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Determinants of neonatal mortality in East Azarbaijan province: a population-based study from Iran

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Abstract

Background Neonatal mortality continues to pose a major challenge to achieving global sustainable development goals, especially in low- and middle-income countries. Consequently, this study focused on examining the factors influencing neonatal mortality in the East Azarbaijan province, Iran.

Methods A cross-sectional study based on population data was conducted utilizing the Iranian Maternal and Neonatal (IMAN) Network data (2018–2019). A multilevel binary logistic analysis was employed to determine the key factors influencing neonatal mortality. Adjusted Odds Ratios and population attributable risk (PAR) for the identified risk factors were presented.

Results The neonatal mortality rate in East Azarbaijan province was 7.37 deaths per 1000 live births. Multivariate analysis indicated that neonates weighing less than 1000 g at birth with OR = 35.23 (PAR = 20.14%); 1000–1500 gram with OR = 12.85 (PAR = 8.03%) and 1500–2500 gram with OR: 3.24 (PAR = 1.62%), babies born with gestational age < 28 weeks was OR = 13.28 (PAR = 8.29%), 28–31 weeks OR = 6.81 (PAR = 4.10), 32–36 weeks OR = 4.33 (PAR = 2.39), male neonates OR = 1.41 (PAR = 0.30), stillbirth history of mothers OR = 2.24 (PAR = 0.90) were significantly associated with higher odds of neonatal mortality.

Conclusion The current study identified significant factors such as birth weight, gestational age, and a history of stillbirths among mothers as contributors to increased neonatal mortality. Prematurity (gestational age of < 37 weeks) and low birth weight (< 2500 g) together account for approximately 45% of the risk of neonatal deaths. Strategies to reduce neonatal mortality should prioritize the prevention of preterm births.

Keywords Newborn, Risk factor, Neonatal mortality, Epidemiology, Iran

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Introduction

Neonatal mortality refers to the death of a live-born infant within the first 28 days of life. Deaths occurring after the seventh day but before the 28th day of life are classified as late neonatal mortality [1]. In 2022, more than two million newborns died worldwide within the first 28 days of life, averaging about 6,500 per day. This represented 47% of all deaths in children under five years old [2]. During this first month, 25 to 50% of all these deaths occur within the first 24 h of life, and 75% during the first week [3].

Certain healthcare indicators, like child mortality rates, are closely linked to a country's level of development. More advanced countries generally have lower child mortality rates, while less developed nations tend to have higher rates. The Sustainable Development Goals (SDGs) aim to reduce the neonatal mortality rate (NMR) to below 12 deaths per 1,000 live births and the under-five mortality rate (U5MR) to 25 by 2030. Analyzing trends in NMR and U5MR, along with the factors affecting child survival, is essential for achieving these goals [4]. Variations in child mortality rates persist across Iranian provinces and regions, necessitating further investigation into underlying causes and contributing factors [5]. Establishing health facilities, providing maternal healthcare, implementing comprehensive vaccination programs, promoting breastfeeding, and maintaining effective referral systems are essential actions to reduce child mortality [6]. Efforts to enhance the survival rates of children rely on accurate data and a clear understanding of the causes of child mortality.

Although child mortality has significantly declined, over half of these deaths appear to be preventable [7, 8]. Prematurity was the leading cause of death in north-west Iran, responsible for 32.3%, 35.2%, and 36.8% of fatalities in 2013, 2016, and 2022, respectively [9]. Numerous studies have found links between newborn deaths and the living conditions of both mothers and newborns [10, 11]. Poor healthcare quality, limited maternal education, and exposure to infections are major contributors to neonatal mortality [12, 13].

Preventive health education, prenatal care, and social support can significantly reduce early neonatal deaths [14]. Global progress in reducing neonatal mortality has been achieved through effective health policies and resource allocation [15].

Nearly half of the deaths among children under 5 occur in newborns. However, many of these deaths can be prevented by enhancing the quality of prenatal care and providing specialized support during labor, delivery, and the post-natal period for both mothers and babies [16]. The neonatal component remains a global challenge due to its direct link to maternal, antenatal, peripartum, and delivery care conditions [17].

Understanding the relationship between healthcare factors and neonatal mortality is essential, as the causes of neonatal death vary by country and are influenced by the availability and quality of health services [18]. Identifying the factors related to mortality is crucial for prioritizing efforts to further reduce them and to eliminate those factors that could lead to subsequent increases in mortality.

Among the risk factors of neonatal mortality in developing countries are educational level of parents, sex of the newborn, gestational age, home delivery without skilled birth attendant, pregnancy complications [19], birth weight, delay in seeking care during illness, lack of preparedness of families and care providers, harmful cultural practices, economic status [15], social exclusion, maternal illiteracy, negative parental attitudes arising from the social environment, gender bias, lack of economic access to healthcare, and lack of basic prenatal, natal, and postnatal services [20].

To develop effective public health policies for pregnancy, childbirth, and neonatal care, it is essential to predict high-risk deliveries by identifying relevant risk factors and creating selective care pathways for those with high-risk pregnancies [21]. Additionally, the early identification of at-risk newborns can assist physicians in providing timely treatment, which directly influences their survival rates and reduces morbidity [22].

Identifying the factors linked to child mortality is essential for reducing it and improving health. Understanding these determinants in specific regions can help policymakers create effective programs to lower neonatal mortality rates. There are few studies on neonatal mortality in East Azarbaijan Province, and none specifically in this region. This study examined the factors contributing to neonatal mortality using a representative dataset. Our findings can help policymakers and researchers develop effective strategies to improve newborn survival in East Azarbaijan, Iran.

Materials and methods

Study design, period, and setting

The present study was population-based cross-sectional and the data were obtained from the IMAN network. Study period was one year from March 2018 to March 2019, which marks the beginning of the year according to the local calendar (Hijri Shamsi).

Data source and sampling

The IMAN network is a nationwide surveillance system operated by the Iranian Ministry of Health and Medical Education (MoHME) that documents two key events related to newborns: birth and death. Approximately 99% of all births in the country take place in hospitals and health facilities known as Tas'hilat Zaymani (Birth

Facilities) [13]. These facilities are often located in remote areas to ensure access to quality childbirth services with trained birth attendants, although this is not always the case. Typically, these facilities handle low-risk deliveries and refer higher-risk cases to hospitals. All births across the country, regardless of the location or outcome, are electronically recorded in the IMAN system. The data collected includes information about the mother, pregnancy and fetal details, delivery specifics, birth outcomes, and newborn care provided in the delivery room if applicable.

Neonatal deaths in hospitals usually occur in delivery rooms or inpatient wards. The IMAN system records data for admitted newborns, including birth details, admission condition, procedures, tests, and hospitalization outcomes. The IMAN system, in use for over a decade, ensures data quality nationwide. Midwives and nurses record data on paper before entering it online, with trained staff using calibrated tools for measurements like birth weight and head circumference. The study analyzed all newborn births and deaths during the period using data from the IMAN database, structured to include relevant variables.

Iran's health system

Iran's health system uses a referral system to organize services by levels, ensuring efficient care. The referral system enables patients to access specialized care by transferring them to suitable facilities, fostering connections between health levels and patients while improving treatment, reducing costs, saving time, and minimizing unnecessary healthcare demand [23].

Study area

East Azarbaijan, one of Iran's 31 provinces, spans 45,491 km² with a population of 3.91 million (2016). Its capital, Tabriz, is among the country's most developed cities, boasting a Human Development Index (HDI) of 0.785, reflecting achievements in health, education, and living standards.

Explanatory variables

The independent variables included in this study were: gender (boy or girl), fetal presentation (cephalic, breech, horizontal or face); number of fetuses (singleton, twin or more); crude and categorized birth weight: (< 1000, 1000–2500, 1500–2500, > 2500 g); head circumference at birth (< 31, 31–37, > 37 cm); length at birth (< 44, 44–54, > 54 cm); Intra-Uterine Growth Restriction-IUGR (yes, no) when the fetal weight is estimated to be below the 10th percentile for its gestational age; mother's education (no education, primary, secondary, diploma, and higher); gestational age crude and categorized: (less than 28, 28–31, 32–36, 37 weeks and over); history of abortion (no, yes); history of neonatal death (no, yes); having health insurance; mother's place of residence (urban, rural or nomadic), history of cesarean section-CS (no, yes); type of delivery (CS, vaginal); mother's age category (less than 19, 19–36, over 36); having consanguineous marriage i.e. a union between two individuals who are related as first or second cousins (no, yes).

The outcome variable was defined as the death of a live-born infant within the first 28 days of life. The study included neonates born at ≥ 22 weeks gestation to mothers residing in the study province, excluding those delivered outside of a hospital.

Statistical analysis

Data were summarized using means (standard deviation) for continuous variables and frequencies (percentages) for categorical variables.

Considering the small amount and random pattern of this missing data, we used the Listwise Deletion method. The Chi-Square test assessed the association between newborn mortality and independent risk factors. The outcome variable was binary: "1" for neonatal death and "0" for survival. Variables with $p \leq 0.1$ were included in a multivariable logistic regression model (Backward method) using Enter procedures. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were calculated, with statistical significance defined as p-value < 0.05.

Population attributable risks were considered with the use of the formula (P(OR-1)χ[P(OR1) + 1])×100, where P is the prevalence of risk factor of neonatal mortality in East Azarbaijan population and OR is the adjusted OR [24]. The 95% CI was calculated by determining the 95% CI for log (P [OR-1]) on the basis of the standard errors for P and OR and transforming back to the 95% CI for the population attributable risk. IBM SPSS Statistics (V.20) (IBM SPSS Statistics, IBM) software was used for data analysis.

Results

During the period of the study (March 2018 to March 2019), there were 53,152 births that took place among residents of the province. The results in Table 1 indicate that the majority of births and neonatal mortalities belonged to the women between the ages of 19–36 with 79.9% and 75.5%, respectively. Also, in terms of fetal presentation, the largest percentage of the births and neonatal mortalities were cephalic with a percentage of 94.7% and 78.8%, respectively.

Tables 1 and 2 also show that most mothers had 'diploma and higher' education with 52.3% and 55.6% among deceased and alive newborns, respectively. 7.1% of neonatal deaths occurred among mothers who had a history of neonatal death compared to 1.2% in alive infants

Table 1 Characteristics and distribution of newborn's mortality- East Azarbaijan Province (Iran)

Variables	Subgroups	Alive	Newborn's death	*p*-value*
		Frequency (Percent)	Frequency (Percent)	
Presentation	Cephalic	49,939 (94.7)	309 (78.8)	< 0.001
	Breech	2166 (4.1)	78 (19.9)	
	Horizontal	198 (0.4)	4 (1.0)	
	Face	457 (0.9)	1 (0.3)	
Number of babies	Singleton	50,963 (96.6)	329 (83.9)	< 0.001
	Twins or more	1797 (3.4)	63 (16.1)	
Mean newborn weight [grams]		3180.0 ± 529.69	1447.8 ± 1020.4	< 0.001
Category of newborn weight [gram]	< 1000	339 (0.6)	207 (52.8)	< 0.001
	1000–1500	343 (0.7)	49 (12.5)	
	1500–2500	3658 (6.9)	54 (13.8)	
	> 2500	48,420 (91.8)	82 (20.9)	
Mean of newborn length [Centimeter]		49.53 ± 3.39	37.66 ± 8.60	< 0.001
Category of newborn length [Centimeter]	< 44	2405 (4.6)	280 (71.4)	< 0.001
	44–54	49,094 (93.1)	111 (28.3)	
	> 54	1261 (2.4)	1 (0.3)	
Mean of newborn head circumference [Centimeter]		34.72 ± 2.39	26.96 ± 5.86	< 0.001
Category of newborn head circumference [Centimeter]	< 31	1725 (3.3)	278 (70.9)	< 0.001
	31–37	49,607 (94.0)	112 (28.6)	
	> 37	1428 (2.7)	2 (0.5)	
Newborn's gender	Boy	27,442 (52.0)	232 (59.2)	0.794
	Girl	25,304 (48.0)	158 (40.3)	
IUGR	No	52,191 (98.9)	361 (92.1)	< 0.001
	Yes	569 (1.1)	31 (7.9)	

*p-value calculated based on chi-square

Table 2 Characteristics of mothers- in relation to infant mortality East Azarbaijan Province (Iran)

Variables	Subgroups	Alive	Newborn's death	*p*-value*
		Frequency (Percent)	Frequency (Percent)	
Number of babies	Singleton	50,963 (96.6)	329 (83.9)	< 0.001
	Twins or more	1797 (3.4)	63 (16.1)	
Cesarean history	No	7683 (43.1)	87 (53.4)	0.008
	Yes	10,156 (56.9)	76 (46.6)	
Type of delivery	Vaginal	19,626 (37.2)	188 (48.0)	< 0.001
	Cesarean	33,134 (62.8)	204 (52.0)	
Mean of mother's age [Age]		28.80 ± 6.38	29.27 ± 6.91	0.154
Category of mother's age	< 19	4149 (7.9)	34 (8.7)	0.073
	19–36	42,138 (79.9)	296 (75.5)	
	> 36	6473 (12.3)	62 (15.8)	
Mother's education	No Education	2215 (4.0)	12 (3.1)	0.274
	Primary	8289 (15.7)	62 (15.8)	
	Secondary	13,023 (24.7)	113 (28.8)	
	Diploma and higher	29,333 (55.6)	205 (52.3)	
Abortion history	No	41,254 (78.2)	251 (68.0)	< 0.001
	Yes	11,506 (21.8)	118 (32.0)	
History of neonatal death	No	52,136 (98.8)	364 (92.9)	< 0.001
	Yes	624 (1.2)	28 (7.1)	
History of stillbirth	No	52,333 (99.2)	383 (97.7)	0.005
	Yes	427 (0.8)	9 (2.3)	
Mother's insurance	Yes	50,249 (95.2)	370 (94.4)	0.411
	No	2511 (4.8)	22 (5.6)	
Consanguineous marriage	No	47,168 (89.4)	321 (87.0)	< 0.001
	Yes	5592 (10.6)	48 (13.0)	
Mother's residence	Urban	38,492 (73.0)	275 (70.2)	0.213
	Rural or nomadic	14,268 (27.0)	117 (29.8)	
Gestational age [Weeks]	< 28	369 (0.7)	211 (53.8)	< 0.001
	28–31	366 (0.7)	39 (9.9)	
	32–36	4101 (7.8)	66 (16.8)	
	> 37	47,924 (90.8)	76 (19.4)	

*p-value calculated based on chi-square

($p < 0.001$). Consanguineous marriage was reported in 13.0% of neonatal deaths compared to 10.6% in alive infants, and this difference was statistically significant ($p < 0.001$). The average weight, length and head circumference of died newborns were lower than survived ones with a significant difference based on chi-square test ($p < 0.001$). The highest neonatal death among the weight classification of newborns belonged to the weight group less than 1000 g ($p < 0.001$).

The highest rate of neonatal death in the classification of length and head circumference of newborns belonged to the group of length less than 44 cm with 71.4% and in the classification group of head circumference belonged to the category less than 31 cm with 70.9% ($p < 0.001$). 16.1% of neonatal deaths occurred among twin and multiple pregnancies while these pregnancies comprised 3.4% of survived babies ($p < 0.001$). Infants with IUGR comprised 7.9% of neonatal mortality and 1.1% of survived infants and this difference was statistically significant ($p < 0.001$). 46.6% of the deaths occurred among mothers who had a history of CS, and 52.0% of the total neonatal mortality was among mothers who gave birth by CS ($p < 0.05$). Most neonatal deaths occurred in gestational ages of less than 28 weeks (53.8%) ($p < 0.001$). Preterm infants comprised 9.8% of survived group and 80.6% of neonatal deaths ($p < 0.001$). In terms of the distribution of observed and expected frequency of stillbirth history of mother on neonatal mortality, a difference was observed ($p = 0.005$). And a significant difference was observed in terms of the abortion history of the mothers

on the occurrence of death in the current newborns ($p < 0.001$).

392 cases of newborn deaths in East Azarbaijan province were recorded during the period of study. In this period, the neonatal mortality rate was 7.37 deaths per 1000 live births.

The multivariable analysis models used a stepwise backwards elimination procedure to identify independent variables that were significantly associated with the study outcome.

Those neonates weighing less than 1000 g at birth were 35.23 times more likely to die (95%CI: 17.73, 69.94) and it led to a PAR of 20.14%; neonates in category 1000–1500 gram with OR = 12.85 (95%CI: 6.73, 24.54) had a PAR of 8.03% and neonates in category 1500–2500 gram with OR: 3.24 (95%CI: 2.02, 5.19, PAR = 1.62%) times more likely to die compared with the neonates weighing greater than or equal to 2500 g at birth.

Those infants who had gestational age of < 28 weeks had a statistically significant OR = 13.28 (95%CI: 6.63, 26.59) to die before 28th day of life and it was estimated to have PAR of 8.29%, 28–31 weeks OR = 6.81 (95%CI: 3.46, 13.40, PAR = 4.10), 32–36 weeks OR = 4.33 (95%CI: 2.73, 6.87, PAR = 2.39) compared to the neonates who were born in 37 and higher weeks of gestation.

History of neonatal death had a protective effect so those mothers who had history of neonatal death had 70% less chance to have neonatal death compared to the mothers who had no history of neonatal death (OR = 0.30, 95% CI: 0.17, 0.51).

Male neonates were more likely (OR = 1.41, 95% CI: 1.12–1.78, $p = 0.003$) to die in the first month of life than female neonates.

There was a significantly higher risk of neonatal death for mothers with stillbirth history 2.24 (95% CI: 1.01, 4.97, $p = 0.04$) in comparison with those without stillbirth history (Table 3).

Table 3 Risk factors of neonatal mortality in East Azarbaijan Province (Iran); evidence from IMAN National system

Variables	Subgroups	Multivariable analysis		
		Adjusted OR (95% CI lower, upper)	*p*-value	PAR
Category of newborn weight	< 1000	35.23 (17.73, 69.94)	< 0.001	20.14
	1000–1500	12.85 (6.73, 24.54)	< 0.001	8.03
	1500–2500	3.24 (2.02, 5.19)	< 0.001	1.62
	> 2500	1.0 (Reference)		
Newborn's gender	Boy	1.41 (1.12, 1.78)	0.003	0.30
	Girl	1.0 (Reference)		
Stillbirth history	No	1.0 (Reference)		
	Yes	2.24 (1.01, 4.97)	0.04	0.90
Gestational age (weeks)	< 28	13.28 (6.63, 26.59)	< 0.001	8.29
	28–31	6.81 (3.46, 13.40)	< 0.001	4.10
	32–36	4.33 (2.73, 6.87)	< 0.001	2.39
	> 36	1.0 (Reference)		
History of neonatal death	No	1.0 (Reference)		
	Yes	0.30 (0.17, 0.51)	< 0.001	0.52
Gestational age* newborn weight		0.88	0.001	

Discussion

This study aimed to identify the risk factors contributing to neonatal mortality in Iran. Significant determinants were revealed, including gestational age below 28 weeks, male gender, a maternal history of stillbirth, and a history of neonatal death (which showed a protective effect).

The study revealed a neonatal mortality rate of 7.37 deaths per 1,000 live births. Compared with countries having a similar Human Development Index (HDI), such as Russia and Argentina, their neonatal mortality rates in 2018 were 3.0 and 6.0 per 1,000 live births, respectively [25]. Moradi-Lakeh et al. observed that geographical disparities in IMR and U5MR in Iran reduced between 1993 and 2008; however, these reductions were not statistically significant. Researchers suggested that adding specialized care to primary health services could improve the situation [26].

The present study found no significant difference in mothers' education levels between groups (deceased vs. surviving babies). Maternal education and household economic status were key contributors to neonatal mortality inequality in 1995–2000 and 2005–2010, respectively.

Educational initiatives in Iran, including mandatory pre-academic programs and literacy campaigns, reduced the impact of maternal education on inequality by 50%. Female literacy rose from 75.9% in 2000 to 80.07% in 2010, with women aged 15–24 achieving a 96.83% literacy rate. By 2010, tertiary education enrollment for women aged 15–18 reached 72.07%, nearly equal to men at 73.07% [27]. Neonatal mortality rates were notably higher among individuals residing in rural regions, those from economically disadvantaged households, and families with prior experiences of abortion or stillbirth.

Maternal education and household economic status were key contributors to neonatal mortality inequality in 1995–2000 and 2005–2010, respectively. Improved maternal education, driven by better schooling policies and increased female literacy and tertiary enrollment, reduced its impact on inequality. However, factors like rural residence, economic status, and history of stillbirth/abortion worsened inequality. Mothers with a history of stillbirth faced a higher risk of neonatal mortality [28]. In this population-based study, it increased the likelihood of neonatal mortality more than three-fold.

Stillbirth and infant mortality are closely linked, as research indicates that stillbirth often shares common risk factors with severe infant morbidity and mortality, highlighting the need for comprehensive prevention strategies [29].

Gestational age < 28 weeks disclosed a significant link with neonatal mortality. This finding was in agreement with studies done in Ghana [30], Ethiopia [31], and Indonesia [19]. Preterm neonates may struggle to adapt to extra-uterine life due to underdeveloped lungs, leading to breathing difficulties, hypoxia, and potentially death [32]. Other investigations also have shown the higher risk of death among babies born less than 28 weeks of gestational age [33].

Birth weight significantly predicts neonatal mortality, with low (LBW) and very low birth weight (VLBW) being key indicators of morbidity and mortality. The risk of neonatal death for LBW in Golestan study was 23 times more than that of normal birth weight [34]. Maternal age (35%), BMI (25%), preterm birth, and maternal chronic disease (25%) are the leading causes of LBW by prevalence [35]. A BMI over 25 is linked to adverse pregnancy outcomes, with risks increasing significantly above 30 and 35 [36]. Maternal overweight is associated with an amplified risk of neonatal mortality [37].

Male gender is a predictive factor for adverse neonatal outcomes. A 2014 meta-analysis of 30 million newborns found male fetuses have a 10% higher stillbirth rate [38]. The study conducted in India and Pakistan also confirmed that neonatal mortality risks were higher among male neonates than their female counterparts [39]. That is, female neonates had a stronger immune system than male neonates' due to genetic differences between females and males.

Our finding on the higher risk associated with having history of neonatal death is consistent with the study of Williams et al. [40] which found history of neonatal death to be an important risk factor for subsequent neonatal death. A retrospective study in Matlab, Bangladesh, found neonates with a history of sibling neonatal death had a 2-fold higher mortality risk than those without such history [41].

No significant difference was found between vaginal delivery and C-section in neonatal survival. Studies suggest regions with high elective C-section rates show limited correlation between delivery method and neonatal death [11]. Access to health centers in remote areas of Iran is provided, where high-risk mothers are identified by healthcare workers and referred to higher levels such as general and specialized hospitals in the referral system.

We found no association between maternal age and NMR, though earlier studies noted a 41% higher neonatal mortality risk for mothers under 18 compared to those aged 18–34 [42]. After adjusting for confounders, neonates of the youngest mothers in Nepal faced a 53% higher risk of mortality compared to those of the oldest mothers [43].

Limitations

The data for this investigation were population-based, sourced from birth registries and nationwide neonatal hospitalization records, minimizing sampling error. Future studies on maternal prenatal health, pregnancy-related diseases, and their link to neonatal mortality could provide deeper insights into factors affecting neonatal outcomes.

Conclusion

The study identified significant factors such as birthweight, gestational age, and maternal history of stillbirth that were associated with neonatal outcomes. Prematurity and low birth weight collectively accounted for 45% of the population-attributable risk of neonatal mortality. Improving prenatal care quality to reduce prematurity is essential for lowering neonatal mortality.

Abbreviations

IMAN	Iranian Maternal and Neonatal
NMR	neonatal mortality rate
U5MR	under-five mortality rate
MoHME	Iranian Ministry of Health and Medical Education
IUGR	Intra-Uterine Growth Restriction
CS	cesarean section
CIs	confidence intervals
HDI	Human Development Index
LBW	low birth weight
VLBW	very low birth weight
BMI	Body mass index

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Authors' contributions

"Conceptualization and research design: Ehsan Sarbazi and Abbas Habibelahi. Data collection: Ehsan Sarbazi, Mohammad Heidarzadeh, Amin Daemi. Data analysis: Amin Daemi, Ehsan Sarbazi. Writing—original draft preparation: Ehsan Sarbazi, Nasrin Rashidi Jazani, Saman Sedighi, Hassan Soleimanpour. Writing—review and editing: Ehsan Sarbazi, Parvin Mostafa-Gharabaghi, Saber Ghaffari fam and Hassan Soleimanpour. Supervision: Ehsan Sarbazi and Abbas Habibelahi. All authors read and approved the final manuscript."

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Data availability

The authors will provide the used raw data for reasonable requests to support the conclusions of this paper open to the public.

Declarations

Ethics approval and consent to participate

Ethics and regulatory approval was obtained from Tabriz University of Medical Sciences Ethics Board (IR.TBZMED.REC.1399.308). Privacy considerations regarding recorded data were maintained throughout the study. All methods were performed in accordance with the relevant guidelines and regulations of

the Declaration of Helsinki (DoH). Informed consent was obtained from their parents or legal guardians.

Consent for publication
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Competing interests
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