Injury- and Non-Injury-Related Factors Associated with Under Five Mortality in Iran: A Multilevel Study

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Abstract

Background: Unintentional and intentional injuries are the most important factors that cause disability and death among children throughout the world, especially in Iran.

Objectives: This study aimed to assess injury- and non-injury-related factors associated with under five mortality (U5M) at individual and community levels in Iran.

Methods: This population-based case-control study recruited a total of 2,228 mothers in Iran in 2017. Subjects were divided into three groups (428 as the case group, 664 as the control group 1, and 1,136 as the control group 2). Data were extracted from health records of mothers and interviews through a researcher-made checklist in the health center of eight provinces of Iran. The multilevel logistic regression model was used to evaluate risk factors of under-five mortality at individual and community levels. Data were analyzed using R V. 3.5.0 software.

Results: Analysis showed gestational age (post-term and pre-term) (OR = 4.20, CI: 3.14 - 5.61 , P < 0.001), pregnancy interval (between 1 to 3 years) (OR = 3.05, CI: 2.15 - 4.13, P < 0.001), history of mother's diseases (OR = 3.14, CI: 2.41 - 4.10, P < 0.001), living in urban area (OR = 1.51, CI: 1.16 - 1.97, P < 0.01) and worst life events among mothers (OR = 1.91, CI: 1.46 - 2.49, P < 0.001) were risk factors associated with under-five injury-related mortality. Moreover, women's literacy (OR = 0.72, CI: 0.54 - 0.97, P < 0.05), mothers being housewife (OR = 0.76, CI: 0.61 - 0.93, P < 0.01) were protective factor at the community level (P < 0.05).

Conclusions: This study revealed factors related to under-five mortality at individual and community levels, which most of them are preventable. Therefore, child mortality can be controlled by improving family health, mothers' education, as well as conducting interventions at the community level.

Keywords: Under-Five Mortality, Injuries, Non-Injuries, Multilevel Model, Iran

1. Background

The mortality rate is one of the most critical determinants of health and human development in the community. It has also been recognized as the most important measure in millennium development goals; thus, knowledge about the distribution and cause of mortality can play a key role in the planning and implementation of health programs (1, 2). One of the most important mortality indicators is the under-five mortality rate (U5MR) (3). According to the UNICEF records, The U5MR dropped from 93 per 1,000 live births in 1990 to 39 per 1,000 live births in 2017 (4). Also, according to the WHO's current report, approximately 73% of U5MR occurred in 2016, 48% occurred in African regions and 25% in Southeast Asia. According to the reports, the number of deaths reported in Africa was 8 times greater than in Europe (9.6 per 1,000 live births). Generally, in 2016, 5.6 million deaths were reported in children under the age of five (15,000 deaths per day); the death rate was reported 22% and 15.1 per 1,000 live births in East-Mediterranean region and Iran, respectively

(5). According to the report of WHO, U5MR in developing countries is more than in developed countries. In other words, U5MR in developing countries is ten times greater than that of developed countries (6). Therefore, Iran as a developing country reported U5MR in 2017 as 14 per 1,000 live births, which shows a decreasing trend compared to the past (7). According to the results of previous studies at the individual level, the risk factors associated with mortality among under-five children for Iran and the whole world are parental socio-economic status, congenital disorders, gestational age, gestational gap, maternal history of a disease, season of birth, being twins, area of living, especially rural area, ethnicity, duration of breastfeeding, poor sanitary conditions, the use of unhealthy drinking water, distance to the nearest health center, immunization status of mother and child, and intentional and unintentional injuries (8-11). Childhood injuries are of major public health problems that require magnificent attention. Injury and violence are leading causes of death throughout the world. Mortality due to injuries in children age 1 to 4 was 33 deaths per 100,000 population in Iran in 2005 (12, 13). According to the current reports in Iran, childhood injury has an important influence on the health system. Childhood injury is also one of the leading causes of under-five mortality that annually causes about 875,000 deaths worldwide. In fact, for children less than one year of age, most deaths are due to injuries (14). An epidemiological study conducted in China (2009 - 2014) among under-five children indicated that mortality due to injury in rural areas was 65 per 100,000 population that was about 3.73 times greater than mortality due to injury in urban areas. The three leading causes of death due to injury were reported as drowning (43.63%), suffocation (27.57%), and road traffic accidents (14.34%) (15). In general, the unintentional injury death rates per 100,000 population were 12.2 in high-income countries and 41.7 in low-middle-income countries in 2004. Factors associated with death due to unintentional injuries (per 100,000 population) have been reported as road traffic accidents (10.7), drowning (7.2), fire burns (3.9), falls (1.9), unintentional poisoning (1.8), and other factors (13.3), with a total rate of 38.8 worldwide (12), while diseases and disorders account for about 70% of all under-five children deaths like acute lower respiratory infections, pneumonia, diarrhea, malaria, and others (6). According to the past studies, rates of injury and accident among one-year-old children were reported as 3,200 accidents; the highest rate of accidents was reported in spring as 1,029 (31.15%). Also, 1,890 (59.1%) cases of the accidents occurred in the urban area and only 429 (13.4%) cases occurred in the rural area in Hamadan, Western Iran. In total, car accidents (53.4%), trauma (12.6%) and falls from height (8.8%) were the most frequent ones among accidents (16). Another study in Shiraz province showed that injuries leading to mortality had the lowest rate of death during the first year of children's life (6.4%). Children between the ages of one and five displayed the highest rate of death (28.7%). The mortality due to electrical injury, traffic accidents, falls, burns, drowning and blunt trauma were more common in children aged 1 - 4 years (14).

2. Objectives

Children mortality, as an indicator of health at the community level, needs more attention in Iran. Owing to the lack of multilevel studies in the world, especially in Iran, and owing to unknown factors related to children's death because of injury and non-injury factors, especially at the community level, this study aimed to identify risk factors that affected under-five mortality in eight provinces of Iran at individual and community levels.

3. Methods

This population-based case-control study was conducted in eight provinces of Iran, including Fars, Golestan, Hormozgan, South Khorasan, Kermanshah, Hamedan, Yazd, and Kohgiluyeh and Boyer-Ahmad. Five districts were selected from each province and then, randomly, two health centers at each district, one from urban, and one from rural areas were selected. The data collection and data entry period were performed from December 2016 to December 2018. A total of 2,228 samples were studied in 3 groups. The case group included 428 mothers who had lost at least one child aged 1 to 59 months due to injuries such as suffocation, burning, drowning, falling, poisoning, road collisions, and violence over the past five years at the time of interview. Because there were not many deaths in some provinces, we included all deaths in the study, the first control group included 664 mothers who had lost at least one child aged 1 to 59 months due to non-injury causes such as malnutrition or conditions such as measles, pertussis, HIV/AIDS, cancers, and other diseases over the past five years. The second control group comprised of 1,136 mothers who had at least a live child aged 1 to 59 months, and had not experienced under-five child death over the same period of time. The subjects in the first control groups were randomly (based on codes of health records) selected using health records and the subjects in the second control group were randomly selected from mothers referred to health centers for their children's vaccination. Data on an individual level were collected by trained interviewers who used standard checklists for interviewing mothers and extracted information from health records. Data on provincial levels such as urbanization rate, women's literacy, and unemployment rates were taken from the Statistical Center of Iran and the Ministry of Health and Medical Education.

3.1. Statistical Analysis

After data collection, data accuracy and discrepancies were evaluated. The data cleaning was performed using statistical analysis software prior to analysis. Data were analyzed at individual and community levels. Categorical data were expressed as frequencies and percentages and quantitative data as mean and standard deviation. Exploratory logistic regression was applied to examine the association between independent variables and the outcome. In addition, a two-level logistic regression model was employed in order to take community-level data into account. Mother's and child's variables were assessed at both individual and provincial levels. Odds ratios with 95% confidence interval were reported for cases for the first control group (model 1) and the second control group (model 2).

Missing data were substituted by multiple imputation method. Collinearity between level 1 and level 2 variables was investigated using the Pearson correlation coefficient for quantitative data and FI-Kramer and Gama for categorical variables. Maximum Likelihood estimation method was employed to fit the two-level logistic models. Data analyses were carried out using R version 3.5.0 software, and the significance level was set as $P < 0.05$.

4. Results

The variance of random components of multilevel model1 and model 2 is presented in Table 1. Table 2 represents the demographic characteristics of the study subjects in three groups as death due to injury (the case group), death due to non-injury causes (the control group 1), live child group (the control group 2). The results showed that 237 (55.4%) subjects in the case group, 452 subjects in control group 1 (68.1%), and 673 of the control group 2 (59.2%) were living in rural areas. In all three groups, the majority of mothers were under 35 years of age (95.3%, 86.4%, and 93.1%, respectively). The number of illiterate mothers in the control group 2 (9.6%) was greater than that of the other two groups. The rate of consanguineous marriages was 75.9% in the case group, 75.6% in the control group 2, and 65.1% in the control group 1. Also, mothers in the case group (41.1%) displayed a noticeable history of disease compared to mothers in the control group 1 (23.9%) and 2 (21.7%). A total of 5.52% of mothers reported a history of smoking during their pregnancy (Table 2).

By definition, the case group included mothers who lost at least one child aged 1 to 59 months due to injuries, and the control group 1 included mothers who lost at least one child aged 1 to 59 months due to non-injury causes, and the control group 2 included mothers with live children aged 1 to 59 months and had not experienced child death at the age of 1 to 59 months over the past five years.

Table 1. Variance Description of Random Component of Multilevel Model 1 and Model 2

Components	Model 1	Model 2
Residual variance	0.71	0.88
Variance of random component	1.32	0.50
ICC, %	65	36

Also, model 1 represented injury versus non-injury death groups, and model 2 compared mothers who experienced child death due to injury with mothers who experienced no child death during the past five years.

Table 3 summarizes the results of model 1, which represents multiple logistic regression for injury versus non-injury death groups. Crude Odds ratios are presented as well as adjusted ones and the results of multilevel analysis. The results showed that the adjusted Odds ratios of living in the urban area as 1.51 (CI: 1.16 - 1.97), pregnancy gap of 1 - 3 years, history of disease in mothers and literate mothers significantly increased the risk of child death due to injuries compared to non-injury deaths. On the other hand, maternal age > 35 years as 0.46 (CI: 0.27 - 0.79), having a history of abortion/stillbirth as 0.50 (CI: 0.27 - 0.94), and low birth weight as 0.16 (0.10 - 0.25) all acted as protective factors for child injury-related death. However, the multilevel analysis revealed that in provinces with a higher rate of women's literacy and neonatal weight (< 2500 g) child injury-related death has dramatically decreased such that the odds ratio was estimated as 0.41 (0.27 - 0.61) and 0.20 (0.11 - 0.36), respectively (Table 3).

When comparing mothers who experienced child death due to injury with mothers with no child death during the past five years in model 2, Odds ratios of having preterm gestation as 4.20 (CI: 3.14 - 5.61), having a pregnancy gap of 1 - 3 years as 3.05 (CI: 2.15 - 4.32), a history of mother's disease as 3.14 (CI: 2.41 - 4.10), and loss of family members as 1.91 (CI: 1.46 - 2.49) significantly increased the risk of under 5 deaths. On the other hand, child death among employed mothers as 0.60 (CI: 0.40 - 0.89) was significantly lower than housewife mothers. Also, multilevel model 2 showed the following results: the Odds ratio of living in the urban area as 1.44 (1.07 - 1.96), having preterm and post-term gestation compared to term gestation as 6.35 (4.57 - 8.84) and 2.91 (1.50 - 5.64), respectively, having pregnancy gap of 1 - 3 year 2.27 (1.53 - 3.32), age at childbirth of > 35 years as 2.43 (1.80 - 3.28), and finally loss of family members as 3.00 (2.20 - 4.09), which increased the risk of child mortality (Table 4).

5. Discussion

In this study, we examined the effects of child, mother, and community characteristics such as mother's literacy,

Table 3. Odds Ratio for Death due to Injuries Compared to Non-Injury Cases

Variables	Crude OR (95%CI)	Adjusted OR (95%CI)	Multilevel OR (95%CI)
Living place			
Urban	1.71 (1.33 - 2.20)[a]	1.51 (1.16 - 1.97)[b]	1.25 (0.81 - 1.92)
Rural	Ref	Ref	Ref
Maternal age			
> 35	0.31 (0.18 - 0.51)[a]	0.46 (0.27 - 0.79)[b]	1.11 (0.61 - 2.05)
≤ 35	Ref	Ref	Ref
Mother's job			
Employed	1.29 (0.83 - 2.00)	1.17 (0.73 - 1.86)	0.92 (0.46 - 1.82)
Housewife	Ref	Ref	Ref
Gap of pregnancy (year/s)			
1 - 3	2.84 (2.02 - 4.00)[a]	2.25 (1.56 - 3.23)[a]	1.17 (0.09 - 1.87)
< 1	1.14 (0.59 - 2.22)	1.18 (0.57 - 2.41)	0.49 (0.17 - 1.34)
First pregnancy	3.15 (2.26 - 4.38)[a]	1.71 (0.66 - 4.40)	0.69 (0.19 - 2.36)
> 3	Ref	Ref	Ref
History of mother's disease			
Yes	2.21 (1.70 - 2.88)[a]	2.07 (1.57 - 2.74)[a]	1.42 (0.86 - 2.38)
No	Ref	Ref	Ref
History of mother's pregnancy			
Live birth	Ref	Ref	Ref
Stillbirth or abortion	0.52 (0.29 - 0.93)[c]	0.50 (0.27 - 0.94)[c]	1.49 (0.73 - 3.03)
First pregnancy	1.76 (1.36 - 2.28)[a]	1.40 (0.55 - 3.51)	1.59 (0.47 - 5.47)
Child's sex			
Girl	1.27 (0.99 - 1.62)[c]	0.84 (0.65 - 1.10)	1.13 (0.79 - 1.63)
Boy	Ref	Ref	Ref
Smoking during pregnancy			
Yes	0.37 (0.20 - 0.66)[a]	0.36 (0.19 - 0.68)[b]	1.68 (0.26 - 1.32)
No	Ref	Ref	Ref
Mother's education			
Literate	0.27 (0.14 - 0.50)	2.27 (1.14 - 4.53)[a]	1.46 (0.70 - 3.06)
Illiterate	Ref	Ref	Ref
Neonatal weight			
Normal	Ref	Ref	Ref
Low birth weight	0.14 (0.12 - 0.17)[a]	0.16 (0.10 - 0.25)[a]	0.20 (0.11 - 0.36)[a]
High birth weight	0.83 (0.50 - 1.39)	0.77 (0.25 - 2.31)	0.89 (0.21 - 3.66)
Urbanization			1.04 (0.96 - 1.12)
Unemployment			0.76 (0.55 - 1.03)
Mother's literacy			0.41 (0.27 - 0.61)[a]

[a] P < 0.001.
[b] P < 0.01.
[c] P < 0.05.

urbanization, and mothers' unemployment on the risk of death before the age of five, across eight provinces of Iran. The results of this study showed that 55.4% of under-five children's mortality rate was due to accidents and injuries, and 68.1% of death were due to other causes such as illness, which occurred in rural regions. This finding is in line with other prior studies in which the frequency of U5M in rural area is more than an urban area, especially in Iran (15, 17). Besides, 56.8% of female U5M were due to accidents that this finding was opposed to past studies (18, 19). The findings of the present paper showed that there was a significant difference between the pregnancy gap of 1 - 3 years and the first pregnancy with U5M in models 1 and 2. Generally, in both models, the gap of pregnancy with 1 - 3 years in case

Table 4. Odds Ratio for Injury-Related Mortality Compared to Living Child

Variables	Crude OR (95%CI)	Adjusted OR (95%CI)	Multilevel OR (95%CI)
Living place			
Urban	1.17 (0.93 - 1.46)	0.98 (0.76 - 1.26)	1.44 (1.07 - 1.96)[a]
Rural	Ref	Ref	Ref
Gestational age			
Term	Ref	Ref	Ref
Preterm	3.10 (2.39 - 4.03)[b]	4.20 (3.14 - 5.61)[b]	6.35 (4.57 - 8.84)[b]
Post-term	1.04 (0.58 - 1.86)	1.43 (0.77 - 2.64)	2.91 (1.50 - 5.64)[c]
Mother's age			
> 35	0.66 (0.40 - 1.10)	0.66 (0.37 - 1.17)	0.90 (0.49 - 1.63)
≤ 35	Ref	Ref	Ref
Twins or more			
Yes	1.43 (0.76 - 2.71)	0.97 (0.47 - 2.00)	1.09 (0.53 - 1.32)
No	Ref	Ref	Ref
Mother's job			
Employed	0.65 (0.45 - 0.94)[a]	0.60 (0.40 - 0.89)[c]	0.66 (0.42 - 1.02)
Housewife	Ref	Ref	Ref
Gap of pregnancy (year/s)			
1 - 3	3.04 (2.20 - 4.20)[b]	3.05 (2.15 - 4.32)[b]	2.27 (1.53 - 3.32)[b]
< 1	1.39 (0.73 - 2.65)	1.23 (0.58 - 2.57)	1.30 (0.60 - 2.88)
First pregnancy	2.39 (1.76 - 3.25)[b]	1.56 (0.61 - 3.96)	1.34 (0.46 - 3.93)
> 3	Ref	Ref	Ref
History of mother's disease			
Yes	2.52 (1.99 - 3.20)[b]	3.14 (2.41 - 4.10)[b]	2.43 (1.80 - 3.28)[b]
No	Ref	Ref	Ref
History of mother's pregnancy			
Live birth	Ref	Ref	Ref
Stillbirth or abortion	0.71 (0.40 - 1.25)	0.72 (0.36 - 1.41)	1.47 (0.73 - 3.00)
First pregnancy	1.34 (1.06 - 1.68)[a]	1.63 (0.66 - 4.04)	1.34 (0.47 - 3.85)
Worst life event			
Others	Ref	Ref	Ref
Loss of family	1.61 (1.27 - 2.04)[b]	1.91 (1.46 - 2.49)[b]	3.00 (2.20 - 4.09)[b]
Urbanization			1.01 (0.96 - 1.07)
Unemployment			0.76 (0.61 - 0.93)[c]
Mother's literacy			0.72 (0.54 - 0.97)[a]

[a] P < 0.05.
[b] P < 0.001.
[c] P < 0.01.

group increased the under-five mortality by more than 3 times (OR ≅ 3) as a result of family crowding, lack of maternal care, cessation of breastfeeding, and less labor experience (regarding child care in the first pregnancy). Also, there was no significant relationship between under-five mortality and pregnancy gap of less than one year. This can be a result of a low number of these children due to stillbirth or congenital disorders. Thus, the cause of death is not injury-related among these individuals. For example, Davanzo et al. found that the overall pregnancy gap

was significantly associated with under-five mortality (20). Also, in model 2, there was a significant difference between under-five mortality and pregnancy interval of 1 - 3 years at the community level. The Odds ratio of under-five mortality due to injury with pregnancy interval of 1 - 3 years was 2.27 higher than in live birth (OR = 2.27).

The history of mother's diseases in both models was significantly associated with under-five mortality; in other words, the history of mother's diseases increased under-five mortality by 3.14 times among children in the model

2 and 2.07 times in the model 1. These results were consistent with other studies. Moreover, there was a significant relationship between the history of mother's diseases and under-five mortality at the community level in the model 2 (OR = 2.43). Mothers play a pivotal role in providing proper children care; thus, sick mothers may not provide sufficient care to their children. This lack of care can cause anxiety and depression in children. Also, mother's diseases may adversely influence successful breastfeeding and may cause congenital disorder that leads to child death due to injury and non-injury-related factors (21). Besides, there was a significant relationship between stillbirth and under-five mortality due to non-injuries causes. As such, the under-five injury-related mortality was 50% lower in children of mothers with a history of stillbirth or abortion in their previous pregnancies, showing that the history of stillbirth or abortion may affect mortality due to non-injury factors (OR = 0.50). Also, the history of abortion or stillbirth among mothers can influence increasing of her child care. All these resulted in decreasing the death of a child due to injuries. These results were consistent with the results of Davanzo et al., suggesting that the history of stillbirth was positively associated with neonatal death (20). Similar to previous studies, in model 1 compared to model 2 there was a significant relationship between mother's age (> 35 years) and under-five mortality (OR = 0.46). Mother's age > 35 years influenced under-five mortality due to non-injury-related factors such as congenital disorders and child's diseases that related to the mother's age. No significant relationship was observed between under-five injury-related mortality and mother's age > 35 years (22). A large number of previous studies showed that under-five injury-related mortality is higher in boys than girls due to psychological differences between the sexes. These differences include physical activity, level of curiosity, type of playing, etc. However, the findings of the present study did not show a significant difference between the sex of children and under-five mortality. Also, a comparison of crude and adjusted Odd ratios on child's sex revealed a qualitative confounder; after adjustment, the confounding effect was removed (18).

In the model 1, a significant correlation was observed between smoking during pregnancy and under-five mortality that is smoker mothers displayed different lifestyles, also side effects of smoking affected children health. Smoking in pregnancy is shown as a factor associated with under-five non-injury-related mortality (OR = 0.36) (23). In addition, because of the strong social stigma considering cigarette smoking by Iranian women, our results regarding smoking during pregnancy were biased. As a result, the number of mothers who declared themselves as smokers was low (under-estimation), which affected the results. There was a significant relationship between neonatal weight and under-five mortality due to non-injury causes at the individual and community level. As such, the under-five injury-related mortality was 84% (at the individual level), and 80% (at the community level) lower in children with neonatal weigh under 2,500 g compared to children with normal neonatal weight that died due to non-injury factors. Thus, it can interpret that due to the susceptibility of children with low birth weight to various diseases, these children may be more likely to die due to non-injuries factors in early ages. On the other hand, since mothers of infants with low birth weight, due to the special health status of their children, may pay much more attention and care of them, they less likely to die from injury-related factors (24).

Moreover, there was a significant relationship between the area of living and under-five mortality at the individual level in the model 1; as such, under-five mortality was reported 51% more in urban areas than that of in rural areas (OR = 1.51). Also, at the community level of the model 2, there was a significant relationship between the area of living and under-five mortality (OR = 1.44), which may be due to lack of appropriate playing space for children and hazards of playing spaces in urban areas. As a result, urban children are at higher risk of exposure to accidents and injuries, which was supported by Khazaei et al. (16). Also, in both multilevel models, there was a risk factor between under-five mortality and urbanization at the community level that was not significant in the present study; this issue was corroborated by Antai and Moradi that urbanization can affect the increase of under-five mortality at the community level (25).

In model 2, there was a significant relationship between gestational age at birth (preterm) with injury-related U5M at the individual and community level. As such, injury-related mortality among preterm children was 4.20 times greater because preterm children are particularly vulnerable to early injuries and need more attention compared with normal children. Also, most of mothers with preterm children have a history of accident and trauma during pregnancy, which can lead to preterm delivery and influence child mortality; thus, these children, especially under the age of one, are more exposed to unintentional or intentional injuries and diseases (26).

In model 2, a history of worst life events among mothers was significantly associated with under-five mortality at the community level. The injury-related U5M was 91% greater in mothers with a history of loss of family (OR = 1.91), which may cause anxiety, depression, and loneliness; these lead to a child's poor care and death. According to the reports, traumatic events in female gender lead to the development of psychopathology. Furthermore, traumatic events affect females twice comparing to males. Depression syndrome occurs among women as 25.5%; thus,

traumatic events can affect attitude, moods, and physical health, which can affect an individual's life (27, 28).

Regarding the mother's job, there was a significant association between being employed mothers and under-five mortality, as the under-five mortality was 40% lower in children of employed mothers compared to children of housewife mothers (OR = 0.60). This can be due to differences in education levels and more awareness of employed mothers than housewife mothers, so it can be effective in reducing infant mortality (29) but, the effect of mother's job at the community level was in contrast to the individual level. In the multilevel model 2, the under-five mortality among children of housewife mothers was 24% lower than children of employed mothers (OR = 0.76). This can be attributed to more time spent by housewife mothers to provide care for children compared with the time spent by employed mothers. Also, stress and anxiety exposure in the work environment and the lack of concentration for child care in employed mothers can influence the health of their children. This result was inconsistent with Tura Debelew et al. study (22). Finally, a significant relationship was found between mothers' literacy level and under-five mortality in both models. As such, the higher mothers' literacy level was associated with a lower risk of under-five mortality in all eight studied provinces. According to the results of a study conducted in India, primary education up to seven years can reduce child mortality while mothers' education levels up to the primary level cannot help reducing child mortality. Also, encouraging women to educate and to be literate and increasing their awareness can influence the utilization of health service, which can reduce child mortality (29). Thus, factors that promote mothers' knowledge can be effective in decreasing under-five mortality due to injury and non-injury-related factors; this finding is consistent with other studies (22, 23).

5.1. Conclusions

The findings of this study revealed that due to various numbers of risk factors associated with death in children under the age of five, the U5M is widely different in different provinces of Iran. Children under the age of five are the most susceptible population to high-risk factors that lead to mortality owing to injury- and non-injury-related factors. Hence, they require magnificent attention. In this study, the association between under-five mortality due to injury- and non-injury-related factors was examined at individual and community levels. Risk factors associated with under-five mortality in both models at the individual level were living in urban areas, the birth interval of 1 - 3 years, the history of mother's diseases, gestational age (< 37 weeks), and experience of loss of family. Also, protective factors associated with under-five injury-related mortalities were mother's age (> 35 years), a history of still-

birth or abortion among mothers, smoking during pregnancy, employed mothers, and neonatal weight. Eventually, multilevel model revealed that in both models, neonatal weight (< 2500 g), literacy level among mothers, living in urban areas, and being housewife were protective factors in eight provinces of Iran. Also, gestational age (post-term and preterm), pregnancy interval of 1 - 3 years, and history of mother's diseases were risk factors associated with under-five injury-related mortality. Therefore, improving the mother's knowledge may reduce under-five mortality. Also, the implementation of an effective training intervention for parents to increase knowledge towards risk factors and protective factors associated with mortality among children is important. Furthermore, more attention should be paid to maternal health during pregnancy as well as awareness towards maternal diseases before pregnancy to decrease the risk of death and reduce under-five non-injury-related mortality.

Footnotes

Authors' Contribution: Data analysis, designing the project, data acquisition in Hamedan province: Mahmoud Hajipour; drafting the manuscripts in Persian and revising the manuscripts in English, preparing of tables: Niloufar Taherpour; data analysis: Abolfazl Payandeh; data acquisition in Golestan province and revising the manuscripts in English: Koorosh Etemad; data acquisition, quality control of data in Kermanshah province: Shahab Rezaeian; data acquisition, quality control of data in Hormozgan province: Fatemeh Zolfizadeh; data acquisition, the focal point of data gathering in South-Khorasan and Yazd provinces: Abdolhalim Rajabi and Ali Ghasemi; data acquisition, the focal point of data gathering in Fars province: Tannaz Valadbeigi; data analysis, designing the project, revising the manuscripts in English: Yadollah Mehrabi; All authors read and approved the final manuscript.

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Table 2. Demographic Characteristics of Mothers and Children in the Case and Control Groups[a]

Variables	Case Group	Control Group 1	Control Group 2
Living place			
Urban	191 (44.6)	212 (31.9)	463 (40.8)
Rural	237 (55.4)	452 (68.1)	673 (59.2)
Mother's age			
$\leq$ 35	408 (95.3)	574 (86.4)	1058 (93.1)
> 35	20 (4.7)	90 (13.6)	78 (6.9)
Mother's job			
Employed	388 (90.7)	615 (92.6)	981 (86.4)
Housewife	40 (9.3)	49 (7.4)	155 (13.6)
Mother's literacy			
Illiterate	12 (2.8)	64 (9.6)	28 (2.5)
Literate	416 (97.2)	600 (90.4)	1108 (97.5)
Consanguineous marriage			
No	103 (24.1)	232 (34.9)	277 (24.4)
Yes	325 (75.9)	432 (65.1)	859 (75.6)
Smoking during pregnancy			
No	413 (96.5)	605 (91.1)	1087 (95.7)
Yes	15 (3.5)	59 (8.9)	49 (4.3)
Maternal history of pregnancy			
live birth	224 (52.3)	412 (62.0)	658 (57.9)
Stillbirth or abortion	16 (3.7)	56 (8.4)	66 (5.8)
First pregnancy	188 (43.9)	196 (29.5)	412 (36.3)
Pregnancy gap (year/s)			
> 3	71 (16.6)	239 (36.0)	383 (33.7)
1 - 3	153 (35.7)	181 (27.3)	271 (23.9)
< 1	14 (3.3)	41 (6.2)	54 (4.8)
First pregnancy	190 (44.4)	203 (30.6)	428 (37.7)
Maternal history of disease			
No	252 (58.9)	505 (76.1)	890 (78.3)
Yes	176 (41.1)	159 (23.9)	246 (21.7)
Worst life event			
Others	277 (64.7)	367 (55.3)	849 (74.7)
Loss of family	151 (35.3)	297 (44.7)	287 (25.3)
History of Physical violence among mothers			
No	411 (96.0)	622 (93.7)	1062 (93.5)
Yes	17 (4.0)	42 (6.3)	74 (6.5)

Child's sex			
Boy	185 (43.2)	327 (49.2)	515 (45.3)
Girl	243 (56.8)	337 (50.8)	621 (54.7)
Neonatal weight			
Normal	387 (90.4)	462 (69.6)	1040 (91.5)
Low birth weight	34 (7.9)	191 (28.8)	75 (6.6)
High birth weight	7 (1.6)	11 (1.7)	21 (1.8)
Gestational age			
Term	265 (61.9)	404 (60.8)	919 (80.9)
Preterm	147 (34.3)	239 (36.0)	164 (14.4)
Post-term	16 (3.7)	21 (3.2)	53 (4.7)
Twins or more			
No	413 (96.5)	634 (95.5)	1108 (97.5)
Yes	15 (3.5)	30 (4.5)	28 (2.5)
Child's status of living			
Living with parent	419 (97.9)	633 (95.3)	1108 (97.5)
Others	9 (2.1)	31 (4.7)	28 (2.5)

[a]Values are expressed as No. (%).