



Identification of maternal attitudes and knowledge about newborn screenings: a Turkey sample

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Abstract

This study was planned to determine maternal attitudes and knowledge about newborn screening. The universe of the descriptive study consisted of postpartum mothers living in the centers of three provinces in the north and east of Turkey. The sample included mothers who were older than 18 years of age, who could read and write Turkish, whose babies were in the 24th and 72nd hour after birth, and who volunteered to take part in the study. The study was completed with 407 mothers. The data were collected with the face-to-face interview method by the researchers using the “Descriptive Information Form” and the “Maternal Attitudes and Knowledge Survey about Newborn Screening.” The results showed that 40.3% of the mothers were between the ages of 25 and 30 years, 52.8% received information about newborn screening, 61.1% received this information during pregnancy (27.3% in the first trimester and 33.8% in the last trimester), and most of the information was provided by a healthcare professional (77.8%). Mothers with only one child ($p = .001$) and those with nuclear families ($p = .024$) were found to have lower maternal attitudes and knowledge about newborn screening. The study showed that the level of knowledge of Turkish mothers about newborn screening is inadequate in general. In particular, the knowledge and attitudes of mothers with nuclear families, those with one child, and those not having regular check-ups during pregnancy are inadequate. Improving mothers’ understanding of screening tests will lead to more successful screening program implementation and earlier detection and care of newborns with a disease.

Keywords Newborns · Neonatal screening · Mothers · Knowledge and attitudes · Turkey

Introduction

Newborn screening is a public health program that was designed around 60 years ago to identify and treat issues that are not evident after birth and treat them early to protect and improve newborn health (Guthrie and Susi 1963; Powell 2019). The diseases detected by the newborn screening program are mainly congenital metabolic diseases but also include endocrinological, hematological, immunological, and cardiovascular diseases and hearing screening (El-Hattab et al. 2018; Therrell et al. 2015). These disorders, which if not diagnosed early can cause major health problems, incapacity, or even death, are difficult to identify clinically and require urgent treatment (Bailey and Zimmerman 2019).

In the first few hours or days after birth, heel blood samples are taken on filter sheets and repeated with a second sample at family health centers in the first 2 weeks of the newborn’s life (Powell 2019; Therrell et al. 2015). These procedures aim to prevent the possibility of serious health

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problems that may arise with early diagnosis and treatment and reduce the cost of possible health care (Powell 2019).

Mothers should have adequate knowledge and positive attitudes about newborn screening. Studies on mothers' level of knowledge about newborn screening show that most mothers have inadequate knowledge (Franková et al. 2019; Silva et al. 2017; Kasem et al. 2022) and do not even remember whether they received information (Blom et al. 2020). Some studies suggest that even mothers who receive information from health professionals have insufficient awareness of certain aspects of newborn screening (Franková et al. 2019).

Healthcare practitioners should use their educational position to inform parents about the content of screening programs, how to implement them, and how to monitor the results (Powell 2019; Therrell et al. 2015). In most European countries, parents are informed about newborn screening (IJzebrink et al. 2021). Those who are given information regarding newborn screening have more positive views toward screening and lower levels of worry and anxiety (Lam et al. 2018; Silva et al. 2017). Mothers prefer to receive information in the prenatal period (Kasem et al. 2022; Arduini et al. 2017) and during newborn screening (Silva et al. 2017). Prenatal education is effective in improving knowledge in the postnatal period (Botkin et al. 2016).

The prevalence of consanguineous marriages, a major risk factor for genetic diseases, is about 25% in Turkey (Hacettepe University Institute of Population Studies 2022). The prevalence of autosomal recessive disorders and congenital malformations caused by consanguineous marriages is rising, posing a severe public health concern (Erdem and Tekşen 2013). Newborn screening programs, one of the critical steps to prevent this, started in Turkey in 1983 with phenylketonuria screening and became a national program in 1994. Today, comprehensive screening programs are offered free of charge by the Ministry of Health in all health centers (Fidan et al. 2022).

Parents have the right to object to the implementation of newborn screening, which is an obligatory public health program. Therefore, what needs to be done at this point is to educate parents through health professionals and involve them in the decision-making process. To this end, parents' lack of knowledge about newborn screening should be determined. Numerous studies (Kasem et al. 2022; Coupal et al. 2020; Sieren et al. 2016) have been conducted to examine maternal attitudes and knowledge about newborn screening in countries where the screens encompassing multiple tests have been adopted comprehensively and for a long time at the national level (Therrell et al. 2015). However, to the best of our knowledge, no multicenter study has been conducted on this subject in Turkey. After all these considerations, our study aims to determine maternal attitudes and knowledge about newborn screening in Turkey and close the gap in this field. The research questions sought to be answered are as follows.

Research questions

1. What is the level of knowledge of newborn baby mothers about newborn screening in Turkey?
2. What are the attitudes of mothers in Turkey toward newborn screening?
3. What are the variables that affect the knowledge and attitudes of mothers of newborn babies toward newborn screening in Turkey?

Materials and methods

Design

This research was planned in a descriptive and correlational design.

Setting and sample

The study was conducted in university and state hospitals in three cities in the north and east of Turkey between June and August 2022. The population of the study consisted of mothers who met the inclusion criteria in the centers of three cities located in the north and east of Turkey, and the population size was determined in line with the data received from the relevant institutions. The sample size was calculated using the sample size formula for known populations. In the study, the smallest sample size was calculated as 381 at a 95% confidence interval using the formula $n = [(N.t2.p.q) / d2.(N - 1) + t2.x.p.q]$. Considering that the standard error will decrease, and the study power will increase as the sample size increases, a total of 407 patients were included in the study, and the power of the sample to represent the population was found to be 93.75%. The inclusion criteria were being older than 18 years, reading and writing Turkish, being within 24 and 72 h after delivery (Fidan et al. 2022; Loeber et al. 2021), and volunteering to participate in the study. Since it is not possible to collect data from the whole country and the researchers work in the centers where the data was collected, the research was carried out in these regions.

Data collection tools

To collect the data, the Descriptive Information Form and the Maternal Attitudes and Knowledge about Newborn Screening Survey were used.

The descriptive information form Developed based on the literature (Arduini et al. 2017; Kasem et al. 2022; Newcomb et al. 2013) to determine the socio-demographic

characteristics of the mothers, the form consists of 29 questions about the maternal age, education level, and employment status; paternal education and employment status; income; family type; place of residence; social insurance; having a consanguineous marriage; hereditary diseases in the family; pregnancy information; and mothers' knowledge about newborn screening programs.

The maternal attitudes and knowledge about newborn screening survey The scale was developed by Newcomb et al. (2013). Its Turkish validity and reliability were performed by Erbay (2020), and it consists of 13 items. It is a 5-point Likert-type scale with 0 = strongly agree, 1 = agree, 2 = not sure, 3 = disagree, and 4 = strongly disagree options. As the score obtained from the scale increases, the knowledge and attitudes of mothers decrease. The highest and the lowest scores that can be obtained from the scale are “0” and “65.”

Cronbach's α value was found to be 0.79 in the original scale. In the internal consistency reliability of the subscales, Cronbach's α value varies between 0.83 and 0.88. In the Turkish version of the scale, Cronbach's α coefficients of the subscales range between 0.609 and 0.773. In this study, the Cronbach alpha value was 0.818 for the subscale of mothers' attitudes toward newborn screening tests (2, 4, 5, 7, 12, 13), 0.795 for the subscale of concepts related to newborn screening tests (8, 9, 10), 0.561 for the subscale of mothers' knowledge about newborn screening tests (1, 3, 6, 11), and 0.849 for the total scale.

Data collection

The researchers obtained the data through face-to-face interviews with mothers who volunteered to participate in the study between the 24th and 72nd hours after delivery, outside of the babies' care, treatment, and feeding hours. Adhering to the mask, distance, and hygiene standards, the researcher collected data from each mother separately using the Descriptive Information Form and the Maternal Attitudes and Knowledge about Newborn Screening Survey, respectively. Data collection took an average of 15 min.

Statistical analysis

IBM SPSS 25.0 (Statistical Package for Social Sciences) package program was used in the evaluation of the data. Percentage values, arithmetic mean, standard deviation, median, and minimum/maximum values were used to present descriptive statistics of the data. Kolmogorov–Smirnov normality test and Q - Q plots were used to determine whether the data were normally distributed. Since the data were not normally distributed, the Mann–Whitney U test was used for

two independent group comparisons, and the Kruskal–Wallis test was used for more than two independent group comparisons. $p < 0.05$ was accepted as statistically significant.

Ethical considerations

This study was performed in line with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Clinical Research Ethics Committee of a state university (date: 21.06.2022/document ID: E-18457941-050.99-52847) and from the relevant institutions to conduct the research. All mothers who agreed to participate in the study were informed about the purpose of the study and the research process and that they could withdraw from the study at any moment without giving any reason. Informed consent was obtained from all patients for being included in the study.

Results

Descriptive characteristics of the mothers involved in the study are given in Table 1. It was found that 40.3% of the mothers were 25–30 years old, 28.8% were high school graduates, and 50.9% were housewives. Of the spouses, 31.7% were high school graduates, and 92.6% were employed. Of the mothers, 87.2% had a nuclear family, 53.3% lived in the city center, 86.5% had social insurance, 51.6% had an income equal to their expenses, 87.7% had no hereditary disease in their families, and 88.2% had no consanguinity marriage.

Table 2 shows the characteristics of the mothers regarding their pregnancy and infant. Of the mothers, 29.0% had their first pregnancy, 37.6% had a living child, and 72.0% had a planned last pregnancy. About 55.8% had a baby girl, 95.3% had regular check-ups during pregnancy, and 16.2% were afraid of heel stick sampling. Of the mothers, 52.8% received information about newborn screening, the source of information was mostly health personnel (77.8%), and 27.3% of the mothers received this information in the first trimester of pregnancy, 33.8% in the last trimester of pregnancy, and 41.2% during the newborn screening.

Table 3 shows the responses of the mothers to the questions related to newborn screening. About 41.3% did not know whether the newborn screening test was compulsory or not, 21.1% did not know that newborn screening programs were performed only with heel stick sampling, 29.0% did not know that one heel stick sampling is sufficient for screening, and 51.1% did not know that the baby should be fed for at least 2 days for heel stick sampling in the screening test. Regarding hearing screening in newborns, 0.5% of the mothers answered “no” and 2.9% answered “do not know.” About vision screening in newborns, 14.5% of the mothers answered no and 13.5% answered do not know. To

Table 1 Descriptive characteristics of mothers ($n=407$)

Descriptive characteristics	<i>n</i>	%
Age		
18–24 years	49	12.1
25–30 years	164	40.3
31–35 years	119	29.2
≥ 36 years	75	18.4
Education level		
Primary school dropout	14	3.4
Primary school graduate	50	12.3
Secondary school graduate	62	15.2
High school graduate	117	28.8
University and above	164	40.3
Employment status		
Employed	200	49.1
Unemployed	207	50.9
Education level of the spouse		
Primary school dropout	14	3.4
Primary school degree	47	11.5
Secondary school degree	53	13.1
High school degree	129	31.7
University and above	164	40.3
Employment status of the spouse		
Employed	377	92.6
Unemployed	30	7.4
Family type		
Nuclear family	355	87.2
Extended family	52	12.8
Place of residence		
City	217	53.3
Province	157	38.6
Village/town	33	8.1
Having a social insurance		
Yes	352	86.5
No	55	13.5
Income status		
Income less than expenses	102	25.1
Income equal to expenses	210	51.6
Income more than expenses	95	23.3
Hereditary disease in the family		
Yes	22	5.4
No	357	87.7
Do not know	28	6.9
Parental consanguinity		
Yes	48	11.8
No	359	88.2
Total	407	100.0

Table 2 Characteristics of mothers related to pregnancy and infant

Characteristics	<i>n</i>	%
Number of pregnancies		
1	118	29.0
2	124	30.4
3	87	21.4
≥ 4	78	19.2
Number of living children		
1	153	37.6
2	153	37.6
≥ 3	101	24.8
Planning status of the last pregnancy		
Yes	293	72.0
No	114	28.0
Gender of baby		
Girl	227	55.8
Boy	180	44.2
Having regular check-ups during pregnancy		
Yes	388	95.3
No	19	4.7
Fear of having a heel prick sampling		
Yes	66	16.2
No	341	83.8
Receiving information about newborn screening		
Yes	215	52.8
No	192	47.2
Source of information on newborn screening*		
Healthcare worker	168	77.8
Internet	71	32.9
Family members/relatives	44	20.4
Friends	34	15.7
Family members/relatives, etc	27	12.5
Other (TV, radio, etc.)	14	6.5
Time of receiving information about newborn screening*		
During screening	89	41.2
Last trimester	73	33.8
First trimester	59	27.3
Total	407	100.0

*More than one answer was given

the question of whether newborns should be screened for hip dislocation, 7.4% of the mothers answered no and 8.4% answered do not know. Of the mothers, 10.1% and 16.2%

answered “yes” and “I do not know” to the statement that the tests for newborn screening are chargeable, respectively.

The total and subscale scores of the Maternal Attitudes and Knowledge about Newborn Screening Survey total and subscale scores are given in Table 4. The mean score of the subscale of the Maternal Attitudes and Knowledge about Newborn Screening Survey was 6.74 ± 6.00 , the mean score of the subscale of concepts related to newborn screening tests was 5.45 ± 5.01 , the mean score of the mothers’ knowledge about newborn screening tests subscale was 5.74 ± 6.01 , and the mean total score of

Table 3 Mothers' information about newborn screening ($n = 407$)

Newborn	<i>n</i>	%
A screening test is compulsory		
Yes	190	46.7
No	49	12.0
Do not know	168	41.3
Screening programs are conducted only with heel prick sampling		
Yes	86	21.1
No	121	29.7
Do not know	200	49.2
One heel prick sampling is sufficient for screening		
Yes	118	29.0
No	129	31.7
Do not know	160	39.3
The baby should be fed for at least 2 days (48 h) for heel prick sampling in the screening test		
Yes	154	37.8
No	45	11.1
Do not know	208	51.1
Hearing screening is performed		
Yes	393	96.6
No	2	0.5
Do not know	12	2.9
Vision screening is performed		
Yes	293	72.0
No	59	14.5
Do not know	55	13.5
Hip dislocation is checked		
Yes	343	84.3
No	30	7.4
Do not know	34	8.4
Screening tests are chargeable		
Yes	41	10.1
No	300	73.7
Do not know	66	16.2

Table 4 The Maternal Attitudes and Knowledge about Newborn Screening Survey total and subscale scores

Surveys	$\bar{X} \pm SD$	Med (min–max)	25p	50p	75p
The maternal attitudes about newborn screening test subscale	6.74 ± 6.00	6 (0–24)	3.00	6.00	10.00
The subscale of concepts related to newborn screening tests	5.45 ± 5.01	5 (0–12)	3.00	5.00	7.00
The maternal knowledge about newborn screening test subscale	5.74 ± 6.01	6 (0–16)	4.00	6.00	8.00
The total score of the Maternal Attitudes and Knowledge about Newborn Screening Survey	17.93 ± 17.00	17 (0–52)	11.00	17.00	24.00

the Maternal Attitudes and Knowledge about Newborn Screening Survey was 17.93 ± 17.00 .

The total and subscale scores of the Maternal Attitudes and Knowledge about Newborn Screening Survey according to some variables are shown in Table 5.

The attitude subscale scores of mothers with a primary school dropout/degree were higher than those of mothers with a secondary school degree, and the attitude subscale scores of mothers with three or more children were higher than those of mothers with one child, showing a statistically

Table 5 Total and subscale scores of the Maternal Attitudes and Knowledge about Newborn Screenings Survey according to some variables

Scales	1 $\bar{X} \pm SD$	2 $\bar{X} \pm SD$	3 $\bar{X} \pm SD$	4 $\bar{X} \pm SD$
Age				
18–24 years	7.00 ± 6.16	5.35 ± 3.10	5.27 ± 3.76	17.61 ± 11.05
25–30 years	6.22 ± 5.14	5.37 ± 3.24	5.58 ± 3.02	17.16 ± 9.12
31–35 years	6.84 ± 5.52	5.29 ± 2.82	5.73 ± 3.35	17.87 ± 9.63
≥ 36 years	7.57 ± 4.57	5.95 ± 2.77	6.41 ± 3.05	19.93 ± 8.44
Test*	6.383; .094	3.206; .361	6.808; .078	6.860; .076
Education level				
Primary school dropout/degree	8.27 ± 4.79 ^a	5.97 ± 2.48	7.03 ± 2.80 ^a	21.27 ± 8.30 ^a
Secondary school degree	5.50 ± 4.55 ^b	5.05 ± 2.99	5.40 ± 3.17 ^b	15.95 ± 9.15 ^b
High school degree	7.11 ± 5.41 ^{ab}	5.70 ± 3.12	5.91 ± 3.19 ^b	18.73 ± 9.30 ^{ab}
University and above	6.36 ± 5.54 ^{ab}	5.22 ± 3.14	5.24 ± 3.31 ^b	16.82 ± 9.70 ^{ab}
Test*	14.143; .003	5.373; .146	20.340; .000	17.546; .001
Employment status				
Yes	7.84 ± 6.24	5.86 ± 3.33	5.70 ± 3.91	19.40 ± 11.18
No	5.69 ± 3.93	5.05 ± 2.64	5.78 ± 2.40	16.52 ± 7.08
Test**	− 2.983; .003	− 2.561; .010	− 1.218; .223	− 2.329; .020
Education level of the spouse				
Primary school dropout/degree	7.13 ± 4.81	5.69 ± 2.81	6.77 ± 3.05 ^a	19.59 ± 8.75
Primary school degree	6.40 ± 4.91	5.53 ± 3.01	5.68 ± 3.02 ^b	17.60 ± 8.56
Secondary school degree	6.08 ± 4.87	5.00 ± 2.84	5.43 ± 3.21 ^b	16.51 ± 8.83
High school degree	7.24 ± 5.86	5.69 ± 3.22	5.62 ± 3.32 ^b	18.54 ± 10.20
Test*	3.653; .301	6.823; .078	9.568; .023	7.889; .051
Employment status of the spouse				
Yes	6.88 ± 5.39	5.44 ± 3.06	5.68 ± 3.26	18.01 ± 9.60
No	5.10 ± 3.55	5.57 ± 2.45	6.43 ± 2.65	17.10 ± 6.90
Test**	− 1.573; .116	− .247; .805	− 1.480; .139	− .230; .818
Family type				
Nuclear family	6.48 ± 5.31	5.46 ± 3.07	5.61 ± 3.22	17.55 ± 9.38
Extended family	8.56 ± 4.90	5.35 ± 2.66	6.65 ± 3.11	20.56 ± 9.34
Test**	− 3.196; .001	− .231; .817	− 2.401; .016	− 2.252; .024
Place of residence				
City	6.70 ± 5.67	5.26 ± 3.14	5.47 ± 3.52 ^a	17.42 ± 10.27
Province	6.93 ± 4.96	5.73 ± 2.94	6.10 ± 2.93 ^b	18.76 ± 8.48
Village/town	6.18 ± 4.27	5.36 ± 2.56	5.82 ± 2.35 ^a	17.36 ± 7.63
Test*	1.419; .492	1.824; .402	7.867; .020	5.107; .078
Having a social insurance				
Yes	6.67 ± 5.41	5.39 ± 3.07	5.63 ± 3.27	17.69 ± 9.61
No	7.20 ± 4.50	5.84 ± 2.69	6.44 ± 2.88	19.47 ± 8.04
Test**	− 1.363; .173	− 1.178; .239	− 2.185; .029	− 2.072; .038
Income status				
Income less than expenses	6.39 ± 5.16	5.51 ± 2.91	5.48 ± 2.97	17.38 ± 8.03
Income equal to expenses	6.59 ± 5.23	5.53 ± 3.27	5.86 ± 3.25	17.98 ± 9.78
Income more than expenses	7.46 ± 5.58	5.21 ± 2.53	5.76 ± 3.45	18.43 ± 10.04
Test*	2.124; .346	1.250; .535	1.624; .444	.528; .768
Hereditary disease in the family				
Yes	7.14 ± 7.74	4.18 ± 3.45 ^a	6.36 ± 4.09	17.68 ± 13.14
No	6.72 ± 5.17	5.59 ± 2.98 ^b	5.77 ± 3.20	18.08 ± 9.16
Do not know	6.71 ± 4.68	4.64 ± 2.98 ^a	4.89 ± 2.73	16.25 ± 9.52
Test*	.446; .800	7.020; .030	1.901; .387	1.045; .593

Table 5 (continued)

Scales	1 $\bar{X} \pm SD$	2 $\bar{X} \pm SD$	3 $\bar{X} \pm SD$	4 $\bar{X} \pm SD$
Parental consanguinity				
Yes	7.40 ± 5.35	5.31 ± 2.75	6.75 ± 2.94	19.46 ± 9.45
No	6.66 ± 5.29	5.47 ± 3.06	5.60 ± 3.24	17.73 ± 9.41
Test**	–.884; .377	–.390; .696	–2.426; .015	–1.194; .232
The number of pregnancies				
1	6.83 ± 5.72	5.32 ± 3.10	5.48 ± 3.40 ^a	17.64 ± 10.18
2	6.45 ± 5.03	5.26 ± 2.95	5.44 ± 3.01 ^a	17.15 ± 8.48
3	6.59 ± 5.42	5.45 ± 3.22	5.72 ± 3.19 ^a	17.76 ± 9.93
≥ 4	7.26 ± 4.96	5.95 ± 2.78	6.62 ± 3.23 ^b	19.82 ± 8.98
Test*	2.033; .566	2.481; .479	10.753; .013	5.451; .142
The number of living children				
1	6.10 ± 5.00 ^a	5.03 ± 2.87 ^a	5.17 ± 3.22 ^a	16.29 ± 9.06 ^a
2	6.74 ± 5.56 ^{ab}	5.51 ± 3.22 ^{ab}	5.66 ± 3.09 ^a	17.91 ± 9.38 ^{ab}
≥ 3	7.73 ± 5.22 ^b	6.01 ± 2.85 ^b	6.72 ± 3.24 ^b	20.46 ± 9.56 ^b
Test*	7.407; .025	7.348; .025	17.859; .000	13.709; .001
Planning status of the last pregnancy				
Yes	6.65 ± 5.18	5.41 ± 3.01	5.57 ± 3.28	17.63 ± 9.40
No	6.98 ± 5.60	5.55 ± 3.07	6.18 ± 3.05	18.72 ± 9.46
Test**	–.230; .818	–.429; .668	–2.026; .043	–.929; .353
Gender of baby				
Girl	6.56 ± 5.15	5.28 ± 3.01	5.83 ± 3.12	17.66 ± 9.24
Boy	6.98 ± 5.48	5.67 ± 3.03	5.63 ± 3.36	18.28 ± 9.66
Test**	–.772; .440	–1.089; .276	–.608; .543	–.459; .646
Having regular check-ups during pregnancy				
Yes	6.63 ± 5.32	5.43 ± 3.06	5.68 ± 3.24	17.74 ± 9.50
No	9.16 ± 4.21	5.79 ± 2.04	7.00 ± 2.56	21.95 ± 6.65
Test**	–2.600; .009	–.625; .532	–1.942; .052	–2.528; .011
Fear of having a heel stick sampling				
Yes	7.39 ± 5.11	5.33 ± 2.78	5.94 ± 3.31	18.67 ± 9.42
No	6.62 ± 5.33	5.47 ± 3.07	5.70 ± 3.21	17.79 ± 9.43
Test**	–1.368; .171	–.398; .690	–.414; .679	–.547; .584
Receiving information about newborn screenings				
Yes	6.67 ± 6.09	5.39 ± 3.22	4.98 ± 3.64	17.03 ± 10.79
No	6.83 ± 4.26	5.52 ± 2.79	6.59 ± 2.42	18.94 ± 7.51
Test**	–1.802; .072	–.534; .594	–6.373; .000	–3.333; .001

The superscripts a, b, and c show within-group differences in each group, and the measurements with the same letters are similar

1 Maternal attitudes about newborn screening test subscale, 2 Concepts about newborn screening test subscale, 3 Maternal knowledge about newborn screening test subscale, 4 Total of the Maternal Attitudes and Knowledge about Newborn Screenings Survey

*Kruskal Wallis test

**Mann-Whitney *U* test was used, Chi-square/*z*; *p* values are given

significant difference between the groups ($p = 0.003$, $p = 0.025$, respectively). The attitude subscale scores of the mothers who were not employed/housewives, those who had a nuclear family, and those who had regular check-ups during pregnancy were lower ($p = 0.003$, $p = 0.001$, $p = 0.009$, respectively).

Mothers who were employed and had no hereditary disease in their family had lower scores in the subscale of attitudes toward newborn screening tests ($p = 0.010$, $p = 0.030$, respectively). Mothers with three or more children had higher scores on the subscale of concepts related to newborn screening tests than mothers with one child ($p = 0.025$).

The subscale scores of the maternal knowledge about newborn screening tests were higher in mothers who were, like their spouses, primary school dropouts/graduates, who had an extended family, who lived in a province, who did not have social insurance, who had consanguinity marriage, who had four or more pregnancies, who had three or more children, whose last pregnancy was not planned, and who did not receive information about newborn screening ($p=0.000$, $p=0.023$, $p=0.016$, $p=0.020$, $p=0.029$, $p=0.015$, $p=0.013$, $p=0.000$, $p=0.043$, $p=0.000$, respectively).

The total scores of the Maternal Attitudes and Knowledge Survey about Newborn Screenings were higher in mothers who were primary school dropout/graduates than those who were secondary school graduates ($p=0.001$). The total scores of the Maternal Attitudes and Knowledge about Newborn Screening Survey were higher in mothers who were employed, who lived in a large family, who had no social insurance, who had three or more children, who did not have regular check-ups during pregnancy, and who did not obtain information about newborn screening ($p=0.020$, $p=0.024$, $p=0.038$, $p=0.001$, $p=0.011$, $p=0.001$, respectively).

Discussion

This study was conducted to determine maternal attitudes and knowledge about newborn screening and the factors affecting them. It is expected that determining the maternal attitudes and knowledge about newborn screening, who are the primary caregivers of newborns, will have a favorable impact on the achievement of health promotion targets connected to newborn screening. Identifying the variables influencing mothers' knowledge and attitudes on this issue will help the essential actions to promote the success of national efforts of these programs and will serve as evidence for international evidence comparison. No multicenter studies, to the best of our knowledge, have investigated maternal attitudes and knowledge about newborn screening, and the factors affecting them in Turkey.

In this study, it was determined that mothers needed informative support regarding newborn screening. It was determined that mothers especially needed information on the method of newborn screening, the number of scans, and the feeding criteria required for screening (Table 3). These findings in the study were found to be in strong agreement with research findings in other studies (Erbay 2020; Kasem et al. 2022; Schwan et al. 2019; Twfeeq and Abed 2016). These results should be used by healthcare professionals serving newborn mothers and integrated into healthcare practices.

In this study, it can be said that the knowledge (information about the diseases screened and the role of genetic factors, interpretation of the results of screening tests) and

attitudes (necessity of screening tests, mothers' concern about the risk of screening tests, confidence that the results of screening tests will not be shared) of mothers in Turkey about newborn screening are at a low level (Table 4). In a study evaluating the knowledge and attitudes of Saudi mothers toward newborn screening, it was determined that the knowledge of mothers was quite limited (Al-Sulaiman et al. 2015).

According to the findings, women in Turkey have little understanding and attitude toward newborn screening. The majority of mothers replied I do not know to the items in the "Maternal Knowledge and Attitudes about Newborn Screening Scale" (Table 3). In another study evaluating Saudi mothers' knowledge and attitudes concerning newborn screening, mothers' understanding was found to be relatively limited (Al-Sulaiman et al. 2015). In the international literature, various studies with results consistent with this research have been conducted (Arduini et al. 2017; Fitzpatrick et al. 2019; Franková et al. 2019; Kasem et al. 2022; Coupal et al. 2020) and mothers' level of knowledge on this subject is moderate or insufficient, and they need further information.

Informing parents about newborn screening is regarded as an essential component of the screening procedure (Franková et al. 2021). According to the results of this current study, most mothers (77.8%) got information on newborn screening from health staff (nurses, midwives, etc.) (Table 2). Similarly, it is reported that the necessary information about newborn screening is provided by healthcare professionals (Araia et al. 2012; Newcomb et al. 2019; Kasem et al. 2022). In many European countries, physicians, nurses, and midwives are in charge of providing postnatal information regarding newborn screening (Franková et al. 2021). Another research that evaluated the maternal attitudes and knowledge about a newborn screening during the prenatal trimester discovered that mothers mostly received information from midwives (Gagnon and Sandall 2007). In this study, the second source of information for mothers was social media such as the internet/newspaper/radio/TV/Facebook. Franková et al. found that 22% of mothers used the internet as a source of information (Franková et al. 2019). Web pages for newborn screening have been produced on the internet, a major media tool for health information (Patterson et al. 2015). Despite this, healthcare providers may be regarded to have an essential role to play in improving mothers' knowledge and views toward newborn screening during the prenatal and postnatal periods.

In this study, 41.2% of the mothers stated that they received information when the baby was screened and 61.1% received information in the prenatal period (27.3% in the first trimester and 33.8% in the third trimester) (Table 2). In a similar study conducted in New Zealand, 73% of mothers were most frequently informed after birth and 60% in the third trimester

(Kerruish et al. 2008). In another study, almost half of the mothers reported that the most appropriate time to receive information about newborn screening was the last trimester (Kasem et al. 2022). In a study conducted with the participation of 27 countries, 37% of the participants indicated that prenatal information should be provided (Franková et al. 2021). Given that the postnatal time is a particularly sensitive phase for both infant care and the mother, this data ought to be provided during the prenatal period (Arduini et al. 2017; Fitzgerald et al. 2017). Pregnant women have more time, can assimilate information better, and receiving early education increases their satisfaction levels (Krishnan et al. 2019).

In this study, a relationship was found between mothers' knowledge about newborn screening and the number of living children (Table 5). In a similar study conducted in Jordan, a relationship was found between the number of children and the knowledge level of mothers (Kasem et al. 2022). The significant relationship between having living children and the sub-dimensions of the scale may be attributable to the fact that the same screening procedures were applied to the previous children. In this study, a positive correlation was also found between the number of pregnancies and the knowledge status of mothers. Franková et al. emphasized that multiparous mothers had better awareness of newborn screening (Franková et al. 2019; Jatto et al. 2018), which may have resulted from the fact that multiparous mothers had more contact with health service providers.

In this study, mothers with consanguinity marriage had higher knowledge of newborn screening concepts (Table 5). In contrast to our study, no significant difference was found between the consanguinity marriage status and individuals' knowledge and attitudes toward newborn screening in a similar study (Erbay 2020).

There are several advantages to having an extended family. In this familial setting, people learn to share and educate one another. These informative and cautious attitudes are also useful in making proper health decisions. In this study, women with extended families had higher levels of knowledge and attitudes. Some previous studies have shown that there are more inappropriate traditional practices and information in extended family models (Zeyneloğlu and Kısa 2018). Nevertheless, the family model was not analyzed in any study exploring knowledge and attitudes concerning newborn screening, and no outcomes relating to this finding were discovered. This is the study's most remarkable result.

Conclusion

It can be said that informing mothers about newborn screening should be an integral part of the screening program. Diseases identified through the screening program

require rapid and effective treatment. Families and health-care professionals have critical roles to play in this context. It is recommended that the awareness level of mothers on this issue be enhanced and the appropriate training programs (online training modules, training booklets) be standardized in the health care system to achieve the intended success in health services focusing on newborn screening. It is recommended that these training programs be given by health professionals, who are primary caregivers, in centers providing primary health care services and in clinics where interaction with the mother is high in the postpartum period.

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Declarations

Ethical approval This study was performed in line with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Clinical Research Ethics Committee of a state university (date: 21.06.2022/document ID: E-18457941-050.99-52847) and from the relevant institutions to conduct the research. All mothers who agreed to participate in the study were informed about the purpose of the study and the research process and that they could withdraw from the study at any moment without giving any reason. Informed consent was obtained from all patients for being included in the study.

Conflict of interest The authors declare no competing interests.

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