOR=2.54, 95% CI: 1.06-6.07) were 2.54 times more likely to have good practice compared to those who delivered before term. Mothers who had good knowledge of sunlight exposure were 40% more likely to have good practices compared to their counterparts (AOR=0.40, 95% CI: 0.23-0.71). Mothers who did not have fear of sunlight exposure (AOR=1.83, 95% CI: 1.08-3.12) were 1.83 times more likely to have good practice than those who had fear of sunlight exposure in their neonates (Table 4).
Table 4. Factors associated with the practice of neonatal sunlight exposure of the study participants (n=420)

| Variables                      | Category       | Practice | COR (95%CI) | AOR (95%CI) |
|--------------------------------|----------------|----------|-------------|-------------|
|                                |                | Good     | Poor        |             |
| Neonatal age                   | 0-15 days      | 39       | 135         | 1           | 1           |
|                                | 16-28 days     | 75       | 171         | 1.73(1.11-2.71) | 1.99(1.15-3.44)* |
| Educational status of the mother| No formal Ed   | 7        | 34          | 1           | 1           |
|                                | Primary Educ.  | 19       | 93          | 0.99(0.38-2.57) | 0.61(0.20-1.86) |
|                                | Secondary & above | 88      | 179         | 2.39(1.02-5.60) | 1.07(0.36-3.19) |
| Occupation of mother           | Housewife      | 45       | 180         | 1           | 1           |
|                                | Government employee | 36    | 53          | 2.72(1.59-4.64) | 1.49(0.74-3.02) |
|                                | Private employee | 30      | 45          | 2.67(1.51-4.69) | 0.93(0.45-1.93) |
|                                | Merchant        | 3        | 28          | 0.43(0.13-1.47) | 0.34(0.08-1.44) |
| Marital status of the mother   | Unmarried      | 2        | 20          | 1           | 1           |
|                                | Married        | 112      | 286         | 3.92(0.90-17.03) | 1.80(0.35-9.20) |
| Family size                    | 1-3            | 35       | 149         | 1           | 1           |
|                                | 4-6            | 65       | 145         | 1.91(1.19-3.05) | 1.86(1.08-3.21)* |
|                                | ≥7             | 14       | 12          | 4.97(2.11-11.67) | 4.43(1.54-12.78)* |
| Type of housing                | Condominium/apartment | 14   | 72          | 1           | 1           |
|                                | Compound/villa | 100     | 234         | 2.19(1.18-4.08) | 2.59(1.26-5.33)* |
| Educational status of husband  | No formal ed   | 4        | 25          | 1           | 1           |
|                                | Primary ed     | 13       | 77          | 1.06(0.32-3.53) | 0.63(0.16-2.42) |
|                                | Secondary & above | 97    | 204         | 2.97(1.01-8.78) | 1.64(0.45-5.99) |
| ANC follows-up                 | 1-3 times      | 21       | 142         | 1           | 1           |
|                                | ≥4 times       | 93       | 154         | 4.08(2.41-6.91) | 2.79(1.49-5.22)* |
| Gestational age                | <37 weeks      | 13       | 98          | 1           | 1           |
|                                | 37-42 weeks    | 96       | 197         | 3.31(1.83-6.01) | 2.54(1.06-6.07)* |
|                                | ≥42 weeks      | 5        | 11          | 3.09(0.94-10.14) | 3.24(0.72-14.55) |
| Birth weight                   | <2.5 kg        | 19       | 96          | 1           | 1           |
|                                | ≥2.5 kg        | 95       | 206         | 1.93(1.11-3.35) | 1.42(0.59-3.39) |
| Knowledge                      | Good           | 38       | 143         | 1           | 1           |
|                                | Poor           | 76       | 163         | 0.57(0.36-0.89) | 0.40(0.22-0.70)* |
| Fear of sunlight exposure      | Yes            | 54       | 188         | 1           | 1           |
|                                | No             | 60       | 118         | 1.77(1.15-2.73) | 1.83(1.08-3.12)* |

*p-value <0.05; AOR: adjusted odds ratio; COR: crude odds ratio; CI: confidence interval

DISCUSSION

This study explored the practices and factors associated with neonatal sunlight exposure among mothers attending governmental hospitals in Addis Ababa, Ethiopia, and found that 27.1% of mothers practiced good neonatal sunlight exposure. The findings of this study were lower than those of studies conducted in Ethiopia in the South Gondar zone (54.3%), Debre Markos town...
(44.6%)\textsuperscript{18} Debre Berhan town (34.3%),\textsuperscript{20} and Aleta Wondo town (32.6%).\textsuperscript{21} The possible reason might be due to differences in housing type, family size, and mothers' fear of sunlight exposure. In this study, the majority of mothers were living in condominiums/apartments, had low family sizes, and had a fear of sunlight exposure to their neonates. In addition, a possible reason might be the cutoff point of the tool used to measure mothers' practice of neonatal sunlight exposure. The other studies used the median value as the cut-off point, and the participants who responded correctly above the median value were classified as having good practice, but in this study, participants who responded correctly to all practice questions were classified as having good practice.

This study found that neonatal age, family size, type of housing, ANC follow-up, gestational age, mothers’ knowledge, and fear of sunlight exposure were associated with mothers’ practice. This study revealed that mothers who had neonates of advanced age (16-28 days) had good practices compared to those who had neonates of an earlier age (≤15 days). This finding was different from those of studies conducted in Debre Markos town, Aleta Wondo town, and the South Gondar zone.\textsuperscript{18, 19, 21} This discrepancy might be due to differences in cultural beliefs, in which mothers fear exposure to neonates aged less than 15 days for different reasons, such as evil eye, cold, and other cultural reasons. Therefore, mothers who have a neonatal age of ≤15 days require special care when designing interventions aimed at increasing their practice of neonatal sunlight exposure.

This study shows that mothers who had higher family sizes had better practices than those who had lower family sizes. This finding is consistent with other studies conducted in Ethiopia.\textsuperscript{18, 19} The scientific explanation might be due to mothers who had low family sizes, especially primipara mothers' lack of experience in the practice of neonatal sunlight exposure. Thus,
mothers with smaller family sizes may require educational provision during follow-up to improve their practice of neonatal sunlight exposure.

Our study shows that mothers who lived in compound/villa houses had better practices compared to those who lived in condominiums/apartment houses. This might be related to the fact that condominiums/apartment houses are very crowded with many populations and do not have lifts and fences, and mothers might fear evil eye and fall accidents. This study showed that mothers who had complete ANC follow-up (≥4 times) had good practice compared to mothers who had lower ANC follow-up. This might be because when ANC visits are regular and complete, the mother has adequate knowledge and practices of neonatal sunlight exposure. Therefore, encouraging mothers to have regular and complete ANC follow-ups is important to improve their practices of neonatal sunlight exposure.

This study also shows that mothers who delivered at term had good practice compared to mothers who delivered before term. The scientific explanation for this might be that sunlight exposure to premature and low-birth-weight neonates is controversial, and most preterm babies stay at the hospital for the treatment of different preterm complications. In this study, knowledge was another modifiable factor associated with the mothers’ practice of neonatal sunlight exposure. Mothers who had poor knowledge about neonatal sunlight exposure had poorer practice than those who had good knowledge. This finding was similar to those of other studies conducted in Ethiopia. This might be related to the fact that mothers who know well and practice neonatal sunlight exposure may perform more practice than mothers who do not know. Future studies are required to identify the effects of knowledge on neonatal sunlight exposure among mothers.
In this study, we found that mothers who did not fear exposing their neonates practiced better than those who had feared. This finding is consistent with other studies conducted in Ethiopia. The mothers’ fear of sunlight exposure to the neonates might be related to their poor knowledge about sunlight exposure, as the majority of the participants in this study had poor knowledge about sunlight exposure. Knowledge is very important for the practice of neonatal sunlight exposure, as it decreases the fear of neonatal exposure to sunlight. Therefore, emphasis should be placed on those mothers when preparing educational interventions during follow-up to improve the practice of neonatal sunlight exposure by increasing knowledge about neonatal sunlight exposure.

**Conclusion**

This study revealed that 27.1% of mothers had good sunlight exposure practices. Advanced neonatal age, having a higher family size, living in compound/villa houses, having complete ANC visits, and having term delivery were associated with good sunlight exposure practice, whereas poor knowledge and fear of sunlight exposure were associated with poor sunlight exposure practice. Therefore, interventions focusing on these findings are required to improve the practice of neonatal sunlight exposure.

**Abbreviations**

ANC: antenatal care; AOR: Adjusted Odd Ratio; COR: Crude Odd Ratio; GMH: Gandhi memorial hospital; NMSC: nonmelanoma skin cancer; TASH: Tikur Anbessa Specialized Hospital; UV: Ultraviolet; UV-B: Ultraviolet B; VDD: Vitamin D deficiency; WHO: World Health Organization; Y12H: Yekatit 12 hospital
Supplementary statement

Supplementary file 1. Sample size, sampling procedure, and questionnaires.

DECLARATIONS

Ethics approval and consent to participate

Ethical clearance was obtained from the Institutional Review Board of Addis Ababa University, College of Health Sciences, School of Nursing, and Midwifery, with a 011/20/SNM reference number. A formal letter was obtained from Addis Ababa Public Health Research and Emergency Management to obtain permission to conduct this study. Written informed consent was obtained from each participant after explaining the purpose and procedures of the study. The privacy and confidentiality of the study participants were maintained by anonymizing the questionnaire and protecting our personal computers with a strong password.

Consent for publication

Not applicable

Availability of data and materials

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

Competing interests

The authors declare that they have no conflict of interest. The author acknowledges that this paper was available on the Addis Ababa University website as a thesis in June 2020.28

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Authors’ Contributions

YA conceptualized and designed the study; collected, analyzed, and interpreted the data; and drafted the manuscript. GT, DG, and MK were involved in data analysis, drafting of the manuscript, and advising the entire research paper. They were also involved in the interpretation of the data and contributed to manuscript preparation. All authors have read and approved the final manuscript.

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Attitudes of mothers attending public hospitals in Addis Ababa, Ethiopia, to neonatal sunlight exposure: a cross-sectional study.

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Sample size calculation for mothers attending public hospitals, Addis Ababa, Ethiopia, 2020.

The sample size was calculated using the single population proportion formula considering the following assumptions; the prevalence of mothers' practice of neonatal sunlight exposure is 45.7% as done in South Gondar Zone, North West Ethiopia among mothers, 95% confidence level, and 5% margin of error.

\[
\text{Sample size (n)} = \frac{Z^2 \times p(1-p)}{d^2}
\]

\[
\begin{align*}
\text{n} &= \frac{1.96^2 \times 0.457 \times 0.543}{0.05^2} \\
\text{n} &= 381
\end{align*}
\]

Where \( Z \) = critical value for normal distribution at 95% confidence level which equals to 1.96 (\( z \) value at \( \alpha =0.05 \))

\( n \) = Sample

\( p \) = prevalence of mothers' practice of neonatal sunlight exposure.

\( d \) = Margin of error=5%=0.05

Adding 10% of the non-respondent rate, the final sample size was 420.
Schematic presentation of the sampling procedure for mothers attending public hospitals, Addis Ababa, Ethiopia, 2020.

Public hospitals in Addis Ababa having follow-up clinic and EPI clinic

Simple random sampling

Three selected public hospitals in Addis Ababa having follow up clinic and EPI clinic

GMH=650
Mothers with newborns attending follow up clinic and EPI Clinic

By using proportional to size allocation formula

\[ \frac{n_f \times NGM}{N} = \frac{420 \times 650}{1,621} = 168 \]

TASH=536
Mothers with newborns attending Follow up clinic and EPI Clinic

\[ \frac{n_f \times NTASH}{N} = \frac{420 \times 536}{1,621} = 139 \]

Y12HMC=435
Mothers with newborns attending Follow up clinic and EPI Clinic

\[ \frac{n_f \times NY12HMC}{N} = \frac{420 \times 435}{1,621} = 113 \]

Systematic sampling techniques

Total sample size =420
### English Version Questionnaires

**Part I - Questions related to Socio-demographic information**

**Instruction:** Socio-demographic characteristics of the study participants in public hospitals, Addis Ababa, Ethiopia, 2020.

| No. | Questions                                      | Coding categories                                                                 |
|-----|------------------------------------------------|------------------------------------------------------------------------------------|
| 101 | Mother’s age                                   | ________ years                                                                     |
| 102 | Neonatal/postnatal/ age                        | ________ days                                                                      |
| 103 | Marital status                                 | 1. Single                                                                         |
|     |                                                | 2. Married                                                                        |
|     |                                                | 3. Divorced                                                                       |
|     |                                                | 4. Widowed                                                                        |
|     |                                                | 5. Others ______________                                                            |
| 104 | Mother’s educational status                    | 1. No formal learning                                                              |
|     |                                                | 2. Grade 1 -8                                                                     |
|     |                                                | 3. Grade 9th -12                                                                  |
|     |                                                | 4. College Diploma                                                                |
|     |                                                | 5. University Degree and Above                                                    |
| 105 | Occupation                                     | 1. Student                                                                        |
|     |                                                | 2. Housewife                                                                      |
|     |                                                | 3. Government employee                                                            |
|     |                                                | 4. Private employee                                                               |
|     |                                                | 5. Daily laborer                                                                  |
|     |                                                | 6. Merchant                                                                       |
|     |                                                | 7. Others ______________                                                            |
| 106 | Residency                                      | 1. Urban                                                                          |
|     |                                                | 2. Rural                                                                          |
| 107 | Type of housing designs                        | 1. Compound House (villa)                                                         |
|     |                                                | 2. Condominium/ Apartments                                                        |
|     |                                                | 3. Other specify __________                                                        |
| 108 | Family size                                    | __________                                                                        |
| 109 | Monthly income                                 | __________ Ethiopian birr                                                           |
| 110 | Husband’s educational status                   | 1. No formal learning                                                              |
|     |                                                | 2. Grade 1 -8                                                                     |
|     |                                                | 3. Grade 9th -12                                                                  |
|     |                                                | 4. College Diploma                                                                |
|     |                                                | 5. University Degree and Above                                                    |
Part II: Maternal and neonatal factors related to the mother's practice of sunlight exposure of their neonates in public hospitals, Addis Ababa, Ethiopia, 2020.

| No. | Questions                                           | Coding categories | Skip to |
|-----|-----------------------------------------------------|-------------------|---------|
| 201 | ANC visit                                           | 1. Yes            |         |
|     |                                                     | 2. No             |         |
| 202 | Number of visits                                    | _______________number |         |
| 203 | Place of delivery                                   | 1. Home           |         |
|     |                                                     | 2. Health center  |         |
|     |                                                     | 3. Hospital       |         |
|     |                                                     | 4. Others ___________ |         |
| 204 | Gestational Age                                     | _______________in wks. |         |
| 205 | Birth weight                                        | ___________in kg |         |

Part III- Knowledge of mothers on sunlight exposure of their neonates in public hospitals, Addis Ababa, 2020.

| No. | Questions                                           | Coding categories | Skip to |
|-----|-----------------------------------------------------|-------------------|---------|
| 301 | Do you know about sunlight exposure                 | 1. Yes            | 401     |
|     |                                                     | 2. No             |         |
| 302 | Source of information about sunlight exposure       | 1. Physician      |         |
|     | (Circle more than one)                              | 2. Midwife/nurse  |         |
|     |                                                     | 3. Television/radio |       |
|     |                                                     | 4. Neighbors/elder people |   |
|     |                                                     | 5. Others ___________ |       |
| 303 | Does sunlight exposure beneficial?                  | 1. Yes            | 305     |
|     |                                                     | 2. No             |         |
| 304 | The benefit of sunlight exposure (Circle more than one) | 1. Strengthen bone |         |
|     |                                                     | 2. Strengthen teeth |       |
|     |                                                     | 3. Keep the child warm |       |
|     |                                                     | 4. Produce vitamin D |       |
|     |                                                     | 5. Strengthen the body |       |
|     |                                                     | 6. Others ___________ |       |
| 305 | Does sunlight exposure harmful                      | 1. Yes            |         |
|     |                                                     | 2. No             |         |
| 306 | The harmful effect of sunlight exposure (Circle more than one) | 1. Skin cancer |         |
|     |                                                     | 2. Sterility      |         |
|     |                                                     | 3. Blindness      |         |
|     |                                                     | 4. Others ___________ |       |
### Part IV- Other factors affecting the practice of mothers on sunlight exposure of their neonate among public hospitals, Addis Ababa, Ethiopia, 2020.

| No | Questions                                                                                           | Code categories                                                                 |
|----|------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| 501 | Do you have a fear to expose your baby to sunlight?                                                   | 1. Yes                                                                          |
|    |                                                                                                      | 2. No                                                                           |
| 502 | Mother’s fear of sunlight exposure (Circle more than one)                                             | 1. Sickness                                                                     |
|    |                                                                                                      | 2. Evil eye                                                                     |
|    |                                                                                                      | 3. Cold                                                                         |
|    |                                                                                                      | 4. Other specify__________                                                       |

### Part V- Practices of mothers on sunlight exposure of their neonates in public hospitals, Addis Ababa, Ethiopia, 2020.

| No | Questions                                                                                           | Coding categories                                                                 |
|----|------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| 401 | Do you expose your neonate on sunlight?                                                             | 1. Yes                                                                          |
|    |                                                                                                      | 2. No                                                                           |
| 402 | Age of the newborns to start sunlight exposure                                                      |                                                                                  |
| 403 | How frequently do you expose?                                                                     | 1. Daily                                                                        |
|    |                                                                                                      | 2. Sometimes                                                                    |
| 404 | Where do you expose your neonate on sunlight                                                        | 1. Outdoor                                                                       |
|    |                                                                                                      | 2. Indoor                                                                       |
| 405 | At what time of the day do you expose your baby outdoors? (Circle more than one)                    | 1. Morning 8-10 AM                                                              |
|    |                                                                                                      | 2. Mid-day 11 AM-1 PM                                                           |
|    |                                                                                                      | 3. Afternoon 2-4 PM                                                             |
| 406 | Condition of clothing during exposure                                                               | 1. Unclothed                                                                    |
|    |                                                                                                      | 2. With diapers and eye protection only                                          |
|    |                                                                                                      | 3. Partly covered                                                               |
|    |                                                                                                      | 4. Completely covered                                                           |
| 407 | For how many minutes do you expose your neonate on sunlight?                                        |                                                                                  |
| 408 | Do you apply lubricants to your neonate body during sunlight exposure?                               | 1. Yes                                                                          |
|    |                                                                                                      | 2. No                                                                           |
|   | If you apply, when do you apply? (Circle more than one) | 1. Before exposure  
2. During exposure  
3. After exposure |
|---|--------------------------------------------------------|----------------------------------------------------------|
| 409 | What things do you apply? | 1. Baby Vaseline  
2. Baby lotion  
3. Butter  
4. Other_____________ |
**Attitudes of mothers attending public hospitals in Addis Ababa, Ethiopia, to neonatal sunlight exposure: a cross-sectional study.**

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Attitudes of mothers attending public hospitals in Addis Ababa, Ethiopia, to neonatal sunlight exposure: a cross-sectional study

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ABSTRACT

Background: Sunlight exposure helps the body produce vitamin D, prevents rickets, and is used for neonatal jaundice treatment. Good neonatal sunlight exposure is exposing the neonate to sunlight in the morning, 8 a.m. to 10 a.m., for 30 to 60 minutes. However, little is known about the practice of neonatal sunlight exposure among mothers in Ethiopia. This study aimed to assess the practices and factors associated with neonatal sunlight exposure among mothers attending public hospitals in Addis Ababa, Ethiopia.

Methods: An institution-based cross-sectional study was conducted among 420 mothers attending public hospitals in Addis Ababa. Study participants were selected using a systematic random sampling method. The collected data were entered into Epi-data version 4.6 and exported to SPSS version 26 for analysis. Descriptive and logistic regression analyses were conducted.

Results: The practice of neonatal sunlight exposure among mothers was 27.1%. Neonatal age of 16-28 days (adjusted odds ratio [AOR]=1.99, 95% confidence interval [CI]: 1.15-3.44), family member 4-6 (AOR=1.86, 95%CI: 1.08-3.21) and ≥7 (AOR=4.43, 95%CI: 1.54-12.78), living in compound/villa houses (AOR=2.59, 95%CI: 1.26-5.33), complete antenatal care (ANC) follow-up (AOR=2.79, 95%CI: 1.49-5.22), delivery at term (AOR=2.54, 95%CI: 1.06-6.07), poor knowledge of sunlight exposure (AOR=0.40, 95%CI: 0.23-0.71), and no fear of sunlight exposure (AOR=1.83, 95%CI: 1.08-3.12) were factors associated with the practice of neonatal sunlight exposure.

Conclusion: This study revealed that 27.1% of mothers had good sunlight exposure. Advanced neonatal age, larger family, living in compound/villa houses, complete ANC visits, and term delivery were associated with good practices, whereas poor knowledge and fear of sunlight
exposure were associated with poor practices. Therefore, interventions focusing on these findings are required to improve the practice of neonatal sunlight exposure.

**Keywords:** Sunlight exposure, neonate, practice, knowledge, Addis Ababa, Ethiopia

**WHAT IS ALREADY KNOWN ON THIS TOPIC**

- Sunlight exposure has a lot of health benefits for newborns and infants.
- Adequate exposure of the neonate to sunshine requires exposure of the neonate to sunlight in the morning, 8-10 a.m., for 30-60 minutes.
- Inadequate exposure of neonates to sunshine leads to vitamin D deficiency, and jaundice are common health problems worldwide.

**WHAT THIS STUDY ADDS**

- Advanced neonatal age, higher family size, living in compound/villa houses, complete ANC visits, and term delivery were associated with good practice of neonatal sunlight exposure.
- Poor knowledge of and fear for sunlight exposure are associated with poor neonatal sunlight exposure.

**HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE, OR POLICY**

- Interventions focused on mothers’ knowledge of sunlight exposure (fear of sunlight, neonatal age, and ANC follow-up) are required to improve the practice of neonatal sunlight exposure.
INTRODUCTION

Sunlight exposure has many health benefits for newborns and infants. It helps the body produce vitamin D, preventing rickets in children, and is used to treat neonatal jaundice during the neonatal period. Vitamin D everyday requirements can be obtained by 30 to 60 minutes of exposure to sunlight in the morning. Vitamin D plays a vital role in bone metabolism through regulation of calcium and phosphate homeostasis. Exposure of neonatal skin to sunlight in the morning is significant to producing nocturnal melatonin sooner, which helps them sleep better. Morning sunlight exposure supports the neonatal physiological system to break down indirect bilirubin.

Timely and proper practice of neonatal sunlight exposure by mothers has many health benefits for neonates. The inadequate practice of exposure of neonates to sunshine by mothers leads to vitamin D deficiency, and jaundice is a common health problem in many developing countries, especially in sub-Saharan African countries such as Ethiopia.

Ultraviolet (UV) radiation weakens the immune system. Skin dendritic cells are damaged by UV-B rays, which also cause regulatory T cells to generate the immunosuppressive cytokine IL-10. Pyrimidine dimerization and DNA strand breaks are induced by UV light. Additional effects of UV radiation include externalization of nuclear antigens on cell surfaces and production of neoantigens, which can exacerbate autoimmune illnesses such as lupus. Another problem associated with chronic UV radiation exposure is photoaging. Numerous epidemiological research showed that sunlight exposure is one of the primary risk factors for the development of melanoma and nonmelanoma skin cancer (NMSC). This risk is greatest in the white population, indicating that melanin has a protective effect. It has also been discovered that
exposure to UV rays during childhood increases the risk of developing skin cancer compared to exposure later in life.\textsuperscript{12}

In Middle East Asia, such as the northern parts of China, Mongolia, and Afghanistan, mothers’ practice of sunlight exposure for neonates is poor. As a result, most neonates develop vitamin D deficiency and rickets.\textsuperscript{6,13} In Ethiopia, shortage of exposure to sunlight and inadequate vitamin D consumption are the main causes of rickets among children. According to a study conducted in Addis Ababa, Ethiopia, 41\% of children under 3 years of age had vitamin D deficiency rickets, and the incidence was higher among infants.\textsuperscript{14} A study conducted in Jimma, Ethiopia, showed that 10.5\% of children under 5 years of age had rickets, with the main identified causes being lack of exposure to sunlight and inadequate intake of vitamin D, and the highest rate (11\%) occurred in infants.\textsuperscript{15-17}

Although daily sunlight exposure remains the cheapest, safest, and most effective method of prevention of rickets, significant numbers of children are not properly exposed to sunlight. According to recent studies in Ethiopia among mothers, 55.4\% in Debre Markos town, 52\% in the south Gondar zone, and 34.3\% in Debre Berhan town had poor practice of exposing neonates to sunlight.\textsuperscript{18-20} Numerous factors may be associated with the practice of neonatal sunlight exposure among mothers. These factors include sociodemographic factors such as age, marital status, educational status, occupation of mother, neonatal age, family size, place of residence, type of housing, educational status of the husband, household monthly income,\textsuperscript{18-24} maternal and neonatal-related factors such as antenatal care (ANC) follow-up, place of delivery, gestational age, birth weight, mother’s knowledge \textsuperscript{13, 16, 17, 21, 23, 25} and fear of sunlight exposure.\textsuperscript{16, 18, 19, 21, 26}

However, little is known about the practice of neonatal sunlight exposure among mothers in
Ethiopia. Thus, this study aimed to assess the practices and factors associated with neonatal sunlight exposure among mothers visiting public hospitals in Addis Ababa, Ethiopia, 2020.

METHODS

Study area, design, and population

This institutional-based cross-sectional study was conducted from March 18 to April 30, 2020, in three public hospitals in Addis Ababa town, Ethiopia: Gandhi Memorial Hospital (GMH), Tikur Anbessa Specialized Hospital (TASH), and Yekatit 12 Hospital (Y12H). All mothers with neonates and those attending follow-up and immunization clinics were included, except those who had neonates above one month of age and were unable to communicate during the study period.

Sample size determination and Sampling procedure

The single population proportion formula was used to calculate the sample size based on the following assumptions: the prevalence of mothers' practice of neonatal sunlight exposure was 45.7%, as done in South Gondar Zone, Ethiopia,\(^{19}\) 95% confidence level, and 5% margin of error. The final sample size, including the non-response rate, included 420 mothers. Three hospitals were selected, using the lottery method. According to recent monthly data from the three hospitals, a total of 1,621 mothers with neonates attended follow-up and immunization clinics, and this was taken as a sampling frame. The total sample size for each hospital was allocated proportionally based on the sampling frame (GMH, N=650; TASH, N=536; Y12H,
N=435). Therefore, 168 mothers from GMH, 139 mothers from TASH, and 113 mothers from Y12H were selected using systematic random sampling at k=3 intervals.

Study variables
The study variable was sunlight exposure practice, and the independent variables included sociodemographic factors such as age, marital status, educational status, occupation of the mother, neonatal age, family size (number of individuals in the family), place of residence, type of housing, household income, maternal and neonatal-related factors such as ANC follow-up, place of delivery, gestational age, birth weight, mothers’ knowledge, and fear of sunlight exposure.

Data collection tool and procedure
Data were collected using the Amharic version of an adapted questionnaire with face-to-face interviews. The questionnaire was first written in English, translated into Amharic versions, and re-translated into English by language experts to ensure consistency. The data collection tool was adapted after an extensive review of the literature on this area. The sociodemographic and maternal and neonatal factors of the mothers were documented using 14 items. Mothers’ knowledge of sunlight exposure was measured using 7 items. Participants who scored above the median value on the mother’s knowledge of the sunlight exposure tool were categorized as having good knowledge. Neonatal sunlight exposure was measured using 10 self-reported items. Participants who responded correctly to all practice questions on the practice questionnaire were considered as having good practice and those who had scored less than or equal to 9 were considered as having poor practice.
The questionnaire was administered to experts to check content validity and accuracy. Data were collected by four trained nurses from other health facility units. Moreover, the completeness of the questionnaire and quality of data collection were checked daily by supervisors, and detailed feedback was provided to the data collectors.

**Data processing and analysis**

The data were checked, coded, and entered into Epi-Data version 4.6 and exported to SPSS Version 26 software for analysis. Descriptive data were reported as frequencies and percentages. A bivariate logistic regression analysis model was used to identify factors associated with neonatal sunlight exposure. Variables with a p-value < 0.25 in the bivariate logistic regression were entered into a multivariable logistic regression analysis. A multivariate logistic regression model was used to identify the association between the independent variables and neonatal sunlight exposure. In the multivariable logistic regression analysis, the statistical significance of associations between independent variables and the practice of neonatal sunlight exposure was determined using odds ratios with a 95% confidence interval and p-values < 0.05.

**Patient and Public Involvement**

Patients and the public were not involved in the design, conduct, reporting, or dissemination plan of this study.

**RESULTS**

**Socio-demographic characteristics of participants**
A total of 420 mothers participated in the study, with a 100% response rate. The mean age of the participants was 28.8 ±5.61 years. Most participants were married (n=398, 94.8%) and residing in urban areas (n=398, 94.8%). More than half of them, 225 (53.6%) were housewives, and 267 (63.6%) had secondary or above educational status. Half of the participants, 210 (50%), had family members of 4-6 and 334 (79.5%) were living in a compound/villa house. The majority of husbands of participants, 304 (72.4%), had secondary or higher educational status (Table 1).

### Table 1. Socio-demographic characteristics of the study participants (n=420)

| Variables                        | Category      | Frequency (n) | Percent (%) |
|----------------------------------|---------------|---------------|-------------|
| Age of mothers                   | ≤24 years     | 93            | 22.1        |
|                                  | 25-29 years   | 151           | 36.0        |
|                                  | 30-34 years   | 102           | 24.3        |
|                                  | ≥35 years     | 74            | 17.6        |
| Neonatal (postnatal) age         | <15 days      | 174           | 41.4        |
|                                  | ≥15 days      | 246           | 58.6        |
| Marital status of mothers        | Unmarried     | 22            | 5.2         |
|                                  | Married       | 398           | 94.8        |
| Mothers' educational status      | No education  | 41            | 9.8         |
|                                  | Primary education | 112     | 26.7        |
|                                  | Secondary and above | 267    | 63.6        |
| Occupation status of mothers     | Housewife     | 225           | 53.6        |
|                                  | Govt. employee | 89            | 21.2        |
|                                  | Private employee | 75        | 17.9        |
|                                  | Merchant      | 31            | 7.4         |
| Family size                      | 1-3           | 184           | 43.8        |
|                                  | 4-6           | 210           | 50.0        |
|                                  | ≥7            | 26            | 6.2         |
| Residence                        | Rural         | 22            | 5.2         |
|                                  | Urban         | 398           | 94.8        |
| Type of housing                  | Condominium/Apartments | 86    | 20.5        |
|                                  | Compound house (villa) | 334  | 79.5        |
| Household monthly income in ETB  | ≤1800         | 90            | 21.4        |
|                                  | 1801-3800     | 102           | 24.3        |
|                                  | 3801-7500     | 122           | 29.0        |
|                                  | ≥7501         | 106           | 25.2        |
| Husband’s educational status     | No formal education | 29       | 6.9         |
|                                  | Primary education | 87        | 20.7        |
|                                  | Secondary & above | 304    | 72.4        |

ETB: Ethiopian Birr, Govt.: government
Maternal and neonatal related factors of participants

Most of the participants, 410 (97.6%), had ANC follow-up and three-fourths of the participants, and 306 (72.9%) delivered their neonates in hospitals. More than two-thirds of neonates, 287 (68.3%) were at term (37-42 weeks) gestational ages, and the majority of neonates, 301 (71.7%) had a birth weight of $\geq 2.5$ kg at the time of delivery (Table 2).

| Variables | Category | Frequency (n) | Percent (%) |
|-----------|----------|--------------|-------------|
| Antenatal care visit | Yes | 410 | 97.6 |
| | No | 10 | 2.4 |
| Number of antenatal care visits (n=410) | 1-3 | 163 | 39.8 |
| | $\geq 4$ | 247 | 60.2 |
| Place of delivery | Home | 7 | 1.7 |
| | Health center | 104 | 24.8 |
| | Hospital | 306 | 72.9 |
| | Other | 3 | 0.7 |
| Gestational age | $<37$ weeks | 107 | 25.5 |
| | 37-42 weeks | 287 | 68.3 |
| | $\geq 42$ weeks | 16 | 3.8 |
| | Unknown | 10 | 2.4 |
| Birth weight | $< 2.5$ Kg | 115 | 27.4 |
| | $\geq 2.5$ Kg | 301 | 71.7 |
| | Unknown | 4 | 1.0 |

Participants’ knowledge, fear, and practice of neonatal sunlight exposure

Most participants (388 [92.4%]) had information about neonatal sunlight exposure. The majority of the participants, 258 (66.5%), heard about the sunlight exposure of neonates from midwives/nurses. Most participants (380 [97.9%]) knew the benefits of neonatal sunlight exposure. The majority of the participants identified vitamin D (n=235, 67.1%). Of the participants, 365 (94.1%) reported good time to expose neonates in the morning. More than half
of the participants (245 [58.3 %]) feared exposing their neonates to sunlight. Of the total participants, 181 (43.1%) had good knowledge and 114 (27.1%) practiced good neonatal sunlight exposure (Table 3).

Table 3. Knowledge, fear, and practice of neonatal sunlight exposure of the study participants (n=420)

| Variables                                      | Category                  | Frequency (n) | Percent (%) |
|------------------------------------------------|---------------------------|---------------|-------------|
| Had information about sunlight exposure        | Yes                       | 388           | 92.4        |
| Source of information about sunlight exposure  | No                        | 32            | 7.6         |
| (n=388)                                        | Physician                 | 173           | 44.6        |
|                                                | Midwife/nurse              | 258           | 66.5        |
|                                                | Television/radio           | 17            | 4.4         |
|                                                | Neighbors/elder people     | 105           | 27.1        |
| Is sunlight exposure beneficial?               | Yes                       | 380           | 97.9        |
| (n=388)                                        | No                        | 8             | 2.1         |
| The benefit of sunlight exposure (n=380)       | Strengthen bone            | 252           | 66.3        |
|                                                | Strengthen teeth           | 6             | 1.6         |
|                                                | Keep child warm            | 73            | 11.3        |
|                                                | Produce vitamin D          | 235           | 67.1        |
|                                                | Strengthen body            | 160           | 42.1        |
| Is sunlight exposure harmful?                  | Yes                       | 190           | 49.0        |
| (n=388)                                        | No                        | 198           | 51.0        |
| The harmful effect of sunlight exposure (n=190)| Skin cancer               | 37            | 19.5        |
|                                                | Sterility                 | 80            | 42.1        |
|                                                | Blindness                 | 104           | 54.7        |
| A good time to expose neonates (n=388)         | Morning                   | 365           | 94.1        |
|                                                | Afternoon                 | 13            | 3.4         |
|                                                | Evening                   | 66            | 17.0        |
| Mothers fear sunlight exposure                 | Yes*                      | 245           | 58.3        |
|                                                | No                        | 175           | 41.7        |
| Knowledge                                      | Good knowledge            | 181           | 43.1        |
|                                                | Poor knowledge            | 239           | 56.9        |
| Practice                                       | Good practice             | 114           | 27.1        |
|                                                | Poor practice              | 306           | 72.9        |

* Sickness, evil eye, cold

Factors associated with the participants' practice of neonatal sunlight exposure

In univariate logistic regression, neonatal age, educational status, occupation and marital status of the mother, family size, type of housing, educational status of the husband, ANC follow-up,
gestational age, birth weight, mother’s knowledge, and fear of sunlight exposure were significantly associated with practice. However, in the multiple logistic regression analysis, neonatal age, family size, type of housing, ANC follow-up, gestational age, mothers’ knowledge, and fear of sunlight exposure had a statistically significant association with practice.

Mothers who had neonates aged 16-28 days (AOR=1.99, 95% CI: 1.15-3.44) were two times more likely to have good practice than mothers who had neonates aged < 15 days. Mothers who had family of 4-6 members (AOR=1.86, 95% CI: 1.08-3.21) and greater than or equal to 7 (AOR=4.43, 95% CI: 11.54-12.78) were 1.86 and 4.43 times more likely to have good practices, respectively, compared to those who had family members of 1-3. Mothers who lived in compound/villa houses (AOR=2.59, 95% CI: 1.26-5.33) were 2.6 times more likely to have good practices than those who lived in condominiums/apartment houses.

Mothers who had complete ANC follow-up (≥4 times) (AOR=2.79, 95% CI: 1.49-5.22) were 2.79 times more likely to have good practice compared to those who had incomplete ANC follow-up. Mothers who delivered at term (AOR=2.54, 95% CI: 1.06-6.07) were 2.54 times more likely to have good practice compared to those who delivered before term. Mothers who had good knowledge of sunlight exposure were 40% more likely to have good practices compared to their counterparts (AOR=0.40, 95% CI: 0.23-0.71). Mothers who did not have fear of sunlight exposure (AOR=1.83, 95% CI: 1.08-3.12) were 1.83 times more likely to have good practice than those who had fear of sunlight exposure in their neonates (Table 4).
Table 4. Factors associated with the practice of neonatal sunlight exposure of the study participants (n=420)

| Variables                  | Practice | Category                          | COR (95%CI)         | AOR (95%CI)       |
|---------------------------|----------|-----------------------------------|---------------------|-------------------|
|                           | Good     | Poor                              |                     |                   |
| Neonatal age              | 0-15 days| 39                                | 1                   | 1                 |
|                           | 16-28 days| 75                                | 1.73(1.11-2.71)     | 1.99(1.15-3.44)*  |
| Educational status of the mother | No formal Education | 7 | 34 | 1 | 1 |
|                           | Primary Educ. | 19 | 93 | 0.99(0.38-2.57) | 0.61(0.20-1.86) |
|                           | Secondary & above | 88 | 179 | 2.39(1.02-5.60) | 1.07(0.36-3.19) |
| Occupation of mother      | Housewife | 45 | 180 | 1 | 1 |
|                           | Government employee | 36 | 53 | 2.72(1.59-4.64) | 1.49(0.74-3.02) |
|                           | Private employee | 30 | 45 | 2.67(1.51-4.69) | 0.93(0.45-1.93) |
| Marital status of the mother | Unmarried | 2 | 20 | 1 | 1 |
|                           | Married | 112 | 286 | 3.92(0.90-17.03) | 1.80(0.35-9.20) |
| Family size               | 1-3      | 35 | 149 | 1 | 1 |
|                           | 4-6      | 65 | 145 | 1.91(1.19-3.05) | 1.86(1.08-3.21)* |
|                           | ≥7       | 14 | 12 | 4.97(2.11-11.67) | 4.43(1.54-12.78)* |
| Type of housing           | Condominium/apartment | 14 | 72 | 1 | 1 |
|                           | Compound/villa | 100 | 234 | 2.19(1.18-4.08) | 2.59(1.26-5.33)* |
| Educational status of husband | No formal education | 4 | 25 | 1 | 1 |
|                           | Primary education | 13 | 77 | 1.06(0.32-3.53) | 0.63(0.16-2.42) |
|                           | Secondary & above | 97 | 204 | 2.97(1.01-8.78) | 1.64(0.45-5.99) |
| ANC follows-up            | 1-3 times | 21 | 142 | 1 | 1 |
|                           | ≥4 times | 93 | 154 | 4.08(2.41-6.91) | 2.79(1.49-5.22)* |
| Gestational age           | <37 weeks | 13 | 98 | 1 | 1 |
|                           | 37-42 weeks | 96 | 197 | 3.31(1.83-6.01) | 2.54(1.06-6.07)* |
|                           | ≥42 weeks | 5 | 11 | 3.09(0.94-10.14) | 3.24(0.72-14.55) |
| Birth weight              | <2.5 kg | 19 | 96 | 1 | 1 |
|                           | ≥2.5 kg | 95 | 206 | 1.93(1.11-3.35) | 1.42(0.59-3.39) |
| Knowledge                 | Good     | 38 | 143 | 1 | 1 |
|                           | Poor     | 76 | 163 | 0.57(0.36-0.89) | 0.40(0.22-0.70)* |
| Fear of sunlight exposure | Yes      | 54 | 188 | 1 | 1 |
|                           | No       | 60 | 118 | 1.77(1.15-2.73) | 1.83(1.08-3.12)* |

*p-value <0.05; AOR: adjusted odds ratio; COR: crude odds ratio; CI: confidence interval

DISCUSSION

This study explored the practices and factors associated with neonatal sunlight exposure among mothers attending governmental hospitals in Addis Ababa, Ethiopia, and found that 27.1% of mothers practiced good neonatal sunlight exposure. The findings of this study were lower than those of studies conducted in Ethiopia in the South Gondar zone (54.3%), Debre Markos town.
Debre Berhan town (34.3%), and Aleta Wondo town (32.6%). The possible reason might be due to differences in housing type, family size, and mothers' fear of sunlight exposure. In this study, the majority of mothers were living in condominiums/apartments, had low family sizes, and had a fear of sunlight exposure to their neonates. In addition, a possible reason might be the cutoff point of the tool used to measure mothers' practice of neonatal sunlight exposure. The other studies used the median value as the cut-off point, and the participants who responded correctly above the median value were classified as having good practice, but in this study, participants who responded correctly to all practice questions were classified as having good practice.

This study found that neonatal age, family size, type of housing, ANC follow-up, gestational age, mothers' knowledge, and fear of sunlight exposure were associated with mothers’ practice. This study revealed that mothers who had neonates of advanced age (16-28 days) had good practices compared to those who had neonates of an earlier age (≤15 days). This finding was different from those of studies conducted in Debre Markos town, Aleta Wondo town, and the South Gondar zone. This discrepancy might be due to differences in cultural beliefs, in which mothers fear exposure to neonates aged less than 15 days for different reasons, such as evil eye, cold, and other cultural reasons. Therefore, mothers who have a neonatal age of ≤15 days require special care when designing interventions aimed at increasing their practice of neonatal sunlight exposure.

This study shows that mothers who had higher family sizes had better practices than those who had lower family sizes. This finding is consistent with other studies conducted in Ethiopia. The scientific explanation might be due to mothers who had low family sizes, especially primipara mothers' lack of experience in the practice of neonatal sunlight exposure. Thus,
mothers with smaller family sizes may require educational provision during follow-up to improve their practice of neonatal sunlight exposure.

Our study shows that mothers who lived in compound/villa houses had better practices compared to those who lived in condominiums/apartment houses. This might be related to the fact that condominiums/apartment houses are very crowded with many populations and do not have lifts and fences, and mothers might fear evil eye and fall accidents. This study showed that mothers who had complete ANC follow-up (≥4 times) had good practice compared to mothers who had lower ANC follow-up. This might be because when ANC visits are regular and complete, the mother has adequate knowledge and practices of neonatal sunlight exposure. Therefore, encouraging mothers to have regular and complete ANC follow-ups is important to improve their practices of neonatal sunlight exposure.

This study also shows that mothers who delivered at term had good practice compared to mothers who delivered before term. The scientific explanation for this might be that sunlight exposure to premature and low-birth-weight neonates is controversial, and most preterm babies stay at the hospital for the treatment of different preterm complications. In this study, knowledge was another modifiable factor associated with the mothers’ practice of neonatal sunlight exposure. Mothers who had poor knowledge about neonatal sunlight exposure had poorer practice than those who had good knowledge. This finding was similar to those of other studies conducted in Ethiopia. This might be related to the fact that mothers who know well and practice neonatal sunlight exposure may perform more practice than mothers who do not know. Future studies are required to identify the effects of knowledge on neonatal sunlight exposure among mothers.
In this study, we found that mothers who did not fear exposing their neonates practiced better than those who had feared. This finding is consistent with other studies conducted in Ethiopia. The mothers’ fear of sunlight exposure to the neonates might be related to their poor knowledge about sunlight exposure, as the majority of the participants in this study had poor knowledge about sunlight exposure. Knowledge is very important for the practice of neonatal sunlight exposure, as it decreases the fear of neonatal exposure to sunlight. Therefore, emphasis should be placed on those mothers when preparing educational interventions during follow-up to improve the practice of neonatal sunlight exposure by increasing knowledge about neonatal sunlight exposure.

**Conclusion**

This study revealed that 27.1% of mothers had good sunlight exposure. Advanced neonatal age, having a higher family size, living in compound/villa houses, having complete ANC visits, and having term delivery were associated with good sunlight exposure practice, whereas poor knowledge and fear of sunlight exposure were associated with poor sunlight exposure practice. Therefore, interventions focusing on these findings are required to improve the practice of neonatal sunlight exposure.

**Abbreviations**

ANC: antenatal care; AOR: Adjusted Odd Ratio; COR: Crude Odd Ratio; GMH: Gandhi memorial hospital; NMSC: nonmelanoma skin cancer; TASH: Tikur Anbessa Specialized Hospital; UV: Ultraviolet; UV-B: Ultraviolet B; VDD: Vitamin D deficiency; WHO: World Health Organization; Y12H: Yekatit 12 hospital
Supplementary statement

Supplementary file 1. Sample size, sampling procedure, and questionnaires.

DECLARATIONS

Ethics approval and consent to participate

Ethical clearance was obtained from the Institutional Review Board of Addis Ababa University, College of Health Sciences, School of Nursing, and Midwifery, with a 011/20/SNM reference number. A formal letter was obtained from Addis Ababa Public Health Research and Emergency Management to obtain permission to conduct this study. Written informed consent was obtained from each participant after explaining the purpose and procedures of the study. The privacy and confidentiality of the study participants were maintained by anonymizing the questionnaire and protecting our personal computers with a strong password.

Consent for publication

Not applicable

Availability of data and materials

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

Competing interests

The authors declare that they have no conflict of interest. The author acknowledges that this paper was available on the Addis Ababa University website as a thesis in June 2020.28

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Authors’ Contributions

YA conceptualized and designed the study; collected, analyzed, and interpreted the data; and drafted the manuscript. GT, DG, and MK were involved in data analysis, drafting of the manuscript, and advising the entire research paper. They were also involved in the interpretation of the data and contributed to manuscript preparation. All authors have read and approved the final manuscript.

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Attitudes of mothers attending public hospitals in Addis Ababa, Ethiopia, to neonatal sunlight exposure: a cross-sectional study.

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Sample size calculation for mothers attending public hospitals, Addis Ababa, Ethiopia, 2020.

The sample size was calculated using the single population proportion formula considering the following assumptions; the prevalence of mothers' practice of neonatal sunlight exposure is 45.7% as done in South Gondar Zone, North West Ethiopia among mothers, 95% confidence level, and 5% margin of error.

Sample size (n)= \[ \frac{Z^2p(1-p)}{d^2} \]

\[ n = \frac{1.96^2 \times 0.457 \times 0.543}{0.05^2} \]

\[ n = 381 \]

Where \( Z \) = critical value for normal distribution at 95% confidence level which equals to 1.96 (z value at \( \alpha =0.05 \))

\( n \) = Sample

\( p \) = prevalence of mothers' practice of neonatal sunlight exposure.

\( d \) = Margin of error=5%=0.05

Adding 10% of the non-respondent rate, the final sample size was 420.
Schematic presentation of the sampling procedure for mothers attending public hospitals, Addis Ababa, Ethiopia, 2020.

Public hospitals in Addis Ababa having follow-up clinic and EPI clinic

Simple random sampling
Three selected public hospitals in Addis Ababa having follow up clinic and EPI clinic

GMH=650
Mothers with newborns attending follow up clinic and EPI Clinic

TASH=536
Mothers with newborns attending follow up clinic and EPI Clinic

Y12HMC=435
Mothers with newborns attending follow up clinic and EPI Clinic

By using proportional to size allocation formula

\[
GMH = \frac{n_f \times NGMH}{N} = 168
\]

\[
TASH = \frac{n_f \times NTASH}{N} = 139
\]

\[
Y12HMC = \frac{n_f \times NY12HMC}{N} = 113
\]

Systematic sampling techniques

Total sample size = 420
### English Version Questionnaires

**Part I- Questions related to Socio-demographic information**

**Instruction:** Socio-demographic characteristics of the study participants in public hospitals, Addis Ababa, Ethiopia, 2020.

| No. | Questions                                      | Coding categories                                      | Skip to |
|-----|-----------------------------------------------|--------------------------------------------------------|---------|
| 101 | Mother’s age                                  | _______ years                                          |         |
| 102 | Neonatal/postnatal/ age                       | _______ days                                           |         |
| 103 | Marital status                                | 1. Single                                               |         |
|     |                                               | 2. Married                                              |         |
|     |                                               | 3. Divorced                                             |         |
|     |                                               | 4. Widowed                                              |         |
|     |                                               | 5. Others _________                                    |         |
| 104 | Mother’s educational status                   | 1. No formal learning                                   |         |
|     |                                               | 2. Grade 1 -8                                          |         |
|     |                                               | 3. Grade 9<sup>th</sup> -12                             |         |
|     |                                               | 4. College Diploma                                     |         |
|     |                                               | 5. University Degree and Above                         |         |
| 105 | Occupation                                    | 1. Student                                              |         |
|     |                                               | 2. Housewife                                            |         |
|     |                                               | 3. Government employee                                  |         |
|     |                                               | 4. Private employee                                     |         |
|     |                                               | 5. Daily laborer                                        |         |
|     |                                               | 6. Merchant                                             |         |
|     |                                               | 7. Others _________                                    |         |
| 106 | Residency                                     | 1. Urban                                                |         |
|     |                                               | 2. Rural                                                |         |
| 107 | Type of housing designs                       | 1. Compound House (villa)                               |         |
|     |                                               | 2. Condominium/ Apartments                              |         |
|     |                                               | 3. Other specify _________                              |         |
| 108 | Family size                                   | _________                                               |         |
| 109 | Monthly income                                | _________ Ethiopian birr                                |         |
| 110 | Husband’s educational status                  | 1. No formal learning                                   |         |
|     |                                               | 2. Grade 1 -8                                          |         |
|     |                                               | 3. Grade 9<sup>th</sup> -12                             |         |
|     |                                               | 4. College Diploma                                     |         |
|     |                                               | 5. University Degree and Above                         |         |
Part II: Maternal and neonatal factors related to the mother's practice of sunlight exposure of their neonates in public hospitals, Addis Ababa, Ethiopia, 2020.

| No. | Questions                                                                 | Coding categories                      | Skip to |
|-----|---------------------------------------------------------------------------|----------------------------------------|---------|
| 201 | ANC visit                                                                 | 1. Yes                                  |         |
|     |                                                                           | 2. No                                   |         |
| 202 | Number of visits                                                          | _______________number                   |         |
| 203 | Place of delivery                                                         | 1. Home                                 |         |
|     |                                                                           | 2. Health center                        |         |
|     |                                                                           | 3. Hospital                             |         |
|     |                                                                           | 4. Others ___________                    |         |
| 204 | Gestational Age                                                           | _______________in wks.                  |         |
| 205 | Birth weight                                                              | ___________ in kg                       |         |

Part III- Knowledge of mothers on sunlight exposure of their neonates in public hospitals, Addis Ababa, 2020.

| No. | Questions                                                                 | Coding categories                      | Skip to |
|-----|---------------------------------------------------------------------------|----------------------------------------|---------|
| 301 | Do you know about sunlight exposure                                       | 1. Yes                                  |         |
|     |                                                                           | 2. No                                   | 401     |
| 302 | Source of information about sunlight exposure (Circle more than one)      | 1. Physician                            |         |
|     |                                                                           | 2. Midwife/nurse                        |         |
|     |                                                                           | 3. Television/radio                     |         |
|     |                                                                           | 4. Neighbors/elder people               |         |
|     |                                                                           | 5. Others ___________                    |         |
| 303 | Does sunlight exposure beneficial?                                        | 1. Yes                                  | 305     |
|     |                                                                           | 2. No                                   |         |
| 304 | The benefit of sunlight exposure (Circle more than one)                   | 1. Strengthen bone                      |         |
|     |                                                                           | 2. Strengthen teeth                     |         |
|     |                                                                           | 3. Keep the child warm                  |         |
|     |                                                                           | 4. Produce vitamin D                    |         |
|     |                                                                           | 5. Strengthen the body                  |         |
|     |                                                                           | 6. Others ___________                    |         |
| 305 | Does sunlight exposure harmful                                            | 1. Yes                                  |         |
|     |                                                                           | 2. No                                   |         |
| 306 | The harmful effect of sunlight exposure (Circle more than one)            | 1. Skin cancer                          |         |
|     |                                                                           | 2. Sterility                            |         |
|     |                                                                           | 3. Blindness                           |         |
|     |                                                                           | 4. Others ___________                    |         |
307 | Good time to expose newborns on sunlight (Circle more than one) | 1. Morning  
2. Afternoon  
3. Evening

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**Part IV- Other factors affecting the practice of mothers on sunlight exposure of their neonate among public hospitals, Addis Ababa, Ethiopia, 2020.**

| No | Questions                                                                 | Code categories                                                                 | Skip to |
|----|---------------------------------------------------------------------------|---------------------------------------------------------------------------------|---------|
| 501| Do you have a fear to expose your baby to sunlight?                       | 1. Yes  
2. No                                                                        |         |
| 502| Mother’s fear of sunlight exposure (Circle more than one)                  | 1. Sickness  
2. Evil eye  
3. Cold  
4. Other specify__________                                                                 |         |

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**Part V- Practices of mothers on sunlight exposure of their neonates in public hospitals, Addis Ababa, Ethiopia, 2020.**

| No | Questions                                                                 | Coding categories                                                                 |
|----|---------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| 401| Do you expose your neonate on sunlight?                                   | 1. Yes  
2. No                                                                        |
| 402| Age of the newborns to start sunlight exposure                            |                                                                                   |
| 403| How frequently do you expose?                                             | 1. Daily  
2. Sometimes                                                                   |
| 404| Where do you expose your neonate on sunlight                              | 1. Outdoor  
2. Indoor                                                                     |
| 405| At what time of the day do you expose your baby outdoors? (Circle more than one) | 1. Morning 8-10 AM  
2. Mid-day 11 AM-1 PM  
3. Afternoon 2-4 PM                                                              |
| 406| Condition of clothing during exposure                                      | 1. Unclothed  
2. With diapers and eye protection only  
3. Partly covered  
4. Completely covered                                                            |
| 407| For how many minutes do you expose your neonate on sunlight?              |                                                                                   |
| 408| Do you apply lubricants to your neonate body during sunlight exposure?    | 1. Yes  
2. No                                                                        |
|   |   |
|---|---|
| 409 | If you apply, when do you apply? (Circle more than one) |
|     | 1. Before exposure  
|     | 2. During exposure  
|     | 3. After exposure   |
| 410 | What things do you apply? |
|     | 1. Baby Vaseline  
|     | 2. Baby lotion   
|     | 3. Butter       
|     | 4. Other__________ |