Objective: To quantify incidence, age distribution, and seasonality of neonatal hypothermia among a large population cohort.

Design: Longitudinal cohort study.

Setting: Sarlahi, Nepal.


Main Exposures: Community-based workers recorded axillary temperature on days 1 through 4, 6, 8, 10, 12, 14, 21, and 28 (213,636 total measurements).

Main Outcome Measures: Regression smoothing was used to describe axillary temperature patterns during the newborn period. Hypothermia incidence in the first day, week, and month were estimated using standard cut-offs. Ambient temperatures allowed comparison of mild hypothermia (36.0°C to ≤36.5°C) and moderate or severe hypothermia (<36.0°C) incidence over mean ambient temperature quintiles.

Results: Measurements lower than 36.5°C were observed in 21,459 babies (92.3%); half (48.6%) had moderate or severe hypothermia, and risk peaked in the first 24 to 72 hours of life. Risk of moderate or severe hypothermia increased by 41.3% (95% confidence interval, 40.0%-42.7%) for every 5°C decrease in average ambient temperature. Relative to the highest quintile, risk was 4.03 (95% confidence interval, 3.77-4.30) times higher among babies exposed to the lowest quintile of average ambient temperature. In the hot season, one-fifth of the babies (18.2%) were observed below the moderate hypothermia cutoff.

Conclusions: Mild or moderate hypothermia was nearly universal, with substantially higher risk in the cold season. However, incidence in the hot season was also high; thus, year-round thermal care promotion is required. Research on community, household, and caretaker practices associated with hypothermia can guide behavioral interventions to reduce risk.

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NEONATAL HYPOTHERMIA has been recognized as a contributing cause of mortality and morbidity among both low-birth-weight and normal-birth-weight babies, even in warm tropical environments. The prevention of neonatal hypothermia is included in essential newborn care, a basic package of interventions that should be provided to all newborns. Strategies to prevent and effectively manage hypothermia have been extensively studied in developed countries, and subsequent improvements in thermal care of the newborn have largely been limited to these settings.

More than 98% of the 4 million annual neonatal deaths occur in developing countries, where specific data on hypothermia are scarce and largely limited to hospital-based data. A number of hospital-based studies in such settings have demonstrated that thermal stress is common, and more than one-half of newborns experience hypothermic episodes. Some hospital-based studies have observed higher mortality risk among admitted babies with hypothermia broadly defined as any temperature measurement lower than 36.0°C or 36.5°C. While these studies indicate that hypothermia may be an important contributor to neonatal mortality, they are limited by lack of adjustment for age of infants at measurement and are predominantly focused on sick infants presenting to tertiary care units. In a retrospective cohort study from Guinea-Bissau, Africa, hypothermia (<34.5°C) measured within 12 hours after birth in a maternity ward was associated with almost 5 times higher mortality in the first week of life.
Most high-risk babies are born in the home in low-resource communities where the burden, health impact, and associations of hypothermia with newborn care practices and health outcomes have been insufficiently documented. Smaller studies in both urban slums and the rural community in India have reported on the incidence of hypothermia, but large population-based investigations of the timing of episodes, cumulative incidence of neonatal hypothermia, and seasonality of risk among babies born at home have not been conducted. Such information is needed to further guide community-based neonatal health promotion packages and to refine messages related to thermal care of the newborn throughout the newborn period. Our previous community-based trials of chlorhexidine cleansing interventions in southern Nepal between 2002 and 2006 included repeated visits by project workers to more than 23,000 babies, producing more than 213,000 axillary temperature measurements. In this article, we analyze these existing data to provide an overview of the pattern, incidence, age distribution, and seasonality of neonatal hypothermia both overall and within subcategories of severity using current World Health Organization (WHO) temperature cutoffs. Future analyses will build on data presented here to examine the relationship between neonatal hypothermia and mortality and how hypothermia incidence varies across potential risk factors, including household care practices and infant, parental, household, demographic, and socioeconomic characteristics.

METHODS

DATA COLLECTION

Data for this analysis were collected during a large, community-based, placebo-controlled, randomized trial of the effect of 2 chlorhexidine digluconate interventions (newborn skin and umbilical cord cleansing) on neonatal mortality and morbidity. Details of implementation and results of these trials have been published previously. Briefly, between September 2, 2002, and February 1, 2006, 23,662 live-born babies in the Nepal Nutrition Intervention Project area of Sarlahi District, Nepal, were eligible to participate in either a comparative phase or a post-trial scale-up phase of the study. Identification, follow-up, and data collection activities remained identical in both phases. Pregnancies were identified at approximately midpregnancy, study procedures were explained, and oral informed consent was obtained. Women received iron–folic acid supplements, deworming with albendazole, weekly vitamin A supplementation, a clean birthing kit, and basic counseling on nutrition and antenatal and postnatal newborn care. Notification of live-born babies to study workers was facilitated by local female staff, and babies were visited as soon as possible after birth and then followed up during the neonatal period on a standard schedule (days 1-4, 6, 8, 10, 12, 14, 21, and 28). These project workers had completed secondary school education and had approximately 7 to 12 years of experience as data collectors in field trials in this setting.

At each home visit, the project worker measured the axillary temperature of the newborn using a locally purchased lithium battery–operated digital thermometer. Workers were trained by supervisory staff using a standard written protocol and directly observed throughout the course of the study for adherence to the protocol. The baby was measured in the lap or arms of the mother or other caretaker, on a blanket or mat placed on the floor, or on a bed. Measurement involved placing the tip of the thermometer in the middle of the axilla and holding the newborn’s arm in place until an automatic audible notification was heard. Data were recorded on forms as displayed on the thermometers on the Fahrenheit scale and were converted to the Celsius scale during analysis.

ANALYTIC DATA SET

All babies with 1 or more measurements of axillary temperature recorded during the home visit schedule were included in the analysis. For the main parent trial, mortality during the neonatal period was the primary outcome; thus, flexibility on timing of the home visit at 28 days was granted during field implementation. Therefore, for the purposes of this analysis, axillary temperatures recorded at the visit on day 28 were included if collected within 7 days of the end of the neonatal period. Daily maximum and minimum environmental temperature recordings (in Celsius) at the Simara Airport (27°09’ 34” N, 84°58’ 47” E, 137 m above sea level) and the Janakpur Airport (26°42’ 39” N, 85°55’ 27” E, 78 m above sea level) were obtained from the Government of Nepal, Department of Hydrology and Meteorology, Ministry of Environment, Science, and Technology. These airports are located approximately 52 km east and 60 km west, respectively, of the geographical center of the study area, and the entire region is at or near sea level with little to no topographical variability.

ANALYSIS

Descriptive analysis included examination of the mean, median, minimum, and maximum, and interquartile range of axillary temperatures by age at the time of the measurement. Locally weighted regression smoothing illustrating the pattern of axillary temperature measurements over time was restricted to the first 10 days of life, where most of the temperature variability occurred. The numbers and proportion of infants meeting WHO definitions for hypothermia (mild, 36.0°C to <36.5°C; moderate, 32.0°C to <36.0°C; severe, <32.0°C) were estimated by 24-hour age intervals. Given the low number of newborn babies meeting the criteria for severe hypothermia (n=23), this category was combined with moderate hypothermia for the remaining analyses. Incidence of hypothermia (any hypothermia and moderate or severe hypothermia) was estimated for the first week of life and the entire neonatal period, and it was expressed in 2 separate ways. First, incidence was estimated as the proportion of newborn babies meeting the specified cutoff for mild hypothermia or for moderate or severe hypothermia at any 1 of his or her measurements throughout the newborn period. This can be considered an estimate of cumulative incidence. Second, incidence was estimated as the proportion of total measurements in which a newborn was found to meet the specified cutoff. This estimate, or the proportion of prevalent days, was adjusted for multiple measurements per child using generalized estimating equations with exchangeable correlation structure.

The average ambient minimum temperature was estimated for each day during the study period as the mean of the minimum temperature from Simara and Janakpur if both measurements were available; the recording from a single airport was used if only 1 was available. Seasonality of hypothermia was examined by creating locally weighted regression smoothing curves of the daily proportion of measures meeting the cutoff for hypothermia and the daily minimum ambient temperature and by plotting these curves over the period from September 3, 2002, to February 1, 2006. For each infant, the mean of the
minimum ambient temperatures recorded throughout the first week of life was estimated; the cumulative incidence (proportion of newborn babies) of moderate or severe hypothermia was compared across quintiles of this average temperature. Separately, prevalent days of any (<36.5°C) or moderate (<36.0°C) hypothermia during the first week of life were estimated and compared by quintiles of minimum ambient temperature.

Analyses were conducted using Stata statistical software version 9.2 (StataCorp LP, College Station, Texas). The Nepal Health Research Council, Kathmandu, Nepal, and the Committee on Human Research of the Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, approved the protocol. The parent trial is registered at http://clinicaltrials.gov (clinicaltrials.gov identifier NCT00109616).

RESULTS

Between September 2, 2002, and February 1, 2006, 23,662 live-born infants in the study area were eligible for inclusion. Of these, 23,257 (98.2%) were met alive at 1 or more home visits during the neonatal period; 17 of these babies did not have any axillary temperature measurements, whereas the remaining 23,240 contributed to the analytic data set. Among these babies, the mean (SD) and median (range) numbers of temperature recordings collected were 9.2 (2.1) and 10 (1-11), respectively. The maximum number of measurements (n=11) was provided by 7910 newborn babies (34.0%), while 20,689 newborn babies (89.0%) contributed 7 or more measurements. The 23,240 babies contributed a total of 213,636 axillary temperature measurements throughout the neonatal period, of which more than three-quarters were collected during the first 2 weeks of life (n=167,607 measurements [78.5%]).

HYPOTHERMIA PATTERNS DURING THE NEONATAL PERIOD

The mean axillary temperature was lowest during the first 24 hours (mean, 36.1°C); measurements were also most variable (SD, 1.0°C; range, 30.3°C-40.3°C) during this period. The medians and interquartile ranges of axillary temperature measurements during the first 10 days of life and a smoothed, locally weighted regression of temperature on age during this period are shown in Figure 1. Among the 14,588 babies who had temperature measured within 24 hours, 8606 (59.0%) were hypothermic (axillary temperature <36.5°C) at the first measurement; only 1 of these babies had severe hypothermia (<32.0°C), whereas 5169 (35.4%) and 3436 (23.6%) had moderate or mild hypothermia, respectively. The proportions of babies meeting the criteria for mild, moderate or severe (combined), or any hypothermia by 24-hour age intervals are shown in Table 1.

CUMULATIVE INCIDENCE

Cumulative incidence of hypothermia (proportion of babies meeting criteria on ≥1 day) and total prevalent days of severe, moderate, mild, and any hypothermia are shown in Table 1 and Table 2, respectively. One or more axillary temperature measurements lower than the WHO cutoff for any hypothermia (<36.5°C) were observed in 92.3% of all newborn babies. Among these hypothermic babies, the minimum temperature observed was in the mild range (36.0°C-36.4°C) for 47.4% of babies and in the upper half of the WHO-defined range for moderate hypothermia (34.0°C-35.9°C) for 48.7% of babies. Only 833 babies (3.9%) had measurements below 34.0°C, and only 23 babies (0.1%) had 1 or more measurements in the severe range (<32.0°C).

Figure 1. Medians and interquartile ranges (IQRs) of axillary temperatures during the first 10 days of life, shown at the midpoint of 24-hour intervals, with locally weighted regression (LWR) smoothing.

Figure 2. Proportion of newborn babies meeting World Health Organization definitions for mild hypothermia, moderate or severe hypothermia, or any hypothermia by age.
were recorded within the first week of life in 95.2% of all babies; among these babies, 41.5% met the criteria for moderate or severe hypothermia. Of all axillary temperature measurements within the first week of life, 15.8% (95% CI, 15.5%-16.1%) were in the moderate or severe range. More than one-third of all measurements (78,553 of 213,636) fit the WHO cutoff for any hypothermia.

### Table 1. Cumulative Incidence and Proportion of Hypothermia Among 23,240 Newborn Babies in the Entire Neonatal Period and the First Week of Life

<table>
<thead>
<tr>
<th>Hypothermia</th>
<th>Babies in Neonatal Period (n=23,240)</th>
<th>Babies in First Week of Life (n=22,114)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (%)</td>
<td>No. (%)</td>
</tr>
<tr>
<td>Severe</td>
<td>23 (0.1%)</td>
<td>13 (0.1%)</td>
</tr>
<tr>
<td>Moderate</td>
<td>11,277 (48.5%)</td>
<td>9,161 (41.4%)</td>
</tr>
<tr>
<td>Mild</td>
<td>20,516 (88.3%)</td>
<td>15,621 (70.6%)</td>
</tr>
<tr>
<td>Any</td>
<td>21,459 (92.3%)</td>
<td>17,958 (81.2%)</td>
</tr>
</tbody>
</table>

Abbreviation: CI, confidence interval.

### Table 2. Incidence and Proportion of Hypothermia Among 213,636 Axillary Temperature Measurements in the Entire Neonatal Period and the First Week of Life

<table>
<thead>
<tr>
<th>Hypothermia</th>
<th>Axillary Temperature Measurements in Neonatal Period (n=213,636)</th>
<th>Axillary Temperature Measurements in First Week of Life (n=94,571)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prevalent Days, No. (%) % (95% CI)</td>
<td>Prevalent Days, No. (%) % (95% CI)</td>
</tr>
<tr>
<td>Severe or moderate</td>
<td>20,689 (9.7%) (8.5-9.8)</td>
<td>14,889 (15.8%) (15.5-16.1)</td>
</tr>
<tr>
<td>Mild</td>
<td>57,864 (27.1%) (26.8-27.3)</td>
<td>27,476 (29.1%) (28.8-29.4)</td>
</tr>
<tr>
<td>Any</td>
<td>78,553 (36.7%) (36.4-37.0)</td>
<td>42,375 (44.8%) (44.4-45.3)</td>
</tr>
</tbody>
</table>

Abbreviation: CI, confidence interval.

*The 95% CIs are adjusted for multiple measurements per infant.*

Figure 3. Seasonality of hypothermia. Locally weighted regression curves are shown for the daily proportion of axillary temperature measurements lower than 36.0°C (moderate or severe hypothermia) and the minimum ambient temperature throughout the study period.

SEASONALITY OF HYPOTHERMIA

Axillary temperature was strongly correlated with ambient temperature. Scatter plots of ambient temperature (Figure 3) peaked in July and August of each calendar year, corresponding with the lowest proportion of axillary temperature measurements lower than 36.0°C; the coldest days of the year (in January) corresponded with the highest prevalence of measurements lower than 36.0°C. Cumulative incidence during the first week of life was substantially higher among babies born in cooler temperatures. For every 1.0°C of difference in minimum ambient temperature (averaged over the first week of life), the risk of moderate or severe hypothermia was 7.2% higher; for each incremental reduction in ambient temperature of 5.0°C and 10.0°C, the risk of hypothermia increased by a factor of 1.41 (95% CI, 1.40-1.43) and 2.00 (95% CI, 1.96-2.04), respectively. Babies exposed to the lowest quintile of average minimum ambient temperatures had 4.03 (95% CI, 3.77-4.30) times higher risk of moderate or severe hypothermia than those in the highest quintile (Table 3).

The proportions of axillary temperature measurements during the first week of life meeting the cutoff were 31.7% (5,765 of 18,213 total measurements in the first week) on days with minimum ambient temperatures in the lowest quintile (range, 3.8°C-11.7°C) and 4.3% (816 of 19,164 total measurements in the first week) on days with minimum ambient temperatures in the highest quintile (range, 25.6°C-29.3°C). Adjusting for age of the infant, the prevalence rate ratio was 7.70 (95% CI, 7.13-8.33) times higher on the coldest days (per quintile) compared with the warmest days (Table 4). The correlation between ambient temperature quintiles and the likelihood of hypothermic axillary temperature measurements was relatively stable whether further restricted to the first day of life or expanded to the entire neonatal period (data not shown).
These data indicate that among newborns in rural Sarlahi, Nepal, axillary temperatures at or below the current WHO cutoffs for mild and moderate hypothermia are common, with 92.3% of babies having 1 or more measurements lower than 36.5°C in the first 28 days. Furthermore, there is a strong association between season and hypothermia, with incidence rates peaking in the coldest months of the year (December-February) and the risk of moderate or severe hypothermia more than 4 times higher among babies in the lowest quintile of mean ambient temperature exposure. However, even among babies in the highest ambient temperature exposure quintile, the proportion with hypothermia in the first week of life was almost 1 in 5 (18.2%), suggesting the continuing importance and relevance of hypothermia risk even in the hot season of a tropical climate.

These estimates in the community confirm hospital reports that the burden of neonatal hypothermia is high in Nepal and other developing countries, where exposure to cold stress is extremely common. In a maternity hospital in Kathmandu, 84.8% and 48.9% of newborns were hypothermic at 2 and 24 hours after birth, respectively. Similarly, 79.3%, 85%, and 62.0% of newborns in urban hospitals of Uganda, Zimbabwe, and Nigeria, respectively, were hypothermic. In a community study of 763 newborns, 17.0% were observed with axillary temperature measurements lower than 35.0°C; this study of 763 newborns, 17.0% were observed with axillary temperature measurements lower than 36.0°C; this proportion was higher in “winter” months (21.5%) compared with “summer” months (13.9%), and hypothermia was associated with approximately 3 times higher mortality risk. In these studies, including the community-based study in India, observations were collected close to the time of birth (generally within hours). The estimate of hypothermia depends substantially on the distribution of ages at which babies’ temperatures are measured. In our study, for example, babies whose serial temperature measurements began within the first day of life had significantly higher risk of meeting the criteria for moderate hypothermia compared with those whose measurements were initiated later.

The large number of newborn babies (>22,000) and the repeated measurements (maximum, 11 per baby) throughout the newborn period allowed for examination of the pattern of hypothermia across the newborn period and precise estimates of incidence in the first 24 hours, first week, and first month of life. Ambient temperatures available for each day between September 3, 2002, and February 1, 2006, allowed for estimates over 3 full calendar years. Given that this was a community-based study of newborns in the home, continuous monitoring of temperature as done in hospital-based studies of neonatal hypothermia was not attempted owing to the logistical challenges. This may lead to an underestimate of hypothermia burden as the largest variation in temperatures occurs during the first 24 to 48 hours of life and axillary temperature measurements were not collected for all babies at this early time; this observation-time dependency was demonstrated by the 40.8% higher likelihood of observing 1 or more measurements in the moderate to severe range among babies who had axillary temperatures first measured within 24 hours.

Any underestimate of the population-level burden of hypothermia might be offset by the choice of digital thermometers and the axilla as the method and location of measurement, respectively. Digital thermometers with an automatic audible notification system are inexpensive, locally available, and substantially easier to use than mercury-in-glass thermometers given the shorter placement time, which is important for neonates, and the ease of reading in low-light settings such as rural homes. These may slightly overestimate or underestimate temperature relative to mercury-in-glass thermometers, leading to upward and/or downward bias in the estimates of hypothermia burden. Recording at the axilla, rather than the rectum, was chosen given the repetitive collection outside of a clinical setting, the ease and safety of placement, and the greater likelihood of compliance from parents. However, in a systematic review of 10 studies comparing rectal vs axillary temperatures among neonates, the pooled mean difference (rectal temperature minus axillary temperature) was 0.17°C (95% CI, −0.15°C to 0.50°C). Adjusting all measurements in this data set upward by 0.17°C would result in decreases in the proportion of babies with 1 or more measurements meeting cutoffs for moderate or severe hypothermia (37.9% [adjusted] vs 48.6% [observed]; 22.0% reduction) or any hypothermia (82.2% [adjusted] vs 92.3% [observed], 11.0% reduction).

### Table 3. Cumulative Incidence and Proportion of Newborn Babies With Hypothermia Within the First Week of Life by Quintile of Minimum Ambient Temperature

<table>
<thead>
<tr>
<th>Minimum Ambient Temperature, Quintile (Range)</th>
<th>Babies, No.</th>
<th>Hypothermia Cases, No. (%)</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (3.8°C-11.7°C)</td>
<td>4426</td>
<td>3245 (73.2)</td>
<td>4.03 (3.77-4.30)</td>
</tr>
<tr>
<td>2 (11.8°C-16.7°C)</td>
<td>4440</td>
<td>2357 (53.1)</td>
<td>2.92 (2.72-3.12)</td>
</tr>
<tr>
<td>3 (16.8°C-22.7°C)</td>
<td>4408</td>
<td>1606 (36.4)</td>
<td>2.00 (1.86-2.15)</td>
</tr>
<tr>
<td>4 (22.8°C-25.5°C)</td>
<td>4418</td>
<td>1156 (26.2)</td>
<td>1.44 (1.32-1.56)</td>
</tr>
<tr>
<td>5 (25.6°C-29.3°C)</td>
<td>4422</td>
<td>805 (18.2)</td>
<td>1 [Reference]</td>
</tr>
</tbody>
</table>

### Table 4. Incidence and Proportion of Axillary Temperature Measurements Lower Than 36.0°C Within the First Week of Life by Quintile of Minimum Ambient Temperature

<table>
<thead>
<tr>
<th>Minimum Ambient Temperature, Quintile (Range)</th>
<th>Axillary Temperature Measurements, No.</th>
<th>Axillary Temperature Measurements &lt; 36.0°C, No. (%)</th>
<th>PRR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (3.8°C-11.7°C)</td>
<td>18213</td>
<td>5765 (31.7)</td>
<td>7.70 (7.13-8.33)</td>
</tr>
<tr>
<td>2 (11.8°C-16.7°C)</td>
<td>18133</td>
<td>4219 (23.3)</td>
<td>5.93 (5.74-6.42)</td>
</tr>
<tr>
<td>3 (16.8°C-22.7°C)</td>
<td>18783</td>
<td>2511 (13.4)</td>
<td>3.36 (3.09-3.65)</td>
</tr>
<tr>
<td>4 (22.8°C-25.5°C)</td>
<td>20278</td>
<td>1588 (7.8)</td>
<td>1.87 (1.72-2.04)</td>
</tr>
<tr>
<td>5 (25.6°C-29.3°C)</td>
<td>19164</td>
<td>816 (4.3)</td>
<td>1 [Reference]</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; RR, risk ratio.

* The PRRs are adjusted for age of the infant; the 95% CIs are adjusted for multiple measurements per infant, using generalized estimating equations.
All infants in this study were participants in the parent chlorhexidine trials, which included a 1-time full-body cleanse of the infant immediately after birth with either chlorhexidine-soaked or water-based placebo-soaked baby wipes. We do not believe this procedure contributed to the incidence of hypothermia in this setting or the conclusions drawn from these analyses. In a pilot study,\(^{27}\) of the feasibility, safety, and acceptability of in-home full-body cleansing of newborns conducted prior to the main trial, there was a body temperature decrease of 0.4°C; the time between the procedure and the return to the mean baseline temperature was about 15 minutes in a study of 286 newborns undergoing the procedure at a tertiary care hospital in Kathmandu.\(^ {28}\) All workers were instructed to minimize the time of the procedure, wrap the baby warmly in a baby blanket provided to all families at the time of the intervention, and reiterate the basic messages on the importance of keeping the baby dry and warm. While there was not a group of babies who did not receive a full-body cleanse, a previous study\(^ {29}\) conducted by our group in the same area immediately prior to this trial measured axillary temperatures of approximately 4000 newborns throughout the neonatal period in an identical manner, allowing comparison between the 2 studies. Adjusting for month of birth, there was a 9.9% (95% CI, 5.0%-13.0%) increased risk of mild hypothermia and a 14.5% (95% CI, 5.6%-20.8%) decreased risk of moderate or severe hypothermia in the skin cleansing trial compared with the previous study. These data suggest that rather than the cleansing intervention increasing hypothermia risk, there might have been a slight shift upward in the axillary temperature distribution, potentially as a result of increased awareness and messages about hypothermia given in the context of the intervention.

In this community, further efforts are required to reduce the exposure of newborn babies to thermal stress. Thermal care is considered important by caretakers in this community; warming of the room in which newborns are cared for (82.2%) and provision of a hat for the baby (82.5%) are nearly universal for (82.2%) and provision of a hat for the baby (82.5%) are relatively common and mustard oil massage is nearly universal, with 99.7% of mothers reporting 1 or more massages of the newborn within 14 days after birth and 40.8% reporting doing so to keep the baby warm.\(^ {30}\) However, newborns are often not dried (18.0%) and wrapped (22.2%) until after the placenta has been delivered,\(^ {31}\) 95.6% of babies are bathed within the first 12 hours after birth,\(^ {31}\) skin-to-skin contact (4.4%) is uncommon,\(^ {30}\) and initiation of breastfeeding within the first hour (3.3%) is rare;\(^ {36}\) these are all practices that might be associated with hypothermia in the first week of life and beyond and could be improved through behavioral change communications.

Further analyses are needed to identify specific factors that are associated with increased risk of hypothermia and risk of mortality and morbidity subsequent to hypothermia. Context-specific and culturally appropriate measures might then be defined to reduce exposure to thermal stress, evaluated for effect, and ultimately scaled up within integrated neonatal health promotion programs.

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Author Contributions: Dr Mullany had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.


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There’s a natural love affair between the ordinary, normal teenager and the automobile. Young people love the shining pain and glistening of a new car. They love, too, the promise of surging power hidden beneath even the beat-up hood of a hot rod.

—From the educational pamphlet “Teenagers and the Automobile,” Ernest Miller, 1964