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The relationship between maternal health literacy and knowledge and attitudes about newborn screenings in different ethnic groups

Ahmet Butun^{1*} , Vasfiye Bayram Deger² and Havva Kacan³

Abstract

Introduction Newborn screening (NBS) programs play a crucial role in early diagnosis and prevention of neonatal morbidity and mortality. Maternal health literacy is a key factor influencing mothers' understanding, perceptions, and engagement with these programs. Ethnic disparities in health literacy and knowledge may affect equitable access and adherence. This study aimed to examine the relationship between maternal health literacy and mothers' knowledge and attitudes regarding newborn screenings across three ethnic groups, Turkish, Arab, and Kurdish, in the multicultural city of Mardin, Turkey.

Methods This descriptive cross-sectional study was conducted with 568 mothers (189 Turkish, 189 Arab, 190 Kurdish) who had children aged 0–1 years. Data were collected through face-to-face interviews between March and June 2025 using a socio-demographic form, the Maternal Knowledge and Attitudes about Newborn Screening Survey (MKANSS), and the Turkey Health Literacy Scale-32. Data analysis included descriptive statistics, chi-square tests, one-way ANOVA, Pearson correlations, and linear regression.

Results Significant ethnic differences were identified in maternal health literacy and NBS-related knowledge and attitudes. Turkish mothers demonstrated the highest health literacy scores, followed by Kurdish and Arab mothers. Similarly, Turkish mothers scored significantly higher on all MKANSS sub-dimensions compared with Arab and Kurdish mothers. Health literacy was strongly correlated with total NBS knowledge-attitude scores in the Turkish group, moderately in the Kurdish group, and weakly in the Arab group. Regression analyses showed that health literacy significantly predicted NBS knowledge-attitude scores in all ethnic groups, with the strongest effect observed among Turkish mothers.

Conclusion Maternal health literacy is associated with mothers' knowledge and attitudes toward newborn screenings, with disparities across ethnic groups. Arab mothers demonstrated lower health literacy and less favourable knowledge and attitudes, indicating the need for targeted, culturally and linguistically appropriate educational interventions. Improving health literacy may enhance maternal engagement with NBS programs and help reduce ethnic disparities in neonatal health outcomes.

Keywords Health literacy, Newborn screenings, Knowledge, Attitudes, Ethnic, Maternal

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Introduction

Newborn screening (NBS) is one of the core components of public health policies in many countries, aiming to diagnose various diseases within the first 28 days after birth, initiate early treatment, or implement management strategies [1]. These screenings provide better prognosis for newborns diagnosed, prevent or reduce potential future complications, and alleviate the burden of morbidity and mortality in the community [1]. By identifying affected newborns before symptomatic disease manifestation, NBS programs enable timely therapeutic interventions that reduce morbidity, mortality, and long-term disease burden [2]. Despite decades of implementation in many countries, variability exists in both program structure and population outcomes, particularly across different ethnic and socioeconomic groups.

Maternal knowledge and attitudes toward NBS constitute critical determinants of screening program effectiveness and equitable implementation [3]. Maternal comprehension of screening procedures, disease significance, and follow-up implications directly influences adherence to diagnostic confirmatory testing and long-term management protocols [2]. Furthermore, positive maternal attitudes facilitate earlier presentation for screening, reduce anxiety and psychosocial distress when results are communicated, and enhance engagement with healthcare systems [4]. Studies from diverse geographic contexts consistently demonstrate that many mothers possess only moderate knowledge regarding NBS components, screened disorders, and the purpose of screening, representing a significant gap in perinatal health literacy [5].

Health literacy has emerged as a fundamental yet often overlooked contributor to maternal knowledge and attitudes regarding NBS. Recent evidence indicates that higher health literacy is independently associated with greater knowledge and more favourable attitudes toward newborn screening, even after controlling for sociodemographic variables [3]. Poor health literacy may impede mothers' ability to comprehend complex screening procedures, understand genetic concepts, or make informed decisions about whether to participate in expanded screening programs [6]. Interventional procedures applied during the neonatal period can often be painful for babies and may increase mothers' anxiety levels [7]. Understanding mothers' attitudes towards newborn screenings is fundamental, as these attitudes stem from previous experiences and cultural norms regarding health practices. A qualitative study by Conway et al. [8] emphasizes the need for more inclusive education that resonates with the unique sociocultural contexts of families involved [8]. These insights elucidate how maternal engagement in the healthcare process, influenced by health literacy, knowledge, and attitudes, is critical for

navigating the complexities of newborn screenings in ethnically diverse populations.

Ethnic disparities in maternal knowledge and attitudes toward NBS persist globally and warrant systematic investigation. Cultural and ethnic identities complicate the dynamics of health literacy and maternal attitudes. Studies show that ethnic minority groups often face lower awareness and knowledge of medical practices and recommended screenings, revealing disparities that can hinder effective healthcare [9]. These discrepancies can be compounded by language barriers and differential access to health information, leading to variations in attitudes towards newborn screenings. Research from rural Tamil Nadu, India demonstrated that only 37.5% of mothers exhibited high knowledge of NBS, with urban residency, higher education, and higher family income significantly influencing awareness and favourable perceptions [2]. Similarly, studies from Jordan revealed moderate to limited maternal knowledge despite overall positive attitudes toward screening programs [5]. These disparities likely reflect complex interactions among culturally-specific health beliefs, linguistic accessibility of health information, differential access to healthcare provider education, and systematic variation in health literacy across ethnic communities. The role of maternal health education is pivotal, as indicated by Tutuba et al. [10], who highlight the positive correlation between enhanced maternal knowledge through targeted education and increased uptake of screening programs [10]. This underscores the necessity of culturally tailored educational initiatives to improve health literacy among diverse ethnic groups.

The intersection of maternal knowledge, attitudes toward newborn screenings, and health literacy presents a multifaceted landscape that requires comprehensive exploration. By examining these elements across different ethnic groups, this study aims to contribute to the development of more effective health communication strategies and educational interventions, ultimately ensuring equitable healthcare access and outcomes for all newborns. The aim of this study was to examine the relationship between maternal health literacy and knowledge and attitudes regarding newborn screenings in different ethnic groups.

Background information about the study area (Mardin)

Mardin is a metropolitan city with a population of 840,000 and is located in southeast Turkey. Mardin is a multicultural city with diverse ethnic and religious communities. It is known that Mardin is home to different ethnic groups, with individuals of Turkish, Kurdish, and Arab origin being the majority. Mardin has a much more heterogeneous population in terms of culture and ethnicity than any other cities in Turkey.

Methods

Study design

This study is a descriptive cross-sectional study with comparative analyses between ethnic groups.

Settings

The setting was a multicultural city of Mardin which is located in the southeastern of Turkey.

Participants and sampling

The study population consisted of individuals living in Mardin, who are literate, aged 18 and over, have a child aged 0–1, and voluntarily agreed to participate in the study, representing diverse ethnic backgrounds. Literacy was defined as the ability to read and understand Turkish, as all instruments were administered in Turkish. This criterion may have excluded mothers who primarily speak Kurdish or Arabic and do not have sufficient proficiency in Turkish. Consequently, the findings may underestimate the extent of limited health literacy among ethnic minority mothers and should be interpreted with caution.

Participants were recruited using convenience sampling methods. A power analysis was conducted to determine the number of participants to be included in the study. This analysis was performed using the G*Power 3.1 program. The effect size was accepted as 0.30, representing a medium effect size. The analysis was carried out using the ‘Exact - Correlation: Bivariate normal model’ option and the ‘exact distribution’ method, and the required sample size was calculated using the a priori method. Input values were determined as follows: one-tailed hypothesis test, correlation coefficient (ρ H1) 0.30, margin of error (α) 0.05, test power ($1-\beta$) 0.95, and correlation according to the null hypothesis (ρ H0) 0. According to the analysis results, the lower and upper critical correlation values were calculated as 0.1541491, the total required sample size as 115, and the actual power of the test as 0.95. The study aimed to reach at least 345 individuals across 3 different ethnic groups. This study was conducted with a total of 568 participants across three different ethnic groups (189 Turkish, 189 Arab, 190 Kurdish).

Data collection

The data were collected from mothers receiving health care at a tertiary hospital and family health centres located in Mardin between March 10, 2025 and June 13, 2025. The data was collected by using questionnaire technique with a data collection form consisting of three parts using face-to-face interview techniques. The first part of the data collection form contains questions about demographic information. The second part includes the ‘Maternal Attitudes and Knowledge about Newborn

Screening Survey (MKANSS)’, and the third part includes the Turkey Health Literacy Scale-32 (THLS-32). The researchers explained the aim of the study to the participants. After participants were informed that their participation was voluntary and that they could leave without reason. The questionnaire was distributed as hard copies and completed on-site during participants’ waiting periods at the healthcare facility, with researchers available to provide clarification if required. Then, the questionnaires were collected by the researchers. The time to fill out the questionnaire took about 15 min.

Data collections forms

Socio-demographic information form

The socio-demographic information form includes questions about ethnicity, the age, education level, employment status, income level, social security, family relationships, history of hereditary diseases, number of pregnancies, number of miscarriages, number of children, pregnancy-related conditions, and knowledge of newborn screening programs of the mothers participating in the study, as well as the ways they obtain this information (Supplementary file). Ethnic group was determined based on self-identification. Participants were asked to indicate the ethnic group with which they primarily identified (Turkish, Arab, or Kurdish).

Maternal knowledge and attitudes about newborn screening survey (MKANSS)

This survey was originally developed by Newcomb et al. [11]. This was adapted into Turkish by Erbay in 2020 [12]. The original survey consisted of 30 items, however, after conducting a validity and reliability study in Turkish, it was reduced to 13 items and deemed suitable for use, $\chi^2 = 2.398$, $p < 0.05$; GFI = 0.90; CFI = 0.92; SRMR = 0.078; RMSEA = 0.08. The Cronbach’s alpha reliability coefficient of this scale has been reported as 0.69. The scale has three main sub-dimensions. These are: ‘mothers’ attitudes towards newborn screening tests’ (items 2, 4, 5, 7, 12, and 13), ‘concepts related to newborn screening tests’ (items 8, 9, and 10), and ‘mothers’ knowledge about newborn screening tests’ (items 1, 3, 6, and 11). The scale uses a 5-point Likert rating (1 = Strongly disagree, 5 = Strongly agree). The possible scores that can be obtained from the scale range from 13 to 65, with higher scores indicating a higher level of mothers’ knowledge and attitudes about newborn screenings.

Turkey health literacy Scale-32 (TSOY-32)

It is a scale consisting of 32 questions developed based on the Conceptual Framework of the European Health Literacy Survey (HLS-EU) study. The scale was adapted to Turkish by Abacıgil et al. [13], and it evaluates the health literacy level of parents. The scale consists of 32 questions

in which participants rate the difficulty level of the topics mentioned in each question using a 5-point Likert scale (very easy = 1, easy = 2, difficult = 3, very difficult = 4, I have no opinion = 5), where 0 indicates the lowest health literacy and 50 indicates the highest health literacy. Scores of 0–25 indicate inadequate health literacy; scores of > 25–33 indicate problematic-limited health literacy; scores of > 33–42 indicate sufficient health literacy; and scores of > 42–50 indicate excellent health literacy [13].

Data analysis

The data were analysed using the SPSS 22.0 statistical program. Frequency and percentage analyses were used to determine the descriptive characteristics of participants, while mean and standard deviation statistics were used to examine the scales. Kurtosis and skewness values were examined to determine whether the research variables showed a normal distribution. The skewness value for the overall health literacy score was found to be -0.674 , and the kurtosis value was 1.025 . In the sub-dimension of accessing information, skewness was -0.549 and kurtosis was 1.435 ; in the sub-dimension of understanding information, skewness was -0.648 and kurtosis was 0.845 ; for evaluating information, skewness was -0.632 and kurtosis was 0.963 ; in the sub-dimension of using information, skewness was -0.618 and kurtosis was 0.478 . In the treatment and service sub-dimension, skewness was -0.592 and kurtosis was 0.882 ; in the prevention and health sub-dimension, skewness was -0.819 , and kurtosis was 0.796 . For the total score of knowledge and attitudes about newborn screenings, the skewness value was -0.345 and the kurtosis value was 0.845 ; for the attitude sub-dimension toward newborn screenings, the skewness was -0.551 and the kurtosis was 1.525 ; for the sub-dimension related to concepts of newborn screenings, the skewness was -0.280 and the kurtosis was 0.190 ; and for the knowledge status dimension of newborn screenings, the skewness was -0.057 and the kurtosis was 0.490 .

In the relevant literature, it is accepted that the skewness and kurtosis values of variables are considered normal distribution if they are between $+1.5$ and -1.5 [14] or between $+2.0$ and -2.0 [15]. It was determined that the variables showed a normal distribution. Parametric methods were used in the analysis of the data. Differences in the proportions of categorical variables in independent groups were analysed using Chi-square tests. Relationships among the dimensions determining the scale levels were examined through Pearson correlation and linear regression analyses.

The Cronbach's Alpha internal consistency coefficient for the total score of the Maternal Attitudes and Knowledge about Newborn Screening Survey was calculated as 0.856 . When evaluated at the sub-dimension level;

the Alpha value of the sub-dimension of 'mothers' attitudes towards newborn screening tests' was 0.812 , the sub-dimension of 'concepts related to newborn screenings tests' was 0.826 , and the sub-dimension of 'mothers' knowledge about newborn screening tests' was found to be 0.829 .

The Cronbach's Alpha internal consistency coefficient for the overall score of the Health Literacy Scale used in the study was found to be 0.954 . When the internal consistency coefficients for the sub-dimensions of the scale were examined; the Cronbach's Alpha value for the sub-dimension of 'accessing information' was 0.911 , for the sub-dimension of 'understanding information' was 0.904 , for the sub-dimension of 'evaluating information' was 0.887 , and for the sub-dimension of 'using information' was 0.899 . Although the primary measures were derived from Likert-type items, analyses were conducted using total and subscale scores from validated instruments with high internal consistency. Distributional assumptions were assessed using skewness and kurtosis statistics, which supported the use of parametric methods.

Ethical consideration

Ethical approval was obtained from Mardin Artuklu University Non-Invasive Clinical Research Ethics Committee (Date: 18/02/2025, Reference number: 2025/2-1). In addition, institutional permission was obtained from the Mardin Provincial Directorate of Health (Date: 25/02/2025, Reference number: E-68051626-770-269432070). Also, written informed consent forms were obtained from all participants. This study was carried out in accordance with the principles of the Declaration of Helsinki.

Results

The descriptive characteristics of participants by ethnic groups were presented in Table 1. In terms of education level; the proportion of mothers with primary school education was higher among Arab mothers, high school graduates were higher among Kurdish mothers, and university graduates were higher among Turkish mothers. Regarding employment status, the employment rate was 19.6% among Turkish mothers, 8.5% among Arab mothers, and 13.7% among Kurdish mothers. In terms of income level, more than half of Arab mothers reported that their income was less than their expenses, while more than half of Kurdish mothers reported that their income and expenses were balanced. The availability of social security was highest in the Turkish group at 78.8% .

Table 2 presented pregnancy-related variables. When examining data related to fertility, it was observed that the number of pregnancies was higher in Arab and Kurdish mothers compared to Turkish mothers, with the rate of five or more pregnancies particularly high in the Arab group (34.9%). The number of children was also higher

Table 1 Descriptive characteristics of participants by ethnic groups

Variables		Turkish		Arab		Kurdish		Total		p
		n	%	n	%	n	%	n	%	
Age of the mother	18–24	38	20.1	45	23.8	12	6.3	95	16.7	$\chi^2 = 33.595$ $p = 0.001$
	25–30	61	32.3	51	27.0	52	27.4	164	28.9	
	31–35	49	25.9	42	22.2	77	40.5	168	29.6	
	36 and older	41	21.7	51	27.0	49	25.8	141	24.8	
Mother's education level	Primary school	44	23.3	80	42.3	58	30.5	182	32.0	$\chi^2 = 30.853$ $p = 0.001$
	Secondary school	49	25.9	54	28.6	46	24.2	149	26.2	
	High school	54	28.6	37	19.6	64	33.7	155	27.3	
	Bachelor's degree	42	22.2	18	9.5	22	11.6	82	14.4	
Employment status of mother	Employed	37	19.6	16	8.5	26	13.7	79	13.9	$\chi^2 = 9.755$ $p = 0.008$
	Unemployed	152	80.4	173	91.5	164	86.3	489	86.1	
Level of income	Income is lower than expenditure	91	48.1	114	60.3	73	38.4	278	48.9	$\chi^2 = 30.066$ $p = 0.001$
	Income equal to expenditure	71	37.6	61	32.3	105	55.3	237	41.7	
	Income is higher than expenditure	27	14.3	14	7.4	12	6.3	53	9.3	
Availability of health insurance	Yes	149	78.8	122	64.6	130	68.4	401	70.6	$\chi^2 = 9.943$ $p = 0.007$
	No	40	21.2	67	35.4	60	31.6	167	29.4	

Chi-Square Analysis

among Arab mothers. No significant differences were found between the groups in terms of miscarriage history or family history of hereditary diseases. The rate of consanguineous marriage between parents was approximately one-third in all ethnic groups.

The rate of attending regular health check-ups during pregnancy was highest among Turkish mothers (93.7%) and lowest among Kurdish mothers (82.6%). The rate of starting pregnancy follow-up within the first three months was 88.9% in the Turkish group, while this rate is 65.3% in the Kurdish group. The rate of correctly answering the statement 'newborn screening programs are carried out only with heel lancing' was higher among Turkish mothers, whereas the answer 'do not know' was more common among Kurdish and Arab mothers. When asked about the best time to learn about newborn screenings, most participants across all ethnic groups indicated 2–3 months before birth.

Health literacy and newborn screening knowledge and attitude scores by ethnic group differences were provided in Table 3. The results showed that overall health literacy scores showed significant differences among ethnic groups ($F = 10.716$; $p < 0.001$; $\eta^2 = 0.037$). Post-hoc analysis results indicated that the scores of Turkish (Mean = 30.56) and Kurdish (Mean = 29.36) mothers were significantly higher than those of Arab mothers (Mean = 26.25). This suggests that the Arab group may be at a disadvantage in terms of health literacy.

Similarly, in all sub-dimensions of health literacy, Turkish and Kurdish mothers scored higher than Arab mothers ($p < 0.001$). In the total knowledge-attitude score for newborn screenings, Turkish mothers (Mean = 47.51) also scored significantly higher than both Arab (Mean = 42.67) and Kurdish mothers (Mean = 44.72). In the attitude

sub-dimension, the Turkish group's score (Mean = 22.33) was higher than the other two ethnic groups. The level of conceptual knowledge was highest among Turkish mothers (Mean = 10.54) and lowest among Arab mothers (Mean = 9.55). In the knowledge status sub-dimension, Turkish mothers (Mean = 14.63) also scored higher than the other two ethnic groups.

Correlation analysis between health literacy and newborn screening knowledge and attitude scores in different ethnic groups was presented in Table 4. A strong and significant positive correlation was found between health literacy in Turkish mothers and the knowledge and attitude score of newborn screenings ($r = 0.575$; $p < 0.01$). The highest correlations were observed in the sub-dimensions of accessing information ($r = 0.598$), understanding information ($r = 0.561$), and treatment and service ($r = 0.577$).

In Arab mothers, the relationship was significant but weaker ($r = 0.332$; $p < 0.01$). No significant relationship was found between some sub-dimensions. In the Kurdish group, the overall correlation was moderate ($r = 0.410$; $p < 0.01$); particularly, the significant relationship between knowledge level and health literacy was identified ($r = 0.425$; $p < 0.01$).

Table 5 showed the impact of health literacy on knowledge and attitudes towards newborn screenings among different ethnic groups. According to the regression analysis in Table 5, health literacy was a strong predictor of the knowledge-attitude score in the Turkish group ($B = 0.474$; $\beta = 0.575$; $p < 0.001$; $R^2 = 0.327$). Although the relationship was significant in the Arab group, the effect size was low ($B = 0.267$; $\beta = 0.332$; $p < 0.001$; $R^2 = 0.105$). In the Kurdish group, the effect size was at a medium level similar to the Arab group ($B = 0.311$; $\beta = 0.333$; $p < 0.001$; $R^2 = 0.106$). In all three groups, the level of health literacy

Table 2 Pregnancy-related variables

Variables		Turkish		Arab		Kurdish		Total		p
		n	%	n	%	n	%	n	%	
Is there consanguineous marriage between the parents?	Yes	65	34.4	67	35.4	59	31.1	191	33.6	$X^2=0.895$ $p=0.639$
	No	124	65.6	122	64.6	131	68.9	377	66.4	
Presence of hereditary disease in the family	Yes	33	17.5	34	18.0	30	15.8	97	17.1	$X^2=6.029$ $p=0.197$
	No	136	72.0	126	66.7	123	64.7	385	67.8	
	Do not know	20	10.6	29	15.3	37	19.5	86	15.1	
Number of pregnancies	1	35	18.5	26	13.8	32	16.8	93	16.4	$X^2=27.929$ $p=0.001$
	2	51	27.0	22	11.6	48	25.3	121	21.3	
	3	42	22.2	37	19.6	35	18.4	114	20.1	
	4	27	14.3	38	20.1	26	13.7	91	16.0	
	5 and more	34	18.0	66	34.9	49	25.8	149	26.2	
Number of miscarriages	No	129	68.3	116	61.4	118	62.1	363	63.9	$X^2=2.341$ $p=0.310$
	1 and more	60	31.7	73	38.6	72	37.9	205	36.1	
Number of children in the family	1	40	21.2	33	17.5	29	15.3	102	18.0	$X^2=30.487$ $p=0.001$
	2	51	27.0	23	12.2	58	30.5	132	23.2	
	3	48	25.4	43	22.8	40	21.1	131	23.1	
	4 and more	50	26.5	90	47.6	63	33.2	203	35.7	
Having regular check-ups during your pregnancy	Yes	177	93.7	166	87.8	157	82.6	500	88.0	$X^2=10.927$ $p=0.004$
	No	12	6.3	23	12.2	33	17.4	68	12.0	
Time to start pregnancy follow-up	I started in the first three months of pregnancy	168	88.9	136	72.0	124	65.3	428	75.4	$X^2=40.107$ $p=0.001$
	I started between the 3rd and 6th months of pregnancy	9	4.8	30	15.9	50	26.3	89	15.7	
	I started between the 6th and 8th months of pregnancy	2	1.1	7	3.7	5	2.6	14	2.5	
	I started after the 8th months of pregnancy	1	0.5	1	0.5	1	0.5	3	0.5	
	I did not have a follow-up done	9	4.8	15	7.9	10	5.3	34	6.0	
Newborn screening programs are carried out only with heel lancing	Yes	92	48.7	59	31.2	40	21.1	191	33.6	$X^2=54.626$ $p=0.001$
	No	44	23.3	23	12.2	57	30.0	124	21.8	
	Do not know	53	28.0	107	56.6	93	48.9	253	44.5	
Best time to learn about newborn screenings	When the baby is screened	20	10.6	37	19.6	49	25.8	106	18.7	$X^2=24.390$ $p=0.001$
	2–3 months before the baby is born	104	55.0	84	44.4	63	33.2	251	44.2	
	2–3 weeks before the baby is born	62	32.8	63	33.3	71	37.4	196	34.5	
	Mothers do not need training about newborn screenings	3	1.6	5	2.6	7	3.7	15	2.6	

Chi-Square Analysis

Table 3 Health literacy and newborn screening knowledge and attitude scores by ethnic group differences

Variables	Turkish	Arab	Kurdish	F	p	η^2	Difference
	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD				
Health literacy general	30.562 $\pm$ 10.885	26.248 $\pm$ 9.593	29.358 $\pm$ 7.184	10.716	0.001	0.037	1,3 > 2
Accessing information	31.371 $\pm$ 11.316	26.951 $\pm$ 10.487	29.530 $\pm$ 7.999	9.256	0.001	0.032	1,3 > 2
Understanding information	30.743 $\pm$ 11.416	26.753 $\pm$ 10.094	29.960 $\pm$ 7.512	8.782	0.001	0.030	1,3 > 2
Evaluating information	29.729 $\pm$ 11.057	25.441 $\pm$ 9.759	28.814 $\pm$ 7.537	10.542	0.001	0.036	1,3 > 2
Using information	30.398 $\pm$ 11.308	25.824 $\pm$ 10.155	29.097 $\pm$ 7.818	10.784	0.001	0.037	1,3 > 2
Treatment and service	30.667 $\pm$ 11.181	26.130 $\pm$ 9.431	29.228 $\pm$ 7.396	11.342	0.001	0.039	1,3 > 2
Health protection	30.462 $\pm$ 11.169	26.367 $\pm$ 10.530	29.481 $\pm$ 7.698	8.790	0.001	0.030	1,3 > 2
Newborn screening knowledge and attitude scale total	47.508 $\pm$ 8.982	42.667 $\pm$ 7.712	44.725 $\pm$ 6.725	18.056	0.001	0.060	1,3 > 2; 1 > 3
Attitudes towards newborn screenings	22.333 $\pm$ 4.577	20.037 $\pm$ 4.085	21.148 $\pm$ 3.438	15.120	0.001	0.051	1,3 > 2; 1 > 3
Concepts related to newborn screenings	10.540 $\pm$ 2.339	9.550 $\pm$ 2.025	10.064 $\pm$ 2.120	9.868	0.001	0.034	1,3 > 2; 1 > 3
Knowledge towards newborn screening	14.635 $\pm$ 3.084	13.079 $\pm$ 2.613	13.513 $\pm$ 2.411	16.492	0.001	0.055	1 > 2,3

One-Way Analysis of Variance; Post Hoc: LSD

Table 4 Correlation analysis between health literacy and newborn screening knowledge-attitude scores in different ethnic groups

Variables	Newborn screening knowledge and attitude scale total			Attitudes towards newborn screenings			Concepts related to newborn screenings			Knowledge towards newborn screening		
	Turkish	Arab	Kurdish	Turkish	Arab	Kurdish	Turkish	Arab	Kurdish	Turkish	Arab	Kurdish
Health literacy general	<i>r</i> 0.575*	0.332*	0.333*	0.537*	0.271*	0.272*	0.405*	0.187*	0.131	0.570*	0.410*	0.425*
	<i>p</i> 0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.010	0.073	0.001	0.001	0.001
Accessing information	<i>r</i> 0.587*	0.331*	0.313*	0.556*	0.265*	0.260*	0.377*	0.176*	0.108	0.598*	0.425*	0.407*
	<i>p</i> 0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.015	0.140	0.001	0.001	0.001
Understanding information	<i>r</i> 0.560*	0.343*	0.346*	0.520*	0.283*	0.308*	0.393*	0.199*	0.126	0.561*	0.416*	0.414*
	<i>p</i> 0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.006	0.085	0.001	0.001	0.001
Evaluating information	<i>r</i> 0.531*	0.261*	0.307*	0.478*	0.213*	0.242*	0.402*	0.137	0.155*	0.530*	0.332*	0.375*
	<i>p</i> 0.001	0.001	0.001	0.001	0.003	0.001	0.001	0.060	0.033	0.001	0.001	0.001
Using information	<i>r</i> 0.542*	0.321*	0.275*	0.519*	0.264*	0.204*	0.392*	0.196*	0.099	0.510*	0.382*	0.389*
	<i>p</i> 0.001	0.001	0.001	0.001	0.001	0.005	0.001	0.007	0.176	0.001	0.001	0.001
Treatment and service	<i>r</i> 0.581*	0.335*	0.312*	0.547*	0.277*	0.260*	0.397*	0.172*	0.141	0.577*	0.422*	0.378*
	<i>p</i> 0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.018	0.054	0.001	0.001	0.001
Health protection	<i>r</i> 0.540*	0.305*	0.321*	0.500*	0.246*	0.259*	0.391*	0.187*	0.109	0.533*	0.371*	0.430*
	<i>p</i> 0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.010	0.135	0.001	0.001	0.001

* $p < 0.01$; Pearson correlation analysis

significantly affects the knowledge-attitude score regarding newborn screenings; however, the effect was most pronounced in the Turkish group.

Discussion

This study revealed that level of maternal health literacy plays a critical role in shaping knowledge and attitudes of mothers regarding newborn screening. The results demonstrate significant disparities across the three ethnic groups examined (Turkish, Kurdish, and Arab), with Turkish mothers consistently demonstrating higher health literacy scores and more favourable knowledge and attitudes toward newborn screening programs. These differences provide important insights into how ethnicity and health literacy intersect to influence maternal engagement with newborn screening practices. Maternal knowledge and attitudes toward NBS were linked to diverse sociodemographic elements and access to information, highlighting the significance of health literacy in shaping these perceptions [3]. The existing literature showed that lower health literacy is associated with reduced knowledge about newborn screenings and less confidence in the safety and efficacy of such interventions, as well as lower trust in healthcare providers and public health authorities [16, 17]. This study suggested that community engagement, culturally and linguistically appropriate interventions are needed to increase level of health literacy and contribute to a better uptake of screening practices.

The results indicating significant differences in health literacy scores among ethnic groups, specifically the Turkish, Kurdish, and Arab mothers. The statistical analysis ($F = 10.716$; $p < 0.001$; $\eta^2 = 0.037$) reinforces the relevance of ethnicity in predicting health literacy, emphasizing a notable disadvantage faced by Arab mothers, with their scores significantly lower than those of their Turkish and Kurdish counterparts. This observation is consistent with previous research indicating that ethnic minority status often correlates with lower health literacy levels, as factors such as socio-economic status, cultural differences, and accessibility to educational resources can hinder health information acquisition and application [18, 19].

The post-hoc analysis corroborates the disparities in health literacy across sub-dimensions. The sub-dimensional analysis reveals that the highest correlations within health literacy occurred in areas such as accessing information ($r = 0.598$), understanding information ($r = 0.561$), and treatment and service ($r = 0.577$). This pattern suggests that Turkish mothers not only possess the ability to seek health information effectively but also comprehend and apply this information to healthcare decisions regarding newborn care. This suggests that Turkish mothers may have better access to health education and

Table 5 The impact of health literacy on knowledge and attitudes towards newborn screenings among different ethnic groups

Ethnic groups	Independent variable	Unstan- dardized coefficients		Standardized coefficients	t	p	%95 Confi- dence Interval	
		B	SE				Lower bound	Upper bound
Turkish	Constant	33.007	1.601		20.615	0.001	29.848	36.165
	Health literacy general	0.474	0.049	0.575	9.611	0.001	0.377	0.572
*Dependent variable = Newborn screening knowledge and attitude scale total, $R = 0.575$; $R^2 = 0.327$; $F = 92.380$; $p = 0.001$; Durbin Watson value = 1.816								
Arab	Constant	35.669	1.549		23.020	0.000	32.612	38.725
	Health literacy general	0.267	0.055	0.332	4.807	0.001	0.157	0.376
*Dependent variable = Newborn screening knowledge and attitude scale total, $R = 0.332$; $R^2 = 0.105$; $F = 23.109$; $p = 0.001$; Durbin Watson value = 1.766								
Kurdish	Constant	35.585	1.951		18.241	0.000	31.736	39.433
	Health literacy general	0.311	0.065	0.333	4.823	0.001	0.184	0.439
*Dependent variable = Newborn screening knowledge and attitude scale total, $R = 0.333$; $R^2 = 0.106$; $F = 23.262$; $p = 0.001$; Durbin Watson value = 1.890								

resources, which is vital for shaping knowledge and attitudes around newborn care. Studies have documented that higher educational attainment is commonly associated with greater health literacy [19, 20], supporting the claim that Turkish mothers potentially benefit from these advantages due to a more supportive educational environment.

In contrast, the significantly lower health literacy scores among Arab mothers indicate a pressing need for targeted interventions to enhance their understanding and attitudes towards newborn screenings. This result aligns with literature suggesting that lower health literacy can lead to poorer health outcomes and a lack of engagement with healthcare services. For instance, studies have shown that barriers such as mistrust in healthcare systems and cultural differences can disproportionately affect ethnic minorities' healthcare interactions and knowledge about healthcare practices [21, 22].

Furthermore, the results regarding the total knowledge-attitude score for newborn screenings reveal that Turkish mothers had a significantly better grasp of this critical health aspect compared to Arab and Kurdish mothers. The higher mean scores in both the attitude and knowledge sub-dimensions among Turkish mothers indicate proactive engagement with health education resources. This aligns with previous works that emphasize the importance of health literacy in fostering positive health behaviours and reducing disparities in health outcomes, particularly among populations with varying cultural backgrounds [23].

Differences in maternal health literacy across ethnic groups appear to reflect structural and systemic factors, particularly inequities in access to linguistically appropriate health information and services, rather than ethnicity itself. Ethnicity in this study should be interpreted as a social and structural marker rather than an intrinsic

determinant. Addressing these disparities through culturally and linguistically appropriate interventions, community-based health education programs are needed for improving health literacy levels and ensuring equitable access to newborn care resources. Understanding the unique cultural contexts of each ethnic group can facilitate the development of more effective health interventions, promoting better health outcomes for mothers and their newborns.

Implications and recommendations

This study demonstrates significant disparities in health literacy and knowledge of newborn screenings across ethnic groups, specifically among Turkish, Kurdish, and Arab mothers. These disparities have crucial implications for public health strategies aimed at enhancing maternal and newborn health. The strong positive correlation between health literacy and knowledge/attitudes towards newborn screenings in Turkish mothers suggests that interventions designed to improve health literacy may be particularly effective in this demographic. Policymakers and health educators could integrate customized health literacy initiatives that consider the specific requirements and cultural backgrounds of diverse ethnic populations to improve knowledge and utilization of healthcare services related to neonatal care. Rather than focusing solely on parental education, efforts to improve maternal health literacy and engagement with newborn screening should prioritize system-level interventions, including the provision of healthcare services and educational materials in Kurdish and Arabic. Enhancing linguistic accessibility within prenatal and postnatal care settings may reduce structural barriers to health information and promote more equitable participation in newborn screening programs.

Although the observed differences in health literacy and newborn screening knowledge were modest in magnitude, such differences may have practical significance at the population level by influencing mothers' ability to understand screening procedures, interpret results, and engage in follow-up care. These findings should therefore be interpreted as indicators of potential inequities in access to health information rather than as direct evidence of differential clinical outcomes.

Given the varying levels of health literacy identified in different ethnic groups, particularly the lower scores seen in Arab mothers, targeted interventions are essential. Initiatives should enhance health literacy through culturally and linguistically appropriate educational materials and programs. In addition, the correlation found between health literacy and knowledge/attitudes towards newborn screenings suggests that health education should be an integral part of prenatal and postnatal healthcare services. Educational campaigns targeting expectant and new mothers could address common misconceptions, promote healthy practices, and provide information on accessing necessary health services. Programs like prenatal classes delivered during pregnancy and early postpartum check-ins can enhance access to crucial information.

Strengths and limitations

One of the strengths of this study is the use of validated data collection tools. In addition, reaching a robust sample size of 568 participants across three different ethnic groups, ensuring statistical power across three ethnic groups, with balanced distribution (189 Turkish, 189 Arab, 190 Kurdish) enhances reliability. Furthermore, the study's focus on correlations between health literacy and knowledge/attitudes regarding newborn screenings addresses an essential gap in the literature, particularly in ethnic minority populations. The identification of significant correlations strengthens the argument for targeted health literacy interventions in maternal care, highlighting the importance of education in improving health outcomes for newborns.

Despite its strengths, the study also acknowledges several limitations that may affect the interpretation of its results. One limitation is the cross-sectional nature of the research, which restricts the ability to establish causal relationships between health literacy levels and knowledge or attitudes towards newborn screenings. Longitudinal studies would be advantageous to better understand how improvements in health literacy may influence maternal knowledge and health-seeking behaviours over time. Longitudinal studies would allow examination of temporal relationships between maternal health literacy and newborn screening knowledge and attitudes,

helping to clarify directionality and potential bidirectional effects.

Another limitation is the potential for respondent bias in self-reported measures of health literacy and, knowledge and attitudes about NBS. Participants may have overestimated their health literacy due to social desirability biases or may not accurately reflect their understanding of the information pertaining to newborn screenings. In addition, participation in this study required basic literacy and voluntary engagement, and therefore, mothers with the lowest levels of health literacy may have been underrepresented, potentially leading to upward-biased estimates of overall health literacy. Moreover, participants were recruited from healthcare institutions, which may have resulted in a selective sample that underrepresents mothers with limited or no access to healthcare services. As these groups may have lower levels of health literacy, the results may overestimate maternal health literacy and newborn screening knowledge relative to the general population. Therefore, the results should be interpreted within the context of healthcare-attending mothers and may not be generalizable to all mothers in the community.

Furthermore, the health literacy indicators assessed in this study primarily reflect access to, comprehension of, and use of Turkish-language health information, as all instruments were administered in Turkish and validated for Turkish-speaking populations. The validity of these measures among Kurdish- and Arab-speaking mothers, particularly those with limited Turkish proficiency, remains uncertain. Therefore, the findings should be interpreted within the context of the Turkish-language healthcare system, and future studies should consider multilingual assessment tools and cross-cultural validation procedures.

In addition, the use of convenience sampling may limit the generalizability of results, as mothers who attend healthcare facilities and agree to participate may differ systematically from those who do not. Because a non-probability sampling strategy was used and ethnic group sizes were intentionally balanced, the findings cannot be generalized to the broader population of Mardin. The results should be interpreted as comparative and exploratory rather than population-level estimates. Finally, while the study highlights existing correlations, it does not delve deeply into the contextual factors that may mediate or moderate these relationships, such as socio-economic status, access to healthcare, and cultural beliefs. Exploring these additional variables would provide a more rounded understanding of the dynamics at play in maternal health literacy and could guide more effective interventions.

Conclusion

Level of maternal health literacy plays a critical role in shaping knowledge and attitudes of mothers regarding newborn screening. Maternal health literacy is a critical determinant of knowledge and attitudes about newborn screenings, with disparities across ethnic groups. Improving level of health literacy through culturally sensitive educational materials and programs is recommended. Targeted education, especially from trusted healthcare providers, could improve knowledge and attitudes, helping to reduce ethnic disparities in newborn screening uptake and outcomes. Educational campaigns could address common misconceptions, promote healthy practices, and provide information on accessing necessary health services.

Abbreviations

MKANSS Maternal Knowledge and Attitudes about Newborn Screening Survey
NBS Newborn Screening
THLS-32 Turkey Health Literacy Scale-32

Supplementary Information

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Supplementary Material 1.

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Not applicable.

Authors' contributions

Ahmet Butun: Conceptualization, Resources, Data curation, Software, Visualization, Methodology, Project administration, Validation, Formal analysis, Writing – original draft, Writing – review & editing. Vasfiye Bayram Deger: Conceptualization, Resources, Data curation, Software, Visualization, Methodology, Project administration, Formal analysis, Writing – review & editing. Havva Kacan: Conceptualization, Resources, Data curation, Software, Visualization, Methodology, Project administration, Formal analysis, Writing – review & editing.

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Data availability

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

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from Mardin Artuklu University Non-Invasive Clinical Research Ethics Committee (Date: 18/02/2025, Reference number: 2025/2 – 1). In addition, institutional permission was obtained from the Mardin Provincial Directorate of Health (Date: 25/02/2025, Reference number: E-68051626-770-269432070). Also, written informed consent forms were obtained from all participants. This study was carried out in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all individual participants included in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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