# Important Risk Factors of Mortality Among Children Aged 1-59 Months in Rural Areas of Shahroud, Iran: A Community-based Nested Case-Control Study

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## ABSTRACT

**Background:** The aim of the study was to evaluate potential risk factors of children mortality between 1-59 months of age.

**Methods:** This nested case-control study was conducted among children born from June 1999 to March 2009 in rural areas of Shahroud, located in the central region of Iran using health care visit reports and follow-up data available in household health records.

**Results:** Mortality was significantly associated with breastfeeding duration (OR: 0.87, 95% CI: 0.81-0.93), total health care visits (OR: 0.90, 95% CI: 0.83-0.98) and low birth weight (LBW) (OR: 7.38, 95% CI: 1.37-39.67).

**Conclusion:** In our study, a longer breastfeeding period and more frequent health care visits were two important protective factors, while LBW was an important risk factor for 1-59 month child mortality. It seems, that complex and multiple factors may be involved in mortality of under 5-year-old children, so combined efforts would be necessary to improve child health indicators.

**Key words:** Childhood, Iran, mortality, nested case-control study, risk factors

Original Article

## INTRODUCTION

Child mortality rate (CMR) is an important determinant of the health status of populations and level of human development. It is also a vital target of the Millennium Development Goals (MDG) to be achieved.[1,2] In general, CMRs are far lower in wealthier countries than poorer ones. In 2008, the median CMR was 109 deaths per 1,000 live births in low-income countries, compared with 5 per 1,000 in high-income countries, representing a more than 20-fold difference.[3] Globally, the number of deaths among children under 5 years of age has decreased from 20 million (147 per 1,000 live births) in 1960 to less than 10 million (80 per 1,000 births) in 2006, and to about 9 million (67 per 1,000 live births) in 2007.[4] Almost, all under 5-year-old children (after the neonatal period) die because of preventable infectious factors or accidents. Achievements of the MDGs indicate that CMR is decreasing at

a very slow pace, and in some countries, the rate is even increasing.[4-6] Most studies show that low birth weight (LBW), malnutrition, deficiency in iodine, iron, vitamin A, and zinc, as well as inadequate breastfeeding are among the leading factors that contribute to death in under 5 year old children. Many social and economic factors, such as family's income and parental educational status contribute to higher CMR.[6] Recent data from World Health Organization has shown an uneven global decrease in CMR. While the current rate in the Eastern Mediterranean region is 82 per 1,000 live births, the CMR in Iran has decreased from 72 in 1990 to 44 in 2000, and 33 in 1,000 live births in 2007.[7] In some rural areas in Iran, however, under 5 CMR trends have had a slow decrease; reports published by the Iranian Ministry of Health and Medical Education (MOHME) indicate a decrease from 45.3 to 29 per 1,000 live births during 1994 to 2004.[8]

According to the annual reports by Shahroud University of Medical sciences and the MOHME, the average mortality rate in the 1-59 month old population in 2008 was 8.8 per 1,000 live births in the rural areas of Shahroud, which is higher than the national average of 6.6 per 1,000 live births.[9-11]

The under 5 CMR includes neonatal deaths (the first 28 days of life), and since risk factors, causes, and related interventions of neonatal mortality differ from those of the 1-59 month, we used an analytic approach and conducted a population-based nested case-control study to evaluate mortality risk factors in a 1-to-59-month-old sample of Iranian children in a rural area.

## METHODS

This nested case-control study was conducted in rural areas of Shahroud, located in the central region of Iran. The study cohort was children born between June 1999 and March 2009. All of the cohort subjects were followed by health care providers based on active surveillance from the first month of life to the end of the 59$^{th}$ month. Our cases were all under 5-year-old children who died after neonatal period. With the occurrence of each case, the corresponding controls were randomly selected from among the children born on the same date and the same population. The subjects were selected through the risk set sampling method with 2 controls for each case. The outcome was mortality, and the independent variables of interest were child's maturity and weight at birth, sex, birth order and interval, parents' level of education, delivery method, pregnancy status (unwished pregnancy, mother's age <18 or >35, pregnancy after successive abortions, pregnancy interval <3 years and some maternal disorders including diabetes, hypertension and malnutrition are considered as high risk pregnancy), delivery site, maternal age at delivery, child growth status on the weight for age chart (a descending or horizontal trend on the weight for age chart for at least 3 months was considered abnormal growth curve), breast feeding duration and total routine child health visits. The data were analyzed using conditional logistic regression models. First, a simple model for each variable was fitted separately and those potential risk factors whose inclusion reaches a reasonably liberal significance level ($P < 0.2$) was kept in a multivariate model. One by one, those risk factors that appeared to have lost their significance within the multivariate model was removed, while checking via the likelihood ratio test (backward approach). Adjusted odds ratio (OR) with 95% confidence interval (CI) was used to estimate the effects of the factors on the outcome. Analyses were performed using the STATA- 9 software.

## RESULTS

We identified 65 cases and 130 controls in this well-defined cohort of 10,912 children, using a risk set sampling method. Frequency distribution of death causes is depicted in Figure 1. As we can see in Figure 1, the most prevalent causes were

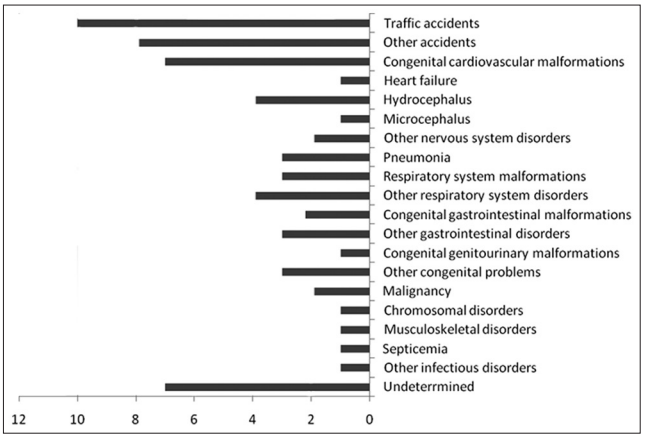


**Figure 1:** Frequency distribution of death causes for 1-59 month old childhood mortality in the rural areas of Shahroud, Iran-2009

congenital disorders (29.2%) and accidents (27.7%). Table 1 presents the descriptive results. Results of the conditional logistic regression for each variable are summarized in Table 2. The multivariate conditional logistic model included high risk pregnancy, abnormal growth, LBW, mother's low level of education, father's low level of education, delivery at home, breastfeeding duration and total child health care visits. As it is demonstrated in Table 2, the remaining factors in the final model

**Table 1:** Descriptive results for risk factors of 1-59 month old childhood mortality in the rural areas of Shahroud

| Variables | Categories/scale | Cases | Controls |
|---|---|---|---|
| | | Count (%)/Mean (SE) | Count (%)/Mean (SE) |
| Gender | Male | 41 (63) | 73 (56) |
| | Female | 24 (37) | 57 (44) |
| Mother's education | >5 years | 21 (32) | 54 (42) |
| | ≤5 years | 44 (68) | 76 (58) |
| Father's education | >5 years | 20 (31) | 63 (48) |
| | ≤5 years | 45 (70) | 67 (52) |
| Mother's age | High risk (≥35 years) | 7 (11) | 16 (13) |
| | Low risk (<35 years) | 58 (89) | 114 (87) |
| Pregnancy type | High risk | 16 (250 | 48 (37) |
| | Low risk | 49 (75) | 82 (63) |
| Delivery route | C section | 21 (32) | 46 (35) |
| | Normal vaginal delivery | 44 (68) | 84 (65) |
| Delivery site | Home | 5 (80 | 8 (6) |
| | Hospital or health center | 60 (92) | 122 (94) |
| Birth order | High risk (≥3) | 5 (8) | 10 (8) |
| | Low risk (<3) | 54 (92) | 108 (92) |
| Growth curve | Normal | 24 (37) | 10 (8) |
| | Abnormal | 41 (63) | 120 (92) |
| Prematurity | Yes | 4 (6) | 9 (7) |
| | No | 61 (94) | 121 (93) |
| Birth interval | High risk(<24 months) | 10 (16) | 14 (11) |
| | Low risk (≥24 months) | 54 (84) | 111 (89) |
| Birth weight | High risk(<2500 g) | 15 (23) | 5 (4) |
| | Low risk(≥2500 g) | 50 (77) | 125 (96) |
| Breast feeding duration | Months | 10.12 (9.22) | 20.22 (6.14) |
| Total health care visits | Count | 10.06 (8.44) | 15.62 (7.18) |

SE: Standard error

**Table 2:** The results of multivariate and final conditional logistic regression models for risk factors of 1-59 month old childhood mortality in the rural areas of Shahroud

| Variables | Multivariate model | | Final model | |
|---|---|---|---|---|
| | Adjusted OR (%95 CI) | *P* value | Adjusted OR (%95 CI) | *P* value |
| High risk pregnancy | 0.54 (0.17-1.69) | 0.2 | - | - |
| Abnormal growth curve | 2.73 (0.55-13.34) | 0.2 | - | - |
| Low birth weight (<2500 g) | 7.38 (1.00-54.42) | 0.05 | 7.38 (1.37-39.67) | 0.02 |
| Mother's low level of education (≤5 years) | 0.41 (0.11-1.48) | 0.1 | - | - |
| Father's low level of education (≤5 years) | 1.20 (0.35-3.99) | 0.7 | - | - |
| Delivery at home | 1.49 (0.39-5.06) | 0.5 | - | - |
| Breast feeding duration (months) | 0.83 (0.78-0.89) | <0.001 | 0.87 (0.81-0.93) | <0.001 |
| Total health care visits | 0.85 (0.79-0.91) | <0.001 | 0.90 (0.83-0.98) | 0.01 |

OR: Odds ratio; CI: Confidence interval

were breastfeeding duration (OR: 0.87, 95% CI: 0.81-0.93), total health care visits of child (OR: 0.90, 95% CI: 0.83-0.98) and LBW (OR: 7.38, 95% CI: 1.37-39.67).

## DISCUSSION

The protective role of breastfeeding in this study was in agreement with previous reports.[12-14] In the developing world, infectious diseases, in general and diarrhea, specifically are significant causes of childhood mortality. As we know, longer breastfeeding may diminish children mortality through its protective effect on infections. Although, the epidemiology of CMR in Shahroud is showing that of the developed world with congenital disorders and accidents as leading causes of deaths, our study suggests breastfeeding as an important protective factor consistently. It seems that Integrated Management of Children Illness (IMCI) strategies have been successful in providing health service units in the region. These strategies emphasize exclusive feeding with breast milk up to the age of six months, as recommended by the WHO.[15,16]

In our study, LBW was reported as a significant risk factor for CMR. This finding is also in agreement with results of most previous studies.[13,17,18] Many factors can cause LBW including poor maternal nutritional conditions and some underlying disorders. The wide CI of OR (1.37-39.67) itself speaks volumes for the uncertainty as regards to this.

The number of total child health care visits was related to under five year old mortality. In fact, late onset of child care and/or lack of care were significant risk factors for children death. This finding also agrees with findings of previous researches.[15,19-21] Regular care visits are important in early diagnosis and treatment of children's acquired or congenital health problems.

Performing a population based nested case control design using risk set sampling of controls can be considered as a strength of our study. With risk set sampling of controls, a population member present for twice as long as another, will have twice the chance of being selected and this can be considered as an important advantage to an ordinary case-control study and reduces selection bias. In addition, cases (children who died) and controls are matched on age, and age is not considered as a confounder.

Our study has some potential limitations that should be consider of them when interpreting the results. Data was extracted from family health files recorded by health house staff. Thus, the impact of other important factors such as lifestyle, socio-economic status, underlying diseases and maternal stature on CMR needs to be further explored using more sophisticated studies. It is also suggested that other sources which could ordinary record all death events (such as cemeteries), as well as socio-economic data (such as hospitals, insurance organizations, and health care providing centers) be considered in data collection and even data be directly elicited from families if possible.

It was expected that parents' low level of education would at least partly account as risk factor for the CMR, but based on our findings there were no statistically significant association between them. In fact, the parents had similar levels of education in our study population context and it was not possible for us to investigate the role of this factor on child death. However, in studies, where parents had various levels of education, the effect of this factor on child mortality rate has been observed.[13-15,21-25]

In summary, it seems that complex and multiple factors may be involved in mortality of under 5-year-old children, so combined efforts would be necessary to improve child health indicators. Various types of intervention can be considered to prevent a majority of deaths in age group of interest. For instance, the importance of health care visits and breastfeeding should be declared, as far as possible and effective efforts must be performed to prevent LBW. More attention should be paid to health cares to prevent preterm births and congenital anomalies. Inappropriate management of services, lack of follow-up and the problems in the referral system are some of the factors that need to be addressed through careful planning to reduce CMR. Finally, reducing fatal accidents, especially traffic events, are another key step to further decreasing CMR.

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