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Published version

SHAFIZADEHKENARI, Mohsen and MEHDIZADEH, Mahiar (2009) Relationship between maternal distress with fetus growth rate: mediator role of heart rate. *Journal of Applied Sciences*, 9 (1). 193-196. ISSN 1812-5654

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Relationship Between Maternal Distress with Fetus Growth Rate: Mediator Role of Heart Rate

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Abstract: The aim of present investigation was to study the relationship between mothers' distress and fetal growth. In this correlational study, 110 pregnant women selected randomly and completed Depression Anxiety Stress Scale (DASS) before ultrasound measurement of fetus. The results of structural equation model have shown that the overall model has been accepted ($\chi^2 = 36.4$, $df = 24$, $p > 0.05$). In fact, by increasing mothers' stress and anxiety, the fetus heart rate was increased and it decreased the height, weight, head circumference and width and femur length of fetus. Therefore, one of the environmental variables that have negative effect on the fetus growth is mother distress, because it can stimulate the fetal autonomic nervous system through the mediating of heart rate.

Key words: Maternal distress, growth rate, fetus

INTRODUCTION

Prenatal period is important because of its progressive changes in the human growth that stem from integrative molecular, biochemical, biophysical, anatomical and functional activities (Malina *et al.*, 2004). This period is one of the critical periods in human growth and development because of its influences on postnatal development. On the other hand, some changes in this period might have negative effects on structural and functional aspects of different body systems (Gallahue and Ozmon, 2002). Therefore, all of the events that occur in the embryo and fetus stages might cause mortality or functional abnormality (Malina *et al.*, 2004).

Genetics and environment are two important determinants in prenatal growth. The genetics cause abnormality through change in genetically information or the number of chromosome. The environment factors that influence on prenatal growth are variable including external agents, pollution, mother's smoking, alcohol consumption, malnutrition and different diseases (Haywood and Catchell, 2001).

One of the environmental concerns is mother's emotional and psychological problems during pregnancy. Unfortunately, the current research findings relevant to relationship between maternal stress and fetus growth rate have demonstrated that some physical and emotional

problems in the postnatal life cause by maternal psychological conditions (Gallahue and Ozmon, 2002).

Some scientific evidences have demonstrated that psychological disorders such as depression, anxiety and distress had negative effect on fetus growth including: low birth weight, low weight (Diego *et al.*, 2006; Alvarado *et al.*, 2002; Negres *et al.*, 2006; Field and Diego, 2008; Rahman *et al.*, 2007), prematurity and pre-term delivery (Negres *et al.*, 2006; Field *et al.*, 2006, 2008a) and other growth outcomes including reduced femur length, abdomen and head circumferences (Field *et al.*, 2006, 2008b).

There are alternative viewpoints about the negative effects of maternal depression and anxiety on the fetus and their emphasis were on the hormonal or neural factors. In one hypothesis, the basis of fetus neurobehavioral development is mother's psychological profiles and it is proposed that the heart rate, blood pressure and breath rate as a mediator of cardio-respiratory systems have important role for this changes. Therefore, by increasing in the mother's depression and anxiety the function of cardio-respiratory systems also confront with incremental changes (Monk *et al.*, 2000, 2003, 2004). Of course, some evidence in the regard of the mediator role of cardio-respiratory indices on the fetus behaviors and growth rate have demonstrated that the effect of maternal anxiety on fetus movements and

resting heart rate was not remarkable in the late pregnancy period (Sjostrom *et al.*, 2002) and fetuses of high anxious mothers spent significantly more time in quiet sleep and exhibited less gross body movement when in active sleep (Groome *et al.*, 1995).

Part of scientific literatures ascertain on the mediator role of hormones and hypothalamus-pituitary-adrenal axis (Field and Diego, 2008; Winstock, 2005; Wadhwa *et al.*, 1996; Jones *et al.*, 2006) and their influences on fetus growth (Diego *et al.*, 2006; Field and Diego, 2008c; Field *et al.*, 2005, 2006). One of the known hormones is cortisol that is the consequences of mother's stressful condition and results in depression, anxiety, anger and distress. Cortisol effects that are further complicated by its interaction with neurotransmitters such as norepinephrine, which may itself cause premature birth via intrauterine growth deprivation related to uterine artery resistance, has been associated with aborted fetus, delayed fetal growth and development, prematurity, low weight and attention and temperament problems (Field and Diego, 2008) and metabolic syndrome such as raised blood pressure and glucose intolerance (Jones *et al.*, 2006). Wadhwa *et al.* (1996) also have proposed the association of plasma levels of adrenocorticotropin hormone (ACTH), beta-endorphin and cortisol and certain psychological factors.

In considering of above mentioned evidences, it seems that the effect of maternal psychological factors on fetus growth rate are different in the whole pregnancy period and may be follow through sensitive period principle. In addition, the hormones and neural system are important mediator factors on the above association. Therefore, the main purpose of present investigation was to study the relationship between maternal distress on fetus growth rate with considering on the mediator role of fetal heart rate. In the present study the Structural Equation Model (SEM) have been used for analyzing the effects of predictor and mediator variables on criterion variables, simultaneously.

MATERIALS AND METHODS

Participants: Subjects were 110 pregnant mother (age = 28.8±4.47 years) with average gestation age of 26.8±6.76 weeks who were selected randomly from Saman clinics in Tehran between July to December 2007. None of them was aware from the aims of study and they were assured that their information would be confidential.

Instruments: The personal information such as mother age and others gathered through demographic questionnaire. Depression Anxiety Stress Scale (DASS)



Fig. 1: Theoretical model of relationship between distress, heart rate and fetus growth

was used to measure the distress level. This scale had 42 items and was scored according to 4-point Likert scale (0 = none and 3 = almost). The reliability of DASS through internal consistency in a pilot study with similar samples computed as equal to Chronbach alpha 0.95.

The ultrasonography method was used to measure the fetus growth rate and heart rate. Its model was Logic 550 Pro USA-1999 and the measurement method was Prova 3.5 Hz Convex for intrauterine scanning and assessment of height, weight, femur length, head width and circumference.

Procedure: At first, the subjects completed consent form to announce their personal and clinical information to investigators. Then, in the Saman clinic and before ultrasound assessment they answered to the DASS questions. For DASS completion, the investigators were mentioned the subjects that they should to answer the items since one month ago. Finally, second investigator carried out the ultrasonography.

Data analysis: Structural equation model and correlation methods were used to determine the associations between all variables simultaneously (Fig. 1). The path analysis method via maximum likelihood was carried out for structural analysis. The confidence level set on 95%.

RESULTS AND DISCUSSION

The results related to distress measures have shown that the average stress was higher than (17.12±5.95) two other distress measures (anxiety was 14.37± 6.05 and depression was 12.44±7.02). The results of fetus growth rate have been shown in Table 1. The current results in comparing with norm results from normal fetus (Callen, 2000) demonstrated that in the present fetuses, head circumference was 50% rank, femur length was higher than 100% rank and weight was approximately 80% rank.

The results of path analysis confirmed the above theoretical model ($\chi^2 = 36.4$, $p > 0.05$). The results of goodness of fit measures also have confirmed the model and showed that the ratio of χ^2 to degree of freedom was 1.64, AGFI = 0.88, Bentler adjusted goodness of fit = 0.99, Bentler-Bennet normed and non-normed goodness of fit were 0.97 and 0.98, respectively.

Table 1: Statistical measures of fetus growth factors and heart rate

Growth	Mean±SD
Weight (g)	1307.210±10.61
Femur length (cm)	95.02000±10.20
Head circumference (cm)	24.41000±7.100
Head width (cm)	6.500010±2.000
Height (cm)	22.58000±7.870
Heart rate (pulse min ⁻¹)	143.3700±7.330

The results of correlation coefficients also showed that all of the maternal distress measures including depression ($r = 0.53$), anxiety ($r = 0.53$) and stress ($r = 0.75$) were significant predictor of fetus heart rate and, fetus heart rate, in turn, was significant predictor of all fetus growth rates including head width ($r = -0.70$), head circumference ($r = -0.88$), weight ($r = -0.70$), height ($r = -0.70$) and femur length ($r = -0.22$).

The purpose of present study was to study the association between maternal distress with fetus growth via mediator role of fetal heart rate. The results have shown that by increasing in maternal depression, anxiety and stress during pregnancy period, the fetal heart rate increases and it deteriorates the fetus growth rate including height, weight and femur length and head dimensions.

These findings confirm earlier similar studies that demonstrated that psychological problems are associated to fetus growth and its reasons were related to hormonal and neural factors (Negress *et al.*, 2006; Rahman *et al.*, 2007; Field *et al.*, 2008b; Field and Diego, 2008; Winstock, 2005).

For example, Diego *et al.* (2006), Alvarado *et al.* (2002), Negress *et al.* (2006), Rahman *et al.* (2007) and Field *et al.* (2008c) have shown the negative relationships between depression and anxiety with fetus weight and birth weight.

Field *et al.* (2006, 2008c) also demonstrated that by increasing in mothers' depression and anxiety the fetus growth measures such as femur length, abdomen and head circumferences decreased. Therefore, according to current and earlier research findings, in the more anxious and depressed mothers we should to expect more problematic fetal live. So, one of the providing appropriate condition for fetus is reducing stressful conditions for pregnant females. In addition, it is recommended that the psychologists help physicians through psychological interventions to decrease mothers' distress.

There are different viewpoints regarding association between maternal psychological conditions with fetus growth rate. Some evidences have claimed that fetal cardio-respiratory mediators were activated through stressful condition and cause growth abnormality. It seems that the environmental stressors via hypothalamus-pituitary-adrenal axis stimulate cortisol, norepinephrine

and through sympathetic neural system they stimulate cardio-respiratory systems (Monk *et al.*, 2000, 2003, 2004). The known fight and flight response mechanism represent the effect of stressful situations on the chemical and, metabolic reactions and functions of different body organs.

In summary, the present findings can support the effect of maternal stress on the fetus heart rate and its inverse relationship with growth factors in which the femur length was affected less than other factors but the head circumference was affected more than others were. The comparisons between our subjects' growth factors with given norm, support above findings. On the other hand, the femur length was in 100% rank order but the head circumference was in the 50% rank order. Thus, those growth factors that were influenced less than other factors (according to correlation coefficient) had better position in the population norm and vice versa.

In conclusion, the role of stressors on the fetus growth in the present era is more important than before and it is necessary to pay attention on mental health as well as physical health and nutrition to deliver babies that are more healthful and with less postnatal problems.

ACKNOWLEDGMENT

The present investigation has supported by the research grant (4/1294) of the first author that has provided through the Research Office of Tehran Tarbiat Moallem University.

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