The relationship between prenatal maternal depressive symptoms and infant vocabulary

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Master’s thesis in Speech and Language Pathology
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Abstract for Master's thesis

Subject: Speech and Language Pathology	
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Abstract:

Early language skills have been linked to behavioral, emotional, social and academic outcomes. Recently, maternal depression has been identified as a potential risk factor for delayed language development in children. It has been hypothesized that altered hypothalamic-pituitary-adrenal axis function in depressed mothers during pregnancy can change the development of neurological structures in the fetus, which subsequently can interfere with postnatal development, such as language learning.

The aim of this thesis was to examine the potential relationship between prenatal maternal depressive symptoms and infant vocabulary. Depressive symptoms in mothers were assessed with the Edinburgh Postnatal Depression Scale at gestational weeks 14, 24 and 34. The children's receptive and expressive vocabularies were estimated with the MacArthur-Bates Communicative Inventory at 14 months postpartum. Confounding variables, that have been identified in the literature to account for a proportion of the variance in language level, such as gestational weeks, infant sex, maternal age, education and smoking during pregnancy were controlled for in the analyses.

A negative association was found between prenatal depressive symptoms in mothers and children's receptive vocabulary. However, when confounders were held constant, depressive symptoms did not predict vocabulary size, indicating that other variables explain the association. Although there was no independent effect of prenatal depression in mothers on infant vocabulary size, interaction effects cannot be ruled out at this point. In future research on this subject, both subjective and objective measures of depression should be included in the analyses and confounding variables should be carefully measured.

Keywords: EPDS, HPA-axis, language development, MCDI, prenatal depression, vocabulary	
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Sammanfattning:

Barns tidiga språkutveckling har ett samband med senare emotionell-social utveckling och akademisk framgång. Prenatal depression hos mammor har nyligen identifierats som en potentiell riskfaktor för fördröjd språkutveckling hos barn. Det eventuella sambandet mellan mammans prenatala depression och barnets språkutveckling har förklarats med de förhöjda nivåerna av kortisol som påvisats hos deprimerade mammor. Höga nivåer av kortisol kan förändra den neurologiska utvecklingen hos fostret på ett för språkutvecklingen ofördelaktigt sätt.

Syftet med den här avhandlingen var att undersöka det eventuella förhållandet mellan depressiva symptom hos mammor under graviditeten och utvecklingen av barns ordförråd. Depressiva symptom hos mammor bedömdes med screeninginstrumentet Edinburgh Postnatal Depression Scale vid tre tidpunkter under graviditeten (v. 14, 24 och 34) och storleken på barnets ordförråd med MacArthur-Bates Communicative Inventory när barnen var 14 månader gamla. Variabler som konstaterats ha en betydelse för barns språkliga nivå, såsom barnets kön, mammans ålder, hennes utbildning, rökning under graviditeten och gestationsveckor, beaktades i analyserna.

Prenatala depressiva symptom hos mammor korrelerade negativt med barnets receptiva ordförråd. Efter att bakgrundsfaktorer och mammans postnatala hälsa tagits i beaktande, predicerade depressiva symptom hos mammor varken barnets receptiva eller expressiva ordförråd. Det här tyder på att prenatal stress sannolikt inte har en oberoende effekt på barnets språkliga utveckling. Interaktionseffekter mellan prenatal depression hos mamman och till exempel barnets kön går inte att utesluta i det här skedet. I fortsättningen skulle det vara viktigt att inkludera både mammans subjektiva upplevelse av depressionen och dess objektiva markörer i analyserna. Därtill måste förväxlingsfaktorer mätas noggrant.

Nyckelord: EPDS, HPA-axeln, MCDI, ordförråd, prenatal depression, språkutveckling

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Contents

References

1 Introduction

Children have different genetic and environmental preconditions to acquire language. Despite this, most children learn the meanings of words effortlessly (Bloom, 2001). However, the inter-individual variability in language development is substantial (Fenson et al., 1994) and has been explained by a number of factors. To find out the reasons for this is important, as early language skills have been linked to behavioral, emotional, social and academic outcomes (Beitchman, Wilson, Brownlie, Walters, & Lancee, 1996).

It has been documented that children with different socio-economic status (SES) perform differently on language tests, such that children with higher SES outperform those with lower SES (Umek, Fekonja, Kranjc & Bajc, 2008). Smoking during pregnancy, which is more common in mothers from lower socio-economic backgrounds (Räisänen et al., 2014a), has been linked to poorer language skills in children (Hernández-Martínez et al., 2017; Franken & Weisglas-Kuperus, 2012). Moreover, there is indisputable evidence that shortened gestation (the age of pregnancy in weeks) and low birthweight are associated with poorer language skills (Franken & Weisglas-Kuperus, 2012). Maternal age has been identified as another factor contributing to children's language level, however, the direction of the association is still unclear (Goisis, Schneider & Myrskylä, 2017). In general, girls score higher than boys on measures of language proficiency (Umek et al., 2008).

Lately, researchers have become increasingly interested in the potential long-term effects of prenatal factors such as maternal depression. *Prenatal depression* is a medical term used to describe depression during pregnancy. The estimated prevalence of this condition varies substantially between studies. Different measurement tools, cut-off points and notions about what constitutes depression in the prenatal period may partly explain these differences. In a Finnish sample investigated by Räisänen et al. (2014b), 0.8% of mothers were diagnosed with major depression during pregnancy. This is consistent with other diagnosis-based studies but lower than 3.1-12.8%, reported by studies using self-report measures (Räisänen et al., 2014b). Prenatal depression is not fundamentally different from depression occurring at other times (Brockington, 1996; Cox, Holden & Henshaw, 2014) and is often caused by a number of interacting factors. However, pregnancy in itself can be a psychological stressor (Reynolds, 2013) and it is therefore not uncommon to experience a first depressive episode around this time (Räisänen et al., 2014b).

Depression is detrimental to the individual, but often affects members of the family as well. In particular, the developing fetus is considered to be in a vulnerable position to changes in the mother's well-being during pregnancy. Depression is associated with both behavioral and hormonal changes (Schmidt, Shelton, & Duman, 2011). During pregnancy, hormonal disruptions are of particular interest, as they are transferred to the fetus via blood circulation. According to the *fetal programming hypothesis,* these may change the way certain developmental processes are carried out (Reynolds, 2013) which subsequently can interfere with postnatal processes, such as language learning.

1.1 Potential effects on child neurology and memory function from altered glucocorticoid levels in mothers

The exact mechanisms underlying the potential relationship between prenatal depression in mothers and infant language development are partly unknown, but the hypothalamic-pituitary-adrenal (HPA) axis has been suggested to have a mediating role in this process (Talge, Neal & Glover, 2007). Together, the hypothalamus, the pituitary gland, and the adrenal glands form a neuroendocrine system (Hamilton-West, 2011). There is some evidence that depression, being a highly stressful state, is associated with alterations in the HPA-axis and its stress response (Burke, Davis, Otte & Mohr, 2005). In moments of physiological or psychological stress, the HPA-axis releases the glucocorticoids cortisol and noradrenaline into the blood flow. These are then transferred to the fetus via placental pathways (Laplante et al., 2004). Sufficient glucocorticoid levels are essential for normal maturation of many parts of the central nervous system (Harris & Seckl, 2011). However, both high and low glucocorticoid levels threaten normal fetal development (Harris & Seckl, 2011).

Excessive cortisol, in particular, may change the way several areas in the brain are developed (Laplante et al., 2004). In animals, increased levels of cortisol have been associated with alterations in brain regions like the hippocampus, amygdala, corpus callosum, anterior commissure, cerebral cortex, cerebellum and hypothalamus (Charil, Laplante, Vaillancourt & King, 2010). The cognitive development of the child follows a hierarchical order, much like the embryonal development (Piaget, 1971). Certain developmental stages have to be completed before the next stage can be carried out. As follows, complex cognitive functions such as language, are dependent on more basal cognitive functions like sensorimotor development, memory, and attention. Changes in the organization or function of the frontal cortex (important for purposeful behavior and attention) or the hippocampus (the main component for memory function) could, in line with this perspective, negatively affect the infant's possibilities to acquire language. The hippocampus is particularly vulnerable to glucocorticoid manipulations (Harris & Seckl, 2011), as many of its receptors react specifically to stress-induced cortisol (Belanoff, Gross, Yager & Schatzberg, 2001). Humans need cortisol to store memories, and short periods of stress can, in fact, improve memory function (Schwabe, Joëls, Roozendaal, Wolf & Oitzl, 2012). However, excessive cortisol levels can have an inhibitory effect on the hippocampus, by hindering glucose from entering the nerve cells in the area, which impairs memory function (Belanoff et. al., 2001). There is some evidence that infants exposed to the mother's prenatal depression develop stress sensitivity (Oberlander et al., 2008; Fernandes et al., 2015) along with higher baseline levels of cortisol (Field, 2011). This could be hypothesized to alter their memory processes.

1.2 Effects of prenatal maternal depression on infant behavior and the infant-mother relationship

In addition to the aforementioned deviances, some behavioral traits have been demonstrated in infants of prenatally depressed mothers. One possible consequence of prenatal depression is premature birth (Liu, Cnattingius, Bergström, Östberg & Hjern, 2016) and low birthweight (Accortt, Cheadle & Schetter, 2015), which both have been linked to difficult temperament (Costantini, Cassibba, Coppola & Castoro, 2012). However, even infants born full term, who have been exposed to their mother's prenatal depression, show difficult temperamental traits (Davis et al., 2007). Davis and colleagues (2007) found children of prenatally depressed mothers to score higher on measures of reactivity and distress than children of non-depressed mothers. In a review on the subject by Field (2011), infants exposed to prenatal depression were irritable and showed higher activity levels than controls (Field, 2011). Together, these traits can challenge the development of secure attachment between the mother and her newborn (Costantini et al., 2012) which is of great relevance to language learning.

In a meta-analysis by IJzendoorn, Dijkstra and Bus (1995) about the relationship between attachment style and language, secure attachment styles were associated with better language skills. When children feel secure, they are more likely to engage in social interactions with adults and explore their surroundings, which supports their cognitive and language development. An insecure child stays focused on its caregivers and is less likely to derive knowledge from its surroundings, because of anxiety (Bowlby, 1969). Interestingly, Pearson and colleagues (2012) who investigated the relationship between prenatal depression and maternal sensitivity, found mothers who had been depressed prenatally but not postnatally to have a higher probability of demonstrating disrupted maternal responsiveness. Together, these findings highlight the importance of the mother's well-being during pregnancy for the mother-infant relationship, and for the language development of the child.

1.3 Effects of prenatal maternal depression on infant language development

Although there are some theoretical implications for a relationship between prenatal maternal depression and infant language development, results have been inconsistent. Null findings are as common as findings indicating a relationship between these two variables. In research about this subject, the term *stress* is often used as an umbrella term including depression and other sources of psychosocial stress. This is problematic, as they do not seem to yield comparable effects on infant cognitive- and language development. For example, Ibanez and colleagues (2015) found that anxiety, but not depression, in mothers was linked to poorer cognitive development in children at two and three years of age. In a study by Ribeiro, Zachrisson, Gustavson and Schjolberg (2016), in which effects from different types of prenatal maternal stress were compared (depression included), only fear of giving birth was negatively associated with language outcome. Still, results from a few studies do imply that prenatal depression and infant language development are associated (Deave, Heron, Evans & Emond, 2008; Skurtveit, Selmer, Roth, Hernandez−Diaz, Handal, 2014; Weikum, Obelander, Hensch, & Werker, 2012)

Deave and colleagues (2008) found depressive symptoms in mothers during pregnancy to increase the odds of developmental delay in children by 34%, as measured by a screening instrument. However, only a few questions in their screening instrument concerned language which makes interpretation difficult. In a population-based study with a significantly larger sample, anxiety and depression during pregnancy were associated with sentence complexity at three years of age (Skurtveit et al., 2014). Maternal depression after pregnancy did not seem to affect the results.

In a study where infants born to non-medicated prenatally depressed women were compared with a healthy group, and a group consisting of depressed mothers who used antidepressant medication, differences in children's speech perception were observed (Weikum et. al., 2012). Children of mothers in the antidepressant group and the depressed group showed opposite patterns in their abilities to discriminate between speech sounds at 6 and 10 months of age compared to the control group. Infants in the antidepressant group showed an accelerated speech perception development, whereas infants in the depressed group showed a delay in succeeding with the tasks. However, postnatal depression was not controlled for, which makes it impossible to rule out the possibility of that explaining the association.

Indeed, in many studies, the effects of prenatal depression decrease or disappear when postnatal rearing is controlled for. In the aforementioned study by Ribeiro and colleagues (2016), symptoms of prenatal maternal anxiety or depression did not seem to have an impact on children's language development, when postnatal distress was controlled for. In a study by Ibanez and colleagues (2015), postnatal depression and parental stimulation mediated the effect of prenatal anxiety on children's language development. Similarly, Austin et al. (2017) found emotional availability and parental structuring to have a protective function. When prenatal subjective stress levels in mothers were high, high levels of emotional availability and structuring reduced the negative effect of prenatal stress on children's language development. It is, thus, of uttermost importance to control for postnatal variables.

As noted by Laplante and colleagues (2004), it is important to distinguish between subjective and objective measures of psychological stress. In their study, where potential stress effects from a natural disaster were investigated, they found prenatal maternal objective stress, but not subjective stress, to be associated with infant language level. In contrast, Laplante and colleagues (2018) found that higher levels of subjective distress during pregnancy were associated with fewer words spoken by the child at 29-34 months. This effect could not be seen with objective stress measures. What is more, subjective and objective measures of stress in mothers, have been associated with infant development independent of each other. Davis and Sandman (2010) conducted a study in which maternal cortisol and psychosocial stress measures did not correlate. Yet, both cortisol levels and pregnancy-specific anxiety were associated with infant mental development.

According to the authors, this could imply that different neurological or vascular processes are operating in the association and, consequently, that the HPA-axis is insufficient in its explanatory power.

1.4 Aim of the thesis

The aim of the present thesis was to examine the possible relationship between *subjectively* estimated depressive symptoms in mothers during pregnancy and language development in their children at 14 months postnatally. Relevant confounding variables were controlled for in the analyses.

2 Method

The present thesis was conducted as a substudy in the multidisciplinary FinnBrain research project. FinnBrain is a large cohort study with the purpose of studying the combined influence of environmental and genetic factors on the development of a child by following its progress from the prenatal period into adulthood. The Ethics Committee of the Hospital District of Southwest Finland has approved the study protocol.

2.1 Participants

Data were obtained from the FinnBrain cohort study, for which participants were recruited via maternity health clinics in Turku, Finland, between 2010 and 2015. Information about the families and their children was continuously collected with questionnaires, public registers, and physiological measures. The families resided in Turku with surroundings and the Åland islands, in southwestern Finland. Both Finnish- and Swedish speaking citizens participated in the study.

The original data consisted of 3837 mothers and their children. For the analyses, data on mothers' depression *and* on their child's vocabulary size was needed. Mothers who had completed only one of the two questionnaires required were excluded from the sample. Premature children, defined as having been born before gestational week 37 (Stolt et al., 2007, p. 9), were additionally excluded, leaving a total of 1032 mothers and their children to analyze. Little more than half of the children were boys (52%) and 48% were girls. There was no variable for intersex children.

2.2 Measures

Results from two commonly used questionnaires were used in the present study. The mothers’ subjective experience of depressive symptoms was estimated with the Edinburgh Postnatal Depression Scale (EPDS) and served as the predictor variable. The outcome variable consisted of the children’s vocabulary size, as estimated by the mother using the MacArthur-Bates Communicative Development Inventory (MCDI).

2. 2. 1 The Edinburgh Postnatal Depression Scale. Depressive symptoms in mothers were measured with the Edinburgh Postnatal Depression Scale (EPDS) (Cox, Holden & Sagovsky, 1987) at three time points prenatally (gwk 14, 24 and 34) and three time points postnatally (3 months, 6 months and 1 year). The EPDS is a widely used self-report questionnaire, which has been translated into many languages and validated in many cultures. The test consists of 10 statements about thoughts and feelings experienced during the previous seven days. The parent chooses between four alternatives which vary in severity (0-3). The total scale ranges from 0-30, with higher points indicating more severe depressive symptoms. The cut-off points used in the present study were those suggested by Matthey, Henshaw, Elliott and Barnett (2006), that is, 13 points or more during pregnancy and 10 points or more postnatally. Results above the cut-off indicate that the respondent may suffer from minor or major depression.

2. 2. 2 The MacArthur-Bates Communicative Development Inventory. In the present study, the Finnish version (Lyytinen, 1999) and the Swedish version (Berglund & Eriksson, 2000) of the the MacArthur-Bates Communicative Development Inventory (MCDI) (Fenson et al., 2007) for children between 8 and 16 months of age, was used to measure the children’s communicative- and language development. However, the parents of this particular study were asked to fill in the form when their child reached 14 months of age. The MCDI is the most widely used parental report form for assessing language and communication skills in infants (Mayor & Plunkett, 2011). In general, parents have been shown to give accurate estimates of their children’s receptive and expressive vocabularies (Mayor & Plunkett, 2011). Especially for younger infants, the MCDI appears to give a reliable estimate of the child’s total vocabulary (Mayor & Plunkett, 2011).

Part I covers early signs of understanding and communication, with sections A-C examining the infant's understanding of simple questions and instructions and attempts to imitate an adult's speech. A list of frequently used words is included in the D-section, where caregivers are asked to make a mark if the child "understands" or "understands and produces" the word in question. These form the receptive and expressive vocabularies of the child. The total number of words listed in the Finnish version of the MCDI is 380 and in the Swedish version 382. In Part II, actions and gestures that infants commonly do are listed. The caregiver can choose between the options "not yet", "sometimes" or "often". Higher scores of the MCDI indicate better communications skills.

Vocabulary size was chosen as a measure of communicative and language development as studies have shown it predicts several language and literacy outcomes over the span of at least nine years (Lee, 2011). McMurray (2007) suggests that early vocabulary size is important because of the snowball effect it may have on subsequent word acquisition. The results in Longobardi, Rossi-Arnaud & Spataro's (2012) study, showed that early differences in word and gesture use at 12 months predicted later language abilities at 23 months. Moreover, the results showed that vocabulary size was more strongly related to later language ability than symbolic gesture use at 12, 16 and 20 months. Thus, for both theoretical and practical reasons, only the D-section (that is, the word list) was used in the statistical analyses of this thesis.

2.3 Statistical analyses

The relationship between depressive symptoms in mothers during pregnancy and vocabulary size in children was examined with two-step multiple hierarchical regression analyses. This two step-procedure was assessed in two separate models, with one model including the MCDI receptive vocabulary score as the outcome variable and the other one the MCDI expressive vocabulary score as the outcome variable. The present thesis included participants that had completed either the Finnish or the Swedish version of the MCDI. As these versions contain a different number of words, the percentage of correctly comprehended or produced words was used to ensure comparability across test versions. As follows, the scale ranged from 0-100, with higher points indicating larger vocabularies.

Potential confounders were entered as predictors at stage 1, consisting of the following variables: maternal age, gestational weeks, infant sex, maternal education, smoking, and postnatal depressive symptoms at 1 year. Maternal education was used as a measure of socioeconomic status (SES), graded on a three-level scale (1. “mid/low”, 2. "high/voc", 3. "high"). The variable for smoking during pregnancy was dummy coded into two separate variables. No smoking was first compared to smoking during the first trimester and secondly compared to smoking during the second and third trimester. To control for postnatal depressive symptoms, EPDS-scores at 1 year were included in the analyses too. Prenatal depressive symptoms as measured by the EPDS (0-30) at gestational weeks 14, 24 and 34 in combination with the predictors already mentioned constituted the second step of the hierarchical analyses. The procedure is illustrated in Figure 1. All statistical analyses were carried out with the statistical package of social sciences IBM SPSS Statistics for Mac (version 25).

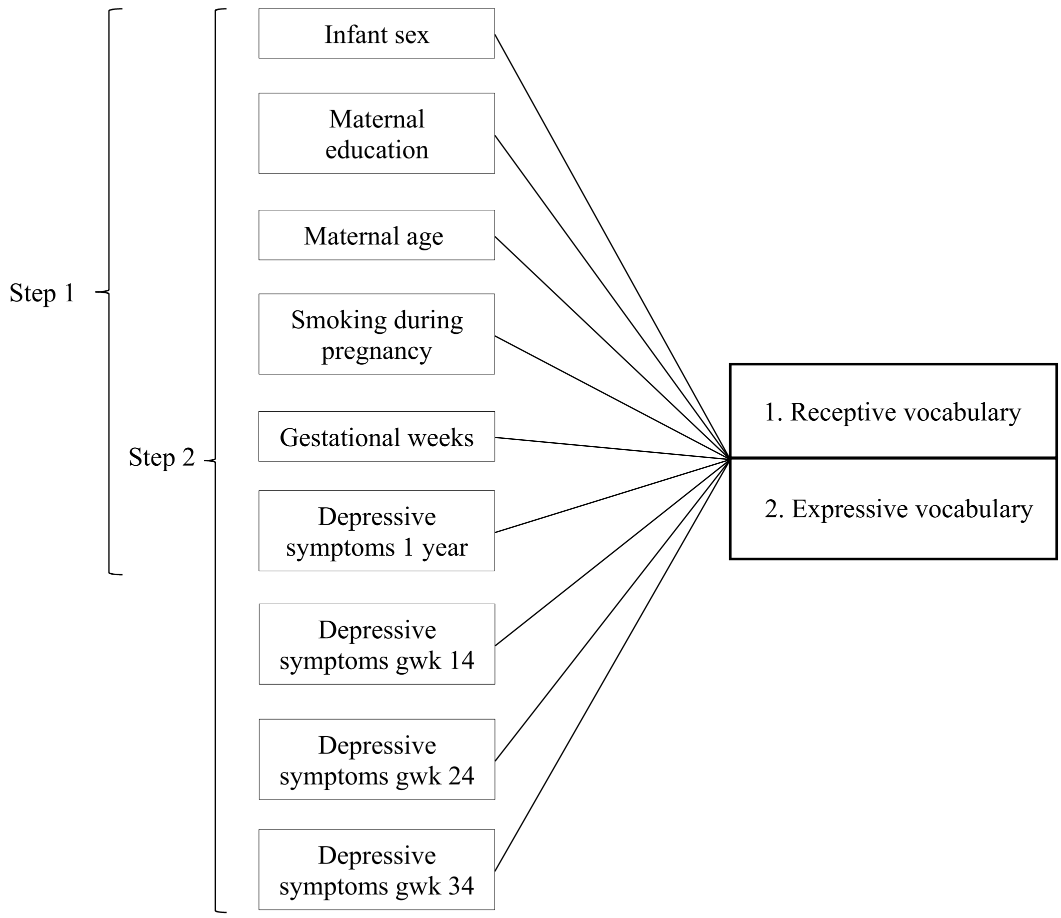

Figure 1

Schematic representation of the regression analyses.

3 Results

The mean age of the mothers in the sample was 31 (*SD* = 4*, range* = 18–45). The majority, 87.3%, had Finnish as their first language and 12.7% Swedish. As many as 69.3% of the mothers had an academic or high vocational education, a common tendency in longitudinal studies. The remaining 30.7% had mid- or low education. Most women were married (58.7%) or unmarried (40.2%). A total of 0.8% had separated and 0.3% had a registered partnership. In the current sample, 97.5% of the mothers did not smoke during pregnancy or stopped during the first trimester, 2.4% continued smoking after the first trimester (0.1% missing). The mean length of gestation was 40 weeks (*SD* = 1.24, *range* = 37–42).

The prevalence of minor and major depressive symptoms in this sample, increased after birth. The prevalence was around 4% during pregnancy and increased at every measurement point postnatally, from 9.1% at 3 months to 10.7% at 6 months, and finally, 13.4% at 1 year postpartum. Descriptive statistics of the EPDS at different time points are shown in Table 1.

Table 1

Descriptive statistics of the EDPS questionnaire

Depressive symptoms (EPDS) (0-30)	*n*	*M*	*SD*	*Min*	*Max*	*% above the clinical cut-off (M)*
Gwk 14	1032	4.69	3.79	.00	22.00	4.2 (15.53)
Gwk 24	1032	4.50	3.84	.00	22.00	3.9 (15.54)
Gwk 34	1032	4.52	3.85	.00	26.00	4.0 (14.85)
3 months	985	4.21	3.79	.00	21.00	9.1 (12.37)
6 months	974	4.47	4.13	.00	24.00	10.7 (13.02)
1 year	1032	4.87	4.13	.00	23.00	13.4 (12.64)

Note. Gwk= Gestational week, prenatal cut-off 13, postnatal cut-off 10.

As expected, the children's receptive vocabularies were larger than their expressive vocabularies. At 14 months, the average receptive vocabulary consisted of 121 words (*SD* = 72*, range* = 0–336) and the average expressive vocabulary of 12 words (*SD* = 18*, range* = 0–173). Descriptive statistics for the MCDI can be seen in Table 2.

Table 2

Descriptive statistics of the D-section in MCDI (14 months)

The MCDI D-section	*n*	*M*	*Mdn*	*SD*	*Min*	*Max*
Words comprehended (%)	1032	31.94	29.47	18.99	.00	88.42
Words produced (%)	1032	3.12	1.58	4.82	.00	45.53
Words comprehended (No.)	1032	121.44	112.00	72.20	.00	336
Words produced (No.)	1032	11.85	6.00	18.33	.00	173

Note. No. = Number.

Girls scored significantly higher than boys, $F_{receptive\ vocabulary}$ (1, 1030) = 19.246, $p < .001$, $F_{expressive\ vocabulary}$ (1, 1030) = 17.010, $p < .001$. In Table 3, girls' and boys' performances on the MCDI are presented separately.

Table 3

Descriptive statistics of the MCDI D-section separately for boys and girls

The MCDI	*M*	*SD*	*Range*
Girls Receptive vocabulary	34.63	19.12	0–88.42
Girls Expressive vocabulary	3.76	5.49	00–45.53
Boys Receptive vocabulary	29.48	18.56	0.26–87.11
Boys expressive vocabulary	2.53	4.03	0–45

Note. The vocabularies are presented in percent.

3.1 Correlations

Correlational analyses revealed that prenatal EPDS-scores measured at three gestational points all correlated significantly with children´s receptive vocabulary at 14 months of age ($r_{s\ \mathrm{Gwk}\ 14} = -.074$, $p = .017$, $r_{s\ \mathrm{Gwk}\ 24} = -.093$, $p = .003$, $r_{s\ \mathrm{Gwk}\ 34} = -.076$, $p = .014$). However, prenatal depressive symptoms did not correlate with children's expressive vocabulary. Likewise, postnatal EPDS-scores significantly correlated with receptive vocabulary ($r_{s\ 3\ \mathrm{months}} = -.079$, $p = .013$, $r_{s\ 6\ \mathrm{months}} = -.076$, $p = .018$, $r_{s\ 1\ \mathrm{year}} = -.081$ $p = .009$), but not with expressive vocabulary. The relationship was negative in both cases, indicating that more severe depressive scores in mothers were associated with poorer vocabulary development in their children. Despite statistically significant results, the effect sizes reflected a weak relationship between these variables.

3.2 Receptive vocabulary

A hierarchical multiple regression analysis was carried out in two steps. The variables added first to the model were gestational weeks, infant sex, the mother's age, her level of education, smoking during pregnancy, and finally, postnatal depressive symptoms at 1 year postpartum. After controlling for these variables, prenatal depressive scores at gestational weeks 14, 24 and 34 were added to the model.

A multivariate correlation matrix showed statistically significant correlations with small effect sizes for several variables. Gestational weeks correlated significantly with receptive vocabulary, $r = 0.119$, $p < .001$, as did infant sex, $r = 0.135$, $p < .001$. Smoking during pregnancy correlated negatively with education, $r_{1\mathrm{st\ trimester}} = -0.175$, $p < .001$, $r_{2\text{-}3\mathrm{rd\ trimester}} = -0.175$, $p > .001$. Maternal age was positively associated with education, $r = 0.296$, $p > .001$. All EPDS measures correlated significantly with each other, but none of the pairwise correlations showed correlations greater than $r = 0.7$. Hence, the assumption of no multicollinearity was met. An additional number of statistically significant correlations were found; however, they will not be reported here due to negligible effect sizes ($r < 0.1$).

A statistically significant regression equation was found for the first stage of the analysis, $F(7, 1006) = 5.845$, $p < .001$, and accounted for 3.2% of the variance in the outcome variable ($R^2_{adj} = 0.032$). Adding Stage 2 to the model, in which prenatal depressive scores were included, yielded a non-significant change in F ($R^2_{adj} = 0.033$, $p = .324$). In other words, the model suggests prenatal depressive symptoms do not explain a significant proportion of the variance in receptive vocabulary in children, after controlling for postnatal depression and background factors such as infant sex.

For the first step of the analysis, infant sex ($\beta = 0.128$, $p < .001$) and gestational weeks ($\beta = 0.115$, $p < .001$) significantly predicted receptive vocabulary. The other variables in the model did not. Likewise, for the second step, only infant sex ($\beta = 0.132$, $p < .001$) and gestational weeks ($\beta = 0.113$, $p < .001$) significantly predicted the outcome variable.

A one-unit increase in depressive symptoms at 14 gestational weeks predicted an increase by 0.04% in receptive vocabulary ($\beta = .007$, $p = .861$). However, an increase by one unit in depressive symptoms at 24 and 34 gestation weeks predicted a decrease in receptive vocabulary by 0.23% ($\beta = - .048$, $p = .301$) and 0.16% ($\beta = - .033$, $p = .452$), respectively. It is worth noting, these coefficients were not statistically significant. All coefficients along with their significance values are shown in Table 4.

Table 4

Coefficients for hierarchical multiple regression with receptive vocabulary as the outcome variable

	Predictors	*B*	*SE B*	*β*	*Sig.*
Step one	Gestational weeks	1.773	0.477	0.115	0.000
	Infant sex	4.877	1.178	0.128	0.000
	Education	1.005	0.751	0.045	0.181
	Mother's age	-0.117	0.141	-0.027	0.407
	Smoking during 1st trimester	-1.005	2.599	-0.025	0.429
	Smoking during 2nd & 3rd trimester	-2.223	0.143	-0.048	0.119
	Postnatal EPDS 1 year	-0.203	0.140	-0.044	0.145
Step two	Gestational weeks	1.739	0.479	1.113	0.000
	Infant sex	5.031	1.181	0.132	0.000
	Education	0.972	0.752	0.043	0.196
	Mother's age	-0.128	0.142	-0.029	0.367
	Smoking during 1st trimester	-1.920	2.603	-0.023	0.461
	Smoking during 2nd & 3rd trimester	-5.050	3.956	-0.040	0.202
	Postnatal EPDS 1 year	-0.056	0.174	-0.012	0.750
	Prenatal EPDS Gwk 14	0.038	0.216	0.007	0.861
	Prenatal EPDS Gwk 24	-0.234	0.230	-0.048	0.301
	Prenatal EPDS Gwk 34	-0.164	0.218	-0.033	0.452

3.3 Expressive vocabulary

Prior to running the second regression analysis, the variable for expressive vocabulary was transformed using the square root. This procedure was carried out to deal with the skewness of the variable. Those participants scoring three times the interquartile range below the 1st or above the 3rd quartile were considered extreme outliers, and consequently, excluded. This way, the assumptions for multiple regression were met.

The predictors of the model were identical to those used in the previous analysis. Only the outcome variable was changed from receptive vocabulary to expressive vocabulary. As before, relevant background factors and postnatal depressive symptoms were entered at the first step of the analysis. These variables, in combination with prenatal depressive symptoms, composed the second step of the analysis.

All inter-correlation coefficients were less than $r = 0.7$, indicating no multicollinearity. A few significant correlations with small effect sizes were found. Infant sex significantly correlated with expressive vocabulary ($r = 0.155$, $p < .001$). Maternal age was negatively associated with smoking during the second and third trimester ($r = -0.100$, $p < .001$). Higher education was consistently associated with less smoking ($r_{\text{smoking during 1st trimester}} = -0.176$, $p < .001$, $r_{\text{smoking during 2nd and 3rd trimester}} = -0.171$, $p < .001$). Correlations smaller than $r < 0.1$ are not reported here.

The results from this hierarchical multiple regression analysis were similar to those derived from the previous analysis. Stage 1 significantly predicted the outcome variable better than the mean, $F_{\text{Model 1}}(7, 986) = 4.776$, $p < .001$, with a R^2_{adj} of 0.026. Adding the prenatal depression variables at Stage 2 did not significantly change R^2, $F(10, 983) = 3.347$, $p < .001$, suggesting prenatal depression does not considerably contribute to the predictive power of the model. The variables *infant sex* ($\beta = 0.152$, $p < .001$) and *maternal age* ($\beta = -0.073$, $p = 0.026$) significantly predicted expressive vocabulary for the first model. The same variables generated significant coefficients for the second model ($\beta_{\text{infant sex}} = 0.152$, p < .001, $\beta_{\text{maternal age}} = -0.072$, $p = 0.029$). The EPDS did not predict the outcome variable significantly at any measurement point. All coefficients are presented in Table 5.

Table 5

Coefficients for hierarchical multiple regression with expressive vocabulary as the outcome variable

	Predictors	*B*	*SE B*	*β*	*Sig.*
Step one	Gestational weeks	0.038	0.024	0.051	0.105
	Infant sex	0.282	0.058	0.152	0.000
	Education	0.035	0.037	0.032	0.339
	Mother's age	-0.016	0.007	-0.073	0.026
	Smoking during 1st trimester	0.021	0.127	0.005	0.866
	Smoking during 2nd & 3rd trimester	0.106	0.197	0.017	0.592
	Postnatal EPDS	0.004	0.007	0.018	0.576
Step two	Gestational weeks	0.038	0.024	0.051	0.108
	Infant sex	0.282	0.059	0.152	0.000
	Education	0.035	0.037	0.032	0.347
	Mother's age	-0.015	0.007	-0.072	0.029
	Smoking during 1st trimester	0.019	0.128	0.005	0.881
	Smoking during 2nd & 3rd trimester	0.099	1.198	0.016	0.616
	Postnatal EPDS 1 year	0.003	0.009	0.012	0.755
	Prenatal EPDS Gwk 14	0.003	0.011	0.012	0.782
	Prenatal EPDS Gwk 24	.001	0.011	0.005	0.914
	Prenatal EPDS Gwk 34	- .001	0.011	- 0.005	0.902

4 Discussion

The aim of the present study was to investigate the possible relationship between prenatal depressive symptoms in mothers and vocabulary development in their children at the age of 14 months. Confounding variables that have been identified in the literature to account for some variation in language level, such as infant sex, maternal age, education, smoking during pregnancy and postnatal depression, were controlled for in the analyses. Prenatal depressive symptoms in mothers did not significantly predict later vocabulary development in children when confounders were held constant.

No association was found between maternal prenatal depressive symptoms and infant expressive vocabulary. This is not surprising considering the nature of the language variable in question. The non-normality of the distribution, often associated with early developmental stages of expressive vocabulary (Fenson et al., 2000), makes it less suitable for statistical analysis than receptive vocabulary. Typically, receptive vocabulary precedes expressive vocabulary (Henriksen, 1999) in language development. At 14 months, most children are only beginning to utter their first words and some do not, despite large impressive vocabularies, produce words at this age. As correlation analysis is based on standardization of covariance, measurement instruments with floor effects like the MCDI at 14 months will not produce viable results. Before producing speech, most children use gestures communicatively (Iverson & Goldin-Meadow, 2005). Some researchers have noted, that gesture use in infants at 14 months of age, predicts later verbal comprehension at 18 months of age and verbal production at 24 months of age (Laakso, Poikkeus, Katajamäki & Lyytinen, 1999). If this is the case, part II in MCDI, which measures communicative acts and gesture use in children at 8-16 months of age, could be a better indicator of the children's expressive language development than the expressive vocabulary section of the MCDI, when measured this early in development.

However, an association was found between prenatal maternal depressive scores and infant receptive vocabulary at 14 months of age. The association was negative in its nature, that is, more prenatal depressive symptoms in mothers were associated with lower scores on receptive vocabulary in their children. As the regression models were not able to explain more than around 4% of the variance in the outcome variables, and prenatal depressive symptoms did not predict the outcome variable, it is likely that confounding variables that have yet not been identified or that are difficult to measure, explain this association.

4.1 Possible explaining variables

A reoccurring suggestion about the mediating link between prenatal maternal depression and infant language development is genetics. As Henrichs and colleagues (2011) noted, it is possible that common genetics rather than causality are at play in the association between maternal depression and infant development. The mother and her child may share genetic components that make them vulnerable to both language delay and mental health issues. Such genetic components may be linked to personality, IQ or cognitive ability (Ribeiro, et al., 2016).

Some genetic factors appear to dictate, to some extent, how the child is affected by early prenatal stressors such as maternal depression (Sandman, Glynn & Davis, 2013). A hypothesis recently put forward by researchers is that the impact of stress exposure during pregnancy could be moderated by infant sex. Nolvi and colleagues (2018) examined the effects of pre- and postnatal stress on infant executive functions and found that prenatal general anxiety predicted infant executive functions differently in boys and girls. When background factors were controlled for, prenatal anxiety negatively affected boys' performance on executive tasks, but not girls'. In contrast, postnatal anxiety predicted poorer executive functioning in girls but not boys. Evolutionary theories suggest that males and females use different strategies when confronted with adverse environments early in life (Sandman et al., 2013). The consequences of exposure to adversity are exhibited in males very early in the life cycle. Female, on the contrary, adapt to unfavorable environments more efficiently than males but suffer from this flexibility in terms of increased fear and anxiety in adolescence and adulthood (Sandman et al., 2013). This means the association may hold for boys but not for girls, at least when tested early in infancy. This aspect could be clarified further with finer statistical models and interaction effects between prenatal maternal depression and infant sex.

The timing and duration of exposure to prenatal stressors is another aspect to consider. The explanation for this has to do with developmental processes in fetal development as well as biologically programmed adjustments in the female body during pregnancy. High levels of maternal cortisol may be particularly harmful if present during the first trimester of pregnancy. At this point, cortical structures are initially forming and the placenta has not yet begun to produce the enzyme 11β-Hydroxysteroid dehydrogenase, which converts cortisol into its inactive form, cortisone (Laplante et al., 2004). This was supported by results in a study by Davis and Sandman (2010), where elevated levels of cortisol early in pregnancy were associated with delayed cognitive development in children as measured by the Bayley Scales of Infant Development at 1 year.

In the present study, the largest correlation coefficient was found for infant receptive vocabulary and prenatal maternal depression during the second trimester of pregnancy. However, the minimal differences between trimesters may be random, as all correlation coefficients were little under $r > 0.1$, which is considered the limit for a small effect. Moreover, depressive symptoms during each trimester were analyzed separately. In the future, the duration of exposure could be analyzed in addition to analyzing all trimesters separately.

Studying the possible effects of maternal prenatal depression on children´s language development is not straightforward, as it cannot develop without social interaction and, therefore, cannot be measured until the child reaches a certain age. Many postnatal- and other inherent factors can influence children’s language development during this time. Despite attempts to control for postnatal effects on language development, it is difficult to control all possible variables. Therefore, it is quite possible that factors in the postnatal environment could explain the association found in the present thesis.

It has been noted that the severity of depression is not indicative of parenting quality (Wang & Dix, 2013). For example, Wang and Dix (2013) found, that severely depressed mothers showed both supportive and non-supportive parenting styles. This means, that regardless of postnatal depressive state, mothers may well be capable of supporting their children's development. The reversed appears to be true as well: mothers who are not depressed after childbirth may have difficulties supporting their child (Pearson et al., 2012). This highlights the importance of not staring blindly at the diagnosis. Rather, personality characteristics and social context should be considered, as they may have a more critical role in determining functionality (Wang & Dix, 2013). With this in mind, it is likely that objective measures of maternal responsiveness or emotional availability would be more appropriate variables in future studies, where one wishes to control for postnatal influences on language development. The Emotional Availability Scales (EA) (Biringen, 2008) have been used to measure four components of emotional availability (sensitivity, structuring, non-intrusiveness, and non-hostility) in mothers during play dyads with their children. Kaivola (2019), who investigated the relationship between emotional availability and depression in mothers, found no associations between the EA-scales and pre- or postnatal depressive symptoms in mothers as measured by the EPDS. However, she found that three out of four components of emotional availability in mothers were associated with receptive vocabulary size in children at 14 months of age.

As we have seen, the quality of parental support during developmental processes in the child is important (Stern, 2002) and adequate levels of support may even alleviate the negative effects from prenatal exposure to maternal stress (Ribeiro et al., 2016; Austin et al., 2017). So far, little attention has been given to the role and health of fathers. This is unfortunate, as it has been recognized that the mental health of both parents is important for the child's well-being. In a study by Edward, Castle, Mills and Casey (2015), paternal depression following childbirth was associated with previous depressive episodes as well as depression in their partners during pregnancy and soon after delivery. Of course, fathers cannot directly influence their child during pregnancy but may do so indirectly by affecting their partners' health. Postnatally, their mental health can either serve as a protective factor or a factor that contributes to the child's disadvantage.

It should, however, be highlighted that the correlation coefficients found in this study were smaller than $r = 0.1$, which is considered the limit for a small effect size. Statistically significant results are more easily obtained in large samples, where associations of minimal magnitude can be detected. However, the clinical significance of these associations is unclear.

4.2 Sample characteristics

The characteristics of the participants in the present study contribute to a certain amount of uncertainty in the interpretation of the results as well as their generalizability. Notably, few mothers in the sample had depressive symptoms above the cutoff. It is possible that severely depressed mothers did not complete the questionnaires, and this is a potential bias we cannot compensate for statistically. Severely depressed mothers are more likely to have deviant stress responses than mildly or moderately depressed mothers (Burke et al., 2005). Consequently, a sample in which severely depressed mothers are underrepresented may underestimate the strength of the association. Although 4 percent of the mothers in this sample were above the clinical cut-off for EPDS prenatally, the mean EPDS for these mothers was 15.31 points. The cut-off for major depressive disorder prenatally is 13. As follows, most mothers had scores little above the cut-off. One could theorize, that mild depressive states are less likely to affect mother or fetus negatively than severe depressive states.

Some evidence implies that lower SES is associated with higher stress levels and rates in maternal depression (Lancaster et al., 2010). In this sample, a majority of the participating mothers had an academic or high vocational education (69.4%). It is common that people with higher education find participating in research attractive and, thus, constitute a large proportion of the total sample. Of course, this limits the generalizability of the results, as some aspects that potentially mediate the relationship between maternal depression and infant language development are more common in less privileged groups of people (Rubertsson, Wickberg, Gustavsson, & Rådestad, 2005).

4.3 Confounders

Some confounders appeared to have a stronger relationship to the outcome variables than others. For example, infant sex predicted both vocabulary comprehension and production at 14 months, in favor of girls. Gestational weeks predicted receptive vocabulary, such that higher gestational age predicted larger receptive vocabularies. In contrast, increased maternal age predicted smaller expressive vocabularies in offspring.

4. 3. 1 Infant sex. In general, girls score higher on average than boys on language tests in infancy (Wallentin, 2009). This was the case in the current sample as well. It is possible that girls have an innate, biological advantage to language acquisition (Sandman et al., 2013). However, it is generally accepted that differences in performance between boys and girls can be explained by both biological and environmental processes. Boys and girls are often treated differently; Bando Grana, López-Bóo and Li (2016) found that parents engaged in activities that develop language, such as reading, more often with girls than boys. In line with this perspective, it is possible that stereotypical parenting in combination with prenatal stress effects could have greater consequences for boys' language learning than girls', at least when tested in early childhood. It should be noted, however, that the differences in performance on language tests tend to decrease or disappear with time (Wallentin, 2009). Moreover, in the current sample, girls' and boys' receptive vocabulary differed 5% on average with standard deviations between 18 and 19%. The difference between girls and boys was, thus, smaller on average than the average difference between individuals within each group. This means other variables, perhaps more important than sex, operate in determining language competence.

4. 3. 2 Gestational age. Although prematurely born children were excluded from the statistical analyses, gestational week significantly predicted language level at 14 months. It appears, that the very last weeks of gestation are important to brain function and subsequent development. It is well known that prematurity (< 37 gwk) is a risk factor for developmental delays in several domains, including language development (Franken & Weisglas-Kuperus, 2012). However, there is growing evidence that infants born early term (37–38 gwk) have a greater risk of neurodevelopmental delay as well (Bentley, Roberts, Bowen, Martin, Morris & Nassar, 2016). Fetal brain development accelerates rapidly in the third trimester. The last stage of fetal brain development is characterized by the differentiation of nerve cells, dendritic growth, the establishment of synapses and myelination (Joseph, 2000). The last brain areas to mature are parts of the midbrain and brainstem, responsible for fine auditory discriminations, along with the forebrain, which generates higher order cognitive ability and purposeful behavior (Joseph, 2000). Naturally, these processes are important to language learning.

In a population-based study by Bentley and colleagues (2016) the risk of poor development increased with every additional week before 39 weeks of gestation. In research, children born preterm are systematically excluded for the purpose of controlling. According to Ribeiro et al. (2016), this may produce a bias by eliminating potentially highly stressful pregnancies, as prenatal stress is highly related to preterm birth. Thus, it is possible that by excluding premature infants, we may have excluded a number of mothers with depression. If possible, planned preterm delivery should not be performed without careful consideration as it may have a long-lasting impact on child development (Bentley et al., 2017).

4. 3. 3 Maternal age. The variable for expressive vocabulary was statistically transformed to be suitable for regression analysis. Transformation is associated with certain risks as it fundamentally changes the nature of the variable. The results from the second regression analysis performed in this thesis should, therefore, be interpreted with caution.

There is mixed evidence as to whether advanced maternal age has a positive or negative effect on children's cognitive ability. According to Goisis and colleagues (2017), the direction of the association may differ according to the time period studied. Their research team found maternal age to be associated with decreased cognitive ability in offspring in a study conducted during the years 1958-70 but associated with increased cognitive ability in their cohort study conducted during 2000-2002. The results were explained with changed parental characteristics. During the years 1958-70 advanced maternal age was associated with high parity, whereas in 2000-2002 with socioeconomically advantaged family background.

In the present study, higher maternal age predicted lower scores on children's expressive vocabulary. Unfortunately, information on parity was not included in these particular analyses, but it is nevertheless possible that older mothers had several children and therefore, less time to support the development of each child. The other possible explanation is biological. Advanced maternal age is generally considered to increase the odds of complications during gestation and delivery (Hansen, 1986). For example, Jacobsson, Ladfors and Milsom (2004) reported on cases where older women more often seemed to give birth to children with low birthweight compared to younger women. As previously mentioned, low birthweight is associated with delayed cognitive development in children.

4.4 Limitations of the study and plans for future research

Despite the advantage of having a large sample, the present thesis has some limitations. As the theories on the association between maternal prenatal depression and infant language stem from biology, and there is uncertainty about the relationship between subjective measures of depression and biomarkers of stress, it could be useful to include both subjective measures and objective measures in future studies about this subject.

The cortisol profiles of the mothers in this sample are likely to be different from each other, as the relationship between depression and cortisol is not clear-cut. It appears, that some forms of depression are associated with hypercortisolemia whereas others are associated with hypocortisolemia (Seth, Lewis & Galbally, 2016). As such, we cannot know by looking at depressive symptoms at a given time point, whether the respondent has high or low levels of cortisol. As mentioned, both high and low cortisol levels constitute risk factors to the development of the fetus.

Weikum et al. (2012) found that children of mothers who had taken antidepressants during pregnancy developed differently from those of mothers who had not medicated their prenatal depression. The most common anti-depressants prescribed to depressed people are serotonin reuptake inhibitors (SRI). These change the hormonal composition in the patient and may, therefore, have a bearing on the development of the fetus during pregnancy, and through programming mechanisms, into infancy. To conclude, not only do we need information about the type of depression and its corresponding neurovascular processes, but also what kind of treatment depressed mothers have received.

4.5 Conclusion

There was a statistically significant association between prenatal maternal depression and children's receptive vocabulary size. However, when relevant confounders were held constant, prenatal maternal depression did not predict children's vocabulary size at 14 months of age, indicating that other variables explain this association. Interaction effects between prenatal maternal depression and for example infant sex, cannot be ruled out at this point. In addition to subjective measures of depression, measures of physiological correlates to depression should be included in the analyses as well as information about antidepressant medication. To better control for the postnatal environment, objective measures of parental responsiveness should be considered, as well as information on parity and birth weight. Notably, the associations were of minimal magnitude ($r < 0.1$), meaning their practical relevance is uncertain.

In light of the results of this thesis, prenatal stress alone is not likely to disrupt an infant's language development. As with all developmental processes, language development is a result of a number of interacting factors. The early programming features that prenatal maternal depression potentially give rise to, can be seen as one risk factor in a *cumulative risk model* (Ribeiro et al., 2016) where early functional variations interact with environmental factors to determine infant outcomes. This is not to say the prenatal period is insignificant. However, it means that possible negative effects can be alleviated if discovered in an early phase.

Swedish summary - Svensk sammanfattning

Förhållandet mellan prenatala depressiva symptom hos mammor och barnets ordförråd

1. Introduktion

De flesta barn tillägnar sig språk utan besvär (Bloom, 2001). Den individuella variationen i språklig nivå är emellertid stor (Fenson m. fl., 2007) och har förklarats med både biologiska och sociala processer. Att identifiera de här processerna är viktigt eftersom tidigt språklig förmåga korrelerar med senare social-emotionell utveckling och akademisk framgång (Beitchman, Wilson, Brownlie, Walters, & Lancee, 1996).

Flickor presterar i allmänhet bättre än pojkar i språkliga test (Umek, Fekonja, Kranjc & Bajc, 2008), på samma sätt presterar i allmänhet barn med högre socioekonomisk status (SES) bättre än barn med låg socioekonomisk status (Umek m. fl., 2008). Resultaten i studier har visat att rökning under graviditeten, prematur födsel eller låg födelsevikt har ett samband med lägre språklig nivå (Hernández-Martínez m. fl., 2017; Franken & Weisglas-Kuperus, 2012). Därtill verkar mammans ålder ha en betydelse för barnets språkutveckling, även om det fortfarande är oklart huruvida hög ålder har en positiv eller negativ effekt (Goisis, Schneider & Myrskylä, 2016).

Mammans *prenatala depression*, eller graviditetsdepression, har identifierats som ytterligare en riskfaktor för fördröjd språkutveckling hos barn. Depression leder till både beteendemässiga och hormonella förändringar hos den drabbade (Schmidt, Shelton, & Duman, 2011). HPA-axeln (stressaxeln) blir hos en del deprimerade kvinnor överaktiv, vilket leder till förhöja nivåer av stresshormonen kortisol och noradrenalin, som sedan överförs till fostret via placentan (Laplante m. fl., 2004). Speciellt höga nivåer av kortisol har visat sig ha ett samband med atypisk utveckling av neurologiska strukturer hos fostret (Laplante m. fl., 2004) vilket senare kan påverka den språkliga utvecklingen. Vidare korrelerar höga nivåer av kortisol hos mamman med höga nivåer av kortisol hos barnet (Field, 2011). Det här kan ha en inverkan på barnets språkliga utveckling eftersom höga nivåer av kortisol påverkar minnesförmågan genom att hindra glukos från att tränga in i hippocampus (Belanoff, Yager & Schatzberg, 2001). En del svåra temperamentsdrag, som reaktivitet eller oro, verkar också vara vanligare hos barn som blivit exponerade för sin mammas prenatala depression än de som inte blivit det (Davis m. fl., 2007; Field, 2011). Det här har betydelse för anknytningen till föräldern, vilken visat sig spela en avgörande roll för många utvecklingsmässiga processer hos barnet. Trygg anknytning är associerad med bättre språkliga förmågor (IJzendoorn, Dijkstra & Bus, 1995), eftersom barnet i en trygg kontext är mera benäget att utforska sin omgivning.

Även om det finns teoretiska implikationer för ett samband mellan graviditetsdepression hos mammor och barnets ordförråd har forskare erhållit motstridiga resultat. Resultat som indikerar ett samband är lika vanliga som nollresultat. I studier där man jämfört den effekt olika typer av psykosocial stress har på barnets kognitiva- eller språkliga utveckling, har depression inte verkat spela en betydande roll (Ibanez m.fl., 2015; Ribiero m.fl., 2016). I några studier har resultaten ändå pekat på att graviditetsdepression kan ha ett samband med barnets tidiga språkljudsdiskriminering (Weikum m.fl., 2012) eller med meningskomplexitet vid 3 år (Skurtveit m.fl., 2014). Tidigare forskning har visat att det är viktigt dels att skilja mellan subjektiva och objektiva mått på depression (Laplante m.fl., 2004; Laplante m.fl., 2018) och dels att beakta mammans postnatala hälsa (Ribiero, Zachrisson, Gustavson & Scholberg, 2016; Ibanez m. fl., 2015; Austin m. fl., 2017).

1.2 Syftet med studien

Syftet med föreliggande studie var att undersöka det eventuella sambandet mellan *subjektivt* uppskattade depressiva symptom hos mammor under graviteteten och storleken på barnets ordförråd vid 14 månaders ålder. Variabler som konstaterats ha en betydelse för barnets språkutveckling, såsom gestationsveckor (gv), mammans ålder, utbildningsnivå, rökning under graviditeten och barnets kön kontrollerades för i analyserna.

2. Metod

Studien genomfördes som en substudie i det multidisciplinära forskningsprojektet Finnbrain, vars syfte är att undersöka betydelsen av både gener och miljö för människans utveckling. Det totala samplet bestod av 3837 mammor och deras familjemedlemmar. För analyserna i den här studien var det nödvändigt att mamman fyllt i både ett formulär om depressiva symptom under graviditeten och ett formulär om barnets ordförråd vid 14 månaders ålder. De mammor som bara fyllt i ett av frågeformulären exkluderades från samplet. Vidare exkluderades prematurer födda innan vecka 37 (Stolt m. fl., 2007, s. 9.) från samplet, så att det slutliga samplet bestod av 1032 mammor och deras barn.

2. 1 Mätinstrument

Två frågeformulär som används både kliniskt och inom forskning utnyttjades för analyserna i den här studien. Antal poäng på screeninginstrumentet Edinburgh Postnatal Depression Scale (EPDS) (Cox, Holden & Sagovsky, 1987) fungerade som indikator på hur svår depressionen var och som prediktorvariabel i de statistiska analyserna. EPDS är ett 10-punkts formulär med frågor om tankar och känslor under de senaste 7 dagarna. Respondentens uppgift är att skatta hur pass väl påståendet stämmer överens med den egna upplevelsen. Maxpoäng på testet är 30 poäng, där högre poäng indikerar svårare depressiva symptom. Mammorna fyllde i formuläret vid tre tillfällen under graviditeten: vecka 14, 24 och 34.

Den svenska (Berglund & Eriksson, 2000) och den finska versionen (Lyytinen, 1999) av MacArthur-Bates Communicative Development Inventory (MCDI) (Fenson m. fl., 2007) användes för att uppskatta barnets expressiva och receptiva ordförråd vid 14 månader. MCDI är ett formulär med frågor om barnets tidiga kommunikativa- och språkliga utveckling, som har visat sig stämma väl överens med mera objektiva metoder att uppskatta barnets språkliga nivå (Mayor & Plunkett, 2011). I D-delen av formuläret ska vårdnadshavaren avgöra ifall barnet *förstår* eller *producerar* de ord som är listade. Antalet förstådda ord utgör barnets receptiva ordförråd och antalet producerade ord barnets expressiva ordförråd. Eftersom den svenska och finska versionen av MCDI innehåller olika antal ord, användes andelen procent förstådda och producerade ord som resultatvariabler i den här studien. Således varierade skalan från 0-100, med högre poäng för större ordförråd.

2. 2 Statistiska analyser

Förhållandet mellan depressiva symptom hos mamman under graviditeten och storleken på barnets ordförråd undersöktes med hjälp av hierarkisk multipel regressionsanalys i två steg. Proceduren gjordes i två omgångar, en gång med barnets receptiva ordförråd som resultatvariabel och en andra gång med barnets expressiva ordförråd som resultatvariabel. Förväxlingsfaktorerna SES, barnets kön, gestationsveckor, mammans ålder, rökning under graviditeten och postnatal depression matades in som prediktorer vid steg 1. Vid steg 2 matades mammans depressiva symptom för varje mätpunkt under graviditeten ytterligare in. På det här sättet var det möjligt att avgöra om storleken på ordförrådet hos barn som blivit exponerade för olika nivåer av mammans prenatala depression, varierade på ett systematiskt sätt.

3. Resultat

Medelåldern hos mammorna i samplet var 31 år (*SD* = 4*, variationsvidd*= 18–45). De flesta, 69,3 %, hade en akademisk eller hög yrkesutbildning och de resterande 30,7 % medel- eller låg utbildning. Den genomsnittliga graviditeten varade i 40 veckor (*SD* = 1,24, *variationsvidd* = 37–42). Andelen finskspråkiga familjer var 87,3 % och andelen svenskspråkiga 12,7 %. Rökning under graviditeten var ovanligt, bara 2,7 % rökte efter den första trimestern. Prevalensen av depression under graviditeten var omkring 4 % och ökade något efter förlossningen, från 9,1 % vid 3 månader till 10,7 % vid 6 månader och slutligen 13,4 % vid ett år efter barnets födsel. Som väntat var barnens receptiva ordförråd större än de expressiva ordförråden. Vid 14 månader förstod barnen i genomsnitt 121 ord (*SD* = 72, *variationsvidd* = 0–336) och producerade i genomsnitt 12 ord (*SD* = 18*, variationsvidd* = 0–173). Flickors ordförråd var signifikant större än pojkars, $F_{receptivt\ ordförråd}$ (1, 1030) = 19,246, $p < 0{,}001$, $F_{expressivt\ ordförråd}$ (1, 1030) = 17,010, $p < 0{,}001$).

Korrelationsanalyserna visade att prenatala EPDS-poäng signifikant korrelerade med receptivt ordförråd hos barn vid 14 månaders ålder ($r_{s\ \mathrm{Gv\ 14}}$ = -0,074, p = 0,017, $r_{s\ \mathrm{Gv\ 24}}$ = - 0,093, p = 0,003, $r_{s\ \mathrm{Gv\ 34}}$ = - 0,076, p = 0,014), men inte med expressivt ordförråd. Relationen var negativ, alltså var svårare depressiva symptom hos mamman associerade med mindre receptiva ordförråd hos barnen. Effektstorleken var emellertid mindre än r = 0,1, vilket anses vara gränsvärdet för en liten effekt. Resultatens praktiska relevans är därför osäker.

Kriterierna för att utföra en regressionsanalys med receptivt ordförråd som resultatvariabel möttes – inga parvisa korrelationer var större än r = 0,7. Det första steget i analysen genererade en signifikant regressionsekvation, F(7, 1006) = 5,845 $p < 0{,}001$, och svarade för 3,2 % av variansen i resultatvariabeln ($R^2_{justerat}$= 0,032). Det andra steget i analysen, där också prenatala EDPS-poäng var inkluderade förändrade inte F på en statistiskt signifikant nivå ($R^2_{justerat}$ = 0,033, p = 0,324). Med andra ord föreslår modellen att prenatala depressiva symptom hos mamman inte förklarar en betydande del av variansen i barnens receptiva ordförråd efter att postnatal depression och bakgrundsfaktorer tagits i beaktande. Vid båda stegen av regressionsanalysen predicerade bara gestationsveckor (β

$_{\text{Steg 1}}$ = 0,115, p < 0,001, $\beta_{\text{Steg 2}}$ = 0,113, p < 0,001) och barnets kön ($\beta_{\text{Steg 1}}$ = 0,128, p < 0,001, $\beta_{\text{Steg 2}}$ = 0,132, p < 0,001) resultatvariabeln på en statistiskt signifikant nivå.

För att en regressionsanalys skulle gå att genomföra med expressivt ordförråd som resultatvariabel, justerades nämnda variabel med kvadratsrotstransformering. De deltagare som hade extrema värden, tre gånger kvartilavståndet ovanför eller under den första och tredje kvartilen exkluderades. Resultaten från den här hierarkiska multipelregressionsanalysen liknade de som härleddes från föregående analys. Steg 1 predicerade resultatvariabeln signifikant bättre än medeltalet, $F_{\text{Modell 1}}$ (7, 986) = 4,776, p < 0,001, med ett $R^2_{justerat}$ på 0,026. Att inkludera prenatala EPDS-poäng vid steg 2 verkade däremot inte förändra den prediktiva styrkan hos modellen, F(10, 983) = 3,347, p < 0,001. Endast barnets kön ($\beta_{\text{Steg 1}}$ = 0,152, p < 0,001, $\beta_{\text{Steg 2}}$ = 0,152, p < 0,001) och mammans ålder ($\beta_{\text{Steg 1}}$ = -0,073, p = 0,026, $\beta_{\text{Steg 2}}$ = -0,072, p = 0,029) verkade predicera det expressiva ordförrådet hos barnet.

4. Diskussion

Resultaten i föreliggande studie visade att depressiva symptom hos mamman under graviditeten korrelerade negativt med barnets receptiva ordförråd. Depressiva symptom hos mamman predicerade ändå inte barnets ordförråd när bakgrundsfaktorer och mammans postnatala depression kontrollerats för. Det här tyder på att prenatal stress troligtvis inte har en oberoende effekt på barnets språkutveckling. Interaktionseffekter, till exempel mellan prenatal depression och barnets kön, går inte att utesluta i det här skedet (Nolvi m.fl., 2018; Ribiero, Zachrisson, Gustavson & Scholberg, 2016). Det finns en del evidens för att pojkar skulle vara mera sårbara för sin mammas prenatala stress än flickor, speciellt om barnen testas under den tidiga barndomen (Nolvi m. fl., 2018). Det kan vara frågan om mera komplexa genetiska processer genom vilka det genetiska arvet påverkar hur barnet reagerar på en ofördelaktig miljö så tidigt som under fosterstadiet (Sandman, Glynn & Davis, 2013). Sambandet mellan mammans depression och barnets ordförråd går också att förklara med genetiska processer; mamman och barnet kan dela genetiskt material som gör dem sårbara för både depression och fördröjd språkutveckling (Ribiero, m. fl., 2016).

Trots att den här studien hade fördelen att ha ett stort sampel finns det en del begränsningar med upplägget. Samplet bestod av till största delen högutbildade mammor, vilket begränsar generaliserbarheten av resultaten. Vidare var de flesta deprimerade mammorna lindrigt deprimerade. Det är rimligt att anta att resultaten hade sett annorlunda ut om flera mammor varit djupt deprimerade, då mera allvarliga depressiva tillstånd kan vara associerade med högre nivåer av kortisol (Burke et al., 2005).

Eftersom pappor blir allt mera närvarande i sina barns liv kan det vara problematiskt att inte kontrollera för deras mentala hälsa (Edward, Castle, Mills & Casey, 2015). Den negativa effekten av mammans prenatala stress på barnets utveckling har visat sig mildras, eller helt försvinna i de fall där barnet fått ett tillräckligt emotionellt stöd under den tidiga uppväxten (Ribiero m. fl., 2016; Austin m. fl., 2017). Objektiva utvärderingar av emotionell närvaro kan vara att föredra framom subjektiva (t.ex. emotional availability scales, EA), eftersom graden av depression inte alltid korrelerar med en förälders grad av närvaro (Wang & Dix, 2013). Det här gäller såväl mammor som pappor och har därför betydelse också för tolkningen av resultaten i den här studien. Trots försök att kontrollera för relevanta postnatala faktorer är det svårt att inkludera alla tänkbara variabler i analyserna, varför den postnatala miljön kan vara det som förklarar relationen mellan mammans prenatala depression och barnets receptiva ordförråd i den här studien.

Det skulle vara viktigt att i framtiden också inkludera information om de deprimerade mammornas användning av antidepressiva läkemedel. Antidepressiva läkemedel kan ha en tendens att försnabba vissa utvecklingsmässiga processer hos barnet (Weikum, Obelander, Hensch & Werker, 2012), vilket kan snedvrida resultaten. Vidare finns det evidens för att graden av depression inte heller korrelerar med fysiologiska mått på stress, såsom mängden kortisol (Seth, Lewis & Galbally, 2016). Det går således inte att avgöra ifall nivåerna av kortisol hos mamman är höga eller låga genom att titta på ett formulär över depressiva symptom. Av den här orsaken skulle det vara viktigt att i fortsättningen inkludera, förutom subjektiva uppskattningar av depressionen, också fysiologiska markörer i analyserna.

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Nadja Bruun

Graviditetsdepression leder inte till sämre språkutveckling hos barn

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Depression hos mammor under graviditeten leder inte till sämre språkutveckling hos barn. Det visar resultaten i en färsk pro -gradu avhandling i logopedi vid ÅA. Nadja Bruun har undersökt förhållandet mellan depression hos mammor under graviditeten och barns ordförråd vid 14 månaders ålder.

Graviditetsdepression hos mammor och barns ordförråd korrelerade ändå svagt, vilket tyder på att de trots allt har ett samband, men att sambandet beror på något annat än depression hos mamman. Det kan vara frågan om en kombination av flera riskfaktorer, som inverkar negativt på barnets språkutveckling - av dem är graviditetsdepression bara en.

Materialet samlades in med hjälp av formulär, som familjerna skulle fylla i och returnera. Depressiva symptom mättes med ett kort screeningformulär vid tre tidpunkter under graviditeten, och barnets språkutveckling med ett formulär där föräldern skulle kryssa i vilka ord barnet förstår och vilka ord barnet både förstår och säger.

Den teoretiska bakgrunden för forskningsfrågan är framförallt biologisk. Utgångspunkten var att det finns en risk att depression under graviditeten påverkar barnets neurologiska utveckling genom förhöjda nivåer av stresshormon, vilket ger barnet sämre förutsättningar att tillägna sig språk.

En myriad av faktorer, både positiva och negativa, kan påverka barnets språkutveckling efter födseln. Det verkar därför vara förnuftigt att ha en helhetsbild på barnets utveckling- det är sällan en enda riskfaktor har ödesdigra konsekvenser.

I fortsättningen behöver flera faktorer i barnets sociala miljö, som den andra förälderns emotionella närvaro, beaktas. De faktiska nivåerna av stresshormon hos mammorna bör också tas med i analyserna, slår avhandlingen fast.

Avhandlingen gjordes inom ramen för Finnbrain-projektet, vars syfte är att kartlägga betydelsen av både gener och miljö för människans utveckling.

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