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Prevalence of Malnutrition among Under-Five Children and Its Related Factors in Southeast Iran

Maryam Juybar; MSc [1], Nastaran Bozorgmehr; MSc [1] & Abolfazl Payandeh; PhD [*2]

[1] Department of Nutrition, Student Research Committee, Zahedan University of Medical Sciences, Zahedan, Iran; [2] Department of Biostatistics and Epidemiology, Infectious Diseases and Tropical Medicine Research Center, Research Institute of Cellular and Molecular Sciences in Infectious Diseases, Zahedan University of Medical Sciences, Zahedan, Iran.

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Corresponding author:
payandeh@zaums.ac.ir
Infectious Diseases and Tropical Medicine Research Center, Research Institute of Cellular and Molecular Sciences in Infectious Diseases, Zahedan University of Medical Sciences, Zahedan, Iran.

Postal code: 9816743174
Tel: +98 5433425838

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ABSTRACT

Background: The absence of related studies, low socio-economic conditions, and a high birth rate in southeastern Iran prompted the authors to conduct this research. This study aimed to assess the prevalence of malnutrition and associated factors in children under the age of five in this region. **Methods:** A total of 1552 children under five years old (802 boys and 750 girls) were randomly selected using a multi-stage sampling method from 17 health service centers (12 urban and 5 rural) in Zahedan. Data were collected using an information form by a locally trained health worker in 2023. A P-value of less than 0.05 was deemed significant. **Results:** The prevalence of underweight, overweight, stunting, and wasting was estimated at 34.8%, 5.3%, 50.3%, and 7.3%, respectively. Significant differences in the prevalence of stunting, wasting, and underweight were observed between boys and girls (P<0.05). A substantial correlation also existed between stunting and the mother's employment status. An important relationship was identified between underweight and the mother's living area. Additionally, there was a significant association between birth weight and height and wasting, stunting, and underweight (P<0.05). **Conclusions:** This study highlights a significant burden of malnutrition alongside a rising incidence of overweight, with notable sex disparities. Maternal employment and living area are correlated with children's height and weight, emphasizing the impact of socio-economic factors. Low birth weight worsens the risks of stunting, wasting, and underweight. These findings underscore the necessity for targeted interventions that address maternal and environmental determinants to reduce the dual burdens of malnutrition.

Introduction

Malnutrition in children is a critical global health issue that impacts millions worldwide. It encompasses both undernutrition, including wasting (low weight-for-height z-score (WHZ)), stunting (low height-for-age z-score (HAZ)), and underweight (low weight-for-age z-score (WAZ)); as well as overnutrition (obesity) (Bhutta *et al.*, 2017, Bouma, 2017). In a study on 2-5 year-old children from eight provinces of Iran, the prevalence of stunting, wasting, and

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underweight were estimated to be 10.1%, 8.4%, and 8.1%, respectively (Rabiei *et al.*, 2024). In another research, the prevalence of stunting, underweight, and wasting in Iran were reported from 4.8 to 15.4%, 4.3 to 10.9%, and 4.3 to 4.9%, respectively, between 1998 and 2017 (Ghodsi *et al.*, 2023). The comparison of these indicators in different periods of life (from birth to youth) is an essential reference for policymakers and health administrations in the field of health (Fadare *et al.*, 2019, Green Corkins and Teague, 2017).

The etiology of pediatric malnutrition is multifaceted and deeply intertwined with socioeconomic conditions, parental health, and education status, as well as environmental factors involving inadequate caloric intake or absorption issues due to illness or environmental factors such as food insecurity (Akombi *et al.*, 2017, Norris *et al.*, 2022, Rytter *et al.*, 2017). Illness-related malnutrition may be particularly challenging due to its association with inflammatory conditions that can alter metabolic demands and nutrient utilization (Black *et al.*, 2008). Conversely, non-illness-related malnutrition often stems from insufficient access to nutritious foods or knowledge gaps regarding healthy feeding practices (Bailey *et al.*, 2015).

Complications arising from malnutrition are extensive. Stunted growth during critical periods can have irreversible effects on physical stature and brain development, leading to diminished academic performance and productivity in adulthood. Immunodeficiency associated with malnutrition increases susceptibility to infections, further exacerbating nutritional deficits in a vicious cycle. These side effects will not be reversed in the following years, even with lifestyle and nutrition modification or more care, and improvement of living conditions. They can affect society economically and culturally (Abu-Fatima *et al.*, 2020, Motedayen *et al.*, 2019).

The phenomenon of malnutrition in children, specifically overnutrition leading to overweight and obesity, is an escalating global health concern with multifaceted implications (Jalali *et al.*, 2019). Overnutrition during childhood not only predisposes individuals to non-communicable diseases such as diabetes and cardiovascular ailments later in life but also impacts psychological well-being and quality of life (Hargreaves *et al.*, 2022). According to the report of the World Health Organization, 41 million children under 5 years of age were obese or overweight in 2017 worldwide. It is predicted that the number of overweight or obese babies and young children in the world will increase to 70 million by 2025 (World Health Organization, 2024).

The absence of related studies and low socio-economic situations, low income, poverty, high inflation rate, high unemployment rate, and high birth rate in Sistan-and-Baluchistan province encouraged the authors to design and conduct the present research. In addition, a piece of detailed information from children (demographic and anthropometric variables) and their parents (sociodemographic characteristics) was recorded. Malnutrition indices were also reported in distinct subgroups. Furthermore, because of the aging of the Iranian population, children's health as the future workforce is more crucial and considerable. Hence, the current research aims to estimate the prevalence of malnutrition and related factors in children under five years old in Zahedan city, southeast Iran (**Figure 1**).

Materials and Methods

Study design and participants

This population-based cross-sectional study was carried out in children aged under five, who were referred to health services centers in Zahedan city, southeast of Iran, in 2023. Inclusion criteria stipulated that the child must be under five years old without any specific illnesses. Those children with incomplete health records were omitted from the study.

Sample size and sampling method

The required sample size was based on the estimation of the proportion formula, with a prevalence for underweight/short stature of 0.50, which yields the maximum value of sample size (Daniel and Cross, 2018), a confidence level of 0.95, and a precision of 0.04 computed as 1200 children. In the data gathering phase, 1552 eligible

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samples were collected (boys: 802; girls: 750) for more precision. A multi-stage cluster sampling method was employed for sampling. The living area (rural/urban) was the stratum. Seventeen centers (12 out of 22 urban; 5 out of 10 rural) were randomly selected from the comprehensive health services centers (clusters) of Zahedan city. Each center represented different regions based on socio-economic status. Five selected rural centers had 18 health houses. Samples were chosen based on the probability proportional to the size (PPS) of the health center/house. Finally, from each selected health center/house, information was collected equally based on children's gender using convenience sampling.

Figure 1. Map of Sistan-and-Baluchistan province, Southeast of Iran.

Measurements

In the current study, a two-part information form was used for data gathering. The first part collected information on the demographics and anthropometrics of the children, while the second part focused on the sociodemographic characteristics of the parents. The forms were completed by an educated health worker, familiar with the local language, through face-to-face interviews with mothers, and from electronic records. Informed consent was obtained before the collection of data from all participants. Weight measurements for children under two years old were taken using a baby scale, while children over two years old were weighed standing up with medical scales. Height measurements for children under two years old were obtained lying down using an infant meter, and for children over two years old, standing height was measured using a stadiometer. WAZ, HAZ, and WHZ indices were calculated using Anthro software version 3.2.2 provided by the Department of Nutrition, WHO, Geneva, Switzerland. The stunting, underweight, wasting, and overweight were determined according to the HAZ, WAZ, WHZ, and WHZ z-scores, respectively. Z-scores ≤ -2 were employed for the first three indices, and s-scores ≥ 2 for the second one (Bhutta *et al.*, 2017).

Ethical considerations

This study was reviewed and approved by the Ethics Committee of Zahedan University of Medical Sciences, Zahedan, Iran, with the approval number: IR.ZAUMS.REC.1401.129.

Data analysis

The data collected were entered into SPSS version 16 for analysis. Descriptive statistics such as mean, standard deviation (SD), percentage, and frequency were used to summarize the characteristics of the study population and related sub-groups. The normality of the quantitative data was assessed using the Shapiro-Wilk test, and quantile-quantile plots. Statistical tests, including independent t-test, one-way ANOVA, chi-square test, Fisher's exact test, and Pearson correlation coefficient, were employed to examine the relationships between variables of interest in the sample and sub-samples. Statistical significance was set at P-value<0.05.

Results

The frequency distribution of parental characteristics, including education level, place of residence, employment status, maternal history of gestational diabetes and preeclampsia, delivery type, maternal age, and number of children, is presented in **Table 1**. The results revealed that the mean age of the parents was 28.41±6.68 year. Notably, a high proportion of fathers (85.3%) and mothers (86.3%) did not possess a university education, while 91.1% of mothers were unemployed. Furthermore, 28.5% of mothers had more than four children.

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Table 1. Frequency distribution of characteristics of the parents (N=1552).

Variables	n (%)
Resident	
Urban	1151 (74.2)
Rural	401 (25.8)
Education level of the father	
Illiterate	74 (4.8)
High school	877 (56.5)
High school diploma	373 (24.0)
Associate	89 (5.7)
Bachelor	107 (6.9)
Master	31 (2.0)
Doctorate	1 (0.1)
Education level of the mother	
Illiterate	160 (10.3)
High school	886 (57.1)
High school diploma	293 (18.9)
Associate	54 (3.5)
Bachelor	126 (8.1)
Master	33 (2.1)
Doctorate	0 (0.0)
Employment status of the father	
Unemployed	102 (6.6)
Governmental	1166 (75.1)
Self- employed	283 (18.2)
Retired	1 (0.1)
Employment status of the mother	
Housewife	1425 (91.8)
Governmental	35 (2.3)
Self- employed	92 (5.9)
Retired	0 (0.0)
Gestational diabetes	
Yea	68 (4.4)
No	1484 (95.0)
Preeclampsia	
Yes	94 (6.1)
No	1458 (93.9)
Type of delivery	
Vaginal	1244 (80.2)
Cesarean	308 (19.8)
Number of children	
1	298 (19.2)
2	479 (30.9)
3	333 (21.5)
4	219 (14.1)
5	112 (7.2)
6≤	111 (7.2)

Additionally, **Table 2** displays the frequency distribution of children's characteristics such as age, birth order, feeding type during the first six months, initiation age of complementary feeding, and breastfeeding duration for children over two years old. The study revealed that 89.5% of infants were exclusively breastfed, 2.1% were formula-fed, and 8.2% received a combination of both during the initial six months of life.

The prevalence of wasting, overweight, underweight, and stunting are 7.3, 5.3, 34.8 and 50.3%, respectively. Moreover, the findings indicated that maternal employment status may act as a risk factor for stunting (P=0.03), and a significant association was observed between underweight status and residency (**Table 3**). In particular, girls exhibited a higher prevalence of wasting (P=0.01), underweight (P<0.001), and stunting (P<0.001) compared to boys. The study underscored the significance of breastfeeding duration concerning stunting. It seems birth weight and birth height are important indicators of a newborn's health and future growth. Birth weight and birth height are significantly associated with underweight and stunting. However, while a significant relationship exists between birth weight and wasting (P=0.04), no association was found between birth height and wasting (P=0.12). Additionally, the mode of delivery influenced breastfeeding duration, with women who underwent natural delivery demonstrating higher success rates in breastfeeding. There were no significant correlations between parental education levels, gestational diabetes, preeclampsia, delivery type, number of children, or feeding practices during the first 6 months, and the prevalence of wasting, underweight, or stunting (**Table 3**).

Discussion

The current study aimed to estimate the prevalence of malnutrition among children under the age of five and its related factors in Southeast Iran. Findings indicated that the prevalence of wasting, overweight, underweight, and stunting are 7.3%, 5.3%, 34.8%, and 50.3%, respectively. Additionally, estimates of the malnutrition prevalence based on anthropometric indices vary across different studies. Some related studies report these rates. For example, the research by Payandeh et al. in the northeast of Iran indicated that the rates of underweight, stunting, and wasting were 7.5%, 12.5%, and 4.4%, respectively in preschool children

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(Payandeh *et al.*, 2013). The reason may be due to geographical residence (Thulier and Mercer, 2009), and socioeconomic conditions (Asbar and Tamrin, 2020, Campos *et al.*, 2020, Thulier and Mercer, 2009).

The results showed that 89.5% of infants were exclusively breastfed, 2.1% were formula-fed, and 8.2% received a combination of both during the initial six months of life. According to the 2015 UNICEF report, the worldwide rate of exclusive breast feeding (EBF) is low compared to the 2012 World Health Assembly endorsement, with the following EBF rates reported in western and central Africa at 25%, East Asia and Pacific at 30%, South Asia at 47%, Central America and the Caribbean at 32%, eastern and southern Asia at 51%, least developed countries at 46%, and worldwide at 38% (Wake and Mittiku, 2021).

The subgroup analysis on children aged more than 2 showed that about 17.6% of them were breastfed for less than 6 months. The results also revealed that stunting is about 10% more in children breastfeeding >6 compared to those breastfeeding ≤6 months. It was also found that the estimated prevalence of wasting, overweight, underweight, and stunting in children breastfeeding for ≤6 months were 9.3%, 5.3%, 33.8%, and 51.7% respectively. These results were confirmed by some studies (19, 22) and a meta-analysis (Mardani *et al.*, 2022). One of the most important reasons could be the effects of socio-demographical factors influencing breastfeeding duration like the education level of the mothers (Zugravu *et al.*, 2018) and the other social and health factors (Thulier and Mercer, 2009).

Table 2. Descriptive characteristics of the children (N=1552).

Variables	Boys (n=802)	Girls (n=750)	Total (n=1552)
Age (month)			
0-12	214 (26.7)[a]	205 (27.3)	419 (27.0)
13-24	160 (20.0)	165 (22.0)	325 (20.9)
25-36	143 (17.8)	160 (21.3)	303 (19.5)
36-48	158 (19.7)	122 (16.3)	280 (18.0)
49-59	127 (15.8)	98 (13.1)	225 (14.5)
Birth order			
First	170 (21.2)	200 (26.7)	370 (23.84)
Second	242 (30.2)	206 (27.5)	448 (28.86)
Third	183 (22.8)	149 (19.9)	332 (21.39)
Fourth	105 (13.1)	104 (13.9)	209 (13.46)
Fifth	54 (6.7)	47 (6.3)	101 (6.5)
Sixth and more	48 (6.0)	44 (5.9)	92 (5.9)
Type of milk consumed in the first six months of birth			
Breast milk	721 (89.9)	670 (89.3)	1391 (89.6)
Powdered milk	19 (2.4)	14 (1.9)	33 (2.1)
Combination	62 (7.7)	66 (8.8)	128 (8.2)
Started receiving complete food (month)			
<6	109 (13.6)	101 (13.5)	210(13.5)
6≤	693 (86.4)	649 (86.5)	1342(86.5)
Duration of breastfeeding in children older than 2 years (month)			
≤6	81 (18.75)	70 (16.47)	151 (17.6)
>6	351 (81.25)	355 (83.53)	706 (82.4)
Age (month)	26.82±16.72[b]	27.43±17.04	27.11±16.87
Weight (kg)	10.13±2.89	9.77±2.98	9.96±2.94
Height (cm)	79.20±12.43	78.13±13.30	78.68±12.86
Birth weight (g)	3010.19±403.50	2984.09±361.66	2997.58±383.95
Birth height (cm)	49.10±2.04	48.99±2.12	49.05±2.08

[a]: *n(%)*; [b]: *Mean±SD.*

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Table 3. Frequency distribution of anthropometric indices according to characteristics of parents and chidren (N=1552).

Variables	Wasting	Normal	Overweight	Underweight	Stunting
College education of the father					
Yes	12(5.3)[a]	207(90.8)	9(3.9)	84(36.8)	115(50.4)
No	101(7.6)	1149(86.8)	74(5.6)	456(34.4)	665(50.2)
P-value[b]	0.24	0.09	0.31	0.48	0.95
College education of the mother					
Yes	12(5.6)	195(91.5)	6(2.8)	84(36.8)	103(48.4)
No	101(7.5)	1161(86.7)	77(5.8)	462(34.5)	677(50.6)
P-value	0.11	0.06	0.08	0.54	0.55
Employment status (mother)					
Housewife	103(7.2)	1242(87.2)	80(5.6)	498(34.9)	722(50.7)
Governmental	4(11.4)	31(88.6)	0(0.0)	11(31.4)	10(28.6)
Self- employed	6(6.5)	83(90.2)	3(3.3)	31(33.7)	48(52.2)
P-value	0.22	0.68	0.23	0.88	0.03
Employment status (father)					
Unemployed	7(6.9)	87(85.3)	8(7.8)	26(25.5)	44(43.1)
Governmental	88(7.5)	1013(86.9)	65(5.6)	413(35.4)	594(50.9)
Self- employed	18(6.3)	256(90.1)	10(3.5)	101(35.6)	142(50.0)
P-value	0.42	0.27	0.20	0.12	0.31
Residence					
Urban	84(7.3)	1006(87.4)	61(5.3)	416(36.1)	584(50.7)
Rural	29(7.2)	350(87.3)	22(5.5)	124(30.9)	196(48.9)
P-value	0.98	0.95	0.89	0.05	0.52
Gestational diabetes					
Yes	2(2.9)	63(92.6)	3(4.4)	19(27.9)	37(54.4)
No	111(7.5)	1293(87.1)	80(5.4)	521(35.1)	743(50.1)
P-value	0.25	0.24	1.00	0.22	0.48
Preeclampsia					
Yes	9(9.6)	79(84.0)	6(6.4)	31(33.0)	43(45.7)
No	104(7.1)	1277(87.6)	77(5.3)	509(34.9)	737(50.5)
P-value	0.61	0.32	0.89	0.70	0.36
Type of delivery					
Vaginal	86(6.9)	1094(87.9)	64(5.1)	424(34.1)	625(50.2)
Cesarean delivery	27(8.8)	262(85.1)	19(6.2)	116(37.7)	155(50.3)
P-value	0.39	0.1	0.47	0.23	0.97
Number of children					
1	28(9.4)	251(84.2)	19(6.4)	108(36.2)	157(52.7)
2	30(6.3)	423(88.3)	26(5.4)	165(34.4)	227(47.4)
3	16(4.8)	304(91.3)	13(3.9)	113(33.9)	176(52.9)
4	20(9.1)	188(85.8)	11(5.0)	68(31.1)	104(47.5)
5	10(8.9)	95(84.8)	7(6.3)	43(38.4)	59(52.7)
6≤	9(8.1)	95(85.6)	7(6.3)	43(38.7)	57(51.4)
P-value	0.19	0.10	0.79	0.68	0.53
Gender					
Boy	44(5.5)	717(89.4)	41(5.1)	188(23.4)	310(38.7)
Girl	69(9.2)	639(85.2)	42(5.6)	352(46.9)	470(62.7)
P-value	0.02	0.1	0.67	<0.001	<0.001
Age group (month)					
0-12	29(6.9)	374(89.3)	16(3.8)	141(33.7)	190(45.3)
13-24	23(7.1)	290(89.2)	12(3.7)	110(33.8)	158(48.6)
25-36	23(7.6)	262(86.5)	18(5.9)	117(38.6)	169(55.8)
36-48	20(7.1)	237(84.6)	23(8.2)	98(35.0)	140(50.0)
48<	18(8.0)	193(85.8)	14(6.2)	74(32.9)	123(54.7)
P-value	0.32	0.29	0.08	0.61	0.04

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Birth order					
First	29(7.8)	315(85.1)	26(7.0)	124(33.5)	187(50.5)
Second	33(7.4)	392(87.5)	23(5.1)	164(36.6)	217(48.4)
Third	16(4.8)	302(91.0)	14(4.2)	109(32.8)	176(53.0)
Fourth	18(8.6)	185(88.5)	6(2.9)	69(33.0)	101(48.3)
Fifth	9(8.9)	85(84.2)	7(6.9)	36(35.6)	51(50.5)
Sixth and more	8(8.7)	77(83.7)	7(7.6)	38(41.3)	48(52.2)
P-value	0.27	0.16	0.23	0.62	0.84
Type of milk consumed in the first six months of life					
Powdered milk	3(9.1)	26(78.8)	4(12.1)	9(27.3)	16(48.5)
Breast milk	104(7.5%)	1217(87.5)	70(5.0)	487(35.0)	703(50.5)
Combination	6(4.7)	113(88.3)	9(7.0)	44(34.4)	61(47.7)
P-value	0.31	0.31	0.31	0.63	0.80
Start receiving complementary foods(month)					
<6	19(9.0)	182(86.7)	9(4.3)	75(35.7)	101(48.1)
6≤	94(7.0)	1174(87.5)	74(5.5)	465(34.6)	679(50.6)
P-value	0.46	0.74	0.46	0.76	0.50
Duration of breastfeeding in children older than 2 years					
≤6	14(9.3)	129(85.4)	8(5.3)	51(33.8)	78(51.7)
6<	51(7.2)	612(86.7)	43(6.1)	294(41.6)	432(61.2)
P-value	0.66	0.32	0.97	0.07	0.03
Birth weight (g)	2917.61±331.67[c]	3001.68±387.02	3039.40±389.90	2921.28±383.29	2960.37±387.48
Birth height (cm)	48.75±2.54	49.05±2.05	49.35±1.81	48.79±2.14	48.95±2.19

[a]: n(%); [b]: Chi esqure test; [c]: Mean±SD.

In the current study, most fathers (85.3%) and mothers (86.3%) did not possess a university education, and 91.1% of mothers were unemployed/housekeepers. No association was also found between parental education and the nutrition of children, which is in the same line as Ahirwar (Ahirwar *et al.*, 2020). To authors' knowledge, most of the previous studies examined only the relationship between mother's education and children's malnutrition (Ghosh, 2020, Hossain *et al.*, 2020, Prasetyo *et al.*, 2023). One literature review published in 2020 suggested that mothers' education can impact the children's nutrition level (Ghosh, 2020). Indonesian research has demonstrate a strong correlation between the prevalence of stunting and parental education (Soekatri *et al.*, 2020).

The novel result of this study is a survey of the potential of a couple of maternal chronic diseases (gestational diabetes or preeclampsia) on anthropometric status. In authors' examination of previous literature, few studies have specifically discussed these factors recently. Krishnaveni's analysis reveals that maternal GDM is associated with adiposity and higher glucose and insulin concentrations in female offspring at 5 (Krishnaveni *et al.*, 2005). One perspective study shows detailed anthropometric measures available, the link between higher birthweight and type 1 diabetes mellitus (T1DM) did not appear to reflect increased adiposity (Ponsonby *et al.*, 2011). One cohort research suggests that GDM participants have different growth patterns when compared to the offspring of non-GDM mothers (Dode *et al.*, 2011).

Randihir's study showed that children of mothers with preeclamsia were taller and heavier, and also had higher systolic blood pressure, partly explained by their increased body size than children of non-preeclamsia mothers. In-utero exposure to preeclampsia may increase the risk of future cardiovascular diseases (Randhir *et al.*, 2020).

The number of children is another factor that usually has been ignored in previous studies. No correlation was found between the number of children and malnutrition. The results of one early scoping review have shown a positive correlation between them (Obasohan *et al.*, 2020). The impact of the number of children malnutrition may be the birth interval or the increase in antenatal care service facilities during pregnancy to achieve better nutritional status among under-five children (Talukder, 2017).

One of the limitations of the current study was

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that the scales measuring the weights and heights of the children were not the same. The reason was that the project was run in a vast area containing 17 different health centers of urban and rural regions using previous electronic health records, which could not be change in practice. The authors emphasize that all records were confirmed by the responsible staff of the centers.

Conclusions

This study reveals a high burden of malnutrition (34.8% underweight, 50.3% stunting) alongside emerging overweight (5.3%), with significant sex disparities. Maternal employment and living area strongly correlate with child height and weight outcomes, highlighting socioeconomic influences. Low birth weight further exacerbates stunting, wasting, and underweight risks. These findings underscore the need for targeted interventions addressing maternal and environmental determinants to mitigate dual malnutrition burdens. Moreover, it is advisable to enhance these interventions' effectiveness by emphasizing factors significantly associated with anthropometric indicators.

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Authors' contributions

Juybar M, Bozorgmehr N, and Payandeh A planned the study design and coordinated the conduct of the study. Juybar M supervised the data collection and participated in drafting the manuscript. Payandeh A and Juybar M carried out statistical analyses and interpretation of the findings. All the authors participated in drafting the manuscript and approved the final draft of the paper.

Conflicts of interest

All authors declared no conflicts of interest to disclose.

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