

Assessment of Maternal Awareness of Neonatal Danger Signs in Makkah, Saudi Arabia: A Cross-Sectional Study

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ABSTRACT

This study evaluated maternal knowledge of neonatal danger signs among mothers of young children in Makkah, identified the most and least recognized danger signs, and analyzed associations between sociodemographic characteristics and knowledge score. A cross-sectional study was conducted among mothers with children aged two years or younger. Participants were recruited from well-baby and vaccination clinics in Makkah and via social media. A validated Arabic AQ-KNDS questionnaire, which covers sociodemographic variables and 16 neonatal danger signs was utilized for data collection. Each correct response received one point (total score range: 0–16). Descriptive statistics summarized knowledge scores, and univariate and multivariable analyses examined associations with sociodemographic factors. 200 mothers completed the questionnaire. Knowledge scores were non-normally distributed. The median knowledge score was 12 (IQR = 5), indicating a moderate level of knowledge. The most frequently recognized danger signs were absence of anus (95%) and failure to pass urine within 24 hours (93.5%), while cough unrelated to breastfeeding (52%) and diarrhea (55%) were the least recognized. In multivariable linear regression, antenatal care attendance was the strongest independent predictor of higher knowledge scores. Saudi nationality, higher parity, and younger maternal age were also independently associated with higher knowledge levels. Mothers in Makkah showed a moderate level of knowledge regarding neonatal danger signs. Maternal knowledge appeared to be influenced by antenatal clinic attendance. Adjusting how education is delivered to specific groups could help improve how well some mothers recognize clinical signs in newborns.

INTRODUCTION

In 2022, approximately 2.3 million children died within the first 28 days of life, accounting for 47% of all global under-five mortalities¹. Although Saudi Arabia has achieved notable progress in child survival and met the Millennium Development Goal 4 targets for reducing under-five mortality², neonatal health continues to represent a critical priority within the Kingdom's public health agenda.

The World Health Organization (WHO) has identified several key neonatal danger signs that indicate life-threatening illnesses. These include feeding difficulties, lethargy, respiratory distress, thermal instability (fever or hypothermia), convulsions, and signs of localized or systemic infection, such as umbilical discharge or jaundice¹.

The effectiveness of life-saving interventions depends on the caregiver's ability to identify symptoms early. However, current literature demonstrates significant knowledge gaps among mothers in Saudi Arabia. For example, a cross-sectional survey of 1,428 women in Riyadh found that only 37% could identify at least three danger signs, with jaundice (48%) and feeding difficulties (46%) being the most commonly recognized³. A similar pattern is observed in the Aseer region, where only one-third of mothers demonstrated satisfactory knowledge⁴.

In Makkah, assessing maternal knowledge is particularly important due

to the unique sociocultural characteristics of the population and the lack of prior localized research. Evaluating the current level of awareness in Makkah will help identify specific educational gaps and refine educational support during antenatal and postnatal visits. Therefore, this study aimed to assess maternal knowledge of neonatal danger signs in Makkah, determine mean knowledge scores using a validated questionnaire, and evaluate socio-demographic predictors such as age, education, and antenatal care attendance that may influence these outcomes.

METHODS

Study Design and Setting: A cross-sectional study was conducted to assess maternal knowledge of neonatal danger signs in Makkah, Saudi Arabia. Data collection took place at selected primary healthcare (PHC) centers and online via social media over a two-month period. The PHC centers in Makkah are geographically divided into four sectors (East, West, North, and South). To ensure representative local coverage, one center was randomly selected from each sector using a simple random generator.

Participants and Recruitment: The study population comprised mothers aged 18 years and older with children aged 24 months or younger. A dual recruitment strategy was employed to ensure a diverse and representative sample: participants were recruited in-person while attending well-baby and vaccination clinics at the selected primary

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healthcare centers, and also engaged online through social media platforms via digital survey links distributed by data collectors.

Study Instrument: Maternal knowledge was assessed using the Arabic version of the Awareness Questionnaire of Neonatal Danger Signs (AQ-KNDS). This tool was previously validated in 2023 through Item Response Theory (IRT), demonstrating excellent validity and reliability (Cronbach's alpha) with a final 16-item structure⁵.

The questionnaire was divided into two primary sections. The first section collected sociodemographic data, including age, nationality, education level, parity, occupation, income, and antenatal care (ANC) attendance. The second section consisted of a knowledge assessment comprising 16 items describing potential neonatal danger signs. For each item, participants indicated whether they considered the sign to be dangerous ("Yes"), not dangerous ("No"), or if they did not know. Each correct identification was assigned 1 point, while "No" or "I do not know" responses yielded 0 points, resulting in a maximum possible knowledge score of 16⁵.

Data Collection Procedures: Data collection was conducted both in-person and remotely. At PHC centers, mothers provided written informed consent before completing the survey on a tablet provided by the researcher. For the online cohort, participants accessed the study via a secure link and were required to provide consent before proceeding. We opted for this self-administered format to encourage more honest responses and reduce the likelihood of social desirability bias.

Sample Size Calculation: The sample size was determined based on the requirements for various statistical tests. To detect differences in knowledge scores across five levels of maternal education (One-way ANOVA) with an effect size of $f = 0.25$ (medium), an alpha level of 0.05, and a power of 0.80, a minimum of 200 participants was required and determined via G*Power⁶. This exceeded the minimum requirements

for estimating the mean ($n=75$) and performing independent t-tests ($n=128$).

Statistical Analysis: Data were analyzed using RStudio (7). Descriptive statistics summarized the sample characteristics, with categorical variables reported as frequencies (%) and continuous variables as means (SD) or medians (IQR). Normality was assessed using the Shapiro-Wilk test. Given the non-normal distribution of knowledge scores ($p < 0.001$), non-parametric tests were utilized, including the Mann-Whitney U test for binary variables and the Kruskal-Wallis test for variables with more than two categories. A multivariable linear regression model was used to identify independent predictors of knowledge. Statistical significance was set at $p < 0.05$.

Ethical Considerations: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board (IRB). Participation was voluntary, and all participants provided informed consent. To ensure confidentiality, no personal identifiers (names or ID numbers) were recorded; unique study ID codes were assigned to each respondent.

RESULTS

Participant Characteristics and Knowledge Distribution

A total of 200 respondents completed the questionnaire. Sociodemographic characteristics are shown in Table 1. The distribution of neonatal danger sign knowledge scores was non-normal (Shapiro–Wilk test, $p < 0.001$), with a negative skew and a ceiling effect. The mean knowledge score was 12.1 (SD = 3.39; 95% CI: 11.63–12.57), and the median score was 12 (IQR = 5), indicating a moderate overall level of knowledge. Item-level analysis showed the highest recognition for absence of an anus (95%) and failure to pass urine within 24 hours (93.5%), while the lowest recognition was observed for cough occurring outside of breastfeeding (52%) and diarrhea (55%).

Table 1. Socio-demographic Characteristics of the Participants.

Variable	Categories	Frequency (n)	Percentage (%)
Age	Mean $\pm$ SD	33.835 $\pm$ 8.40	-
Nationality	Saudi Non-Saudi	167 33	83.5 16.5
Marital Status	Married Widow Divorced Single	185 2 12 1	92.5 1 6 0.5
Education Level	Higher Education University High School Primary Illiterate/read and write	26 113 44 10 7	13 56.5 22 5 3.5
Number of Children	One Child Two Children Three or more Children	52 54 94	26 27 47
Prior Neonatal Death (including miscarriage, stillborn or death within 28 days of birth)	Yes No	47 153	23.5 76.5
Occupation	Unemployed Health Sector Other fields	121 17 62	60.5 8.5 31
Family Income (SAR)	Less than 5000 5000 to less than 15000 More than 15000	77 83 40	38.5 41.5 20
Antenatal Clinics Attendance	Yes No	126 74	63 37

Demographic and Socioeconomic Predictors

Age: Age showed a weak but statistically significant negative association with knowledge scores (Spearman's $\rho = -0.21$, $p = 0.002$), indicating that younger participants tended to have higher knowledge levels.

Nationality: Nationality was significantly associated with knowledge scores. Saudi participants had higher scores than non-Saudi participants (mean 12.41 vs. 10.55). This difference was confirmed using Welch's t-test ($t(39.93) = 2.48$, $p = .017$, with a 95% confidence interval of [0.34, 3.38]) and supported by the Mann-Whitney U test ($W = 3531$, $p = 0.01$), indicating robustness to non-normality.

Occupation: Knowledge scores differed significantly by occupational field ($\chi^2(2) = 6.71$, $p = 0.035$). Post-hoc pairwise comparisons using Dunn's test with Bonferroni correction revealed that healthcare workers ($n = 17$, Median = 15) had significantly higher knowledge scores than those working in other fields ($n = 62$, Median = 12; adjusted $p = 0.029$). Although the median score for unemployed participants ($n = 121$) was also lower than that of healthcare workers, this difference did not reach statistical significance after adjustment for multiple comparisons (adjusted $p = 0.118$).

Antenatal Care (ANC) Attendance: Attendance at antenatal care clinics was strongly associated with higher knowledge scores. Participants who attended ANC had a higher median score¹³ compared with those who did not attend¹¹, and this difference was highly statistically significant ($p < 0.001$, Mann-Whitney U test).

Education: No statistically significant differences in knowledge scores were observed across education levels ($p = 0.56$), indicating that formal education alone was not a strong determinant of neonatal danger sign knowledge in this sample.

Number of Children (Parity): Parity was not significantly associated with knowledge scores in univariate analysis ($p = 0.19$, Kruskal-Wallis Test), although a positive trend was observed among participants with a higher number of children.

Income: Household income did not show a significant association with knowledge scores ($p = 0.13$, Kruskal-Wallis Test) in univariate testing.

Multivariable Analysis

A multivariable linear regression model was fitted to identify independent predictors of neonatal danger sign knowledge. The model was statistically significant ($F(14, 185) = 4.04$, $p < 0.001$) and explained 23.4% of the variance in knowledge scores. After adjustment for covariates, antenatal clinic attendance remained the strongest independent predictor of higher knowledge ($\beta = 1.73$, $p < 0.001$). Saudi nationality was independently associated with higher scores, with non-Saudi participants scoring lower ($\beta = -1.93$, $p = 0.011$). Higher parity (three or more children compared with one child) was associated with increased knowledge ($\beta = 1.55$, $p = 0.037$), and younger age remained an independent predictor, with scores decreasing by 0.094 points per additional year of age ($\beta = -0.094$, $p = 0.015$).

DISCUSSION

This study demonstrates a moderate level of knowledge regarding neonatal danger signs (NDS) among mothers in Makkah. There is a pronounced disparity in recognition across symptom categories. While participants showed high awareness of visible physical anomalies,

such as the absence of anus, nearly half did not recognize metabolic and respiratory indicators, including diarrhea and non-feeding-related coughing. This gap in recognition is clinically significant and may contribute to delays in seeking medical intervention.

A significant challenge in establishing a national baseline for Neonatal Danger Sign (NDS) knowledge is the methodological heterogeneity found in Saudi literature. For example, a study in Riyadh used open-ended interviews requiring spontaneous recall and found that only 37% of mothers had "adequate" knowledge³. Similarly, research in the Aseer region relied on maternal experience rather than a standardized metric⁴.

The higher median score of 12 out of 16 observed in this study likely reflects the use of the AQ-KNDS questionnaire. Whereas recall-based studies assess immediate awareness, the recognition-based tool employed here provides a more comprehensive evaluation of a mother's ability to identify clinical red flags. The AQ-KNDS, grounded in Item Response Theory, offers a validated and standardized metric that enables more reliable national and international benchmarking compared to previous regional studies.

In this cohort, Antenatal Care (ANC) attendance emerged as the strongest independent predictor of knowledge. This aligns with findings from Iraq, where frequent ANC visits were significantly associated with higher awareness⁸. Interestingly, our analysis found that formal education was not a significant predictor after adjusting for confounders—a finding consistent with the study in Egypt⁵, but contrasting with research from Palestine, Iraq, and Ethiopia, where maternal education was a significant determinant^{8,9,10}.

The absence of a significant educational influence in Makkah may suggest that the Saudi primary healthcare system may function as an equalizer. By providing targeted clinical information during ANC visits, the healthcare system appears to bridge the gap observed between different educational backgrounds, positioning clinical exposure as a more effective tool for health literacy than general education.

In a Sudanese article, fever was the most recognized symptom, yet 54.8% of participants had negative attitude towards the risks of neonatal diarrhea¹¹. This parallels our findings in Makkah, where diarrhea was among the least recognized danger signs. While fever is easily detected, symptoms like diarrhea are often dismissed, despite their potential to cause dehydration in neonates¹².

Several limitations should be acknowledged. The sample size ($n = 200$) may restrict the generalizability of the results to the broader Saudi population. Additionally, the dual recruitment strategy involving PHC centers and online platforms may have introduced selection bias, as participants recruited through these channels often possess higher baseline health literacy.

CONCLUSION

Mothers in Makkah had a moderate level of knowledge regarding neonatal danger signs. Maternal knowledge appeared to be influenced by antenatal clinic attendance. Adjusting how education is delivered to specific groups could help improve how well some mothers recognize clinical signs in neonates.

Authorship Contribution: Anwar Aziz Althaqfi: Data collection, writing manuscript, editing and statistical analysis. Sadeem Khalid Algethami: Data collection. Salman Alsubhi: Supervisor, overseeing statistical analysis, manuscript editing, and final approval of the version to be published.

Potential Conflicts of Interest: None

Competing Interest: None

Acceptance Date: 04 March 2026

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