

Antenatal maternal state and anthropometric characteristics of the neonates: II. Impact of personality dimensions and stress

Antenatalinė motinų psichikos būseną ir antropometrines naujagimių charakteristikas: II. Asmenybės dimensijų ir streso įtaka

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SUMMARY

Background. It is well known that stress during pregnancy is associated with negative neonatal outcomes. The association between antenatal maternal personality traits and neonatal outcomes has never been studied. Therefore, the aim of this study was to evaluate the relationship between antenatal maternal psychosocial stress and personality traits versus anthropometric characteristics of the neonates.

Methods. Three-hundred and seven randomly selected pregnant women attending 2 obstetric clinics agreed to participate in the study and were evaluated for acute and chronic perceived psychosocial stress using DSM-III-R Axis IV criteria in all three trimesters of pregnancy and were evaluated for personality traits using the Big-Five Personality Inventory in the second trimester of pregnancy. After women delivered a birth we analyzed 102 birth delivery medical case histories and obtained information about birthweight, height, Apgar scores of the neonates and calculated Body Mass Index (BMI) of the neonates. **Results.** Perceived acute psychosocial stress in the third trimester pregnancy was found to be significant predictor of height of the neonates ($\beta=-0,26$, $p=0,007$). Perceived acute psychosocial stress in the first and second trimesters of pregnancy, perceived chronic psychosocial stress in all trimesters of pregnancy as well as Big-Five personality dimensions did not predict any anthropometric characteristic of the neonates. Mothers who had acute psychosocial stress scores in the third trimester of pregnancy from 0 (no stress) to 3 (medium stress) delivered significantly taller neonates when compared to women who had acute psychosocial stress scores from 4 (severe stress) to 6 (catastrophic stress) in the third trimester of pregnancy ($52,0\pm 2,3$ cm and $50,5\pm 1,5$ cm, respectively, $p=0,003$).

Conclusions. Higher level of acute, but not chronic, psychosocial stress in the third trimester of pregnancy is associated with higher height of the neonates. Maternal personality traits are not associated with anthropometric characteristics of the neonates.

Higher level of acute psychosocial stress in the third trimester of pregnancy is associated with smaller height of the neonates.

Key words: antenatal maternal stress and personality traits, birthweight, height, Apgar scores, Body Mass Index.

SANTRAUKA

Įvadas. Gerai žinoma, kad stresas nėštumo metu turi neigiamą įtaką vaisiui ir naujagimiui. Moterų asmenybės bruožų įtaka vaisiui ir naujagimiui nebuvo plačiai tyrinėta. Todėl šio tyrimo tikslas buvo įvertinti ryšį tarp psichosocialinio streso nėštumo metu, asmenybės bruožų nėštumo metu ir naujagimių antropometrinių ypatybių.

Metodai. 307 atsitiktiniu būdu pasirinktos nėščiosios, kurios lankėsi dvejose moterų konsultacijose, sutiko dalyvauti tyrime. Nėščiųjų patirtas ūminis ir lėtinis psichosocialinis stresas buvo vertinamas naudojant DSM-III-R IV ašies kriterijus visų trijų nėštumo trimestrų metu, o nėščiųjų asmenybės bruožai buvo vertinami naudojant Didžiojo penketo asmenybės inventorių (angl. *Big-Five Personality Inventory*) antrą nėštumo trimestrą. Antrame tyrimo etape buvo analizuojamos 102 moterų gimdymo ligos istorijos. Iš ligos istorijų buvo surinkti duomenys apie naujagimių svorį, ūgį ir Apgar skalės rezultatus. Taip pat buvo suskaičiuoti naujagimių kūno masės indeksai.

Rezultatai. Nėščiųjų patirtas ūminis psichosocialinis stresas trečio nėštumo trimestro metu turėjo statistiškai reikšmingą įtakos naujagimių ūgiui ($\beta=-0,26$, $p=0,007$). Moterys, kurių ūminio psichosocialinio streso balai trečią nėštumo trimestrą buvo nuo 0 (nėra streso) iki 3 (vidutinis stresas), pagimdė statistiškai reikšmingai aukštesnius naujagimius nei moterys, kurių ūminio psichosocialinio streso balai trečią nėštumo trimestrą buvo nuo 4 (didelis stresas) iki 6 (katastrofiškas stresas) (atitinkamai $52\pm 2,3$ cm ir $50,5\pm 1,5$ cm, $p=0,003$). Ūminis psichosocialinis stresas pirmą ir antrą nėštumo trimestrą, lėtinis psichosocialinis stresas visų trijų nėštumo trimestrų metu ir asmenybės dimensijos nėštumo metu neturėjo įtakos naujagimių antropometrinėms ypatybėms.

Išvados. Ūminis psichosocialinis stresas trečią nėštumo trimestrą yra susijęs su mažesniu naujagimių ūgiu. Asmenybės bruožai nėštumo metu neturi įtakos naujagimių antropometrinėms ypatybėms. Didelis ūminis psichosocialinis stresas trečią nėštumo trimestrą yra susijęs su mažesniu naujagimių ūgiu.

Raktažodžiai: psichosocialinis stresas, asmenybės bruožai, naujagimis, svoris, ūgis, Apgar balai.

INTRODUCTION

The interest in relation between antenatal maternal psychosocial factors and neonatal outcomes renewed relatively recently. One reason for that is still high prevalence of poor neonatal outcomes, especially prematurity, in developing, as well as in developed, countries [1, 2].

It is well known that antenatal maternal distress is associ-

ated with a number of negative neonatal outcomes [3]. Large epidemiological studies found that perception of negative life events during gestation is significantly related to increased risk of preterm delivery [4] and lower birthweight [5, 6]. The widely accepted underlying mechanism is that stress causes the release of catecholamines resulting in placental hypoperfusion that leads to restriction of oxygen and nutrients to the fetus [5, 7].

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It might cause fetal growth impairment and/or may precipitate the development of preterm delivery. Moreover, stress-related corticosteroids and opiates increase the susceptibility to infectious diseases (especially chorioamnionitis) that may lead to adverse outcomes of pregnancy [7]. On the other hand, indirect negative influence on neonatal outcomes must also be taken into consideration, because stressed women are more likely to smoke cigarettes or use alcohol and caffeine [8].

The relationship between antenatal maternal personality traits and neonatal outcomes has not been widely studied. But some personality traits might predispose maternal behavior that interferes with well-being of the fetus. For example, high levels of neuroticism are associated with higher levels of anxiety and stressfulness [9] that in turn might have negative influence on neonatal outcomes [3]. Also, personality traits might modulate emotional as well as endocrine response to psychosocial stressors [10]. The increased reactivity to psychosocial stressors might be predisposed by certain personality traits and cause changes in hormonal profile which may lead to an unfavorable environment to the fetus [5, 11].

Therefore the aim of this study was to evaluate the relationship between antenatal maternal psychosocial stress, antenatal maternal personality traits and anthropometric measurements of the neonates.

SUBJECTS AND METHODS

The study and its consent procedures were approved by the Regional Committee of Ethics in Biomedical Research at the Kaunas University of Medicine, Kaunas, Lithuania. In a period of 2003–2005 pregnant woman attending 2 obstetric clinics in Kaunas, Lithuania, were randomly invited to participate in the study. Three-hundred and seven pregnant woman agreed to participate in the study and were evaluated by psychiatrist (L.K.) for acute and chronic psychosocial stress in the first trimester (12th–16th week of pregnancy), in the second trimester (22nd–26th week of pregnancy) and in the third trimester (32nd–36th week of pregnancy) of pregnancy and were evaluated for personality traits in the second trimester of pregnancy. Women were also interviewed about smoking and use of alcohol during pregnancy. From a sample of women who agreed to participate in the study we randomly selected 102 women and obtained birth delivery medical case histories after they delivered a birth. Three (3%) women were excluded from the study because they had diagnosis of diabetes, 2 (2%) women were excluded from the study because they delivered very low bodyweight neonates (<1500 g). This is the same group of subjects on whom we previously reported the relationship between antenatal maternal depression and anxiety versus anthropometric characteristics of the neonates [12].

Psychosocial stressors were classified according to the life events using the Diagnostic and Statistical Manual of Mental Disorders, third edition, revised (DSM-III-R) [13] Axis IV criteria of the Perceived Psychosocial Stress Scale (PPSS). This instrument evaluates acute and chronic perceived psychosocial stressors. The subjects were interviewed about negative life events that are considered to cause psychosocial stress. Each negative life event is rated according to how severe it would be to an average individual. The score for chronic stress and the score for acute stress are set and higher the score indicates the higher perceived chronic stress or the higher perceived acute

stress, respectively. Score of 1 indicates no psychosocial stress, 2 – mild psychosocial stress, 3 – medium psychosocial stress, 4 – severe psychosocial stress, 5 – very severe psychosocial stress and 6 – catastrophic psychosocial stress.

Antenatal maternal personality traits were evaluated using Lithuanian version of the The Big Five Personality Inventory (BFPI) [9] that is a short instrument designed to assess the Big-Five personality dimensions. The BFPI consists of 5 subscales. Each subscale consist of 8 items and evaluates personality dimensions of Extroversion, Agreeableness, Conscientiousness, Neuroticism and Openness, respectively. Each item is a descriptor and is rated in a 5-point scale from 1 (agree strongly) to 5 (disagree strongly). The score on each of the BFPI personality dimensions subscales is measures and ranges from 8 to 40. The BFPI showed good psychometric properties compared with longer instruments used to measure the Big-Five personality dimensions [9].

Information on birthweight (in grams) of the neonates, height (in centimeters) of the neonates, Apgar scores on the 1st and 5th minutes of extrauterine life of the neonates and duration of pregnancy (in weeks) was collected from the medical documentation. We also calculated Body Mass Index (BMI) of the neonates. Weight and height of the neonates was substantiated by neonatologist who supervised childbirth in the first 24 postnatal hours. BMI was calculated using formula: $BMI = \text{weight (kilograms)} / \text{height}^2 \text{ (meters)}$. Apgar score of the neonates was evaluated by neonatologist who supervised childbirth in the 1st and 5th postpartum minutes. Apgar score is used in clinical practice to assess neonate's respiratory effort, heart rate, color, tone and reflex irritability. Scoring range is from 0 to 10. Apgar scores between 8 and 10 indicate that the neonate is making smooth transition to extrauterine life; scores ≤ 7 are associated with increased morbidity and mortality of the neonates.

STATISTICAL ANALYSES

We used stepwise linear regression analyses to examine whether perceived acute and chronic maternal psychosocial stress in the first, second or third trimesters of pregnancy and maternal personality traits evaluated using the BFPI in the second trimester of pregnancy predicted anthropometric characteristics of the neonates. Four separate regression models were created for each of the anthropometric characteristics of the neonates: birthweight, height, BMI, Apgar score on the 1st postpartum minute and Apgar score on the 5th postpartum minute. In these models scores on the BFPI, scores of perceived acute and chronic psychosocial stress in all trimesters of pregnancy, age of mothers at the time of delivering the birth, number of gestations, duration of pregnancy, use of alcohol during pregnancy, smoking during pregnancy and gender of the neonates were used as independent variables. F probability of 0,05 or less was used as criterion to include independent variable to the model and F probability of 0,1 or more was used as criterion to remove independent variable from the model.

Next we analyzed only those anthropometric characteristics of the neonates that were significantly predicted by either perceived acute maternal psychosocial stress or perceived chronic maternal psychosocial stress. We compared anthropometric characteristics of the neonates whose mothers perceived psychosocial stress score was from 0 (no stress) to 3 (medium stress) with anthropometric characteristics of the neonates whose mothers perceived psychosocial stress score was from 4 (severe stress)

Table 1. Significant predictors of anthropometric characteristics of the neonates

Anthropometric characteristics of the neonates ^a	R ²	Significant Predictors	
Birthweight (in grams) β (p)	0,17	Duration of pregnancy 0,32 (0,002)	Age of mother 0,3 (0,003)
Height (in centimeters) β (p)	0,28	Gender of neonate -0,35 (<0,001)	Duration of pregnancy 0,31 (0,001) Perceived acute stress in the 3 rd trimester -0,26 (0,007)
Apgar score on the 1 st postpartum minute β (p)	0,15	Duration of pregnancy 0,39 (<0,001)	
Apgar score on the 5 th postpartum minute β (p)	0,17	Duration of pregnancy 0,42 (<0,001)	

to 6 (catastrophic stress). In this analysis we employed General linear model where anthropometric characteristics of neonates were used as dependent variables, score of perceived acute and chronic psychosocial stress from 0 (no stress) to 3 (medium stress) and from 4 (severe stress) to 6 (catastrophic stress) in the first, second or third trimester, respectively, as fixed factors and gender of the neonate as covariate.

All continuous data are represented as means ± standard deviation, all categorical data as numbers and percent. A probability level of $p < 0.05$ was considered as statistically significant. All statistical analyses were performed using software from Statistical Package for Social Sciences 13.0 for Windows (SPSS, Inc., Chicago, Ill., USA).

RESULTS

A total of 97 birth delivery medical case histories were analyzed. Mean age of mothers at the time of birth delivery was 30 ± 5 years; mean duration of pregnancy was 39 ± 2 weeks. Seventy-one (73%) woman had natural delivery and 26 (27%) had Cesarean section. There were 53 (55%) boys and 44 (45%) girls delivered.

Multivariate stepwise regression analysis revealed that the height of the neonates was significantly predicted by the perceived acute psychosocial stress in the third trimester of pregnancy ($\beta = -0,26$, $p = 0,007$) [Table 1]. But the height of the neonates was predicted more by the gender of the neonate ($\beta = -0,35$, $p < 0,001$) and by the duration of pregnancy ($\beta = 0,31$, $p = 0,0001$). Perceived chronic psychosocial stress in all trimesters of pregnancy and perceived acute psychosocial stress in first and second trimesters of pregnancy, as well as Big-Five personality dimensions did not predict any anthropometric characteristics of the neonates. Duration of pregnancy was the strongest predictor of birthweight ($\beta = 0,32$, $p = 0,002$) and Apgar scores in the 1st ($\beta = 0,39$, $p < 0,001$) and 5th ($\beta = 0,42$, $p < 0,001$) postpartum minutes. Birthweight was also predicted by the maternal age ($\beta = 0,3$, $p = 0,003$).

Next, as it might be predicted from regression analysis, after adjusting for gender of the neonate we found that neonates whose mothers perceived acute psychosocial stress score in the third trimester of pregnancy was from 0 (no stress) to 3 (medium stress) were significantly taller when compared to the neonates whose mothers perceived acute psychosocial stress score in the third trimester of pregnancy was from 4 (severe stress) to 6 (catastrophic stress) ($52,0 \pm 2,3$ cm and $50,5 \pm 1,5$ cm, respectively, $p = 0,003$) [Figure 1].

DISCUSSION

This study shows that higher level of antenatal maternal

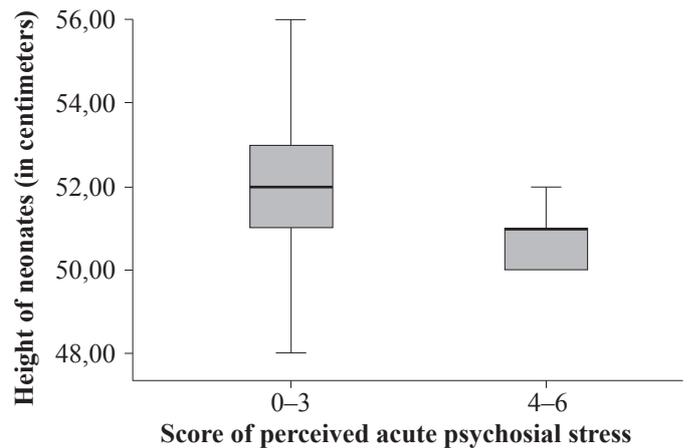


Figure 1. Height of the neonates whose mothers perceived acute psychosocial stress score in the third trimester of pregnancy was from 0 (no stress) to 3 (medium stress) versus height of the neonates whose mothers perceived acute psychosocial stress score in the third trimester of pregnancy was from 4 (severe stress) to 6 (catastrophic stress) ($p = 0,003$) (adjusted for duration of pregnancy)

perceived acute psychosocial stress in the third trimester of pregnancy is associated with smaller height of the neonates. Antenatal maternal personality traits are not associated with anthropometric characteristics of the neonates.

Acute psychosocial stress in the third trimester of pregnancy was negative predictor of height, but not of weight and BMI, of the neonates. Gender of the neonates and duration pregnancy were stronger predictors of neonatal height when compared to acute psychosocial stress in the third trimester of pregnancy. We did not find studies evaluating association between antenatal maternal stress and height of the neonates, although it is well known that stress during pregnancy interferes with fetal growth and have negative influence on duration of pregnancy [3]. And higher levels of perceived stress during pregnancy are associated with lower birthweight [5, 6].

It is known that experiences of social adversity during pregnancy, including psychosocial stress, affects biological outcomes of pregnancy via maternal, placental and fetal neuroendocrine, immune/inflammatory and vascular processes [14]. Stress activates hypothalamic-pituitary-adrenal axis and it causes an increase in excretion of catecholamines [15]. Study by Teixeira and colleagues [16] found significant and positive association between high levels of antenatal maternal anxiety (that is associated with increased plasma noradrenaline concentrations

[17]) and increased uterine artery resistance index, indicating decreased blood flow to fetus. Moreover, animal studies found that infusion of noradrenaline decreases uterine blood flow in pregnant sheep and reproductive tissues of sheep were found to be more sensitive to vasoconstrictive effect of noradrenaline when compared to other body tissues [18]. So, it has been suggested that at time of stress mother protects herself in expense of the fetus [19].

Furthermore, stress during pregnancy might have negative effect on cognitive capabilities of the offspring during infancy [20] and childhood [21]. Huiznik et al. [20], after adjusting for a large number of covariates, found that higher levels of antenatal maternal anxiety in mid-pregnancy as well as higher levels of early morning cortisol in late pregnancy are negatively related to motor and mental development at eight postnatal months. Additionally, large prospective study found that higher levels of antenatal maternal anxiety predicted higher risk of emotional problems and development of hyperactivity / attention problems in boys [22]. Also, antenatal maternal exposure to stress and traumatic life events was found to be associated with altered adult outcomes, such as increased lifetime risk of development psychiatric disorders including schizophrenia [23] and affective disorders [24]. Van Os and Selten [23] found that offspring of mothers who witnessed the German invasion to the Netherlands in 1940s while being pregnant had significantly higher risk of developing schizophrenia in later adulthood.

Antenatal personality traits were not significant predictors of anthropometric characteristics of the neonates. But we think that large prospective studies evaluating the influence of antenatal maternal personality traits on well-being of the neonates are needed, because certain personality traits might predispose behavior that could interfere with development of the fetus. In a recent study it was found that pregnant women who were afraid of delivering a child were more anxiety-prone, more short-tempered, and lower in socialization when compared to control pregnant women [25]. Personality traits of Socialization and Monotony avoidance were found to be significantly different before birth delivery between mothers who request a cesarean section and those who do not

[26]. Also, use of alcohol during pregnancy correlates with impulsive personality traits [27]. A recent study by O'Leary and colleagues [10] found that cortisol production in response to stress is a marker for psychopathic personality traits. On the other hand some personality traits might act as protective factors for fetus. A recent study found that less openness and higher neuroticism were associated with blunted HPA axis responses to psychological stress in women. Evaluation of personality is relatively simple and psychological interventions targeting such "unfavorable for fetus" personality traits and activating "favorable for fetus" personality traits could be used in pregnant women.

In this study, besides antenatal maternal stress and personality traits, we analyzed the influence of maternal age, number of gestations, duration of pregnancy, gender of neonates and use of alcohol as well as smoking during pregnancy, on anthropometric characteristics of the neonates. There are more pathological and physiological factors that have negative influence on the duration of gestation and fetal growth that we did not include into our analysis, such as hypertension, chronic maternal illness, maternal addiction to drugs, malnutrition, infection, maternal height and weight, socio-economic conditions and others [28, 29]. The main limitation of this study is a relatively small sample size (97 neonates). On the other hand the strengths of this study included community-based population from a defined geographical area of Lithuania, the measurements of perceived psychosocial stress and evaluation of personality traits were performed by psychiatrist, using standardized instruments.

CONCLUSIONS

Results of this study indicate that a higher level of perceived acute psychosocial stress in the third trimester of pregnancy is associated with smaller height of the neonates. Women who perceived no to medium acute psychosocial stress in the third trimester of pregnancy delivered significantly taller neonates when compared to women who perceived severe to catastrophic acute psychosocial stress in the third trimester of pregnancy. Antenatal maternal personality traits are not associated with anthropometric characteristics of the neonates.

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