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THE RELATIONSHIP BETWEEN VERY PREMATURE CHILDREN'S DEVELOPMENT AND MOTHERS' EMOTIONAL STATE COMPARED TO CONTROL GROUP

Master's project in psychology

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ABSTRACT

Objective The aim of this study is to describe the emotional state of mothers of children born very preterm compared to mothers of children born at-term and examine relations between mothers' emotional state and cognitive, language, motor and social-emotional development in very preterm and term born children at the age of two. The impact of postnatal characteristics and demographic data on both matters were examined. **Methods** Participants were 151 children born very preterm (<32 gestational weeks) and 149 children term born with 130 mothers of very preterm and 148 term born children mothers. At 2 year's age for the children, maternal current emotional state was assessed as well as how they felt after birth using the Emotional State Questionnaire (EST-Q2). Child developmental outcomes were assessed using the Bayley Scales of Infant and Toddler Development Third Edition (Bayley-III). **Results** Mothers of children born very preterm reported significantly lower scores on the EST-Q2 subscales after giving birth compared to mothers of term born children. Mothers' emotional state was associated with prematurity and social-emotional development of children. Children's development was mainly described by prematurity and mothers' depression. Severity of neurodevelopmental disability is an important factor, describing approximately 44% of preterm children's developmental outcomes and 22% in control group. **Conclusion** Findings highlight the need to identify and support mothers of children born very preterm with mental health problems.

Key words maternal emotional state; depression; children's development; neurodevelopmental disability; very preterm child

KOKKUVÕTE

Väga väikese gestatsioonivanusega enneaegsete laste arenguliste näitajate mõju emade emotsionaalsele seisundile ja seisundi mõju laste arengule võrreldes kontrollgrupiga

Eesmärk Käesoleva töö eesmärk oli uurida enneaegselt sündinud laste ja ajaliselt sündinud laste emade emotsionaalset enesetunnet ja analüüsida seoseid emade enesetunde ning enneaegselt ja ajaliselt sündinud laste kognitiivse, keelelise, motoorika ja sotsiaal-emotsionaalse arengu vahel, kui laps oli kaheaastane. Uuriti sünnijärgsete ja demograafiliste faktorite mõju nii emade enesetundele kui lapse arengule. **Meetod** Uurimuses osales 151 enneaegset (<32 gestatsiooninädala) ja 149 ajaliselt sündinud last ning 130 enneaegse lapse ema ja 148 ajaliselt sündinud lapse ema. Lapse 2. aasta vanuses hinnati Emotsionaalse Enesetunde Küsimustikuga (EEK-2) emade enesetunde hetkeseisundit ja kuidas nad tundsid ennast pärast sünnitust. Lapse arengut hinnati Bayley arenguskaalaga (Bayley-III). **Tulemused** Enneaegsete lastega emade EEK-2 alaskaalade skoorid olid märkimisväärselt madalamad pärast sünnitamist võrrelduna ajaliselt sündinud laste emadega. Skoorides ei esinenud märkimisväärseid erinevusi 2 aastat pärast sündi. Emade emotsionaalne enesetunne oli seotud enneaegsuse ja lapse sotsiaal-emotsionaalse arenguga. Laste arengut seletas peamiselt lapse enneaegsus ja emade depressioon. Lapse arenguhäire on oluline faktor, seletades ligikaudu 44% enneaegsete laste ja 22% ajaliselt sündinud laste arengust. **Järeldused** Tulemused rõhutavad vajadust identifitseerida ja toetada väga enneaegselt sündinud lastega emade emotsionaalse enesetundega seotud probleeme.

Märksõnad ema emitsionaalne enesetunne; depressioon; lapse areng; arenguhäire; väga enneaegne laps

CONTENTS

INTRODUCTION

The Concept of Prematurity

Prematurity is usually defined to the live birth of a baby with a gestational age of less than 37 weeks (Kramer, 1987), while the full-term pregnancy lasts for 40 weeks.

The terms "low birth weight" and "premature" were used interchangeably in the scientific literature from the 1920s to the 1960s. However, not all small babies are premature, and not all premature babies are small. In 1961, the World Health Organization recommended that low birth weight no longer be used as the official definition of prematurity. (Wilcox, 2001)

Classifications of Prematurity

According to the international definition by WHO (WHO, 1992), a delivery is preterm when occurring before 37th completed week of pregnancy. Different studies use either birth weight or gestational age to determine the preterm birth. In international terms a preterm delivery refers to an infant with all signs of life, whose weight is under 2500 grams irrespective of gestational age (WHO, 1992), which is classified as low birth weight (LBW). Birth weight classification also includes very low birth weight (VLBW), which is less than 1500 g and extremely low birth weight (ELBW), which is less than 1000 g (WHO, 1992). International differences in terms of birth weight are significant, ranging from 4% to 50% (Ehrenberg, Kirss, Parve, Kirss & Poolamets, 2003). Many preterm infants are small for gestational age, but have a normal birth weight, and the rates of mortality and morbidity for these infants differ from those for term infants of normal birth weight (Behrman & Butler, 2007).

Every fifth infant with low birth weight is not premature, also some infants weighing over 2500 g could be born 2 weeks prematurely. It is important to measure gestational age to be exact in determining prematurity. Prematurity defined by gestational age recognizes mildly preterm, which is 32-36 weeks of gestational age, very preterm (VPT), which is 28-31 weeks of gestational age and extremely preterm (EPT), which is less than 28 weeks of gestational age. (Ehrenberg et al., 2003) The current thesis focuses on the infants of very low gestational age (VLGA, <32 weeks).

The Incidence of Premature Birth and Mortality Rates

The percentage of preterm deliveries has risen steadily over the last 2 decades (Behrman & Butler, 2007). More than 20 million infants worldwide, representing

15.5% of all births, are born with low birth weight (WHO & UNICEF, 2004), or weighing less than 2500 grams (Child Health Research Project Special Report, 1999). According to the data of WHO and UNICEF (2004), the level of low birth weight in developing countries (16.5%) is more than double the level in developed regions (7%). In 2005, the highest rates occurred in Africa and North America, where 11.9% and 10.6% of the births were preterm, whereas Europe had the lowest rate, where 6.2% of the births were preterm (Beck et al., 2010). In Estonia, in 1992 and 2003-2007 the number of incidences of prematurity has been constantly around 6% (Tellmann, Karro, Rudov & Serkina, 2008). The rate of birth before 32 weeks' gestation is 1-2% (Tucker & McGuire, 2004). In Estonia, perinatal morbidity among infants with birth weight <1000 grams has decreased in 1992-2009 around 68% (Tervise Arengu Instituut, 2010). Factors that have contributed to the overall rise in the incidence of preterm birth include increasing rates of multiple births, greater use of assisted reproduction techniques, and more obstetric intervention (Tucker & McGuire, 2004).

Cause and Risk Factors of Prematurity

Prematurity is not a defined disease or syndrome, and there is no one specific cause or fixed set of outcomes (Behrman & Butler, 2007). In most cases, preterm deliveries begin spontaneously, but sometimes doctors decide to deliver a baby early because of concerns for mother's health (CDC, 2012; MOD, PMNCH, Save the Children, WHO, 2012). Still, different countries have very similar risk factors (Ehrenberg et al., 2003). According to researh, preterm labour is caused due to the coexistence of them. Some of the greatest risk factors of premature birth include history of previous premature birth, multifetal pregnancy (carrying twins, triplets, quadruplets or more) and certain uterine or cervical abnormalities (MOD, 2012). In addition to anamnestic and pregnancy related factors, also socioeconomic status (SES) and demographic factors play a significant role in predicting premature birth (Ehrenberg et al., 2003). SES risk factors include low eduction, being a single mother, age of the mother (younger than the age of 18, older than the age of 35), if she is pregnant for he first time or not and the level of stress she is having (Cox & Grady, 2003; Ehrenberg et al., 2003).

The Morbidity of Premature Birth

Approximately 15 million premature babies were born in 2010, which makes more than 1 in 10 of the world's babies (MOD, PMNCH, Save the Children, WHO, 2012). Over the past 20-30 years, advances in perinatal care have improved outcomes for infants born after short gestations. Better outcomes are in a positive correlation with increasing gestational age (Tucker & McGuire, 2004). Nevertheless, increased morbidity has brought along various problems: the increase in rates of cronical diseases and disabilities (cronical lung disease, visual problems, cerebral palsy etc.) (Ormisson, Mägi, Varendi & Toome, 2010; Toome et al., 2008). Cerebral palsy is a non-progressive abnormality of movement and posture, with increased tone and stretch reflexes in one or more extremities (Washburn, Dillard, Goldstein, Klinepeter, deRegnier & O' Shea, 2007). Neurodevelopmental impairment is defined as the presence of at least one of the following: a mental developmental quotient 2 SDs below the age and sex standardized mean, cerebral palsy, visual impairment, or significant hearing impairment (Guillen et al., 2012).

Specific diseases are caused by their immature organism. These diseases are bronchopulmonary dysplasia (BPD), retinopathy of prematurity (ROP), necrotizing enterocolitis (NEK), intraventricular hemorrage (IVH), periventricular leucomalacia (PVL) and positive blood-culture sepsis. The risk for later developmental disorders is greater for infants who are diagnosed with one of these disorders than for those who have neither of them. Children diagnosed with neonatal disease are also diagnosed with at least one of the previously mentioned diseases. It is limited to evaluate later development and quality of a very preterm infant during the first days and weeks, although, suffering from four neonatal diseases (BPD, III-IV degree IVH, III-IV degree PVL, ≥ III degree ROP) increases the risk for the child to have later neurosensory impairment or even death (Toome et al., 2009). Having one of these diseases, increases the risk for later outcome at the age of 18 months twice and having three diagnosis increases the risk for three times (Schmidt, Asztalos, Roberts, Robertson, Sauve & Whitfield, 2003). When gestational age increases, the relative importance of these diseases decreases and they do not appear in children born at-term. More of child's development is discussed later on.

Age Adjustment for Prematurity

Chronological age (CH) is used to indicate the age from the day the child was born (Toome et al., 2008). Gestational age (GA), which is represented as completed weeks, is the time elapsed between the first day of the last menstrual period and the day of delivery (Engle, 2004). The term, corrected age (CA) refers to the age the child would be if the pregnancy had been at-term. It means, that the number of weeks or months the infant was born prematurely (before 40 weeks of gestation) is subtracted from the CH (Engle, 2004; Toome et al., 2008). Corrected age has also been indicated to as adjusted age, gestation-adjusted age, postconceptual age, and term-equivalent age (D'Agostino, 2009). The proper assessment of growth and development over the first year must take account of prematurity and therefore it is recommended that the correction is continued until 2 years of age or even up until 3 years for more immature children (Marlow, 2004). In this paper, the term corrected age will be used.

The Concept of Mental Health and Maternal Depresssion

Emotions and emotional health are understood as people's positive or negative reactions to events that they consider as relevant to their concerns when life is proceeding in a desirable or undesirable manner (Koole, Van Dillen & Sheppes, 2010; McCann, 2011). Already years ago clinicians have noted an association between childbirth and mental disturbance (Miller, 2005). There has been an increase in emotional problems in parents in the last 20 years (Schepman, Collishaw, Gardner, Maughan, Scott & Pickles, 2011). Mental health problems such as depression and anxiety are extremely widespread during pregnancy and after childbirth all around the world, including one in three to one in five women in developing countries, and about one in ten in developed countries (WHO, 2008). The incidence of reactive emotional state of depression varies from about 25% to 75% among all women giving birth (Miller & Rukstalis, 2005) and is predicted by maternal stress (Davis, Edwards, Mohay & Wollin, 2003). Maternal depression is a multifaceted illness that describes a range of physical and emotional changes having varying consequences for a woman's mental health, her functioning as a mother, the family's functioning, and her child development (Clark & Fenichel, 2001; Onunaku, 2005). These problems are frequently undiagnosed, because many of its central features such as fatigue and poor sleep are also usually associated with motherhood itself and belong to the gender stereotype of what motherhood should include (WHO, 2008). Previously, the concept

of mental health has been extended to anxiety, social dysfunction, and sleeping difficulties in addition to depression (Vänskä et al., 2011).

Maternal Depression and Prematurity

Mothers of very premature infants report higher percentages of depressive symptoms than mothers of full-term infants (Davis et al., 2003; Treyvaud et al., 2010) and lower perceptions of parental competence (Olshtain-Mann & Auslander, 2008). They rate themselves as more distressed than fathers (Jackson, Ternestedt, Magnuson, Schollin, 2007; Miles, 1992; Tommiska, Östberg & Fellman, 2002; Trause, 1993). Mothers of very premature infants are significantly at a great risk for depression, posttraumatic stress disorder (Kersting et al., 2004; Meyer, Garcia Coll, Seifer, Ramos, Killis & Oh, 1995; Miles, Holditch-Davis, Schwartz & Scher, 2007) and long-term stress overall (Cronin, Shapiro, Casiro & Cheang, 1995; Stjernqvist, 1992) especially when the infant is subsequently hospitalized in the Neonatal Intensive Care Unit (NICU) (Olshtain-Mann & Auslander, 2008). The most common grief feelings among parents with a critically ill infant admitted to NICU, are sadness, worry resulting in sleeping difficulties, loss of appetite and disinterest in work (Yu, Jamieson & Astbury, 1981). Feelings of sadness, loss of interest, self-accusations, loneliness and inability for enjoyment are the best identifiers of depressive patients (Ööpik, Aluoja, Kalda & Maaroos, 2006)

Singer et al. (1999) have found that at 1 month mothers of VLBW infants have more psychological stress than mothers of term infants. Although, mothers of low-risk VLBW infants or ELBW infants did not differ from term mothers 2 years after birth, while, mothers of high-risk infants continued to report psychological distress (Singer, 1999). It is consistent with Tommiska, Östberg and Fellman (2002), who have found that most parents of prematurely born infants seem to have recovered from stress related to birth by the time the child has reached the age of 2. A low level of perceived control significantly correlates with depression (Aluoja, Leinsalu, Shlik, Vasar & Luuk, 2004), which could make mothers feel very insecure and worried about their role as a mother, which in turn could make them feel sadness. Although, situation like this could be caused by the impact of cognitive processes (attention, memory and most of all interpretation of a stressfull event) on the regulation of emotions (Joormann & D'Avanzato, 2010).

There are quite many researches on the subject how parents are feeling psychologically right after their babies are born. However little is known about the parents'emotional state and functioning during the months following the infants's discharge from the NICU (Olshtain-Mann & Auslander, 2008). Still, some researchers have found that parenting stress is predicted at both 2-3 months and even 2-3 years after childbirth by pregnancy related anxiety, depression, general anxiety and neuroticism (Saisto, Salmela-Aro, Nurmi & HalmesmAki, 2008).

Risk Factors of Maternal Stress

It is important to bring out the fact that it might not be the maternal recall of the severity of the infant's illness, but perceptions of severity are what matter and are related to anxiety and stress scores (Catlett, Miles & Holditch-Davis, 1994; Shields-Poe & Pinelli, 1997). Also the perception of stress and anxiety have more impact than the stressful event itself (Dozois & Dobson, 2004). Cronin et al. (1995) have found that the parents of VLBWIs experienced more impact when children had a functional handicap or low adaptive developmental quotient. The impact did not change over time. Length of time the infant was hospitalized during its first year of life, extreme prematurity and a cardiovascular diseases seems to be of significance (Dudek-Shriber, 2004; Stjernqvist 1992). Maternal depression is associated with ongoing infant illness (Vigod, Villegas, Dennis & Ross, 2010) and neurodevelopmental disability (Treyvaud et al., 2011). Singer et al. (1999) point out that child medical risk status, age and developmental outcome of the infant are some variables that impact VLBW birth, which impact parenting stress. Maternal depression is linked directly to lower infant birth weight, higher rates of malnutrition and diarrhoeal disease, infectious illness, hospital admission and decreased completion of recommended schedules of immunization in children (WHO, 2008). Depression is associated with earlier gestational age (Vigod, Villegas, Dennis & Ross, 2010). Although, in some researches it has been found that birth weight and gestational age are not associated with depressive symptoms (Davis et al., 2003). For families with very preterm children, parental mental health symptoms may also identify families at risk of greater stress (Treyvaud et al., 2011). High scores are also associated with low family income, less parental education and marital status (Cronin et al, 1995; Schepman et al., 2011; Tannous, Gigante, Fuchs & Busnello, 2008). Single women experience more stress as a new mother than married new mothers (Copeland & Harbaugh,

2005). The amount of children in the home and child interactive behavior predicted parental stress at 18 months (Brummelte, Grunau, Synnes, Whitfield, Petrie-Thomas, 2011). Depressive symptomatology is associated with educational status of mothers, indicating significantly higher depressive symptoms in primary education compared to mothers who have completed secondary education (Davis et al., 2003). Mental health problems do not only have a harmful affect on them, but it has a severe impact directly on their infant and on parenting an infant (Chiverton, 2007; WHO, 2008). There is a pathway of children's chronic illness affecting the mother's perceived health, which then affects the development of children (Lung, Shu, Chiang & Lin, 2010). If women are not able to take care of their baby, the survival and development of the infant is at risk (WHO, 2008) and there could be negative outcomes in the infant-mother relationship (Chiverton, 2007) and child's development. Along with parental mental health, perceived childcare pressure is another factor which continuously negatively affects it (Lung et al., 2010). Before the impact of maternal depression on developmental outcomes of children is discussed, we take a look at the overall development of preterm children.

The Development of Preterm Children

Researchers have found that children born prematurely bring along more problems compared to full-term controls. These problems include poor outcomes in motor function, visuomotor integrative skills, IQ, academic achievement, language, executive function, and attention-deficit hyperactivity disorder/behavioral issues (Aylward, 2005). Children who are born preterm report significantly lower cognitive scores compared with children born at-term (Bhutta, Cleves, Casey, Cradock, & Anand, 2002). Decreasing gestational age is positively associated with poorer parent-reported language skills at the age of 2 (corrected for gestational age at birth) (Foster-Cohen, Edgin, Champion & Woodward, 2007). In addition, there are cognitive deficits in spatial and non-verbal reasoning, perceptual-motor skills, memory and executive functioning (Orchinik et al., 2011). Poorer cognitive outcomes for children in the EPT group are associated with early childhood neurodevelopmental impairment and lower SES (Orchinik et al., 2011).

In some cases, outcomes of VLBW and ELBW children worsen as they become older (Aylward, 2002). 50-70% of children born extremely preterm have later school difficulties, despite their average IQ scores (Aylward, 2002; Lynn, Cuskelly,

O'Callaghan & Gray, 2011). In one study of 89 ELBW children, 52% were functioning in the normal range at age 4-years; however only 31% were normal at age 8 (Aylward, 2002). Preterm children do show accelerated rates of change in motor development over the first two years, however the change is not as evident in cognitive function (Aylward, 2002). In addition to poor outcomes in physical and cognitive health, preterm birth is also a major predictor of economic costs (Petrou et al., 2003).

Risk Factors for Developmental Outcomes of Children

Low birth weight is related to cognitive, linguistic, motor and social development (Sansavini, Rizzardi, Alessandroni & Giovanelli, 1996). Also, there appear to be gender differences in the outcome of preterm children. Boys are reported to have more behavioral problems and higher rates of disability (Aylward, 2002). Sex of the child is related to linguistic (communicative) and social development in the first two years of life (Sansavini et al., 1996), with girls ahead of boys (Prior, Bavin, Cini, Reilly, Bretherton, Wake & Eadie, 2008). Children who had breast milk compared to those who did not have it at all, were more likely to have higher scores on Bayley Mental Developmental Index, Bayley Psychomotor Developmental Index and higher scores for motor regulation (Vohr et al., 2006). Breastfeeding is linked to better social and cognitive outcomes for infants (Sohr-Preston & Scaramella, 2006). It is essential to ensure the growth, health and development of children (WHO, 2009). The combination of reduced infant feeding and maternal depression and anxiety predicts delays in infant social development (Galler, Harrison, Ramsey, Forde, Butler, 2000). Marital status has a large effect on cognitive development and it is to some extent mediated by family income and quality of the home environment (Bacharach & Baumeister, 1998). Some of the risk factors that slow cognitive development are lower class status, larger family size, lower maternal education and therefore weaker cognitive facilitation during interaction tasks (Fuller et al., 2010). Low parental education is also related to motor, cognitive, linguistic and social development (Sansavini et al., 1996).

Maternal Depression and Cognitive, Language, Motor and Social-Emotional Development

Maternal health affects negatively cognitive, motor, social, behavioural and emotional development of children (Galler et al., 2000; WHO, 2008). Severity of maternal depression is related to lower child developmental outcomes (Singer et al., 1999). It might be due to depression that interferes with mothers' capability to respond sensitively and consistently to their children and therefore, mothers are less able to meet their infants' emotional and physical needs (Sohr-Preston & Scaramella, 2006). There is a significant negative relationship between maternal moods, especially maternal depressive symptoms and cognitive development (Cornish et al., 2005; Galler et al., 2000). Children of mothers depressed after pregnancy are at increased risk for cognitive problems (Grace, Evindar & Stewart, 2003, Sohr-Preston & Scaramella, 2006, Vänskä et al, 2011). Mother's depression may interfere with their ability to use play and reading opportunities to extend child's cognitive and language skills (Sohr-Preston & Scaramella, 2006). Maternal health is also significantly associated with the language development (Mensah & Kiernan, 2010; Quevedo, Silva, Godoy, Jansen, Matos, Tavares Pinheiro & Pinheiro, 2012). Depressed mothers seem to use speech directed to infant less efficiently than nondepressed mothers (Sohr-Preston & Scaramella, 2006). Chronical maternal depression is associated with lower motor performance, and the effects are similar for boys and girls (Cornish et al., 2005). Althought, some researchers have found no significant effects of maternal depression on infant motor behaviour (Grace, Evindar & Stewart, 2003). Children of depressed mothers are also at risk for social and emotional difficulties (Sohr-Preston & Scaramella, 2006).

THE AIM OF THIS STUDY

The aims of the study were to investigate the mother´s emotional state after the birth of very preterm baby; to investigate the impact of prematurity and maternal health itself to the outcomes of child development and to investigate the impact of prematurity on maternal health. On the basis of previous studies we have full hypothesis:

1. It is expected that the mothers of very preterm infants have lower outcome figures on emotional state compared to the mothers of full-term infants right after baby's birth and after 2 years.

2. Secondly, it is expected that mother's emotional state is influenced by the infant's gestational age, birth weight, gender, severity of the illness, length of hospital stay, cognitive outcomes, age, marital status, education, family's income and number of children in the family. The influences are expected to be different in control group.
3. Thirdly, is is expected that mother's emotional state, factors concerning postnatal characteristics and demographic factors have an impact on children's development. The impact is expected to be different in control group.

METHODS

Subjects

The national study population (Figure 1) consisted of 187 VLGA infants (gestational age 22 to 31 weeks) born alive during a one-year period from 1 January to 21 December 2007 in Estonia, covering a population approximately 1.34 million and around 15 000 births per annum. From that group, 158 (84.5%) infants survived until discharge home. After discharge two more babies died before the corrected age of 24 months. 155 infants (99%) of those alive at the age of two years, had a follow-up assessment at the corrected age of 24 months as one family of a VLGA infant had moved away from Estonia. Because two questionnaires about mothers health were unfilled and two of the children lived with their father, they were eliminated from the study. The final number of children in the premature group was 151 (gestational age 22 to 31 weeks, M= 28.8, SD=2.1, 56.3% boys, 43.7% girls). Due to the fact that 38 babies were twins or triplets, one mother had died between the two assessments, one child lived in orphanage, it was down to 130 mothers (ages 17-44 years, M=31.3, SD=6.40), who fulfilled the questionnaires. Since there are no developmental norms currently available for healthy and born-at-term children two years of age, then a control group was recruited.

To each surviving VLGA infant, a full-term control infant was matched using the following inclusion criteria: 1) born at-term with a GA ≥37 weeks; 2) no requirement for medical care during the first week of life; 3) born in the same area of the country and of the same gender and nationality as the VLGA infant; 4) born next after the expected date of birth of the VLGA infant. 153 (98%) of the invited full-term

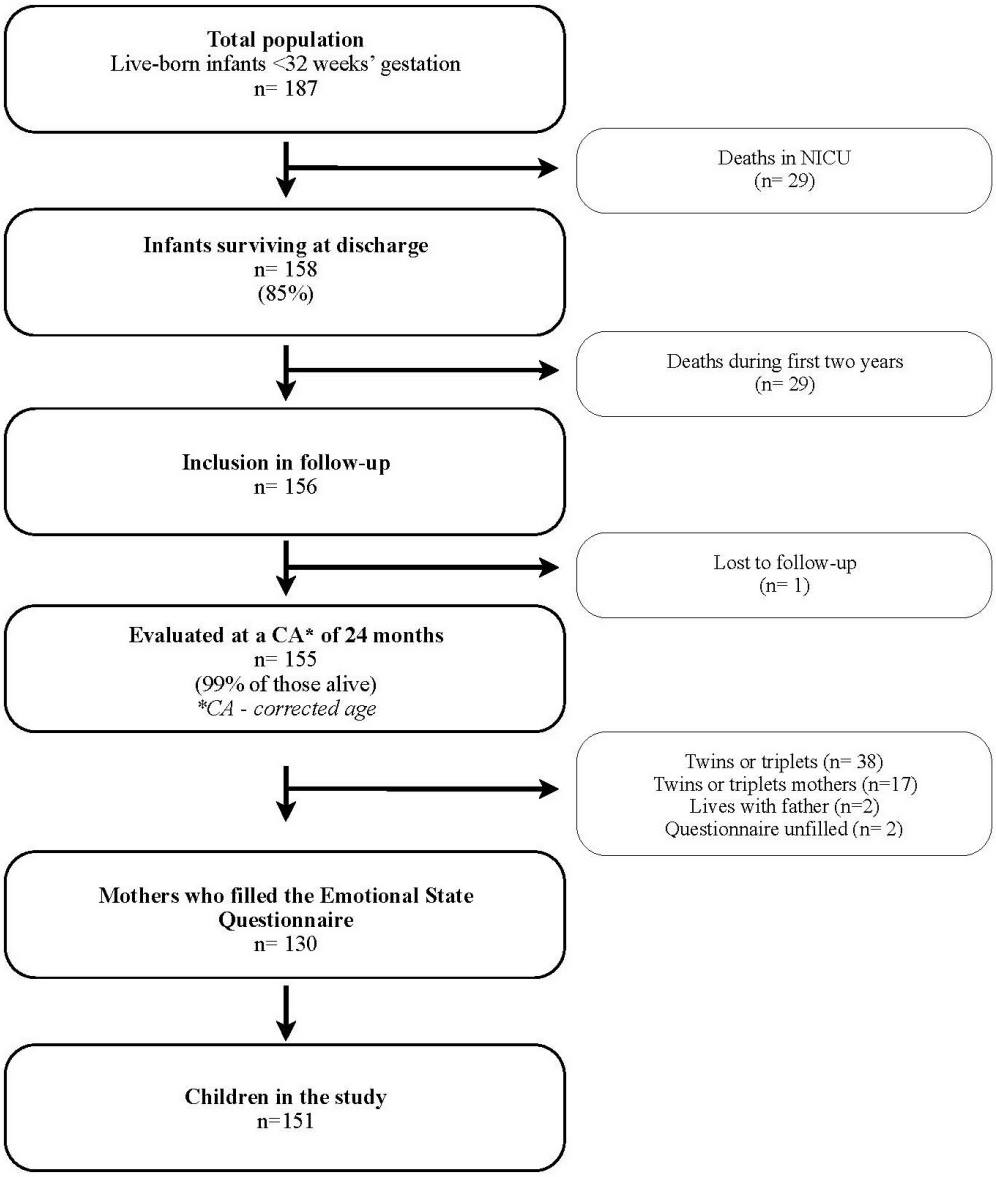

Figure 1. *Flow chart of the national survey in Estonia, recruitment January 1, 2007 to December 31, 2007*

controls were entered into the study. One infant with the diagnosis of congenital toxoplasmosis and another with congenital hypothyreosis, both diagnosed after the first week of life, were included in the analysis of the results. The questionnaire was unfilled by 4 mothers, whose children were also excluded from the study. The final number of children in control group was 149 (gestational age 37 to 42 weeks, M= 39.56, SD=1.19, 56.4% boys, 43.6% girls) and the number of mothers was 148 (ages 19-42 years, M=30.5, SD=4.75).

Procedure

The current study is part of a regional cohort study assessing the health and development of all the children born very premature before 32. weeks' gestation during 2007 in Estonia. The study was carried out from March 2009 to April 2010 at the Tallinn's Children Hospital and Tartu University Hospital's Children Clinic. It was approved by the Ethics Review Committee on Human Research of Tartu University and written informed consent was obtained from children's parents for participation in the study. Perinatal data on all VLGA infants were collected prospectively in the national neonatal research register. Data about length of hospital stay, neonatal disease and if children had breast milk after leaving the hospital were only detected for pemature group. The organization of perinatal care, the procedures for collection of study data, the criteria used for definitions, and the recent changes in care and short-term outcome for very preterm infants in Estonia have been published recently (Toome, Ringmets, Andresson, Ilmoja, Saik & Varendi, 2012).

Two-year follow-up assessment was also conducted. At the infants' age of corrected 24 (±1) months, families were invited to one of two respective centers for a comprehensive assessment by a pediatrician, a child neurologist, and a child psychologist. The examiners were aware of the prematurity versus full-term birth status of the infants. The assessment consisted of a physical examination, an assessment of development using the third edition of the Bayley Scales of Infant and Toddler Development (Bayley-III) (Bayley, 2006). Bayley-III provided age-standardized Cognitive, Language, and Motor Composite Scores with a mean (SD) score of 100 (±15). The infants who functioned below the lower limit of the test were included with a score of -4 SD. In addition, the demographic background information was assessed using the structured parental interviews. To investigate emotional state of the mothers of preamature and at-term infants, they had to answer to the questionnaire about how they felt 2 years ago in 2007 and at present time in 2009. My contribution to this thesis was to enter the data of Emotional State Questionnaire of 278 mothers, who fulfilled it.

Method

To participate in the study mothers had to fulfill two questionnaires about their emotional state and one about the social-emotional development of their children.

1. The Emotional State Questionnaire (EST-Q2) (Aluoja, Shlik, Vasar, Luuk & Leinsalu, 1999) was used to assess the emotional state of mothers from both groups (added in the Appendix 1). A new modification of EST-Q was created in 2002. Completing the Emotional State Questionnaire mothers rated their answers on a scale ranging from 0 - "not at all" to 4 – "all the time". There are five subsales of the questionnaire: depression (questions 1-8), anxiety (9-14), agoraphobia-panic (15-19), asthenia (22-25) and insomnia (26-28). There are also two questions about social anxiety (20-21). In this paper, social anxiety is referred to as a subscale. Mothers were asked to circle the number that best described their emotional state after the child was born in 2007 and how they were feeling after two years in 2009. The cut-off points for the subscales for defining substantial symptoms and the likelihood for disorder are: depression ≥ 12, anxiety ≥ 12 , agoraphobia-panic ≥ 7, asthenia ≥ 8 and insomnia ≥ 6. Questionnaires were handed out in Estonian and Russian.
2. Questions about children's social-emotional development (SE) were assessed with The Social-Emotional Scale of Bayley-III (Bayley, 2006). Completing the scale, mothers rated their answers on a scale ranging from 0-"can't tell" to 5-"all of the time". Mothers were asked to circle the number that best described how often they observe the behavior described in their child. If their child had not displayed the behavior they were asked to circle 0 for "can't tell". The scale is divided with stopping points for different age groups. Questionnaires were handed out in Estonian and Russian.
3. Cerebral palsy (CP) was defined and classified according to Surveillance of Cerebral Palsy in Europe collaborative group (SCPE, 2000) and the Gross Motor Function Classification System (GMFCS) (Palisano et al., 1997) was used to quantify motor function in infants with CP. The severity of impairments was defined as follows (modified from reference: BAPM, 2008): 1) normal development (no impairments detected in motor, cognitive, speech, hearing, and ophthalmological assessment); 2) mild neurodevelopmental disability (CP with GMFCS level 1, Cognitive and/or Language Composite Scores -1 SD to -2 SD below norm, near normal vision and hearing); 3) moderate neurodevelopmental disability (CP with GMFCS level 2, Cognitive and/or Language Composite Scores -2 SD to -3 SD below norm, hearing loss corrected with aids, vision moderately reduced but better than severe visual

impairment, or blind in one eye with good vision in the contralateral eye); 4) severe neurodevelopmental disability (CP with GMFCS level 3, 4 or 5, Cognitive and/or Language Composite Score <-3 SD below norm, no useful hearing even with aids, blind or can only perceive light or light reflecting objects). Developmental delay was calculated according to the Bayley-III original norms as well as to the full-term controls' means.

4. For statistical analyses SPSS 20 was used.

RESULTS

The distribution of mothers' demographics is presented in Table 1. Mothers of premature group included 65.4% Estonians, 33.1% Russians and 1.5% Ukrainians and Gypsies. Control group consisted of 70.9% Estonians, 28.4% Russians and only one, 0.7% was Ukrainian. VLGA infants were more likely to be from low income families and their parents were less likely to have a higher education. Majority of mothers, 53.8% in premature group had secondary education, compared to control group, that included 32.4% of mothers with secondary education. Almost the same gap appeared between higher education in premature group, consisting of 27.7% of mothers compared to the control group of 50.7% of mothers (one mother in premature group did not answer to the question about education). In both groups, majority of the mothers were married. Premature group included 46.9% and control group 50.7% of mothers. Approximately 40% of the mothers in both groups were in common-law marriage (3 mothers in premature group and 1 in control group did not answer to this question). The number of children in the household was quite similar between two groups, mothers having mainly one or two children. The biggest difference is seen in premature group, where 8.5% of mothers had three or more children (3-9) and only one mother (0.7%) had more than three children. Premature group mothers appeared to have more twins or triplets (13.1%) than control group mothers (0.7%).

Children's postnatal and demographic characteristics are presented in Table 2. VLGA infants had a significantly lower body weight when compared with full-term controls. Premature infants' birth weight varied from 430 to 2254 grams, compared to control group infants' birth weight, which varied from 2084 to 5034 grams. The mean difference in weight was 2266.5 grams. Neonatal disease was diagnosed in 44% of very preterm infants.

Table 1

Demographic characteristics of mothers of very premature infants (<32 gestational weeks) and their full-term controls.

	Premature group mothers	Control group mothers
Age	31.3 (6.4)	30.48 (4.7)
	(17-44 years)	(19-42 years)
Nationality		
Estonian	85	105
Russian	43	42
Other	2	1
Education		
Primary education	7	3
Incompleted secondary education	9	8
Secondary education	70	48
Incompleted higher education	7	14
Higher education	36	75
Marital status		
Single	17	14
Married	61	75
Common-law marriage	52	59
Income (per month)		
0.06-64 EUR	10	4
64-128 EUR	21	12
128-256 EUR	36	25
256- 383 EUR	30	48
383-639 EUR	21	25
>639 EUR	9	33
Number of children		
1	57	75
2	46	54
3	16	18
> 3	11	1
Births		
Single	113	147
Multiple	17	1

Note. Premature group, n=130; Control group, n=148. Mean (M) and standard deviation (SD, given in parenthesis) are calculated for age only.

Table 2

Postnatal and demographic characteristics of surviving VLGA infants (<32 gestational weeks) and their full-term controls.

	Premature group infants	Control group infants
Gestational age	28.8 (2.1)	39.6 (1.2)
Birth weigth	1325.4 (389.1)	3591.9 (453.6)
Boys	85	84
Girls	66	65
Neonatal disease		
Yes	67	0
No	84	0
Length of hospital stay	58.1 (32.4)	-
Duration of feeding with breastmilk	149.8 (175.8)	306.3 (213.7)

Note. Premature group, n= 151 infants; Control group, n=149 infants. Mean (M) and standard deviation (SD) are calculated for gestational age, birth weight, length of hospital stay and duration of feeding with breastmilk. SD is given in parentheses. '–' indicates that factor was not measured in control group.

Cerebral palsy was diagnosed in 11.3% of VLGA infants (Table 3). According to Bayley-III original norms, the proportions of VLGA infants at follow-up with normal development and with mild, moderate, or severe neurodevelopmental disability were 59.6%, 28.5%, 5.3%, and 6.6%, respectively. The proportions of full-term infants at follow-up with mild, moderate, or severe neurodevelopmental disability were 84.6%, 12.8%, 2.7%, and 0%, respectively. Therefore, 11.9% of the children in premature group had moderate (5.3%) or severe (6.6%) neurodevelopmental impairment. VLGA infants had significantly lower mean Cognitive, Language, and Motor Composite Scores compared to full-term controls. The difference between the two groups was not that big in social-emotional scores. Information about Bayley-III scores was not available for complete samples across measures, means are based on different sample sizes.

Table 3

Outcomes for very low gestational age infants and their full-term controls and Bayley-III composite and subtest scores for at two years corrected age for prematurity.

	Premature group infants	Control group infants
Cerebral palsy		
Yes	17	0
No	134	148
Bayley-III scores		
Cognitive Composite Score	95.1 (15.2)	103.1 (12.8)
Language Composite Score	89.0 (14.6)	95.7 (12.9)
Motor Composite Score	94.9 (18.0)	103.1 (13.6)
SE	104.3 (23.7)	105.9 (18.8)
Severity of impairment		
Normal	90	126
Mild	43	19
Moderate	8	4
Severe	10	0

Note. Premature group, n=151, Control group, n=149. Mean (M) and standard deviation (SD) are calculated for Bayley-III scores.

Premature and Control Group Mothers' EST-Q2 Scores

The mean differences in EST-Q2 scores in 2007 in both, premature and control group, are as follows: the highest scores of mothers' emotional state after birth appear in the subscales of anxiety (M=8.9, SD=5.3), depression (M=6.9, SD=6.7) and asthenia (M=5.9, SD=3.9). They also suffered from symptoms of insomnia (M=3.8, SD=3.2) and symptoms of agoraphobia-panic (M=1.4, SD=2.6). The lowest scores appear in social anxiety (M=0.8, SD=1.5). The total score for all the subscales was not as high as expected (M=27.3, SD=18.3). The mean differences in EST-Q2 scores measured in 2009 were smaller. The highest scores still appeared in the subscales of anxiety (M=6.4, SD=4.3), asthenia (M=4.7, SD=3.4) and depression (M=4.2, SD=4.3). Lower scores were found for insomnia (M=2.8, SD=2.6), social anxiety (M=0.7, SD=1.2) and agoraphobia-panic (M=0.8, SD=1.5). The total score for all the subscales of 2009

Table 4. *Mean differences in 2007 EST-Q2 scores and 2009 EST-Q2 scores between premature and control group: results of t-test.*

EST-Q2 scales	Premature group mothers						Control group mothers							
	2007			2009			2007			2009			2007	2009
	Min-Max	M	SD	Min-Max	M	SD	Min-Max	M	SD	Min-Max	M	SD	*t*	*t*
Depression	0-32	9.7	7.7	0-23	4.2	4.3	0-22	4.5	4.4	0-20	4.0	4.3	6.9***	0.3
Anxiety	0-24	9.9	5.8	0-21	6.3	4.6	0-22	8.0	4.8	0-16	6.6	4.0	2.9**	-0.6
Agoraphobia-panic	0-17	2.0	3.4	0-11	1.0	1.8	0-9	0.9	1.5	0-8	0.6	1.3	3.5***	1.6*
Social anxiety	0-8	1.1	1.7	0-8	0.7	1.3	0-6	0.7	1.2	0-13	0.7	1.1	2.5**	0.4
Asthenia	0-16	6.4	4.4	0-15	4.4	3.5	0-16	5.6	3.4	0-11	5.0	3.3	1.8***	-1.4
Insomnia	0-12	4.3	3.4	0-10	2.7	2.5	0-12	3.5	3.0	0-6	3.0	2.7	2.0	-0.6
EST-Q2 total score	0-96	32.8	21.6	0-80	18.5	14.2	0-57	22.6	13.4	0-55	19.7	12.8	4.5***	-0.7

Note. * $p<0.05$; ** $p<0.01$; *** $p<0.001$. Premature group, n=130; Control group, n=149. Min-Max= Minimum and maximum score; M= Mean; SD= Standard deviation; *t*-scores were calculated to compare premature group and control group mothers' emotional state in 2007; and to compare premature group and control group mothers' emotional state in 2009.

was lower compared to data measured in 2007 (M=19.2, SD=13.4).

The mean differences in emotional state between premature group and control group in both 2007 and 2009 were measured with *t*-test. The results are displayed in Table 4. The degrees of freedom (df) remained between 260 and 272. Values were calculated, comparing both groups' scores of 2007 and comparing the scores of 2009. It was found that the difference between total scores in 2007 was 10.2 points. Mothers of very premature infants report more depression symptoms than do mothers of infants born at-term measured in 2007, with the difference of 5.2 points. Higher scores on the subscales of the emotional state in 2007 for premature group also include anxiety, with a difference of 1.9 points and asthenia, with the difference of 0.8 points. Compared to previous subscales, premature group mothers show lower levels of symptoms on the subscales of agoraphobia-panic, with a gap of 1.1 points and 0.4 point difference in social anxiety. Insomnia appeared as statistically not significant. Emotional state measured 2 years after the birth is statistically significant only on the agoraphobia-panic subscale. Mothers of premature infants report higher scores than the mothers of control group on the agoraphobia-panic subscale, differing 0.4 points. Scores of premature group mothers still remain lower two years after the birth in 2009 than in year 2007. Also, control group mothers report lower scores on emotional state two years after the birth in 2009 than in year 2007.

EST-Q2 Scores (2009) for Mothers with Very Preterm Children Diagnosed with Normal or Mild and Moderate or Severe Neurodevelopmental Disability

Since there appeared no statistically significant differences in mothers emotional state measured in 2009 between premature and control group mothers, we decided to see if the difference was influenced by childrens neurodevelopmental disability (Table 5). Premature group mothers were divided by their children's neurodevelopmental disability. Two groups were formed: 1) children with normal or mild neurodevelopmental disability and 2) children with moderate or severe disability. Since only four children in control group had moderate impairment and no one was diagnosed with severe impairment all the mothers with children having normal, mild, moderate or severe impairment were included to the analysis. Degrees of freedom (df) remained between 149-162 in analysing normal or mild disability group with control group and between 233-258 when analysing moderate or severe group with control group.

Mothers of children with moderate or severe neurodevelopmental disability report higher scores in every subscale compared to mothers of children with normal or mild neurodevelopmental disability. The difference in depressive symptoms is 3.1 points and in anxiety symptoms 2 points. The total EST-Q2 scores for mothers of children with normal or mild impairment remains 2.1 points lower compared to scores of control group mothers. We were also interested if there is a significant difference between control group mothers' scores and scores of mothers, whose child is diagnosed with normal or mild neurodevelopmental disability. Also, the scores of mothers of children with moderate or severe neurodevelopmental disability were compare with the EST-Q2 scores of control group mothers. The difference for mothers of children with moderate or severe disability and control group appeared statistically significant in symptoms of social anxiety and EST-Q2 total score.

Table 5

Difference in EST-Q2 scores (2009) means for mothers with very preterm children diagnosed with normal and mild or moderate and severe neurodevelopmental disability.

	Premature group mothers						Control group mothers				
	Severity of impairment										
	Normal or mild			Moderate or severe			Normal, mild, moderate, severe			1	2
EST-Q2 scales	Min-Max	M	SD	Min-Max	M	SD	Min-Max	M	SD	*t*	*t*
Depression	0-18	3.8	3.8	1-23	6.9	6.5	0-20	4.0	4.3	- 0.3	2.3
Anxiety	0-20	6.0	4.4	0-21	8.0	5.6	0-16	6.6	4.0	-1.1	1.3
Agoraphobia-panic	0-11	0.9	1.8	0-5	1.3	1.5	0-8	0.6	1.3	1.2	2.0
Social anxiety	0-8	0.7	1.3	0-4	1.1	1.5	0-13	0.7	1.1	0.1	1.5*
Asthenia	0-15	4.3	3.5	0-13	5.1	3.6	0-11	5.0	3.3	-1.6	0.2
Insomnia	0-10	2.6	2.3	0-10	3.3	3.5	0-6	3.0	2.7	-0.9	0.5
EST-Q2 total score	0-80	17.6	13.3	2-61	24.9	18.3	0-55	19.7	12.8	-1.2	1.4*

Note. *p<0.05; Premature group: normal and mild, n=133; moderate and severe, n=18; Control group: normal, mild, moderate, severe, n=149. 1- *t*-test scores comparing control group mothers' scores with scores of premature group mothers' of children with normal or mild impairment.; *2- t*-test scores comparing control group mothers' scores with scores of premature group mothers' of children with moderate or severe impairment.

The Impact of EST-Q2 Scores about 2007, Gender and Prematurity on EST-Q2 Total Score about 2009

We used GLM univariate analyses to analyse if the EST-Q2 subscale scores about 2007, child's developmental outcomes, gender or prematurity have an impact on the total score measured in year 2009 with both groups taken together. The results are seen in Table 6. EST-Q2 total score is impacted by how mothers felt right after the birth. Social anxiety has the biggest impact on mothers' total EST-Q2 score in year 2009, describing 6%. There are some variations in the models used, although, social anxiety and asthenia remain statistically significant in both models. Prematurity remains significant in the first two models, describing 4%-5% of EST-Q2 total score.

Table 6

The effect of EST-Q2 scales (2007), Bayley-III scores, gender and prematurity on EST-Q2 total score (2009) in premature and control group mothers.

	Model 1			Model 2			Model 3		
	F	η^2	p	F	η^2	p	F	η^2	p
EST-Q2 scales									
Depression	4.2	0.02	0.041			0.158	-	-	-
Anxiety	7.0	0.03	0.009			0.053	-	-	-
Agoraphobia-panic			0.797			0.581	-	-	-
Social anxiety	12.8	0.06	0.001	8.9	0.05	0.003	-	-	-
Asthenia	9.9	0.04	0.002	9.7	0.05	0.002	-	-	-
Insomnia			0.254			0.269	-	-	-
Bayley-III scores									
Cognitive Composite Score	-	-	-			0.616			0.652
Language Composite Score	-	-	-			0.556			0.371
Motor Composite Score	-	-	-			0.373	7.0	0.03	0.009
SE	-	-	-	12.0	0.06	0.001	11.8	0.05	0.001
Gender			0.450			0.571			0.277
Prematurity	9.5	0.04	0.002	9.7	0.05	0.002			0.302

Note. n= 278; '–' indicates that factor was not measured.

When the subscales in the second model were replaced with the total score of EST-Q2 about 2007, it appeared statistically significant, explaining approximately 40% of mothers' health in 2009, $F(8, 183)= 111.8$, $\eta^2=0.38$, $p=0.0001$. When the premature and control group mothers were analysed separately, no major differences appeared.

There only difference emerged in the third model. Premature group's mothers' score was influenced by motor and SE development of the children compared to control group mothers, where merely a trend was suggested for SE (p=.062).

The Influence of Postnatal Characteristics and Infants' and Mothers' Demographics on EST-Q2 Total Scores about 2007 and 2009

Independent variables like gestational age, birth weight, length of hospital stay, neonatal disease and gender were analysed to find out their impact on EST-Q2 total score in 2007. Gestational age appeared as a statistically significant influence on mothers' EST-Q2 total score about 2007 in premature group only, $F(3,108)=6.3$, $\eta^2=0.055$, $p=0.013$. No statistically significant results were found for birth weight, length of hospital stay, neonatal disease or gender. Analysing factors' influence on the EST-Q2 total score measured in 2009, neonatal disease was replaced with severity of neurodevelopmental disability. Also, length of hospital stay was excluded from the analyses. It appeared, that severity of neurodevelopmental disability is related to EST-Q2 scores of mothers of VLGA infants, $F(9,104)=5.2$, $\eta^2=0.130$, $p=0.002$. No statistically significant results were found for gestational age, birth weight and gender.

Independent variables like mother's age, marital status, income and mother's education were analysed. There appeared no statistically significant demographic variables that influence the total EST-Q2 score about 2007 or 2009 comparing the groups separately. Although, there appeared a trend in the influence of mother's age ($p=0.062$) on total scores about 2007 in premature group. When the groups were analysed together, a trend was suggested in marital status ($p=0.054$) and income per person in the family appeared as significant when mother's education was excluded from the model, $F(18, 227)=2.4$, $\eta^2=0.049$, $p=0.041$. When the factor of number of children was added, it did not turn out to be statistically significant. Other factors were not statistically significant.

The Impact of EST-Q2 2009 Scores on Children's Developmental Outcomes

The impact of the subscales of EST-Q2 scores about 2009 on children's developmental outcomes were analysed (Table 7). Both groups were included into the analyses to see if prematurity has an effect on children's developmental outcomes. Although, it remains unclear if prematurity affects mothers' emotional state and if it in turn affects children's developmental outcome, or is this relationship direct.

Depression symptoms explain 2.4% for cognitive, 2.9% for social-emotional and 3.1% for language development. Cognitive development is described by 2.2% of symptoms of asthenia and 6.3% by prematurity. Language development is described by 1.8% of symptoms of asthenia, 3.2% by gender and only 0.06% by prematurity. Motor development is predicted only by 6.8% described by prematurity. In addition to depression, social-emotional development is influenced by 2.1% of social anxiety symptoms. When the subscale scores about 2009 were replaced with the total score about mothers' emotional state two years after the birth, it appeared as statistically significant for cognitive development ($F(4,245)=6.9$, $\eta^2=0.027$, $p=0.009$), language development ($F(4,244)=5.6$, $\eta^2=0.022$, $p=0.019$), motor development ($F(4,244)=14.6$, $\eta^2=0.056$, $p=0.0001$) and social-emotional development ($F(4,210)=15.8$, $\eta^2=0.070$, $p=0.0001$).

Table 7

The effect of EST-Q2 scales (2009), gender and prematurity on children's developmental outcomes in premature and control group children.

	Premature and control group children											
	Cognitive			Language			Motor			SE		
	F	η^2	p	F	η^2	P	F	η^2	p	F	η^2	p
EST-Q2 scales												
Depression	5.9	0.024	0.015	7.7	0.031	0.006			0.063	6.1	0.029	0.015
Anxiety			0.581			0.271			0.102			0.391
Agoraphobia-panic			0.450			0.150			0.426	7.8	0.036	0.006
Social anxiety			0.171			0.946			0.261	4.4	0.021	0.038
Asthenia	5.3	0.022	0.022	6.0	0.024	0.015			0.072			0.743
Insomnia			0.555			0.651			0.706			0.622
Gender			0.100	7.8	0.032	0.006			0.396			0.762
Prematurity	16.1	0.063	0.000	9.7	0.002	0.039	17.5	0.068	0.000			0.692

Note. n=300

When the groups were compared separately, it appeared that depression symptoms of preterm infants' mothers have an impact on cognitive ($F(7,106)=6.1$,

η^2=0.055, p=0.015), language (F(7,106)=6.3, η^2=0.056, p=0.013) and social-emotional development (F(7,93)=5.4, η^2=0.055, p=0.022). Social-emotional development is also influenced by premature group mothers' agoraphobia-panic symptoms, F(7,93)=4.3, η^2=0.044, p=0.042. Gender was statistically important in premature group for language development, F(7,106)=5.9, η^2=0.053, p=0.017. In control group, only asthenia was a significant factor related merely for cognitive development, F(7,128)=4.0, η^2=0.030, p=0.047.

The Impact of EST-Q2 2009 Scores of Mothers of VLGA Children with Normal or Mild Developmental Disability on Children's Developmental Outcomes

The relationship between EST-Q2 scores and children developmental outcomes appeared only in language development, where symptoms of agoraphobia-panic explain 5.4% and symptoms of social anxiety explain 4.3% of language development of children with normal or mild neurodevelopmental disability (Table 8). EST-Q2 total scores had an impact on motor development, F(1,97)=4.6, η^2=0.045, p=0.035, and for social-emotional development, F(1,85)=6.6, η^2=0.072, p=0.012.

Table 8

The impact of EST-Q2 2009 scores of mothers of VLGA children with normal or mild developmental disability on children's developmental outcomes.

	Children with normal or mild neurodevelopmental disability											
	Cognitive			Language			Motor			SE		
EST-Q2 scales	F	η^2	p	F	η^2	P	F	η^2	p	F	η^2	p
Depression			0.744			0.361			0.822			0.555
Anxiety			0.691			0.134			0.186			0.673
Agoraphobia-panic			0.272	5.2	0.054	0.025			0.102			0.074
Social anxiety			0.793	4.1	0.043	0.045			0.444			1.000
Asthenia			0.739			0.097			0.547			0.729
Insomnia			0.491			0.075			0.108			0.368

Note. n=133

The Impact of EST-Q2 2009 Scores of Mothers of VLGA Children with Moderate or Severe Developmental Disability on Children's Developmental Outcomes

The relationship between EST-Q2 scores and children developmental outcomes appeared in cognitive, language and social-emotional development (Table 9). Depressive symptoms describe 52.3% of cognitive development of children with moderate or severe neurodevelopmental disability, 51.6% for language development and 46.7% for social-emotional development. Language development is also explained by 50.3% of anxiety symptoms and 46.4% of agoraphobia-panic symptoms. Social anxiety explains 49.3% of social-emotional development of children with moderate or severe neurodevelopmental disability. EST-Q2 total score did not appear as statistically significant in influencing children's developmental outcomes.

Table 9

The impact of EST-Q2 2009 scores of mothers of VLGA children with normal or mild developmental disability on children's developmental outcomes.

	Children with moderate or severe neurodevelopmental disability											
	Cognitive			Language			Motor			SE		
EST-Q2 scales	F	η^2	p	F	η^2	P	F	η^2	p	F	η^2	p
Depression	8.8	0.523	0.018	8.5	0.516	0.019			0.152	6.1	0.467	0.042
Anxiety			0.078	8.1	0.503	0.022			0.709			0.170
Agoraphobia-panic			0.061	6.9	0.464	0.030			0.558			0.178
Social anxiety			0.343			0.510			0.214	6.8	0.493	0.035
Asthenia			0.458			0.683			0.418			0.273
Insomnia			0.878			0.553			0.681			0.141

Note. n=18

The Impact of EST-Q2 2009 Scores of Control Group Mothers on Children's Developmental Outcomes

In control group, the relationship between EST-Q2 scores and children developmental outcomes (n=149) appeared in cognitive development (Table 10). Symptoms of asthenia describe 3% of language outcomes of full-term infants, $F(1,112)=4.0$,

η^2=0.030, p=0.047. Also, control group children's social-emotional development is 4.7% influenced by the total score of EST-Q2, F(1,112)=5.5, η^2=0.047, p=0.020

The Influence of Postnatal Characteristics and Infants' and Mothers' Demographics on Children's Developmental Outcomes.

Duration of feeding with breast milk is an important factor in describing children's developmental outcomes in premature group (Table 10). Social-emotional development is 5.2% explained by duration of feeding with breastmilk, motor development by 3.2%, cognitive development by 3.1% and language development by 2.8%. No statistically significant results emerged in control group, except for motor development, that is 6.8% explained by duration of feeding with breastmilk. Severity of impairment was statistically significant in both groups and for every developmental outcome, except in social-emotional development in control group. Severity of impairment describes 12.7%-59.2% of children's developmental outcomes in premature group and 12.2%-33.6% in control group. Gender appeared statistically importand in premature group, describing 4% of language development. No statistically significant results were found in gestational age and birth weight.

Also, demographic variables like mother's age, marital status, income, mother's education, nationality, number of children in the family and multiple child factor were of interest. Age of a mother of VLGA infant has an influence on child's social-emotional development, F(59,66)=5.3, η^2=0.074, p=0.024. Control group mothers' marital status has an impact on language development, F(65,81)=5.3, η^2=0.116, p=0.007, and on social-emotional development, F(60,61)=5.7, η^2=0.157, p=0.005. Control group mothers' income per person in the family has an influence on language development, F(65,81)=2.4, η^2=0.127, p=0.047. A trend is suggested for nationality (p=0.052) that could have an influence on language development for control group children. When income was left out from the analyses, control group mothers' education became a signifiant factor for language F(25,122)=3.1, η^2=0.089, p=0.021, and motor development, F(25,122)=2.8, η^2=0.084, p=0.030. Control group mothers' marital status has an influence on children's social-emotional development, F(24,98)=4.7, η^2=0.088, p=0.011. VLGA infants motor development is influenced by the fact if there appeared multiple birth, F(33,116)=4.3, η^2=0.036, p=0.040. Also, a trend is suggested for age of mothers of VLGA infants (p=0.056).

Table 10. *The impact of postnatal and demographic characteristics on developmental outcomes for very low gestational age infants and their full-term controls.*

	Premature group infants												Control group infants											
	Cognitive			Language			Motor			SE			Cognitive			Language			Motor			SE		
	F	η²	p	F	η²	p	F	η²	p	F	η²	p	F	η²	p	F	η²	p	F	η²	p	F	η²	p
GA			0.222			0.195			0.816			0.874			0.100			0.388	4.7	0.033	0.031			0.861
BW			0.062			0.248			0.115			0.931			0.534			0.667			0.528			0.953
BM	4.5	0.031	0.035	4.1	0.028	0.046	4.6	0.032	0.034	6.6	0.052	0.011			0.076			0.396	10.2	0.068	0.002			0.074
IMP	52.9	0.533	0.000	47.3	0.505	0.000	67.3	0.592	0.000	5.8	0.127	0.001	16.3	0.189	0.000	35.2	0.336	0.000	9.6	0.122	0.000			0.288
Gender			0.517	5.6	0.040	0.017			0.492			0.967			0.945			0.869			0.184			0.939

Note. Premature group, n=151; Control group, n=149
GA- Gestational Age; BW- Birth weight; BM- Duration of feeding with breastmilk; IMP- Severity of impairment.

DISCUSSION

The comparison of mothers of very low gestational age infants with their full-term controls, indicated that mothers of premature infants report significantly higher scores on depressive, anxiety, agoraphobia-panic and asthenia scores after giving birth. The difference between the study and control group was not statistically significant only referring insomnia and social anxiety. Our results accord with studies also showing that mothers of very premature children report higher percentages of depressive symptoms (52%) than mothers of full-term infants (Davis et al., 2003; Treyvaud et al., 2010) and have more psychological stress (Singer et al., 1999). They feel lower levels of perceived control (Aluoja et al., 2004), which could be due to specific disabilities that prematurely born children are at risk. Our findings contribute to the argument that most parents of prematurely born infants seem to have recovered from birth-related stress well by the time the child is two years old (Tommiska, Östberg & Fellman, 2002). We found that the EST-Q2 scores about the emotional state two years after the birth equalized, remaining no statistically significant differences, except agoraphobia-panic, between the study and control group. We thought it was important to compare premature group mothers' emotional state scores in two groups to see if it changes the results of previous analyses. We divided the groups in two: 1) mothers whose children have normal or mild neurodevelopmental disability and 2) mothers whose children have moderate or severe neurodevelopmental disability. The results indicated that mothers of children with moderate or severe impairment report higher depressive and anxiety symptoms compared to mothers of children with normal or mild development and control group two years after birth. The effect was confirmed, since those children are diagnosed with cerebral palsy, have very low cognitive and/or language composite scores, hearing loss, moderately reduced vision, blindness in one eye or blind in both eyes. Mothers experience more impact of stress, when children have a functional handicap or low developmental quotient (Cronin et al., 1995). As regards to the first hypothesis, mothers of very preterm infants have lower outcome figures on emotional state scales compared to the mothers of full-term infants after birth.

Secondly, it was hypothesized that mother's emotional state is influenced by infant's postnatal and infant's and mother's demographic characteristics. Our study found that both group mothers' emotional state when the child was two years old is described by how they felt after birth. Also, very important contributor in describing EST-Q2 scores about 2009 is prematurity, which is in concordance with what was

discussed earlier. Our findings also partitally contribute to the argument that children's developmental outcomes are related to mother's stress (Cronin et al., 1995). Our results indicate that only social-emotional development of the child contributes to the EST-Q2 total score and also motor development, when the EST-Q2 subscales of 2007 were not included in the analysis. Neurodevelopmental impairment is an important factor in describing prematurely born children's mothers' emotional state, which concurs with study by Treyvaud et al. (2011), where they found that neurodevelopmental disability identifies families at risk of greater stress. Consistent with Vigod et al. (2010) we found that prematurely born infants' mothers' emotional state after the birth is explained by infant's gestational age. When comparing premature group's and control group's mothers together, it appeared that income per person in the family has a relationship with mothers' emotional state two years after the birth (Tannous et al., 2008). The result could be explained through preterm birth, which is a major predictor of economic costs (Petrou et al., 2003).

Based on previous finding, we were also interested if mother's emotional state and infant's postnatal characteristics have an impact on child's cognitive, language, motor and social-emotional development at the age of two years. Our results revealed important findings that mother's depression symptoms when the child was two years old, describes cognitive, language and also social-emotional development of the child. Although, mothers overall emotional state has an influence on cognitive, language, social-emotional and motor developmental outcomes. These results accord with Singer et al. (1999), who found that maternal depression is related to lower child developmental outcomes. It might be due to depression that interferes with mothers' capability to respond sensitively and consistently to their children and therefore, mothers are less able to meet their infants' emotional and physical needs (Sohr-Preston & Scaramella, 2006). For example, mother's depression may interfere with their ability to use play and reading opportunities to extend children's cognitive and language skills (Sohr-Preston & Scaramella, 2006). Our results revealed that language development is also affected by the symptoms of asthenia experienced after birth. Both language and cognitive development are influenced by asthenia measured two years after birth. Agoraphobia-panic symptoms and scores of two questions about social anxiety measured in 2009 have an impact on children's social-emotional development. These findings agree with previous researches stating that maternal health problems overall affect negatively cognitive, language, motor and social-

emotional development of children (Galler et al., 2000; WHO, 2008). Gender is an important factor connected to children's language development. As it has been found in previous studies, prematurity is to some extent responsible for children's cognitive, language and motor development. This finding is supported by many other researchers, who have verified that preterm children bring along more problems compared to children born at-term. These problems include poor outcomes in motor function, visuomotor integrative skills, language, IQ and behavioral issues (Aylward, 2005) and neurodevelopmental disabilities. Although, it remains uncertain if prematurity is perhaps a mediator in the relationship between mothers' emotional state and children's developmental outcomes. Being born prematurely brings along the possibility for several diseases and impairments that could influence mothers emotional state that in turn has an impact on children's developmental outcomes.

It was expected that depressive symptoms of mothers of very preterm children with normal or mild neurodevelopmental disability have greater influence on children's developmental outcomes compared to mothers of very preterm children with moderate or severe neurodevelopmental disability. Depressive symptoms describe approximately 50% of children's developmental outcomes, except motor development, with moderate or severe neurodevelopmental disability. The results were surprising, because it was thought that mother whose child has a moderate or severe disability or mental retardation cannot influence their children's developmental outcomes (even when she has no depressive symptoms and remains positive). Although, they did report higher symptoms than mothers of children with no disability or with mild disability. However, the relationship seemed to be the other way around from what was expected. Several studies have found that chronical illnesses and/or developmental diasbilities, for example neurodevelopmental disability (Treyvaud et al., 2011) and cardiovascular diseases (Dudek-Shriber, 2004) affect mothers perceived health, which in turn affects the development of children (Lung, Shu, Chiang & Lin, 2010). It is important to interpret these analyses as relationships between two factors, because we cannot be entirely certain which factor exactly is responsible for predicting another factor. Further analyses are needed to explain these relationships.

Another important factor describing child's development is feeding with breast milk. It is connected to cognitive, language, motor and social-emotional developmental outcomes in children born with very low gestational age and influence

on motor development in full-term infants (Sohr-Preston & Scaramella, 2006, Vohr et al., 2006). WHO (2009) has stated that feeding with breast milk is essential to ensure the growth, health and development of children. For the current study, it was found that the severity of neurodevelopmental disability is significantly connected with developmental outcomes in children. It predicted 13%-59% cognitive, language and motor development for both groups' children and social-emotional development only in very premature children. The percentages were higher in premature group. Interestingly, gender played a significant role only in premature group and in the outcomes of language development. It is in concordance with a study (Sansavini et al., 1996) stating the relationship between the sex of the child and linguistic development in the first two years of life. The same study reported also a relationship between gender and social development, however our study did not find any statistically significant connections between these two factors. Our results also did not completely concur with studies showing that low birth weight is related to cognitive, language, motor and social development (Sansavini et al., 1996). Although, gestational age is related to motor development of infants born at-term. Our results are in concordance with the finding that mothers' education has an influence on language and motor development (Sansavini, Rizzardi, Alessandroni & Giovanelli, 1996).

Limitations and Further Implications

It is difficult to have all the mothers fulfill questionnaires right after birth. There are not enough resources for it. One way to do it, is to answer the questions retrospectively. In this study, this method was used and it is therefore important to interpret these findings with caution, since the emotional state about how mothers felt after birth was assessed two years after it. Also, it is difficult if not impossible to obtain reliable and valid measures about young children's development from children themselves. Most frequently parent-report measures are used. In the current study (and in all studies using The Social-Emotional Scale of Bayley-III), mothers themselves assessed their children's social-emotional development and therefore the scores might be biased as the result of social desirability. Also, there are yet no Estonian norms for Bayley-III scales. The strong point of this research is that all the children were examined by pediatrician, a child neurologist, and child psychologist for valid results. Many mothers had handwritten notes on their questionnaires, for

example claiming that sleep difficulties were due to the fact that their children were awake. In future studies, a formal assessment of external sources of life stressors could be included to provide a clearer picture of maternal depression. Furthermore, the analyses demonstrate that use of the selected variables in univariate analyses can be problematic when the model includes a moderate to large number of correlated variables as predictors.

Conclusion

Mothers of very preterm infants report significantly higher scores of maternal depressive symptoms after birth than mothers of term born infants. Depressive symptoms after the birth and two years after it are significant in describing children's lower cognitive, language, motor, social-emotional development. This study suggests the need for broader recognition on mothers' emotional state and specifically on depression symptoms. Findings highlight the need to identify and support mothers of children born very preterm with mental health problems.

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Appendix 1

Emotsionaalse enesetunde küsimustik **EEK-2**

*Nimi*_____ *Sugu* ____ *Vanus*____/____ *Kuupäev* _____/_____/_____

Lugege tähelepanelikult läbi alltoodud loetelu probleemidest ja vaevustest, mis võivad inimestel mõnikord esineda. Tõmmake ring ümber sellele vastusevariandile, mis kõige paremini kirjeldab seda, KUIVÕRD SEE PROBLEEM ON TEID HÄIRINUD VIIMASE KUU VÄLTEL.

	Üldse mitte	**Harva**	**Mõni-kord**	**Sageli**	**Pide-valt**
1. Kurvameelsus	0	1	2	3	4
2. Huvi kadumine	0	1	2	3	4
3. Alaväärsustunne	0	1	2	3	4
4. Enesesüüdistused	0	1	2	3	4
5. Korduvad surma- või enesetapumõtted	0	1	2	3	4
6. Üksildustunne	0	1	2	3	4
7. Lootusetus tuleviku suhtes	0	1	2	3	4
8. Võimetus rõõmu tunda	0	1	2	3	4
9. Kiire ärritumine või vihastamine	0	1	2	3	4
10. Ärevuse- või hirmutunne	0	1	2	3	4
11. Pingetunne või võimetus lõdvestuda	0	1	2	3	4
12. Liigne muretsemine paljude asjade pärast	0	1	2	3	4
13. Rahutus või kärsitus, nii et ei suuda paigal püsida	0	1	2	3	4
14. Kergesti ehmumine	0	1	2	3	4
15. Äkilised paanikahood, mille ajal esinevad südamekloppimine, õhupuudus, minestamis-tunne või muud hirmutavad kehalised nähud	0	1	2	3	4
16. Kartus viibida üksi kodust eemal	0	1	2	3	4
17. Hirmutunne avalikes kohtades või tänavatel	0	1	2	3	4
18. Kartus minestada rahva hulgas	0	1	2	3	4
19. Kartus sõita bussi, trammi, rongi või autoga	0	1	2	3	4
20. Hirm olla tähelepanu keskpunktis	0	1	2	3	4
21. Hirm suhtlemisel võõraste inimestega	0	1	2	3	4
22. Loidus- või väsimustunne	0	1	2	3	4
23. Vähenenud tähelepanu- või keskendumisvõime	0	1	2	3	4
24. Puhkamine ei taasta jõudu	0	1	2	3	4
25. Kiire väsimine	0	1	2	3	4
26. Uinumisraskused	0	1	2	3	4
27. Rahutu või katkendlik uni	0	1	2	3	4
28. Liigvarajane ärkamine	0	1	2	3	4

Käesolevaga kinnitan, et olen korrektselt viidanud kõigile oma töös kasutatud teiste autorite poolt loodud kirjalikele töödele, lausetele, mõtetele, ideedele või andmetele.

Olen nõus oma töö avaldamisega Tartu Ülikooli digittaalarhiivis DSpace.

Eleri Viinalass