




## Effect of maternal mental health during pregnancy on infant growth at six months of age in Suburban communities in South of Iran

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### Abstract

**Background:** Due to the controversial effects of mental health disorders during pregnancy on infant health, the present study aimed to evaluate the effect of gestational depression, stress, and anxiety on the growth of offspring at six months of age in disadvantaged communities in South of Iran.

**Methods:** The sample comprised of 470 pregnant women (response rate=98%) who are participated in the Bandar Abbas Pregnancy Cohort study. Maternal mental health was measured by the DASS-21 questionnaire during pregnancy. Data on infant growth was collected based on infant's growth chart at six months of age. The relative risk of suboptimal infant growth was calculated by Modified Poisson regression models at 5% significant level.

**Results:** The prevalence of depression, anxiety, and stress was 19.0%, 26.1% and 6.5%, respectively. At six months of age, the mean (SD) of infant's weight (gram), height (cm) and head circumference (cm) were 7287.30 (1019.85), 63.23 (5.62) and 41.39 (2.70), respectively. Compared to normal mothers, the risk of suboptimal weight at six months of age significantly increased by 71% in mothers who were classified as having depression (Adjusted RR: 1.71, 95% CI: 1.07, 2.09). The presence of anxiety significantly increased the risk of suboptimal height at six months of age by 43% (ARR: 1.43, 95% CI: 1.07, 1.92). There were no statistically significant effects of either depression anxiety or stress on the suboptimal head circumference at six months of age.

**Conclusion:** Our results showed that mental health disorders of pregnant women might adversely influence the weight and height growth of offspring within the first six months of age. Screening protocols to early diagnose of mental health disorders during pregnancy, and to strict follow up of diagnosed cases postpartum are proposed.

**Keywords:** Depressive disorders, Growth chart, Prospective studies, Community-participatory research

**Conflicts of Interest:** None declared

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### ↑What is "already known" in this topic:

One major consequence of maternal mental disorders might appear through missed antenatal visits, which leads to intrauterine growth retardation, frequent hospital admissions for infants, and increased risk of infant morbidities such as diarrhea and malnutrition.

### →What this article adds:

- The prevalences of depression, anxiety, and stress in our study were lower than previous reports.
- Maternal depression during pregnancy has an effect on an infant's height at 6 months of age.
- Anxiety during pregnancy may lead to a 43% higher risk of stunting in 6-months old infants.
- The negative effects of maternal mental disorders on an infant's growth may be influenced by many social, cultural and behavioral factors.

## Introduction

Pregnancy is an important emotional experience, usually results in huge mental and physical changes in pregnant women. As a result, pregnant women are typically more susceptible to various mental disorders, including stress, depression, and anxiety compared to non-pregnant women (1). Nearly 10% and 13% of women experience depression either during or after pregnancy worldwide, respectively. This figure is even worse in the developing countries, as 15.6% of women in the pregnancy period and 19.8% of women in the post-partum period experience mental disorders (2). In addition to the adverse effects on maternal health, these psychological problems also can have adverse effects on infant health and family relationships. Affected mothers cannot carry out their responsibilities efficiently; as a result, the infant's growth may also be jeopardized (3).

Maternal mental health is influenced by various factors including advanced age, stressful occupations, high-risk pregnancy, history of abortion, unintended pregnancy and birth complications, and infant morbidities (4-6). One major consequence of maternal mental disorders might appear through missed antenatal visits, which leads to intrauterine growth retardation, frequent hospital admissions for infants, and increased risk of infant morbidities such as diarrhea and malnutrition (2).

Given the strong relationship between physical and mental health in pregnancy and its negative effects on maternal and infant health, the provision of comprehensive antenatal care packages with the aim to maintain and improve mental health is highly warranted (7). In addition, mental disorders can be easily detected and treated, which justifies the necessity to take action against the problem. Despite the importance of maternal, newborn, and child health as one Sustainable Development Goal (SDG), most studies investigating the effects of maternal health during pregnancy on child development in Iran had a cross-sectional and retrospective nature. Therefore, the present study used data of a population-based prospective cohort study to evaluate the effects of maternal mental disorders during pregnancy on infant growth at the first six months of life in suburban neighborhoods of Bandar Abbas city during 2016-2017.

## Methods

This study used the data from a population-based prospective cohort study entitled: "A population-based prospective study to identify contributors to mother and child health in suburban communities". The study, which is called henceforth "Bandar Abbas pregnancy cohort", was ethically approved and financially granted by National Institute for Medical Research Development (NIMAD) in 2016 (registration code: 943607) and is currently ongoing in the two most socially and economically vulnerable neighborhoods of Bandar Abbas city. The cohort sample consists of 1000 pregnant women who are residing in the study neighborhoods and had conception without medical interventions. Following recruitment in pregnancy, data were collected using interviews and evaluation of medical and healthcare records through four visits (pregnancy, 1, 6, and 12 months postpartum). The details of the methodology

have been published elsewhere (8).

By the time of the present study, the data of 470 cohort subjects had been collected and were used for the analysis. Mental disorders during pregnancy were defined as the presence of depression, anxiety, and stress in the pregnancy and were measured using a 21-item DASS questionnaire (Depression, Anxiety, and Stress Scale). The questionnaire measures depression (seven questions, score range: 0-28), anxiety (seven questions, score range: 0-20), and stress (seven questions, score range: 0-34). The reliability and validity of this scale were previously confirmed in an Iranian population (9). It is worth mentioning that suspected cases of mental health problems following administering the DASS questionnaire were advised to refer to a psychiatric counselor for further diagnosis and treatment.

Using child growth charts during the first 6-months of life, the outcome variables were defined as weight for age (in grams), height for age (in centimeter), and head circumference for age (in centimeter). The outcomes were further dichotomized based on below (suboptimal) and above (optimal) the red percentile (-2 SD) (7).

Socio-Economic Status of households (SES) was measured by Principal Component Analysis (PCA) on nine household properties (private car, motorcycle, freezer, dish-washer, microwave oven, PC or laptop computer, vacuum cleaner, washing machine, color TV (LCD/LED)) (10), and was named "asset". The asset variable was further dichotomized into poor or good SES based on the median.

For data analysis, we used chi-square for assessing the association between the qualitative variables. Predictors for the final model were selected in a backward selection scheme using a significance level of less than 20%. Modified Poisson regression models were used to calculate relative risk (with 95% CI) of the effect of mental disorders on infant growth. Confounding variables were defined as those with a significance level below 0.2 (11) and were birth weight, infant infections, teething at 6 months for weight; birth height, infant's gender, SES, maternal occupation, and teething at 6 months for height; and birth rank, maternal occupation, and teething at 6 months for head circumference. All analyses were done using Stata version 14 (StataCorp, College Station, TX, USA) and GIS version 10.3. The significance level was set at <0.05.

## Results

The mean (SD) age of the mothers was 27.24 (5.65) years (range: 16-42 years), while the majority were housewives (n=453, 96.38%) and had secondary/high school education (n=264, 56.17%). The results of the DASS showed that 16.49% (n=77) of the subjects were classified as having mental disorders. More specifically, 19% (n=89), 26.1% (n=122), and 6.47% (n=30) of the subjects were classified as having depression, anxiety, and stress during pregnancy, respectively.

Boys comprised 53.62% (n=252) of the newborns. Of all infants, 25.96% (n=122) were non-exclusively breastfed (including formula, cow's milk, or both), and 49.48% (n=232) had at least one tooth at 6 months of age (Table 1).

The mean (SD) of weight (in grams) was 3080 (900) at birth and 7287.30 (1019.85) at six months of age. The mean (SD) of height (in centimeters) was 49.23 (3.14) at birth and 63.23 (5.62) at six months of age. The mean (SD) of head circumference (in centimeters) was 33.54 (2.14) at birth and 41.39 (2.70) at six months of age (Table 2).

The results of the modified Poisson regression model showed that compared to normal mothers, the risk of

suboptimal weight at six months of age significantly increased by 71% in mothers who were classified as having depression (Adjusted RR: 1.71, 95% CI: 1.07, 2.09). The presence of anxiety significantly increased the risk of suboptimal height at six months of age by 43% (ARR: 1.43, 95% CI: 1.07, 1.92). On the other hand, there was no statistically significant effect of depression, anxiety or stress on the suboptimal head circumference at six months of age (Table 3).

Table 1. General characteristics of cohort subjects and their offspring in Suburban communities in the South of Iran, 2018

Variable	Category	N	Relative frequency
Maternal education	Illiterate/ reading & writing	128	27.23
	High school/ diploma	264	56.17
Maternal occupation	Academic	78	16.60
	Housekeeper	453	96.38
	Staff	17	3.62
Current pregnancy	Planned	404	85.96
	Unplanned	66	14.04
Gestational trimester	1 <sup>st</sup>	92	19.87
	2 <sup>nd</sup>	170	36.72
	3 <sup>rd</sup>	201	43.41
Weight at birth (gram)	<2500	195	41.49
	≥2500	275	58.51
Height at birth (cm)	<45	38	8.09
	≥45	432	91.91
Head circumference at birth (cm)	<33	113	24.09
	≥33	356	75.91
Infant feeding	Breast milk	348	74.04
	Other <sup>†</sup>	122	25.96
Multivitamin intake	Regular	422	89.79
	Irregular/Not used	48	10.21
infection contraction within 6-months	No	383	81.49
	Yes	87	18.51
Weight at 6-months	Normal	363	77.23
	Suboptimal	107	22.77
Height at 6-months	Normal	283	60.21
	Suboptimal	187	39.79
Head circumference at 6-months	Normal	264	56.17
	Suboptimal	206	43.83

<sup>†</sup> including formula, cow's milk, food, etc.

Table 2. Distribution of maternal and infant characteristics according to infant growth at 6 months of age in Suburban communities in the South of Iran, 2018

Variable		Weight growth			Height growth			Head circumference		
		Normal N (%)	Sub- Optimal N (%)	p	Normal N (%)	Sub-op- timal N (%)	p	Normal N (%)	Sub-op- timal N (%)	p
Maternal educa- tion	Illiterate/ El- ementary	90 (70.3)	38 (29.6)	0.047	73 (57)	55 (42.9)	0.120	72 (56.2)	56 (43.7)	0.550
	High school/ diploma	207 (78.4)	57 (21.6)		155 (58.7)	109 (41.3)		144 (54.5)	120 (45.4)	
	Academic	66 (84.6)	12 (15.3)		55 (70.5)	23 (29.4)		48 (61.5)	30 (38.4)	
Current preg- nancy	Planned	313 (77.4)	91 (22.5)	0.758	246 (60.8)	158 (39.1)	0.457	227 (56.1)	177 (43.8)	0.985
	Unplanned	50 (75.7)	16 (24.2)		37 (56)	29 (43.9)		37 (56)	29 (43.9)	
Infant sex	Girl	155 (71.1)	63 (28.9)	0.003	130 (59.6)	88 (40.3)	0.811	125 (57.3)	93 (42.6)	0.635
	Boy	208 (82.5)	44 (17.4)		153 (60.7)	99 (39.3)		139 (55.1)	113 (44.8)	
exclusive breast feeding	Yes	274 (78.7)	74 (21.2)	0.190	213 (61.2)	135 (38.7)	0.457	198 (56.9)	150 (43.1)	0.592
	No	89 (72.9)	33 (27)		70 (57.3)	52 (42.6)		66 (54.1)	56 (45.9)	
multivitamin	Yes	329 (77.9)	93 (22)	0.264	251 (59.4)	171 (40.5)	0.335	233 (55.2)	189 (44.8)	0.215
	No	34 (70.8)	14 (29.1)		32 (66.6)	16 (33.3)		31 (64.5)	17 (35.4)	

Table 2. Ctd

Variable		Weight growth			Height growth			Head circumference		
		Normal N (%)	Sub- Optimal N (%)	p	Normal N (%)	Sub-op- timal N (%)	p	Normal N (%)	Sub-op- timal N (%)	p
Weight at birth (gram)	<2500	122 (62.5)	73 (37.4)	<0.001	-	-	-	-	-	-
	≥2500	241 (87.6)	34 (12.3)		-	-		-	-	
Height at birth (cm)	<45	-	-	0.031	20 (52.6)	18 (47.3)	-	-	-	-
	≥45	-	-		263 (60.8)	169 (39.1)		-	-	
Head circumfer- ence at birth (cm)	<33	-	-	0.024	-	-	-	53 (46.9)	60 (53.1)	-
	≥33	-	-		-	-		210 (58.9)	146 (41)	
teeth	No	178 (74.4)	61 (25.5)	0.147	143 (59.8)	96 (40.1)	0.864	134 (56)	105 (43.9)	0.963
	Yes	185 (80)	46 (19.9)		140 (60.6)	91 (39.4)		130 (56.2)	101 (43.7)	
infection con- traction within 6-months	no	311 (81.2)	72 (18.8)	<0.001	232 (60.5)	151 (39.4)	0.737	213 (55.6)	170 (44.4)	0.610
	Yes	52 (59.7)	35 (40.2)		51 (58.6)	36 (41.3)		61 (58.6)	36 (41.3)	
Depression	No	339 (77)	101 (22.9)	0.709	265 (60.22)	175 (39.77)	0.980	247 (56.1)	193 (43.8)	0.955
	Yes	24 (80)	6 (20)		18(60)	12(40)		17(56.6)	13(43.3)	
Anxiety	no	299 (76.6)	91 (23.3)	0.517	235 (60.2)	155 (39.7)	0.966	225 (57.7)	165 (42.3)	0.142
	yes	64 (80)	16 (20)		48(60)	32(40)		39(48.6)	41(51.2)	
Stress	no	351 (76.8)	106 (23.1)	0.189	275 (60.1)	182 (39.8)	0.921	258 (56.4)	199 (43.5)	0.460
	yes	12 (92.3)	1 (7.7)		8 (61.5)	5(38.4)		6(46.1)	7(53.8)	

Table 3. Results of the modified Poisson regression model for the effect of depression, anxiety, and stress on anthropometric measures of a 6-months old infant in Suburban communities in the South of Iran, 2018

Exposure		Weight <sup>6</sup>			Height <sup>5</sup>			Head circumference <sup>7</sup>		
		RR	Lower limit	Upper limit	RR	Lower limit	Upper limit	RR	Lower limit	Upper limit
Depression	No		1.00			1.00			1.00	
	Yes	1.71	1.07	2.09	1.10	0.67	1.81	0.67	0.26	1.72
Anxiety	No		1.00			1.00			1.00	
	Yes	1.76	0.82	3.76	1.43	1.07	1.92	0.74	0.48	1.69
Stress	No		1.00			1.00			1.00	
	Yes	1.23	0.605	2.50	0.82	0.44	1.54	0.42	0.39	1.48

<sup>6</sup> Adjusted for infant sex, having tooth at 6 months, birth weight, infection contraction within 6 months

<sup>5</sup> Adjusted for multivitamin intake, maternal education, birth height

<sup>7</sup> Adjusted for infant sex, head circumference at birth, multivitamin intake

## Discussion

In the present study, we found that 16.5% of pregnant women in suburban communities in Bandar Abbas were classified as having mental disorders. More specifically, the prevalence of depression, anxiety, and stress was calculated as 19%, 26.1% and 6.47%, respectively. These values are found to be lower than what has been reported from previous reports among women in Iran (25.6%- 42.8%) (12, 13). Moreover, the prevalence of anxiety in our study was substantially lower than what was reported previously from Bandar Abbas, (i.e., 42%) (14). The observed discrepancy can be explained by using different instruments to measure mental health disorders and differences in study samples in terms of study setting and cultural context.

The mean weight, height, and head circumference of the

infants at 6 months was 7.28 (1.01) kg, 63.23 (5.62) cm, and 41.39 (2.70) cm, respectively. The results of a study in infants below 2 years of age in Bandar Abbas showed a mean (SD) weight of 5.8 (SD=0.24) and 6.15 (SD=0.26) kg and a mean height of 65 (SD=4.2) and 66.7 (SD=7.5) cm in girls and boys aged 6 months, respectively (15). A comparison of the results shows that infants in our study weighed more than infants in other studies while there was no significant difference in height.

Similar to the results of the study by Katherine L. Wisner, our findings showed that maternal depression during pregnancy might affect infant growth, especially height, at 6 months (16). In the current study, the risk of stunting at 6 months in infants of mothers who had anxiety during pregnancy was 43% higher than its risk in infants of healthy

mothers, while depression, stress and anxiety had no significant effect on weight and head circumference at 6 months. However, the results of a study by Kabiri et al. showed a significant correlation between maternal mental health and infant weight and head circumference at birth and two months (17). The results of another cohort study of 1200 mothers showed that maternal mental health during pregnancy had a direct effect on infant growth by six months and depression during pregnancy was associated with a decreased infant growth at 6 months (18). The possible mechanisms through which maternal depression affects infant growth and development may be an unhealthy lifestyle and reduced odds of follow-up on the necessary gestational and postpartum care. Depressed mothers are likely to allocate less time to their babies due to lack of energy, fatigue, and impatience, resulting in inadequate infant care. On the other hand, insufficient social support by family members and relatives, lower socio-economic status, lower education, and marital problems may also affect maternal mental health. Moreover, the mothers might be blamed for delivering a girl due to cultural reasons, which may worsen stress during pregnancy and hamper child development (12).

Anxiety, depression, and stress in pregnancy are risk factors for adverse outcomes for mothers and children. Anxiety in pregnancy is associated with shorter gestation and has adverse implications for fetal neurodevelopment and child outcomes. Anxiety about a particular pregnancy is especially potent. Chronic strain, exposure to racism, and depressive symptoms in mothers during pregnancy are associated with lower birth weight infants with consequences for infant development (5). Anxiety can also impact reproductive outcomes, such as the higher risk for preterm birth, LBW infants and fetal and infant neuro-development. Results of studies showed anxiety measured in pregnant women at the second and third trimesters predicted reduced and length. Anxiety during the third trimester predicted shorter gestational age (19-21). It is also reported that maternal anxiety has a significant impact on birth weight (19, 22, 23), while in some other studies, significant differences between fetus's growth restriction, neonatal Apgar score, birth weight, birth length and head circumference among anxious and non-anxious women has not been reported (24). These risk factors can affect infant growth especially the height of the child.

Considering the relatively high prevalence of mental disorders during pregnancy and their adverse effects on the mother and infant, it is recommended that mothers undergo screening for mental disorders on the first prenatal visit and at the end of each semester. Moreover, it may be useful to study the effect of postpartum depression on infant growth in one year.

### Strength of the study

The study used data from a population-based prospective cohort study. The prospective nature of the cohort study prevents misclassification and recall biases, while being population-based provides a wider spectrum of the target population for the results.

### Limitations

Having measured mental health through questionnaire might have estimated the prevalence of mental health different from what it would be by clinical tests.

### Conclusion

The results of this study showed a relatively high prevalence of anxiety and stress in pregnant women. Our study also showed that depression, anxiety, and stress could negatively affect infant health and growth at the year of life, especially in the first six months.

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### Conflict of Interests

The authors declare that they have no competing interests.

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