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Association Between Iranian Parental Literacy and Children's Height and Weight: A Comprehensive Analysis

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Abstract

Background The health of children under five is a key indicator of societal well-being and is strongly linked to maternal literacy. This study aims to investigate the relationship between parental literacy and child health in Iran, utilizing refined econometric methods.

Methods A total of 520 children aged 0-4 were randomly selected from 2,654 children born in the past 4 years in five different health centers in Urmia city. Data on the children's health (height, weight, age) were collected along with socio-economic information about their parents to measure the HAZ (Height-for-Age Z-score) index. Two ordinary least squares regression models were used to assess the impact of parental factors on their children's health status. Only variables that had previously demonstrated a statistically significant coefficient in univariate linear regression models were included in the final model.

Results The mean HAZ index for the children was -0.78, with no statistically significant difference between genders. The variables of parental literacy years and urban living had a statistically significant positive effect on the children's health status in both models. Specifically, for each additional year of education, the average child HAZ index increased by 0.095 and 0.057 in the models for mothers and fathers, respectively.

Conclusion The findings of this study suggest that parental literacy, particularly maternal literacy, plays a critical role in promoting and improving the health status of children. Therefore, investing in women's literacy, particularly for those who are disadvantaged or have limited access to education, can be a highly effective and cost-effective strategy.

Keywords Children, Health status, Height for Age Z-score, Iran, Parents

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1 Introduction

The health status of infants and children under five years of age is a critical indicator for measuring a community's health, economic development, and the success of health systems. At least four of the eight Millennium Development Goals are directly related to child health.[1] Consequently, health system researchers have focused on assessing the current situation, identifying the factors affecting it, and formulating policies to reduce the mortality rate and improve children's health status.[2] In general, children's health depends on the care provided by families and communities, as well as the level and quality of healthcare services they receive.[3] Research findings have demonstrated that maternal socio-economic characteristics, including age, employment status, income level, education level, and place of residence, significantly influence the health status of infants and children.[4]

The mean age of Iranian mothers living in urban and rural areas at the time of their first child's birth was approximately 29 and 28 years, respectively, in 2016. On average, there was a 2.5-year age gap between their first and second childbirth.[5] In 2018, according to the United Nations Population Fund (UNFPA), the average number of children per woman worldwide was 2.5, with notable differences between developed and developing countries. Women in industrialized societies gave birth to an average of 1.7 children, while women in other countries gave birth to an average of four children.[6] The World Bank Group reported that in 1960, the total fertility rate in Iran was 6.927 births per woman, which dropped to 2.137 births per woman in 2018.[7] Iran has shifted from a country with a high fertility rate to a country with a low fertility rate, due to increasing gestational age, economic constraints, and changes in the lifestyles of Iranian families.[8-10]

In the past two decades, numerous investigations have been conducted to assess the nature and extent of the relationship between a mother's level of literacy and the health status of her infant and children. However, the results of these studies have been conflicting and inconsistent.[1,11-15] Furthermore, these studies vary significantly in terms of methodology, making it difficult to compare their findings directly. The heterogeneity in the studies is attributed to factors such as defining the response variable to determine children's health status, random sampling, obtaining a sufficient number of samples, and the method of specifying analytical models. Failure to account for these methodological details can lead to biased results, which is evident in many related studies.

Despite UNESCO's efforts to promote global literacy through programs such as Global Literacy for All, it is alarming to note that, as of 2011, over 774 million people aged 15 and above worldwide could not read or write, with two-thirds of them being women.[16] The global illiteracy rate has decreased over the years, but the illiteracy rate among women has remained constant at 63%-64%.[17]

Studying the link between a mother's literacy and her child's health is vital because literacy affects health-seeking behaviors, comprehension of medical guidance, and preventive care—key factors in child health. This research provides evidence on how maternal education influences immunization, nutrition, and illness rates, guiding interventions like literacy and health programs to reduce disparities. It supports global health goals by clarifying the impact of literacy on health outcomes.

In this study, we employed econometric models to explore the potential relationship between parental literacy levels and the health status of children aged between zero and foure years. We aimed to minimize the methodological limitations of prior studies and present more precise findings about the Iranian community.

2 Methods

Study design and participants

This cross-sectional study was conducted in 2022 in Urmia, a city located in northwestern Iran and the capital of West Azerbaijan Province. The primary objective of the study was to investigate the health status of children under the age of five. A total of 520 mothers who had given birth within the last foure years were randomly selected from a list of eligible participants.

To ensure representativeness, the researchers employed a population-proportional-to-size sampling method. Specifically, they randomly selected one comprehensive active health center from each of the city's five districts, with the selected centers and their corresponding sample sizes being as follows: Isar (157), Shohada (106), Alborz (100), Iqbal (83), and Sahiyeh (74).

The sampling approach aimed to obtain a diverse sample that accurately reflects the population of Urmia. The data collected from this study will provide valuable insights into the health status of young children in this region, informing the development of effective public health policies and interventions.

The geographical distribution of the samples was based on the assumption that the place of residence has a significant correlation with educational level, and the researchers endeavored to involve all groups of mothers with different educational levels in the study. The required minimum sample size (520 cases) was determined considering the total fertility rate of Iran (2.14%), a multiplier of two for the design effect due to the use of two-stage sampling, a first type error of 0.01, an accuracy value of 0.1, and a response rate of 0.7.

The inclusion criteria specified that the participants should have a mother and child record at the health centers, the mothers should have no genetic diseases, and the children should be between 0 and 4 years old.

Data collection

We applied a specific questionnaire to gather the required data, which was divided into two main parts. The first part focused on the socioeconomic characteristics of both mothers and fathers, while the second part assessed the health status of their children. The first part encompassed the following variables: age (yearly), location of residence during the last 5 years (urban, rural, and suburban), level of education (years), average monthly household expenses during the past year, employment status (employed, unemployed), health insurance coverage (yes, no), household size, current marital status (married, single), number of children, number of pregnancies experienced by the mother, access to safe drinking water (yes, no), access to basic sanitation facilities (yes, no), and smoking habits during and after pregnancy (yes, no). The second part of the questionnaire included questions about the child's age (monthly), height (in centimeters), weight (in kilograms), gender (male, female), birth order, and any existing diseases.

To ensure the questionnaire's validity, we initially reviewed, modified, completed, and finalized it with the assistance of experts in health economics and health policy. Furthermore, to establish its reliability, we tested the validated questionnaire with 10 mothers who had given birth within the past 3 years. We examined their understanding of the questions, their ability to complete the questionnaire, and the required time to do so, among other factors. This process was repeated 2 weeks later to assess the questionnaire's consistency, and we made the necessary adjustments.

During the first 3 months of 2022, one of the study researchers (NMKh) collected the data after receiving the necessary training on data sources and standardized interviewing techniques. Most of the required data was extracted from mother-child files, and any unanswered questions were addressed through telephone interviews with the mothers. In cases where a mother declined to participate in the study, another randomly selected mother was substituted.

Health status measures

To assess the health status of children aged 0-4, we used the HAZ (Height-for-Age) index, a nutritional status indicator. This index measures stunting due to prolonged malnutrition or frequent illnesses in children and compares their growth pattern to the WHO child growth standard. The HAZ Z-score is calculated as follows:

$$HAZ\ Z-score = \frac{hij - h^{-}j}{\sigma j}$$

Where hij represents the observed height of child i in group j, these groups are categorized based on the child's gender and year of birth, while hj and σj are the mean and standard deviation of height in the reference group, respectively. Children aged 24 months or less were measured in a lying position (length), while older children were measured in a standing position (height). If the Z-score of children under 5 years old falls between -2 and +2, their height is considered normal. If this value is between -2 and -3, the child is suffering from moderate stunting, and if it is less than -3, the child is severely stunted.

Moreover, we determined the Z-scores of weight-for-age, weight-for-height, and body mass index for the age of the studied children. The weight-for-age Z-score is a measure of a child's current and past nutritional status. This index helps to identify whether a child is underweight or severely underweight. If the Z-score value is between -2 and -3, the child is classified as underweight, while a value less than -3 indicates severe underweight. On the other hand, a child with a Z-score above +1 is likely to gain weight.

The body mass index for age Z-score indicates the child's present nutritional status. This index, like the weight-for-height Z-score index, is helpful in screening for weight gain and obesity, and it is calculated by dividing weight (in kilograms) by the square of height (in meters). If the Z-score values for body mass index (BMI) for age or weight-for-height exceed +3, the child is classified as obese. If the Z-scores fall between +2 and +3, the child is considered overweight. If the scores fall between +1 and +2, the child is considered overweight or at risk of being overweight. A Z-score value between -2 and +1 indicates normal weight, while values between -2 and -3 indicate thinness, and a value less than -3 signifies severe thinness.

Statistical analysis

Using version 15 of STATA software, we conducted an ordinary least squares linear regression analysis to examine the relationship between children's health status and their parents' literacy level. Specifically, the model is formulated as follows:

$$HAZi = \beta o + \beta 1\ medui + \beta 2Xi + \in i$$

Where HAZ is the dependent variable measuring the child's health, medu is the factor representing the parent's literacy level for child i, X is the vector of control variables (including socioeconomic variables related to either the mother or father in separate models), βo, β1, and β2 are

coefficients, and ∈ is the residual value accounting for unobserved heterogeneity. We assume that β1 is greater than zero, indicating a positive effect of parental literacy on children's health.

To determine the predictor variables included in the final regression model, we performed multiple univariate regression equations with HAZ as the dependent variable. We selected only the independent variables

Table 1 Socio-economic characteristics of studied households, parents, and children aged 0-4 years in Urmia city in 2022 (N=520)

Parameters	Mean (SD)	Median (IQR)	Range	*P*-value[#]
Children information				
Age (y)	1.97 (1.14)	2.07 (1.90)	0.01 – 3.81[*]	-
Gender (male)	0.53 (0.50)	1.00 (1.00)	0.00 – 1.00	-
Height (cm)	81.49 (13.80)	85.00 (19.00)	48.00 – 106.00	-
Weight (kg)	11.70 (3.59)	12.00 (4.60)	3.20 – 20.00	-
Birth rank (n)	1.74 (0.77)	2.00 (1.00)	1.00 – 5.00	-
Being twins (n)	0.03 (0.18)[&]	0.00 (0.00)	0.00 – 1.00	-
Having a private room (%)	0.48 (0.50)	0.00 (1.00)	0.00 – 1.00	-
Having a disease (%)	0.04 (0.21)[$]	0.00 (0.00)	0.00 – 1.00	
Parents information				
Age (y)				
Mothers	31.43 (6.11)	31.00 (9.00)	17.00 – 64.00	< 0.01
Fathers	35.97 (6.44)	35.00 (8.00)	20.00 – 68.00	
Education (y)				
Mothers	12.18 (4.29)	11.50 (4.50)	0.00 – 23.00	0.44
Fathers	12.38 (4.26)	11.50 (4.50)	0.00 – 23.00	
Basic insurance (%)				
Mothers	0.94 (0.23)	1.00 (0.00)	0.00 – 1.00	0.79
Fathers	0.94 (0.23)	1.00 (0.00)	0.00 – 1.00	
Supplementary insurance (%)				
Mothers	0.36 (0.48)	0.00 (1.00)	0.00 – 1.00	1.00
Fathers	0.36 (0.48)	0.00 (1.00)	0.00 – 1.00	
Having a job (%)				
Mothers	0.10 (0.30)	0.00 (0.00)	0.00 – 1.00	< 0.01
Fathers	0.99 (0.07)	1.00 (0.00)	0.00 – 1.00	
Smoking status (%)				
Mothers	0.01 (0.08)	0.00 (0.00)	0.00 – 1.00	< 0.01
Fathers	0.23 (0.42)	0.00 (0.00)	0.00 – 1.00	
Mother's activity on social networks (hr)	1.42 (1.22)	1.00 (1.50)	0.00 – 7.00	-
Maternity delivery information				
Unsuccessful pregnancy (%)	0.18 (0.39)	0.00 (0.00)	0.00 – 1.00	-
Unsuccessful pregnancy (n)	0.25 (0.62)	0.00 (0.00)	0.00 – 5.00	-
Number of children (n)	1.79 (0.79)	2.00 (1.00)	1.00 – 5.00	-
Household information				
Monthly expenditure (USD)	231.24 (80.31)	212.77 (106.38)	12.77 - 638.30	
Dimension (n)	3.81 (0.85)	4.00 (1.00)	2.00 – 8.00	-
House ownership (%)	0.58 (0.49)	1.00 (0.00)	0.00 – 1.00	-

The significance of the difference in values between mothers and fathers has been measured.
*These children's ages are equivalent to 5 – 1389 days.
$ 23 children had at least one disease at study time.
& 17 children were born twins.

with significant coefficients at the 0.05 level in these equations. To address collinearity issues, we used Pearson's and Spearman's tests for quantitative and qualitative variables, respectively. Among factors with a correlation coefficient greater than 0.7, we included the variable with the highest regression coefficient in the final model. Additionally, we assessed heteroskedasticity using White's test.

3 Results

Table 1 presents findings related to the socio-economic characteristics of households, parents, and children aged 0-4 years in Urmia. The children's mean (SD) age was 1.97 (1.14) years, with 53% being boys and 96% having no disease. Additionally, the average (SD) height and weight of these children were 81.49 (13.80) cm and 11.70 (3.59) kg, respectively.

Mothers' mean age (SD) was 31.43 (6.11), which was significantly lower than fathers' mean age (SD) at 35.97 (6.44) years. The mean number of years of education for mothers (SD) was 12.18 (4.29), and fathers' literacy years were slightly higher, at 12.38 (4.26). These results reveal a substantial gender disparity in employment, with nearly universal employment among fathers and low employment rates among mothers. One percent of the surveyed mothers had a history of smoking during the past year, compared to 23% of the surveyed fathers. The average household size and monthly household expenditure (SD) were reported as 3.81 (0.85) persons and 231.24 (80.34) US dollars, respectively. Overall, these findings provide insights into the socio-economic characteristics of households, parents, and young children in Urmia. The results suggest a gender imbalance in employment among parents and a relatively low maternal employment rate. The prevalence of smoking among fathers was also relatively high.

This study analyzed child health indicators, including raw BMI and four Z-scores (HAZ, WAZ, WHZ, BMIZ), with stratification by gender (Table 2). The mean BMI (95% CI) was 17.24 (17.04–17.43), with no significant gender disparity. For HAZ, the overall mean was -0.78 (-0.87 to -0.69), with boys (-0.83; -0.95 to -0.71) and girls (-0.72; -0.85 to -0.59) showing no statistically significant difference. Similarly, WAZ (0.17; 0.09–0.24), WHZ (0.87; 0.75–0.98), and BMIZ (0.89; 0.77–1.01) exhibited no significant gender-based variations, except for WAZ, which was statistically higher in girls.

The associations between parental socio-economic factors and child health status were assessed using two separate multivariate linear regression models, with HAZ as the outcome variable (Table 3). Both maternal and paternal education levels, as well as urban residence, demonstrated statistically significant positive effects on child HAZ. Each additional year of maternal education was associated with an increase in mean HAZ ($\beta = 0.095$; 95% CI: 0.073–0.117), while paternal education showed a more minor but significant effect ($\beta = 0.057$; 95% CI: 0.034–0.080). Urban residence was also positively associated with HAZ in both models (mothers: $\beta = 0.289$, 95% CI = 0.088–0.490; fathers: $\beta = 0.351$, 95% CI = 0.139–0.563).

Additionally, paternal supplementary health insurance showed a modest positive association with child health status, while other socio-economic variables were not significantly associated. These findings underscore the importance of parental education and urban living conditions in improving child health, with paternal health insurance offering an additional beneficial effect.

We conducted both the Kolmogorov-Smirnov univariate

Table 2 Health outcome Z-scores of studied children aged 0-4 years by gender subgroups

Indexes	Gender	Mean (SD)	Median (IQR)	95% CI
Body mass index (BMI)	Total	17.24 (2.25)	17.03 (2.69)	17.04–17.43
	Male	17.23 (2.17)	17.00 (2.42)	16.97–17.49
	Female	17.25 (2.34)	17.16 (2.92)	16.96-17.55
Height for age Z-score (HAZ)	Total	-0.78 (1.02)	-0.75 (1.08)	-(0.87–0.69)
	Male	-0.83 (1.03)	-0.80 (1.08)	-(0.95–0.71)
	Female	-0.72 (1.01)	-0.68 (1.07)	-(0.85–0.59)
Weight for age Z-score (WAZ)*	Total	0.17 (0.90)	0.16 (1.17)	0.09–0.24
	Male	0.08 (0.96)	0.08 (1.10)	-0.03- +0.19
	Female	0.27 (0.82)	0.25 (1.08)	0.16-0.37
Weight for height Z-score (WHZ)	Total	0.87 (1.34)	0.81 (1.76)	0.75–0.98
	Male	0.79 (1.33)	0.78 (1.74)	0.64-0.95
	Female	0.95 (1.34)	0.97 (1.73)	0.78-1.12

* WAZ Z-score for female children is statistically significantly higher than that of males

test and the Doornik-Hansen multivariate test to assess the normal distribution of the dependent and predictor variables. Additionally, we examined the normality of the regression residuals using the Jarque-Bera test. Our findings indicated that all factors exhibited a normal distribution at a significant level of 0.01 ($p > 0.01$).

To evaluate the potential for multicollinearity, we calculated Pearson correlation coefficients for parametric independent variables and Spearman correlation coefficients for non-parametric independent variables. Our results revealed that none of the predictor variables were highly correlated, with a correlation coefficient greater than 0.16. However, we did observe a moderate correlation between mothers' age and the number of children they had, with a correlation coefficient of 0.43.

and children under five years old.[1,18] In this regard, we conducted a study using 520 randomly selected children aged 0–4 years in Urmia city. The mean age of the mothers and fathers was 31.43 and 35.97 years, respectively, and their average years of education were 12.18 and 12.38 years, respectively. The mean age, height, and weight of the children were 1.97 years, 81.49 cm, and 11.70 kg, respectively, with 4% of them having at least one disease. The study's findings indicate that parental literacy in both models has a positive and significant impact on children's health status, which aligns with previous research.[1,18] The coefficients for mothers are notably stronger than those for fathers. Specifically, an extra year of maternal literacy correlates with a 0.095 increase in the HAZ index, whereas this coefficient is 0.057 for

Table 3 Multivariate linear regression analysis of parental socio-economic factors and child health status (Dependent variable: Height-for-age Z-score)

Parameters	Model 1: Mothers			Model 2: Fathers		
	coefficient (SE)	95% CI	*P*-value	coefficient (SE)	95% CI	*P*-value
Education (y)	0.095 (0.011)	0.073–0.117	**< 0.01**	0.057 (0.011)	0.034-0.080	**< 0.01**
Living place (urban/suburban)	0.289 (0.103)	0.088–0.490	**< 0.01**	0.351 (0.108)	0.139-0.563	**< 0.01**
Supplementary insurance (y/n)	0.162 (0.087)	-0.008–0.332	0.07	0.191 (0.094)	0.005-0.376	**0.04**
Occupation (y/n)	0.054 (0.135)	-0.212–0.320	0.63	0.762 (0.539)	-0.280-+1.821	0.16
Activity in social networks (hr)	0.053 (0.033)	-0.010–0.119	0.11	0.093 (0.034)	0.026-0.160	**< 0.01**
Household expenditures (USD)	0.001 (0.001)	-0.001–0.001	0.51	0.001 (0.001)	0.001-0.001	0.05
Household dimension (n)	0.010 (0.050)	-0.109–0.089	0.99	-0.070 (0.054)	-0.177 to +0.038	0.20
House ownership (y/n)	-0.091 (0.080)	-0.249-0.067	0.23	-0.119 (0.086)	-0.289-+0.050	0.17
Constant	-2.219 (0.300)	-2.809 to -0.629	**< 0.01**	-2.45 (0.68)	-3.781 to -1.116	**< 0.01**
Model statistics	N: 520 F-statistic: < 0.01 R-squared: 0.67 Adjusted R-squared: 0.65 *P*-value for Breusch-Pagan: < 0.01			N: 520 F-statistic: < 0.01 R-squared: 0.51 Adjusted R-squared: 0.48 *P*-value for Breusch-Pagan: < 0.01		

4 Discussion

Over the past two decades, numerous studies have highlighted the impact of socioeconomic factors, particularly mothers' literacy, on the health of infants

fathers, consistent with most related studies.[18,19] This observation can be attributed to the direct and vital role that mothers play in raising children, providing prenatal and postnatal care, ensuring proper nutrition, and making timely decisions to prevent health deterioration.[18]

Notably, the regression model incorporating maternal variables explained a greater proportion of the variance in child health outcomes (Adjusted $R^2 = 0.65$) compared to the paternal model (Adjusted $R^2 = 0.48$), suggesting that maternal characteristics may play a more central role in shaping child health in this population. However, some studies report a greater influence of fathers' literacy on children's health status. [20–23] This could be due to differences in lifestyle, cultural norms, and the father's more dominant position in some families.[24]

Residence location also significantly affects children's health status, with children residing in urban areas generally exhibiting better health. The study indicates that children whose parents have lived in Urmia city for the past 4 years have higher health levels than their suburban counterparts. Specifically, urban mothers' children have, on average, a 0.289 higher HAZ index than those of non-urban mothers, while urban fathers' children have a 0.351 higher HAZ index than those of non-urban fathers. These findings are consistent with those of Aslam et al. [24] and are expected, given the better access to higher-quality healthcare services in urban areas, as well as the relatively better economic status of families residing in such areas. Additionally, parents in urban areas tend to have higher levels of education than their non-urban counterparts.

In contrast to the mothers' model, the second model revealed a positive and statistically significant effect of having supplementary health insurance on children's health status, with a significant level of 5%.[1] Specifically, this factor led to an increase in their HAZ index by 0.191. The analysis showed that the occupational status of mothers did not have a statistically significant effect on the health status of their children, despite only 10% of the mothers being employed. This finding was also observed in the fathers' model; however, the result is not reliable, as 99.42% of the fathers were used, leaving only two individuals classified as unemployed, which limited the model's ability to detect an effect. Similar studies in this area have reported highly variable findings. Some studies have indicated that having a job, particularly for mothers, has a positive effect on children's health, while others have reported an adverse effect.[1,24–26] More specific studies are required to provide a more accurate understanding of the relationship between mothers' occupational status and the health of their babies and children.

No statistically significant relationship was observed between family size or housing conditions and children's health status, contrary to the researcher's initial expectations. These results contradict the findings of Chen et al. and Shahraki et al., who demonstrated a positive and significant relationship between increasing income, smaller household size, home ownership, and children's health levels.[1,18]

Another unexpected outcome of this study was the lack of a statistically significant correlation between mothers' smoking status and their childrens' health status. This finding contrasts with previous research, including England et al., which showed an inverse and meaningful relationship.[27] However, the limited number of tobacco-using mothers in the subgroup (only three, representing less than one percent of all mothers) may have distorted the regression model, making it difficult to obtain valid coefficients. Therefore, caution is required when interpreting these results.

Children's Health Status

The study findings revealed that the mean BMI value was 17.24, which was similar for both genders. However, the average BMIZ value for the children was 0.89, which is slightly above the international reference average but still within the normal range. The BMIZ value for girls (0.97) was marginally higher than that of boys (0.82), but this difference was not statistically significant.

The mean HAZ index was -0.78, which was lower than the reference value, indicating that the average height of the studied children aged 0–4 years across different age groups was below the standard average height. The HAZ index did not differ significantly between boys (-0.83) and girls (-0.72).

The mean WAZ index was 0.17 and exhibited a statistically significant difference between boys (0.08) and girls (0.27). The obtained values suggested that the children's weight status was appropriate compared to the reference population, as the values were close to zero and did not exceed the absolute value of one.

Strengths and Weaknesses

The present study aimed to address methodological limitations in prior research on the relationship between parents' education levels and children's health status. Specifically, a sufficiently large sample size was randomly selected from all births in the city of Urmia. Comprehensive health status measures were employed, adjusted for age-sex groups, and directly comparable to standard values. In addition, the study controlled for a range of socio-economic factors and analyzed the separate effects of maternal and paternal education, resulting in more accurate and unbiased regression coefficients.

However, the study has certain limitations that must be considered when interpreting its findings. Notably, children born in rural health centers were omitted, thus limiting the generalizability of the results to families whose children were born in urban and suburban health centers in Urmia. Furthermore, differences in lifestyle, parental roles in child-rearing, and social structures across societies, cultures, and countries may limit the

generalizability of these results beyond the Urmia population. Therefore, caution should be exercised when extrapolating the study's coefficients to other regions.

Policy Recommendations

The findings of this study highlight the decisive role of parental literacy—especially maternal education—in improving child health outcomes. To translate this evidence into action, policymakers should prioritize investments in female education, particularly for women with limited access to schooling or low literacy levels, as this represents a cost-effective strategy to reduce under-5 mortality, childhood disease burden, and long-term healthcare costs.Targeted efforts are especially needed in regions with high illiteracy rates, such as Sistan-and-Baluchistan Province, where 29.1% of women lack basic literacy compared to just 8.8% in Tehran. Addressing gender disparities in education is equally critical, as exemplified by West Azerbaijan Province's 9% literacy gap between women (86.3%) and men (95.1%).

Beyond education, enhancing health literacy among parents can further amplify these benefits by empowering families to make informed healthcare decisions, thereby reducing medical expenses and increasing household income over time. From an economic perspective, healthier populations require fewer medical resources and contribute more to productivity, reinforcing the value of such interventions.

To monitor progress, we recommend expanding the Integrated Health System (SIB portal) to include annual height and weight measurements for all children under 5 years, rather than the current practice of only recording data for infants under one year. This would enable systematic tracking of growth indicators across age and sex subgroups, facilitating early identification of health disparities and more targeted policy responses.

5 Conclusion

This study demonstrates that parental education, particularly maternal literacy, and urban residence are significant predictors of improved health outcomes among children aged 0-4 years in Urmia, Iran. The analysis revealed a consistent positive association between these socioeconomic factors and child health status, as measured by anthropometric indices. Notably, supplementary health insurance emerged as an additional protective factor, whereas parental occupational status showed no statistically significant relationship with child health indicators.

These findings carry important policy implications. Targeted interventions to enhance maternal education, especially in rural or underserved communities, could yield substantial improvements in pediatric health outcomes. Similarly, expanding access to health insurance may provide secondary benefits for child welfare. The lack of association with occupational status suggests that cognitive and environmental factors (e.g., health literacy and urban health infrastructure) may outweigh purely economic determinants in this context.

Future research should investigate the specific mechanisms by which maternal education affects child health, potentially examining mediators such as healthcare utilization patterns, nutritional knowledge, or vaccination adherence. Longitudinal studies could further elucidate the temporal relationships between these variables. These findings contribute to the growing evidence base supporting education-focused interventions as cost-effective strategies for improving population health.

Declarations

Acknowledgments

Not applicable.

Authors' Contributions

CA, NMKh, and HFE conceived the idea of the study. CA and NMKh contributed to the study design, CA and NMKh performed the statistical analysis, CA, NMKh, AF, and HFE participated in the interpretation of the results. CA, NMKh, AF, and HFE critically revised manuscript drafts. All authors read and approved the final version of the manuscript.

Availability of Data and Materials

The datasets generated and/or analyzed during the current study are not publicly available due to confidentiality concerns, as individual privacy could be compromised. However, the data are available from the corresponding author upon reasonable request.

Conflict of Interest

The authors declare that they have no competing interests.

Consent for Publication

All authors have read and approved the final manuscript and have provided their consent for publication.

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Ethical Considerations

Verbal informed consent was obtained from all participants in this study, based on a protocol approved by the Research Ethics Committee at Urmia University of Medical Sciences (code: IR.UMSU.REC.1400.334).

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