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Relationship between Structural and Intermediate Social Determinants of Health and Low Birth Weight: A Path Analysis

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ABSTRACT

Background: Low birth weight is one of the most important health indicators for assessing the status of newborns in every country. It is, therefore, necessary to identify factors associated with this adverse pregnancy outcome. This study was conducted to determine predicting factors associated with low birth weight using path analysis.

Methods: This prospective study was performed on 719 eligible pregnant women with a gestational age of 24-28 weeks who visited the health centers in Ilam, Iran. The participants were selected through stratified cluster sampling. The data were collected using relevant scales and analyzed using SPSS software (version 19.0) and LISREL (version 8.8).

Results: The incidence rate of low birth weight was obtained at 7.5%. The risk scores of low birth weight were 2.7, 2.5, 3.3, 1.8, and 2.8 times higher in the participants with stress, anxiety, depression, domestic violence, and food insecurity, respectively, compared to those without the mentioned conditions. The goodness of fit index confirmed the favorable fit of the model. The most influential direct determinants of birth weight were the number of prenatal visits (β=0.19) and mother's body mass index (β=0.02). The most important direct determinant of birth weight was stress in this study (β=-58.006).

Conclusion: The etiology of low birth weight is complex and may involve demographic characteristics, as well as nutrition, reproductive, and socioeconomic factors. Given that prenatal care and psychological and nutritional factors are the major determinants, it is essential to take fundamental steps, including the improvement of living standards and nutritional status in pregnant women, more regular prenatal care visits, and pre-conception counseling.

Keywords: Food insecurity, Intermediate determinants, Low birth weight, Pregnancy outcome, Psychological factors, Structural determinants

Introduction

Birth weight is a very strong predictor of a newborn's growth and survival (1). About 20 million low-birth-weight infants are born every year. According to the epidemiological reports, the risk of death among these infants is 20 times higher than that in other infants (2, 3). The prevalence rate of low birth weight varies from 16% in developing countries to higher rates in Asia and Africa (4, 5). A meta-analysis in Iran reported the prevalence of low birth weight in the country as 9% (6). While low birth weight has a complex etiology, preterm birth and/or intrauterine growth restriction have been identified as its primary causes (7-9). Other factors affecting low birth weight and are considered as social determinants of health include insufficient prenatal care, maternal stress, hard work, lack of family and social support, and malnutrition (10). According to the World Health Organization's conceptual framework of determinants affecting health, the factors that affect health are socio-economic factors, psychosocial conditions, such as stress, anxiety, depression, and social support as well as other factors, including

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prenatal care and food security (11).

Determinants of health are classified in three broad categories including 1- social, economic, and political factors including the government, political entities, economic processes, culture, and social system performance, 2- structural factors including education, income, sex, ethnicity, and occupational status, and 3- intermediate factors including psychosocial factors, behavioral factors, and health system (12, 13). While most previous studies have focused on the relationship between unfavorable outcomes of pregnancy and socioeconomic status of families, few studies have evaluated the correlation between pregnancy outcomes and other social determinants of health, especially in developing countries (14).

A few studies reported a positive correlation between low birth weight and stressful events before or after pregnancy (15, 16). Research has also shown that low birth weight correlated with father's violence, mother's distress, and maternal anxiety during the second and third trimesters of pregnancy (17). Low birth weight plays a significant role in increasing mortality rates and health problems. It is also a major cause of infant death and other health problems in Iran. Therefore, this study was conducted to determine predicting factors associated with low birth weight.

Methods

This prospective study was performed in selected health centers in 10 cities of Ilam, Iran, from April 2016 to March 2017. All eligible pregnant women who met the inclusion criteria were recruited in this study. The inclusion criteria were: 1) literacy 2) willingness to participate in the study, 3) gestational age of 24-28 weeks, 4) absence of confirmed medical conditions, and 5) no history of a low-birth-weight infant. Women who were not willing to participate in the study or did not provide all the required data were excluded from the study. Random sampling was performed to select the participants.

First, each city was divided into five geographical regions (i.e., central, northern, southern, western, and eastern regions). The required health centers were then randomly selected from each region. The number of participants in each city was determined based on the population of its childbearing women. All eligible women with a gestational age of 24-28 weeks were included in the study. The women were informed of the study objectives, ensured the confidentiality of their information and their right to withdraw at any time. Moreover, written informed consent was obtained from all participants and they were asked to complete the study questionnaires.

The participants were followed up until delivery and the information related to childbirth and pregnancy outcomes was collected to determine the incidence rate of low birth weight. In this study, the good fit of a conceptual model of path analysis (Figure 1) was studied to determine

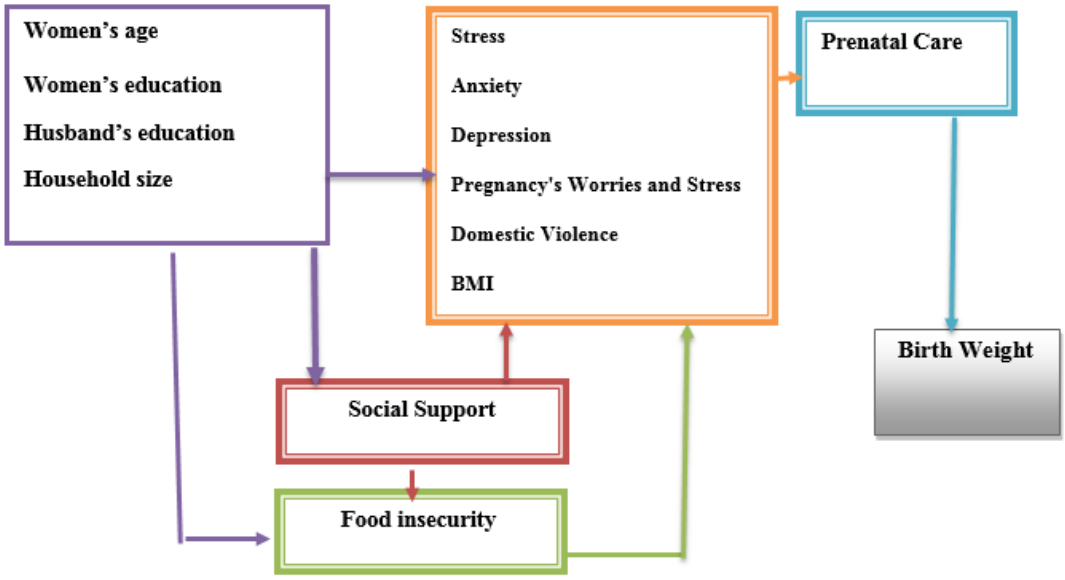

Figure 1. Theoretical path model for the effects of structural and intermediate social determinants of health predictors on birth weight by the World Health Organization model

predicting factors associated with low birth weight.

The final sample size was determined at 837 people using the following equation (n=629, P: 9%; d^2: 0.0005) (6):

$$n = \frac{Z^2 P(1-P)}{d^2}.$$

Regarding the design effect (1.2) and sample attrition (10%), the sample size reached 837 pregnant women. The data collection instrument consisted of three main parts. The first part collected demographic and obstetric characteristics. The second part dealt with socioeconomic status, and the third part assessed intermediate determinants of health including, 1) Stress, anxiety, and depression, 2) Food insecurity, 3) Domestic violence, 4) Social support, and 5) Pregnancy anxiety.

The Demographic and Obstetric Questionnaire

This research-made questionnaire contained items, such as mother's age, husband's age, ethnicity, gestational age, number of pregnancies, the interval between pregnancies, unplanned pregnancy, number of prenatal visits, and use of supplements.

The Socioeconomic Status Scale

This was also a researcher-made questionnaire collecting information about parents' educational and occupational levels, family size, family income, and average household expenditure. The face and content validity, as well as the reliability of this questionnaire, were assessed and confirmed in this study (Cronbach's alpha=0.794).

The 21-Item Depression, Anxiety, and Stress Scale (DASS-21)

This 21-item scale was developed by Lovibond in 1995. It assesses the symptoms of stress, depression, and anxiety through three seven-item subscales scored based on a Likert-type scale from zero to three. Previous studies in Iran and other countries have widely used the DASS-21 and confirmed its validity and reliability (18).

The Pregnancy-Anxiety Scale (PAS)

It contains 25 items arranged in six subscales, including maternal health, infant's health, childbirth and motherhood experience, mother-child affection, personal-familial, and personal-occupational. All items are scored on a five-point Likert-type scale and the total scores range between zero and 100. The scores obtained from the scale indicate a pregnant woman's level of anxiety and determine factors causing the anxiety. The reliability and validity of the scale have been confirmed in Iran (19).

The Domestic Violence

The questionnaire, developed by the World Health Organization, measures intimate partner's violence during pregnancy. It assesses the three types of violence (i.e. physical, sexual, and emotional violence) on a five-point Likert-type scale. A single positive answer to any items shows the presence of violence. Many researchers have examined the scale's validity in Iran. Cronbach's alpha for the physical, mental, and sexual violence subscales has been calculated as 0.92, 0.89, and 0.88, respectively(20).

The Multidimensional Scale of Perceived Social Support (MSPSS)

The MSPSS was developed by Zimet et al. in 1998. It is a 12-item instrument assessing the perception of social support received from family, friends, and significant others. The total scores of the scale range between 12 and 84. Scores 12-48, 49-68, and 69-84 show low, medium, and high levels of perceived social supports, respectively. The validity of the Persian version of the MSPSS was confirmed through content analysis. Different studies in Iran confirmed the reliability of the scale by obtaining Cronbach's alpha at 0.86-0.9 for the subscales and 0.86 for the entire scale (21).

The Household Food Insecurity Access Scale (HFIAS)

This scale consists of nine items and four frequencies of occurrence (i.e., most of the time, sometimes, seldom, and never). It collects information about food insecurity in terms of the household's access to food. The minimum and maximum scores of each item are zero and three, respectively. This scale has favorable validity and reliability. Its validity has been confirmed through examining its face, content, and construct validity. Moreover, Cronbach's alpha of 0.86 showed its strong internal consistency (22).

Statistical Analysis

The collected data were analyzed using SPSS software (version 19.0, SPSS Inc., Chicago, IL, USA) and LISREL (version 8.8, Scientific Software

International, IL, USA). Descriptive statistics were used to determine the frequency, percentage, mean, and standard deviation. Inferential statistical tests, including the chi-square test, Fisher's exact test, and logistic regression analysis were used to examine the correlations between determinants of health and low birth weight. Path analysis was applied to determine the most important determinants of low birth weight and the direct and indirect effects of various variables.

Ethical Considerations

This study was extracted from a Ph.D. dissertation on reproductive health. The project was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences, Tehran, Iran (ID: sbmu.rec.1394.112). Written consent was obtained from all participants once they were provided with details about the study objectives.

Results

Of the 837 pregnant women who were initially included in the study, 118 were excluded due to reasons, such as returning incomplete questionnaire responses, intrauterine fetal demise, unwillingness to continue participation, and inaccessibility of health records to follow up pregnancy outcomes. Therefore, the final analysis was performed on the information obtained from 719 women. The mean age of the participants was 28.68 ± 4.4 years. Overall, 340 women (47.3%) were nulliparous and 58.5% of all participants had a vaginal delivery. Most women owned a house (86%) and about half of them had university degrees (51.3%). The husbands were mostly self-employed (63.7%) and the income of most families (83.2%) was equal to or more than $250.

The analysis of the correlation between structural determinants of health and low birth weight based on the Chi-square test indicated a significant difference between the two groups in terms of the husband's education and occupation as well as household income. According to the results of logistic regression analysis, the husband's education and occupation and household income significantly correlated with low birth weight. In other words, the risk of low birth weight in women with a university-educated husband and women with an employed husband was respectively 66% and 86% which were lower than that in women whose husbands were unemployed or had a junior high school or lower educational degrees (Table 1).

Table1. Relationship between socio-economic characteristics of the participants and low birth weight

Variable	Low birth weight Number (%)	Normal weight Number (%)	OR (CI: 95%)	P-value
Women's education				
Elementary	9 (13.0)	60 (87.0)	Ref	
Middle	14 (5.3)	251 (94.7)	0.37 (0.15-0.90)	0.085
High school	29 (8.2)	326 (91.8)	0.77 (0.26-1.31)	
Husband's education				
Elementary	10 (15.4)	55 (84.6)	Ref	
Middle	22 (7.8)	261 (92.2)	0.46 (0.20-1.03)	0.035
High school	20 (5.9)	321 (94.1)	0.34 (0.15-0.77)	
Women's occupation				
Housewife	45 (7.6)	547 (92.4)	Ref	0.894
Employees	7 (7.2)	90 (92.8)	0.94 (0.41-2.16)	
Husband's occupation				
Unemployed	3 (25.0)	9 (75.0)	Ref	
Employee	38 (8.8)	396 (91.2)	0.28 (0.07-1.10)	0.016
Self-employed	11 (4.5)	232 (95.5)	0.14 (0.03-0.60)	
Household size				
1-3	39 (7.3)	492 (92.7)	Ref	0.712
4 and above	13 (8.2)	145 (91.8)	1.13 (0.58-2.17)	
Household income				
Less than 10 million Rials	16 (13.9)	99 (86.1)	Ref	0.006
10 million Rials and above	36 (6.3)	538 (93.7)	0.41 (0.22—0.77)	
The average household costs				
Less than 10 million Rials	32 (9.5)	306 (90.5)	Ref	0.064
10 million Rials and above	20 (5.7)	331 (94.3)	0.57 (0.32-1.03)	

Table 2. Relationship between intermediate social determinants of health and low birth weight

Variable	Low birth weight Number (%)	Normal weight Number (%)	OR (CI: 95%)	P-value
Food Security				
Food security	22 (4.9)	431 (95.1)	Ref	<0.001
Food insecurity	30 (12.7)	206 (87.3)	2.85 (1.60-5.06)	
Social Support				
Low	13 (12.5)	91 (87.5)	Ref	
Moderate	23 (6.6)	325 (93.4)	0.49 (0.24-1.01)	0.116
High	16 (6.8)	221 (93.2)	0.50 (0.23-1.09)	
Stress				
No	29 (5.5)	496 (94.5)	Ref	0.001
Yes	23 (14.0)	141 (86.0)	2.79 (1.56-4.97)	
Anxiety				
No	37 (6.3)	550 (93.7)	Ref	0.007
Yes	15 (14.7)	87 (85.3)	2.56 (1.35-4.86)	
Depression				
No	7 (4.4)	153 (95.6)	Ref	<0.001
Yes	28 (6.5)	404 (93.5)	3.38 (1.81-6.31)	
Pregnancy's Worries and Stress				
No	28 (5.5)	481 (94.5)	Ref	0.001
Yes	24 (13.3)	156 (86.7)	2.64 (1.48—4.69)	
Domestic Violence				
No	21 (5.5)	358 (94.5)	Ref	0.030
Yes	31 (10.0)	279 (90.0)	1.89 (1.06-3.36)	
Unwanted Pregnancy				
No	43 (7.2)	554 (92.8)	Ref	0.395
Yes	9 (9.8)	83 (90.2)	1.39 (0.65-2.97)	
Prenatal Care				
Adequate	5 (1.0)	504 (99.0)	Ref	<0.001
Inadequate	47 (26.1)	339 (73.1)	35.62 (13.89-91.33)	

**Received less than 50% of the visits expected for the gestational age

Table 3. The goodness of fit indices for the model

Model index	X2/df	RMSEA	GFI	NFI	CFI
	9.65	0.11	0.90	0.82	0.82

Furthermore, low birth weight was significantly correlated with food insecurity, stress, anxiety, depression, pregnancy-specific stress, domestic violence, and inadequate prenatal care based on the analysis of the correlation between intermediate determinants of health and low birth weight using the Chi-square test. In the logistic regression analysis, the risk scores of low birth weight in women with food insecurity versus those with food security, stressed women versus unstressed women, women with pregnancy-specific stress versus those without pregnancy-specific stress, and women with domestic violence versus those without domestic violence were 2.8, 2.7, 2.6, and 1.8, respectively (Table 2).

The goodness of fit index, normalized fit index, comparative fit index, and root-mean-square error are measures used to examine the model fitting. In this model, the measures were favorable and the model fitted well (Table 3). As shown in Figure 2 and Table 4, the direct effects of the variables were measured by calculating beta coefficients that are path coefficients. The indirect effects of the variables were determined by multiplying the standard path coefficients. The sum of direct and indirect effects yielded the total effect. The results of path analysis showed that the number of prenatal visits and the mother's body mass index directly affected the infant's birth weight. Other social determinants of health, such as social support, food insecurity, stress, anxiety, depression, domestic violence, and pregnancy-specific stress had indirect effects on birth weight.

Among the variables with direct effects, prenatal care and stress had the greatest positive and negative effects (β=0.19 and -58.006), respectively. Stress, depression, anxiety, prenatal care status, domestic violence, family size, and social support had the greatest total effects on birth weight. However, mothers' age had the lowest effect on the infant's birth weight (β=0.0002).

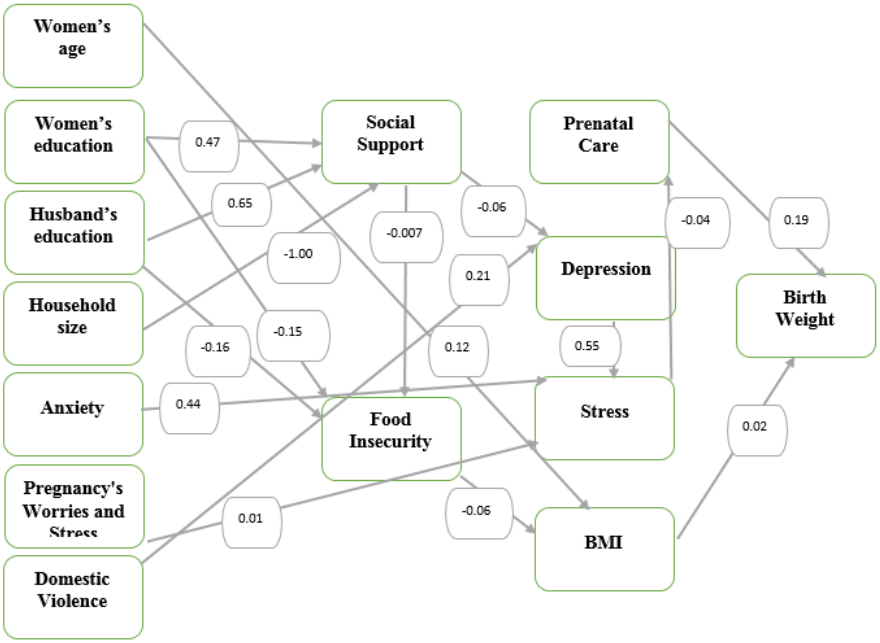

Figure 2. Full empirical model Empirical Path Model for the investigation of the effects of social determinants of health on birth weight

Table 4. Path confidence for the effects of social determinants of health on birth weight

Predictor variable	Effect		
	Direct	Indirect	Total
Women's age	-	0.002	0.002
Women's education	-	0.908	0.908
Husband's education	-	1.256	1.256
Household size	-	-4.065	-4.065
Food insecurity	-	-0.047	-0.047
Social support	-	1/917	1/917
Stress	-	-58.006	-58.006
Anxiety	-	-25.522	-25.522
Depression	-	-31.903	-31.903
Domestic violence	-	-6.699	-6.699
Pregnancy's Worries and Stress	-	-0.580	-0.580
BMI	0.02	-	0.02
Prenatal Care	0.19	-	0.19

Discussion

The incidence of low birth weight in Ilam, Iran, was almost high (7.5%). The results of other studies showed an increase in the prevalence of this adverse pregnancy outcome from 1991 to 2010 (23). However, one of the goals of Healthy People 2020 is to decrease the low birth weight rate to less than 5% (24). The total prevalence rate of low birth weight has been estimated at 9% in Iran (6). Although different studies have adopted different designs, the overall prevalence rate of low birth weight in Iran is high and its reduction requires the use of clearer healthcare policies during pregnancy. Moreover, well-designed studies in different parts of Iran are essential to determine the associated risk factors.

The etiology of low birth weight is complex and may involve demographic characteristics, as well as nutrition, reproductive, and socioeconomic factors (25). Other potential causes of low birth weight include infection, mother's malnutrition, multiple pregnancies, pregnancy problems, such as preeclampsia (2, 3, 7, 9), mother's mental stress, drug abuse, smoking, inadequate prenatal care, and infertility treatment (26). In this study, the obtained correlations between socioeconomic factors and low birth weight suggested that husband's educational and occupational levels as well as household income significantly correlated with low birth weight. In other words, the risk of low birth weight was higher in the women whose husband had lower education and income.

Path analysis showed that birth weight was

increased by mother's age and education level, as well as the husband's education level. Mahmoudi et al. (27) and Silvestrin et al. (28) reported similar findings. However, socioeconomic status did not directly affect birth weight. It affected birth weight indirectly through influencing other determinants. Researchers believe that while unfavorable socioeconomic conditions are not the direct and independent determinants of pregnancy outcomes, they may reduce the duration of pregnancy through unhealthy behaviors, exposure to stress, and psychological responses to stress (29).

Other determinants of adverse pregnancy outcomes are intermediate social determinants of health, including psychosocial factors, such as social support, stress, anxiety, depression, and domestic violence and other factors, such as food insecurity and health care status (10, 27, 30). The risk scores of low birth weight were 2.7, 2.5, and 3.3 times higher in the participants with stress, anxiety, and depression, respectively, compared to those without these factors.

Some studies have reported the adverse effects of psychosocial factors, such as stress and anxiety during pregnancy, childbirth, and breastfeeding on pregnancy outcomes, including preterm birth and low birth weight (31, 32). Rondo et al. found a direct correlation between maternal psychosocial distress or stress and adverse pregnancy outcomes (33). Stressful life events, such as perceived stress and pregnancy anxiety have also been reported to correlate with preterm birth and low birth weight (34).

Path analysis in this study showed that stress had the greatest indirect effect on birth weight. In other words, birth weight decreased with an increase in the mother's stress. Witt et al. found a significant correlation between low birth weight and stress during pregnancy (35). The results of other studies are consistent with those of the present study (36, 37). Many researchers believe that the most common solution for reducing adverse pregnancy outcomes caused by stress and anxiety during pregnancy is to provide mothers with social support (38). In this study, social support was an intermediate factor that increased birth weight by reducing stress and depression.

Given that psychological factors, such as stress, anxiety, and depression, are not measured in routine prenatal care visits, the degree of these problems during pregnancy is not clear and their effects on maternal and fetal health have not been estimated so far. Therefore, in order to improve maternal health and prevent adverse pregnancy outcomes, the mentioned factors should be measured in all three trimesters. Moreover, prospective studies are required to measure the psychological factors and their effects on pregnancy outcomes during each trimester of pregnancy. Appropriate interventions can then be developed based on their results.

There was also a significant correlation between domestic violence and the low birth weight in this study. The risk of low birth weight in women experienced domestic violence was 1.8 times greater than that in other women. Rosen et al. found a significant correlation between domestic violence and the low birth weight in a way that the risk of low birth weight in individuals experienced domestic violence was twice as that in other individuals (39).

In this study, the risk of low birth weight in women with food insecurity was 2.8 times higher than that in women with food security. Likewise, Mozayeni et al. reported a significant correlation between mothers' food insecurity and low birth weight. Following that, the risk of low birth weight was 10.46 times higher in mothers with food insecurity than in those with food security (40).

Considering that few studies have been performed on food insecurity during pregnancy and its effect on pregnancy outcomes, further studies in this regard are essential in different parts of the world. The results of such studies can be used for decision making and the development of interventions aiming at the improvement of mothers' and infants' health and reduction of adverse pregnancy outcomes (30).

Another factor influencing pregnancy outcomes was sufficient prenatal care visit which was considered as an intermediate social determinant of health. In this study, the risk of low birth weight was higher in women receiving inadequate prenatal care, compared to other women. Other studies have also reported similar findings. The results of previous studies supported that the incidence of adverse pregnancy outcomes, such as the low birth weight correlated significantly with the adequate prenatal care visits, time of visits, and the number of prenatal visits (41).

While most previous studies evaluated a limited number of social determinants of health as risk factors of pregnancy outcomes, the present study considered both structural and intermediate determinants, especially food insecurity that has been rarely examined. This was one of the strengths of this study. Adopting a longitudinal

design was another strength of this study. Therefore, the results of this study can be used as guidelines for not only further studies but also health programs for mothers and infants.

Conclusion

Low birth weight is one of the most prevalent adverse pregnancy outcomes associated with social determinants of health. According to the path analysis, the improvement of the health of mothers and infants requires increasing the number of prenatal care visits and evaluating psychological and nutritional factors as the social determinants of health. Furthermore, fundamental steps are needed to prevent low birth weight by identifying high-risk groups and causes of elevated risk and improving living standards, increasing regular prenatal care visits, pre-pregnancy counseling, screening mothers' psychosocial status in every trimester of pregnancy, and improving nutritional status in pregnant women.

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Conflicts of interests

No conflict of interests is declared by the authors in this study.

References

1. Muthayya S. Maternal nutrition & low birth weight-what is really important. Indian J Med Res. 2009; 130(5):600-8.
2. Katz J, Lee AC, Kozuki N, Lawn JE, Cousens S, Blencowe H, et al. Mortality risk in preterm and small-for-gestational-age infants in low-income and middle-income countries: a pooled country analysis. Lancet. 2013; 382(9890):417-25.
3. Lee AC, Katz J, Blencowe H, Cousens S, Kozuki N, Vogel JP, et al. National and regional estimates of term and preterm babies born small for gestational age in 138 low-income and middle-income countries in 2010. Lancet Global Health. 2013; 1(1):e26-36.
4. Black RE, Allen LH, Bhutta ZA, Caulfield LE, De Onis M, Ezzati M, et al. Maternal and child undernutrition: global and regional exposures and health consequences. Lancet. 2008; 371(9608):243-60.
5. Christian P, Lee SE, Donahue Angel M, Adair LS, Arifeen SE, Ashorn P, et al. Risk of childhood undernutrition related to small-for-gestational age and preterm birth in low-and middle-income countries. Int J Epidemiol. 2013; 42(5):1340-55.
6. Sharifi N, Dolatian M, Fathnezhad A, Pakzad R, Mahmoodi Z, Nasrabadi FM. Prevalence of low birth weight in iranian newborns: a systematic review and meta-analysis. Int J Women Health Reprod Sci. 2018; 6(3):233-9.
7. Moraes AB, Zanini RR, Riboldi J, Giugliani ER. Risk factors for low birth weight in Rio Grande do Sul State, Brazil: classical and multilevel analysis. Cad Saude Publica. 2012; 28(12):2293-305.
8. Soleimani F, Sharifi N, Rasti Borujeni F, Amiri M, Khazaiyan S. Nourodevelopmental follow-up in high-risk infants. Tehran Univ Med J. 2015; 72(11):733-41.
9. Suzuki K, Tanaka T, Kondo N, Minai J, Sato M, Yamagata Z. Is maternal smoking during early pregnancy a risk factor for all low birth weight infants? J Epidemiol. 2007; 18(3):89-96.
10. Sharifi N, Dolatian M, Kazemi AF, Pakzad R. The relationship between the social determinants of health with preterm birth in Iran based on the WHO model: a systematic review and meta-analysis. Int J Womens Health Reprod Sci. 2018; 6(2):113-22.
11. Mirabzadeh A, Dolatian M, Forouzan AS, Sajjadi H, Majd HA, Mahmoodi Z. Path analysis associations between perceived social support, stressful life events and other psychosocial risk factors during pregnancy and preterm delivery. Iran Red Crescent Med J. 2013; 15(6):507-14.
12. Marmot M, Allen J, Bell R, Bloomer E, Goldblatt P. WHO European review of social determinants of health and the health divide. Lancet. 2012; 380(9846):1011-29.
13. Sharifi N, Dolatian M, Mahmoodi Z, Mohammadi Nasrabadi F. Gestational diabetes and its relationship with social determinants of health according to world health organization model: Systematic review. Iran J Obstet Gynecol Infertil. 2017; 19(40):6-18.
14. Vettore MV, Gama SG, Lamarca Gde A, Schilithz AO, Leal Mdo C. Housing conditions as a social determinant of low birthweight and preterm low birthweight. Rev Saude Publica. 2010; 44(6):1021-31.
15. Khashan AS, McNamee R, Abel KM, Pedersen MG, Webb RT, Kenny LC, et al. Reduced infant birthweight consequent upon maternal exposure to severe life events. Psychosom Med. 2008; 70(6):688-94.
16. Nkansah-Amankra S, Luchok KJ, Hussey JR, Watkins K, Liu X. Effects of maternal stress on low birth weight and preterm birth outcomes across neighborhoods of South Carolina, 2000–2003. Maternal Child Health J. 2010; 14(2):215-26.
17. Silverman JG, Decker MR, Reed E, Raj A. Intimate partner violence victimization prior to and during pregnancy among women residing in 26 US states: associations with maternal and neonatal health. Am J Obstet Gynecol. 2006; 195(1):140-8.
18. Sahebi A, Asghari M, Salari RS. Validation of depression anxiety and stress scale (DASS-21) for an Iranian population. Iran Psychol. 2005; 4(1):

299-313.
19. Navidpour F, Dolatian M, Yaghmaei F, Majd HA, Hashemi SS. Examining factor structure and validating the Persian version of the pregnancy's worries and stress questionnaire for pregnant Iranian women. Glob J Health Sci. 2015; 7(6):308-18.
20. Hajian S, Vakilian K, Mirzaii Najm-abadi K, Hajian P, Jalalian M. Violence against women by their intimate partners in Shahroud in northeastern region of Iran. Glob J Health Sci. 2014; 6(3):117-30.
21. Bagherian-Sararoudi R, Hajian A, Ehsan HB, Sarafraz MR, Zimet GD. Psychometric properties of the persian version of the multidimensional scale of perceived social support in Iran. Int J Prev Med. 2013; 4(11):1277-81.
22. Mohammadi F, Omidvar N, Houshiar-Rad A, Khoshfetrat MR, Abdollahi M, Mehrabi Y. Validity of an adapted Household food insecurity access scale in urban households in Iran. Public Health Nutr. 2012; 15(1):149-57.
23. Zarrati M, Shidfar F, Moradof M, Nasiri Nejad F, Keyvani H, Rezaei Hemami M, et al. Relationship between breast feeding and obesity in children with low birth weight. Iran Red Crescent Med J. 2013; 15(8):676-82.
24. Darling RD, Atav AS. Risk factors for low birth weight in New York state counties. Policy Polit Nurs Pract. 2012; 13(1):17-26.
25. Dandekar RH, Shafee M, Sinha SP. Prevalence and risk factors affecting low birth weight in a district hospital at Perambalur, Tamilnadu. Glob J Med Public Health. 2014; 3(2):1-5.
26. Heaman M, Kingston D, Chalmers B, Sauve R, Lee L, Young D. Risk factors for preterm birth and small-for-gestational-age births among Canadian women. Paediatr Perinat Epidemiol. 2013; 27(1): 54-61.
27. Mahmoodi Z, Karimlou M, Sajjadi H, Dejman M, Vameghi M, Dolatian M. Working conditions, socioeconomic factors and low birth weight: path analysis. Iran Red Crescent Med J. 2013; 15(9):836-42.
28. Silvestrin S, Silva CH, Hirakata VN, Goldani AA, Silveira PP, Goldani MZ. Maternal education level and low birth weight: a meta-analysis. J Pediatr. 2013; 89(4):339-45.
29. Kramer MS, Goulet L, Lydon J, Séguin L, McNamara H, Dassa C, et al. Socio-economic disparities in preterm birth: causal pathways and mechanisms. Paediatr Perinat Epidemiol. 2001; 15(Suppl 2):104-23.
30. Yadegari L, Dolatian M, Mahmoodi Z, Shahsavari S, Sharifi N. The relationship between socioeconomic factors and food security in pregnant women. Shiraz E Med J. 2017; 18(1):e41483.
31. Divney AA, Sipsma H, Gordon D, Niccolai L, Magriples U, Kershaw T. Depression during pregnancy among young couples: the effect of personal and partner experiences of stressors and the buffering effects of social relationships. J Pediatr Adolesc Gynecol. 2012; 25(3):201-7.
32. Coussons-Read ME, Okun ML, Nettles CD. Psychosocial stress increases inflammatory markers and alters cytokine production across pregnancy. Brain Behav Immun. 2007; 21(3):343-50.
33. Rondo PH, Ferreira RF, Nogueira F, Ribeiro MC, Lobert H, Artes R. Maternal psychological stress and distress as predictors of low birth weight, prematurity and intrauterine growth retardation. Eur J Clin Nutr. 2003; 57(2):266-72.
34. Dominguez TP, Schetter CD, Mancuso R, Rini CM, Hobel C. Stress in African American pregnancies: testing the roles of various stress concepts in prediction of birth outcomes. Ann Behav Med. 2005; 29(1):12-21.
35. Witt WP, Litzelman K, Cheng ER, Wakeel F, Barker ES. Measuring stress before and during pregnancy: a review of population-based studies of obstetric outcomes. Matern Child Health J. 2014; 18(1):52-63.
36. Borders AE, Grobman WA, Amsden LB, Holl JL. Chronic stress and low birth weight neonates in a low-income population of women and birth. Obstet Gynecol. 2007; 109(2 Pt 1):331-8.
37. Laraia BA, Siega-Riz AM, Gundersen C. Household food insecurity is associated with self-reported pregravid weight status, gestational weight gain, and pregnancy complications. J Am Diet Assoc. 2010; 110(5):692-701.
38. Hetherington E, Doktorchik C, Premji SS, McDonald SW, Tough SC, Sauve RS. Preterm birth and social support during pregnancy: a systematic review and meta-analysis. Paediatr Perinat Epidemiol. 2015; 29(6):523-35.
39. Rosen D, Seng JS, Tolman RM, Mallinger G. Intimate partner violence, depression, and posttraumatic stress disorder as additional predictors of low birth weight infants among low-income mothers. J Interpers Violence. 2007; 22(10):1305-14.
40. Mozayeni M, Dorosty-Motlagh AR, Eshraghian MR, Davaei M. Relationship between food sequrity and stress in pregnant mothers and low birth weight infant in child birth conducted in 2020 in tehran akbar abadi hospital. Int J Curr Life Sci. 2014; 4(6):2915-21.
41. Brown SJ, Yelland JS, Sutherland GA, Baghurst PA, Robinson JS. Stressful life events, social health issues and low birthweight in an Australian population-based birth cohort: challenges and opportunities in antenatal care. BMC Public Health. 2011; 11(1):196.