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The Effect of Antenatal Maternal Anxiety, Depression, and Stress on Infant Development at 6 Months of Age

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ABSTRACT

Background: Mental disorders can significantly impact maternal health and neonatal health and development. This study investigated maternal anxiety, depression, and stress during pregnancy concerning their children's development.

Methods: In this follow-up study, all pregnant women with gestational age > 12 weeks referring to an obstetrics and gynecology clinic affiliated with Shahid Sadoughi University of Medical Sciences over six months were included.

Data on mothers were collected using a personal information questionnaire and the Depression Anxiety Stress Scale (DASS)-42 standard questionnaire. Finally, based on the inclusion and exclusion criteria, the children of 73 mothers were included in the study. Infant development was assessed based on the Persian version of the Ages and Stages Questionnaire (ASQ) at six months postpartum.

Data analysis was conducted using the Pearson correlation test and multiple regression analysis. Statistical analyzes were carried out using SPSS 21. A P-value <0.05 was considered statistically significant.

Results: In this study, 39.7%, 63%, and 56.2% of women suffered from depression, anxiety, and stress, respectively. In this study, a significant relationship was found between antenatal maternal depression and gross motor (P: 0.022), fine motor (P: 0.003), personal-social (P: 0.009), and communication skills (P: 0.0180). Moreover, there was a significant relationship between maternal anxiety and personal-social (P: 0.012) and gross motor domains (P: 0.008). Also, a significant association was observed between personal-social skills and maternal stress (P: 0.030).

Conclusion: As shown by the results, antenatal maternal mental illness can interfere with the development of children. Therefore, paying attention to the mental health of pregnant women is necessary.

Keywords: Anxiety, Depression, Development, Prenatal, Stress

Introduction

Maternal mental health is considered a public health priority worldwide(1, 2). Mental health disorders, including depression, anxiety, and stress, are highly common in pregnant women but often overlooked(3-5). These disorders wield significant effects on maternal health and neonatal health and development. In addition, they can reduce the quality of life, increase the risk of chronic diseases and substance abuse, impose economic burdens on the healthcare costs of society, cause job losses, and deteriorate mothers' incomes(1). Furthermore, antenatal maternal mental health problems can be associated with adverse outcomes in young children's behavioral, cognitive, and emotional development(6). Various studies have shown the detrimental effects of stress, tiredness, and maternal mood on the offspring's physical condition, growth, and development(7-9).

Some studies have documented that the report of increased stress, depression, and anxiety during pregnancy in mothers is associated with their infant's delayed cognitive and motor development(10). In a study by Haselbeck et al., infants whose mothers experienced more distress during pregnancy had lower fine motor

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development at 16 months of age(11). A study conducted using data from 3379 mother-infant pairs in the Shanghai Birth Cohort concluded that antenatal maternal depression, anxiety, and stress had a negative relationship with early neuro-development in infants. However, it was not the case for postpartum depression(12). Awareness of risk factors and detection of the effects of psychological distress during pregnancy are essential for early interventions to reduce adverse outcomes for the mother, child, and family(2).

Unfortunately, scant attention has been paid to the mental health problems of mothers and their relationship with the developmental status of children in our societies. Therefore, this study aimed to investigate how antenatal maternal anxiety, depression, and stress are related to infant development.

Methods

In this longitudinal follow-up study, a sample of 102 pregnant women was selected using the census method from those referred to the Obstetrics and Gynecology Clinic affiliated with Shahid Sadougi University of Medical Sciences in Yazd for fetal care during the second half of 2019.

All women participating in this study were in their second or third trimester of pregnancy. Exclusion criteria were non-Iranian mothers, any maternal physical illness such as diabetes mellitus, hypertension, epilepsy, multiple sclerosis, drug addiction, smoking, and multiple pregnancies. Pregnant women who did not fill in the questionnaire completely or failed to respond to the phone were also excluded from the study. Before entering the study, the study goals were explained to the participants. Informed consent was obtained from participants, and the interviewers completed a questionnaire on demographic, socio-economic factors, and medical history. The Persian version of the Depression Anxiety Stress Scale (DASS)-42 questionnaire was also filled out through face-to-face interviews with pregnant women. As a screening tool, the 42-item self-report DASS measures negative emotional states of depression, anxiety, and stress. There are 14 items for each disorder, and the final score is calculated by scoring all items.

Pregnant women were asked to read each item and, select one of the "NEVER," "SOMETIMES," "OFTEN," or "ALMOST ALWAYS" responses, which were scored on a range of zero to three. This tool measures and reflects the experience of people in the past week(13).

After explaining the follow-up process, the contact information of mothers, including their phone numbers were collected.

Follow-up was conducted via phone, and infants were evaluated for developmental skills using the Persian version of the ASQ questionnaire at six months of age. It should be noted that each questionnaire contained 30 items on five domains of development. The scores of each developmental domain were summed up and the child's developmental status was evaluated based on the overall score of the questionnaire. Scores domain below the cut-off point or more than two standard deviations below the reference group mean were assumed abnormal and reported as develop-mental delay.

Exclusion criteria for infants were congenital malformations, microcephaly, hypoxia at birth, chromosomal abnormalities, low Apgar score, and other neurological disorders.

Out of 102 pregnant women at the baseline, 29 were excluded from the study (10 for gestational diabetes, 3 for incomplete answers, three for being twins, two for abortion, two for being lost to follow-up, eight for premature birth and 1 for death in two months) and finally, n=73 cases were included in the study.

Ethical considerations

The ethics committee of Shahid Sadoughi University of Medical Sciences, Yazd, Iran approved this study (Ethical Code: IR.SSU. MEDICINE.REC.1398.101).

Statistical analysis

SPSS software 21 was used for data analysis in this study. Pearson Chi-Square test and ANOVA tests were used for bivariate analysis.

Results

Of 102 pregnant women initially, 10 participants were excluded due to gestational diabetes. Other exclusions consisted of three cases of incomplete questionnaires, three twin preg-nancies, two abortions, and eight preterm deliveries. One infant died at two months of age, and two were lost to the follow-up. In the end, 73 cases were evaluated.

About 39.7%, 63%, and 56.2% of the mothers suffered from depression, anxiety, and stress, respectively. Moreover, 37% of neonates were male, and 68.5% of mothers were below 30 years of age.

In this study, antenatal maternal depression was significantly related to gross motor (P: 0.022), fine motor (P: 0.003), personal-social (P: 0.009),

and communication skills (P: 0.0180). The higher severity of depression symptoms was associated with a lower mean of the said domains. The lowest scores of developmental domains were obtained in severe and extremely severe depression groups. (Table 1).

A significant relationship was established between maternal anxiety during pregnancy and the personal-social (P: 0.012) and gross motor domains (P: 0.008). Furthermore, at six months of age, the mean score of gross motor and personal-social domains were significantly lower in children of mothers who exhibited severe and extremely severe prenatal anxiety symptoms.

In this study, we found a significant relationship between personal-social skills and maternal stress (P: 0.030), and the lowest mean of personal-social skills was recorded in mothers who displayed severe and very severe symptoms of stress.

Notably, irrespective of the severity of stress, a significant relationship was observed between the mean scores of gross motor and fine motor domains (P: 0.044 and 0.032) in the offspring of mothers with/without symptoms of stress.

The results of the study suggested that the development of female children born to mothers with gestational depression was significantly associated with the severity of depression in two domains of fine motor (P: 0.031) and gross motor (P: 0.024) but this was not the case for male infants(Table 2).

Furthermore, gross motor, fine motor, problem-solving, and personal-social skills were found to be significantly correlated with the severity of maternal anxiety symptoms in female infants. However, it was not the case for male infants. Moreover, no difference was observed in the stress group with regard to gender.

A recent study described that the developmental delay in the field of communication was more significant in the second (P: 0.047) and third (P: 0.002) children of mothers suffering from depressive symptoms during pregnancy than in their first child.

In mothers who displayed anxiety symptoms during pregnancy, the developmental delay was more significant in the personal-social domain (P: 0.047) in the second child, and in the communication domain (P: 0.005) in the second and third children compared to the first child. Moreover, the growing number of children in the family was associated with the growth delay in this domain.

Also, in mothers suffering from prenatal stress, the second child exhibited a greater developmental delay in gross motor, fine motor, and personal-social skills, and the second and third children in communication skills compared to the first child.

Table 1. Mean ASQ in infants born to mothers with antenatal depression, anxiety and stress

Skill		Depression		Anxiety		Stress	
		Mean ± SD	P	Mean ± SD	P	Mean ± SD	P
Gross motor	Normal	±11±54.4	0.022	11±54.4	0.008	11±55	0.096
	Mild	8.5±55		8.7±57.5		14±52	
	Moderate	15±45		12.3±49		11±50.5	
	Severe	18.4±41.7		16.3±47		19.7±45	
Fine motor	Normal	4.4±57.6	0.003	7.4±56.5	0.100	3.4±58	0.099
	Mild	10±51.7		2.5±58.3		10.3±54	
	Moderate	8±55		7.7±53.5		8±53.3	
	Severe	8.7±48.3		7±53		9±51.3	
Problem solving	Normal	5±57	0.547	5.3±56	0.254	5±5606	0.428
	Mild	5±56.3		4±58.3		3±58.5	
	Moderate	4±57.5		5.3±57.4		7±56	
	Severe	7±54.5		5.5±56		4±55.7	
Personal -Social	Normal	7.4±57	0.009	8.3±55.4	0.012	7.5±57.3	0.030
	Mild	5.4±56.7		0.0±60		7±56	
	Moderate	11.3±52		9±55.3		8.5±53.5	
	Severe	10.3±48		10±51.5		12±49.4	
Communication	Normal	7±57.6	0.018	8±56.5	0.220	6.5±58	0.101
	Mild	6.3±56		1.5±59.6		3±59	
	Moderate	10.3±55		7.8±56		9.5±53.3	
	Severe	15±46.7		13±51.5		9.5±53.3	

Table 2. Mean ASQ in infants of mothers with antenatal depression, anxiety and stress by gender

Skill	Gender		Depression		Anxiety		Stress	
			Mean ± SD	P	Mean ± SD	P	Mean ± SD	P
	Male	Normal	8±56	0.141	4.4±57.2	0.294	11±55	0.213
		Mild	3.5±57.5		12±55		3.8±59	
		Moderate	10±55		10.4±48		12.5±48	
		Severe	19±35		19±49.3		26±45	
Gross motor								
	Female	Normal	12±53.3	0.024	13±53	0.015	11.7±54.3	0.159
		Mild	9.2±54.5		0±60		18±44.2	
		Moderate	13±35		13.5±49.2		10±۵۲	
		Severe	18±47		15.4±15.5		18.4±45	
	Male	Normal	4±58	0.107	5±57.3	0.179	2.5±58	0.366
		Mild	7±50		3±57.5		6±57	
		Moderate	10±55		9±58		9.5±51.4	
		Severe	12±47.5		9±56		13.2±50	
Fine motor								
	Female	Normal	5±58	0.031	8.5±56	0.022	4±57.7	0.233
		Mild	11±52		.2±59.2		14±51	
		Moderate	7±55		6±56		7±54.2	
		Severe	6.5±49		7±50.5		7.5±52	
	Male	Normal	4±58	0.099	6±55.6	0.408	5±56.6	0.236
		Mild	3.5±47.5		4±58.3		3±58.5	
		Moderate	2.5±59		9±54		7±56	
		Severe	10±55		2±59.3		4±55.7	
Problem solving								
	Female	Normal	6±56.3	0.400	5.3±56	0.030	5±57	0.395
		Mild	2.5±58		4±58.3		5±57	
		Moderate	4.8±56.3		2.3±59		6±57	
		Severe	4±54		6±53		4±54	
	Male	Normal	3.4±58.5	0.104	4.3±57	0.306	4.2±58	0.150
		Mild	3.5±57.5		0±60		2±59.3	
		Moderate	14.3±51.3		13.4±51		11±52	
		Severe	13±47		11±54.3		19±48.3	
Personal -Social								
	Female	Normal	9±56	0.107	10±55	0.019	9±57	0.109
		Mild	6±56.5		0±60		9±52.5	
		Moderate	9.5±52.5		6.2±57		7.3±54.2	
		Severe	9±48		9.3±49.5		10.7±50	
	Male	Normal	8.5±58	0,072	9±55	0.816	11±56	0.133
		Mild	10.7±52.5		2±59.2		0±60	
		Moderate	15±52.5		13±53		12±50	
		Severe	18±۴۴		16±51.4		23±46.7	
Communication								
	Female	Normal	5.6±58	0.283	4.3±57.3	0.259	4.8±58.4	0.496
		Mild	6.5±56.5		0±60		4.2±57.5	
		Moderate	3±57.5		4.5±57		8±55	
		Severe	13.4±49		12±51.5		14±50	

Discussion

The prenatal period is a critical time for neural development, and therefore too much exposure to adverse conditions increases the vulnerability of the nervous system, which provokes long-term changes in infants' brain and behavioral development. (14-16) According to World Health Organization's reports, about 10% of pregnant women and 13% of women who have recently given birth have experienced mental disorders, the most prevalent of which is depression. In developing countries, the rate is higher than 15.6% during pregnancy and 19.8% after delivery. (17).

The results of this paper demonstrated that maternal depression, anxiety, and stress during pregnancy affect the development of children at six months of age. This effect varies based on gender and the number of children. Our study showed a significant relationship between prenatal depression and delay in the development of communication, gross motor, fine motor, and personal-social skills. Black MM et al. also found that infants whose mothers reported depressive symptoms had lower cognitive, motor, and orientation skills at 6-12 months than infants born

to mothers without depression(18). According to Tuovinen et al.'s study, a higher depression score during and after gestation correlates with a lower developmental score and a lower score in fine and gross motor skills, communication, problem-solving, and personal-social skills in children(19). Vameghi et al, found a significant correlation between the severity of mothers' depression and developmental delay in gross motor and problem-solving skills(20). The findings of Deave et al. emphasize the importance of depression in pregnancy arguing that some sequels of child development attributed to postpartum depression are partially caused by depressive symptoms during pregnancy (21).

However, Mohammadi Parsa et al.'s study on 300 mothers and children in Hamedan, no significant relationship was identified between maternal depression and developmental delay in gross and fine motor domains(22). This study revealed a significant association between gross motor, fine motor, problem-solving and individual-social skills and the severity of maternal anxiety symptoms in female infants. Contrary to our findings, no gender difference was reported in the developmental domains of the children born to mothers with anxiety during pregnancy in the study of Niloufer Soltan Ali et al. (23).

A significant relationship between maternal anxiety during pregnancy and personal-social and gross motor domains was found in this study. DiPietro JA et al. also reported the link between child development problems and maternal prenatal anxiety (24).

Buss et al. argued that changes in gray matter volume of the brain induced by maternal anxiety during pregnancy may make individuals more prone to developmental, neurodevelopmental, cognitive, and intellectual disorders(25).

Our study also found a significant relationship between personal-social skills and maternal stress during pregnancy. Simcock G et al. reported a significant negative relationship between six-month-old infants' personal-social skills and mothers' stress experiences(26). Other studies have explored the effects of pregnancy stress on children's neurodevelopment as an impaired motor and cognitive development(27).

Study Limitations

It is necessary to mention the limitations of the present research here:

1. Considering that the sample was taken from volunteers at an antenatal care center, it may not be representative of the general population.
2. Maternal anxiety, depression, and postpartum stress were not studied, which may affect the results.
3. Six months may be too early to estimate the infant's neurodevelopment.

Therefore, more studies with extended follow-up are warranted to confirm our findings on the relationship between antenatal maternal depression, stress, and anxiety with offspring development.

Conclusion

Our study demonstrated that depression, anxiety, and stress are fairly common in pregnant, and prenatal maternal emotional complaints could interfere with the development of their children. Therefore, in addition to the physical health of pregnant women, further attention should be paid to their psychological aspects.

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Conflicts of interest

The authors have no conflict of interest to report.

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