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Long term follow-up study of preterm born children: How neuropsychological outcome at the age of 9 predicts educational and occupational outcome as well as psychological welfare at the age of 30?

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ABSTRACT

Objective: In this prospective long-term follow-up study, preterm born infants were followed into adulthood. We examined the effects of preterm birth on neuropsychological outcome at the age of 9 and further survey how preterm birth and the neuropsychological outcome associated with the educational and occupational outcome as well as psychological wellbeing at the age of 30. The study also sought to inspect if difficulties in neuropsychological outcome at the age of 9 were differently associated with educational and occupational outcome later in life among preterm born children compared to controls. Finally, the study examined whether there is a linear association between gestational weeks and neuropsychological outcome.

Methods: This study is part of a larger follow up study: The Perinatal Adverse events and Special Trends In Cognitive Trajectory (PLASTICITY). Participants were 88 individuals with birth weight 2000g or less (LBW-group) and 71 controls born 1971-1974 in Kätilöopisto Maternity Hospital, in Helsinki. All participants went through neuropsychological assessment at the age of nine followed by a questionnaire at the age 30 including questions about education, work history, health and possible disabilities.

Results: LBW group had poorer WISC performance in childhood, lower average grades of high school diploma, lower educational status and poorer health status in adulthood compared to controls. Poor test performance in WISC was associated with lower educational but not occupational status similarly in both groups. There was a weak positive correlation between both the WISC performance, and the average grades of high school diploma, and gestational weeks. However, this correlation vanished in both comparisons with LBW group only.

Conclusions: Overall LBW individuals without grave neurological disability seem to be doing quite well at adulthood and they seem to have overcome early disadvantages related to LBW and possible prematurity. It is however important to clinically follow preterm individuals in childhood to recognize those at risk for suboptimal development later in life.

Keywords:

long-term, follow-up, preterm, low birth weight, neuropsychological, cognition, educational, occupational

INTRODUCTION

In Finland approximately 5% of children are born before gestational week 37 and about 4% of all children born in Finland weight less than 2500g. These numbers are equivalent in all Nordic countries and have stayed roughly the same since 1970s (THL: Pohjoismaiset perinataalitilastot 2014). WHO defines birth before 37 weeks as preterm, with moderate preterm birth 32-<34 weeks, late preterm birth 34-<37 weeks, very preterm birth in weeks 28-<32 and extremely preterm birth as under 28 weeks (WHO, 2012). Other way to categorize preterm birth is via birth weight, with low birth weight defined as less than 2500g, very low birth weight less than 1500g and extremely low birth weight less than 1000 g (WHO, 2006). Both categorizations are useful in the study of preterm born children. Duration of pregnancy is nowadays defined by ultrasound which is far more reliable method than maternal recall of last menstrual cycle (Lee et al. 2017). Before ultrasound preterm birth could be assessed also by birth weight. Due to the development of neonatology in 1980s and 1990s mortality and morbidity rates of very low birth weight infants have decreased markedly (Horbar et al., 2002) and there has also been great increase in the births of late preterm infants from 1980's to the beginning of 21st century (Raju et al. 2006). In 1990s surfactants and antenatal steroids were started to be used as a part of the treatment of preterm infants (Lehtonen, 2009). For a long time one of the most important objectives in the treatment of preterm infants was lung maturation (Lehtonen, 2009). Today preterm infant care concentrates more on protecting the brain, because it has long term consequences for the infant's future.

Preterm infant's brain is highly susceptible to adverse events like peri- and neonatal brain injury (Deng, 2010). The most common neuropathology in preterm infants is white matter injury (WMI) (Rees and Inder, 2005). The etiology behind WMI is thought to be multifactorial, but hypoxia, ischemia and inflammation are thought to be the most likely causes (Deng, 2010). Typical consequence of this type of injury is periventricular leukomalacia (PVL) with typical components of focal and diffuse white matter injury (Volpe, 2009). Although the risk for PVL is more elevated for more immature infants, there is also a risk for PVL with moderate to late preterm infants and PVL can go undiagnosed in this group (Laptook, 2013). In association with PVL, neuronal loss in thalamus, basal ganglia and cerebellum has been observed (Volpe, 2009). There is evidence that longer gestation benefits brain development by increasing gray matter density (Davis et al. 2011). As a consequence of a preterm birth, alterations in the cortical structures can be found at school age (Rogers et al., 2014) and aberrant brain network connectivity observed at school age and even in adulthood (Bäuml et al., 2014; Nagy et al., 2003). The cognitive deficits observed in preterm children later in life are likely related to the adverse brain development early in life (Volpe, 2009).

Children born preterm score lower on cognitive tests and have elevated risk for ADHD compared to term born children and the degree of immaturity is associated with reduced cognitive scores (Bhutta et al., 2002). Preterm children have lower overall neuropsychological profiles but there is also great diversity in the profiles (Lundequist, Böhm and Smedler, 2013). Preterm children have reported to show difficulties in attention and executive functions (Mulder et al., 2009) and this may affect their school performance, education and employment opportunities later in life even if their overall cognitive performance is within normal range. Verbal abilities are relatively intact in preterm born children and they usually do not complain everyday memory difficulties (Lundequist, et al., 2013) but there is evidence of difficulties in spatial location memory (Baron et al., 2010). Visual-motor development can also be compromised in this group (Böhm, Lundequist and Smedler, 2010). The educational performance of the preterm children is also worse than term born children as a group (Botting et al., 1998) and this might be the consequence of the observed neuropsychological difficulties.

Many studies of the neurodevelopmental outcome are of very or extremely low birth weight infants or very premature infants. However, there is less knowledge about late preterm infants and their neurodevelopmental outcome (Stephens and Vohr, 2009). Because the majority of preterm infants are born late preterm, there might be potential for public health concerns, if their development is suboptimal. There is evidence that gestational age and birth weight are directly proportional to the cognitive performance at school age (Bhutta et al., 2002), so that late preterm born children succeed better than very premature born children, but worse than term born children. Late preterm infants have been observed to have lower general conceptual ability, lower verbal, nonverbal, spatial, visuomotor scores and lower adaptability than full term born children at age of 3 years (Baron et al., 2014). At school age moderately preterm and late-preterm born children have more special education needs than full-term children (Chyi et al., 2008). Late preterm birth is associated with increased risk for medical problems like diabetes, asthma, cerebral palsy and subtle neuropsychological weaknesses (Baron et al., 2012) with implication that there might be need for special education and other kinds of intervention later in life. In recent meta-analysis (Allotey et al., 2018) concluded that any degree of prematurity can have negative effect on cognitive performance and that effect persists through school age. Even though very preterm born children are at the greater risk for cognitive difficulties, late and moderate prematurity also carry a risk for suboptimal cognitive development.

There are few longitudinal follow-up studies of preterm infants that trail the developmental path into adulthood. These studies are often about very preterm born infants. Very few of the studies are prospective follow-up studies but cross-sectional cohort studies. According to Swedish national cohort study of preterm born infants, preterm birth was associated with higher risk of disability, lower income and lower chance of higher education in adulthood (Lindström et al., 2007). Rather surprising was the finding that moderate and late preterm birth carried significantly increased risk for disability and covered 74% of all disability among preterm group (Lindström et al., 2007). In another national cohort study from Norway, there was also elevated risk for medical disability and lower educational status associated with preterm birth (Moster, Lie & Markestad, 2008). These social and medical risks were associated with decreasing gestational age (Moster, Lie & Markestad, 2008). In a long term follow up study very preterm born children were reported to have different personality styles in young adulthood compared to term born children (Allin et al., 2014) which might indicate risk for psychiatric problems. On the other hand, despite the medical and educational problems preterm born children have equivalent quality of life as term born children in young adulthood (Cooke, 2004).

This study is a prospective longitudinal follow-up where the developmental path of preterm born infants has been followed late into adulthood. The aim is to examine the effects of preterm birth on neuropsychological outcome at the age of 9 and further survey how preterm birth and the neuropsychological outcome is associated with the educational and occupational outcome as well as psychological wellbeing at the age of 30. The study also seeks to inspect if difficulties in neuropsychological outcome at the age of 9 are differently associated with educational and occupational outcome later in life in preterm born children compared to controls. Finally, the study examines whether there is a linear association between gestational weeks and neuropsychological outcome.

METHODS

Participants

This study is part of a larger follow-up study, the Perinatal Adverse events and Special Trends In Cognitive Trajectory (PLASTICITY), where the developmental path of children with certain pre- and perinatal risks are being followed late into adulthood (Hokkanen, Launes & Michelsson, 2013). The study cohort comprised of a consecutive serie of 1196 infants from total of 22359 infants born alive 1971-1974 in Kätilöopisto Maternity Hospital, in Helsinki (Michelsson, Ylinen, Saarnivaara, & Donner, 1978). Infants with any of the following risks were included: low birth weight (2000g or less), neurological symptoms, severe respiratory problems, Apgar score < 7 at the age of 5 or 15 minutes, hyperbilirubinemia, hypoglycemia, septic infections or maternal diabetes. Children with severe consequences, such as cerebral palsy, mental retardation or sensory disabilities, were excluded from follow-up. Of the 324 infants with birth weight at or below 2000 g during the study period, 86 died and 22 had severe disabilities by the age of 5 (Michelsson, Lindahl, Parre, & Helenius, 1984; Michelsson & Noronen, 1983). Of the 216 children included in the follow-up, 128 participated in the neuropsychological assessment at 9 years. Majority of these LBW children (88%) were born preterm (Michelsson & Noronen, 1983) and the rest possibly born preterm, because gestational weeks were only approximation before ultrasound. There are 159 participants who went through neuropsychological assessment at the age 9 and filled out a questionnaire at the age of 30. They form the sample of the present study. Of those 88 were children with birth weight 2000g or less (LBW-group) and 71 with no perinatal risks (Control group) (Table 1.).

Background Information

Information collected at birth included maternal background variables and extended perinatal medical variables. For the purposes of present study, we concentrated on maternal background variables including age of the mother, maternal diabetes, toxemia, anemia and high blood pressure, because of their possible impact on later development. None of the pregnancies had involved infertility treatment.

The family socioeconomic status at age 9 was estimated using 5-level classification, 1 indicating the highest and 5 the lowest level, based on the occupation of the father (or mother, in cases of a single caretaker). Family psychosocial problems score at age 9 included items for poor housing conditions, divorce, relocations, alcohol abuse, unemployment, family conflicts, domestic violence, imprisonment, severe diseases or mental problems in family, summed, max score 50.

Table 1. Sex distribution, birth weight and gestational weeks

	LBW n=88	Control n=71
Sex (males)	42% (37)	43.7% (31)
Birth weight (g)		
Mean (SD)	1699 (269)	3451 (525)
Min-Max	900-2000	2300-4700
Gestational weeks		
Mean (SD)	33 (2.9)	39 (1.4)
Min-Max	25-40	35-42

Neuropsychological Assessment

At the age of 9 children went through neuropsychological assessment as part of the study. Neuropsychological assessment included several tests reported in detail in Hokkanen, Launes and Michelsson (2013), but in the present study we only included Wechsler Intelligence Scale for Children (WISC) test results (Wechsler, 1949; Wechsler, 1971).

Outcome Questionnaire

At the age of 30 a questionnaire was sent to study participants. The questionnaire included questions about education, work history, health and possible disabilities. The question for education had originally six categories: comprehensive school, matriculation, trade school, college, university, doctoral. It was modified to involve three categories: comprehensive school only, college-level and university level. Learning difficulties were assessed originally with separate questions for reading, spelling, speech, mathematics, motor and visuospatial difficulties. They were transformed into one dichotomized variable for any self-reported learning difficulties, yes/no. Employment was assessed originally with a question of eight categories: full time employment, part time employment, hourly employed, unemployed, studying, sick leave, retired, retirement due illness, other. Question was transformed into a dichotomized variable of: employed at the moment, yes/no. Health status was originally 5-scale question: How do you estimate your health at the moment? very good, good, moderate, poor, very poor. It was transformed into 3-scale variable: good, moderate, poor. Symptoms of illness variable was gathered from ten questions assessing psychological and possibly psychosomatic symptoms including: headache, intestinal problems, depression, manic-depression, schizophrenia, obsessive-compulsive thoughts, panic symptoms, anxiety, sleeping disorders and suicidal thoughts. All the symptoms were assessed by dichotomized scale of yes/no. These questions were modified into sum variable assessed by 3-scale: no symptoms, one symptom, two or more symptoms. Life-satisfaction was originally 5-scale question: How satisfied are you with your life-situation? With options of very satisfied, satisfied, partly satisfied, not very satisfied, not at all satisfied. It was transformed into dichotomized variable: satisfied/not satisfied.

Statistical Methods

LBW group and control group were compared for background information and demographics, WISC performance at 9, and questionnaire items at 30 years of age. Categorical variables were analyzed using a Chi-square test for independence, with

Yates Continuity Correction when necessary. Continuous variables were analyzed using an independent samples t-test (two-tailed). Effect sizes were reported using phi in relation to chi-square comparisons and Eta squared in relation to ANOVA.

In order to study the association between neuropsychological performance at the age of 9 and outcome at the age of 30, participants were divided into two groups according to their performance-level on WISC with lowest 25 percentiles in the other group and the rest in the other.

The relationship between WISC total IQ at the age of 9 and birth weight, as well as the average grades of high school diploma and birth weight, were investigated using Pearson product-moment correlation. Preliminary analysis was performed to ensure no violation of normality, linearity and homoscedasticity.

RESULTS

Background Variables

Maternal variables which may have affected the health status of the newborn were compared between LBW and control group. There was no significant difference in maternal age between LBW children (M= 25.9, SD= 4.9) and controls (M= 26.7, SD= 4.6; t(134)= .907, p= .366). Groups did not differ in other maternal variables either (Table 2.). Because maternal diabetes was one of the inclusion criteria for study group, none in the control group did have it. Groups did not differ in father's socioeconomic status at the age of nine years [$\chi 2$ (3, n=142) = 1.435, p= .697, phi= .101] or the socioeconomic status scores [LBW M = 3.36, SD = 2.38, controls M = 3.32, SD = 2.69; t(147)= -.103, p= .608].

Neuropsychological Performance at the Age of 9

There was a significant difference in the total IQ scores (mean difference= 8.65, 95% CI: 4.75 to 12.54), verbal IQ scores (mean difference= 7.50, 95% CI: 3.65 to 11.36) and performance IQ scores (mean difference= 8.22, 95% CI: 3.82 to 12.62) between premature children and control group (Table 3.).

School Performance

There was a significant difference in the average grades of high school diploma between the LBW-group (M= 7.9, SD= .80) and controls (M= 8.4, SD= .86; t(152)= 3.81, p= .000). The magnitude of the difference in the means (mean difference= .51, 95% CI: .25 to .78) was moderate (eta squared = .087).

Outcome at the Age of 30

Self-reported education status, learning difficulties, employment status, health status, symptoms of illness and life satisfaction were compared between LBW-group and controls (Table 4.). There was a significant association between LBW and lower education status and worse self-rated health status at the age of 30 years, compared to the control group. For other variables the associations were not statistically significant.

Table 2. Maternal background variables at birth

		LBW		Control		χ2	p	phi
		n	%	n	%			
Diabetes						.00	1.00	.058
	Yes	1	1.1	0	0.0			
	No	87	98.9	37	100			
Blood Pressure						1.016	.313	.110
	Yes	26	29.5	7	18.9			
	No	62	70.5	30	81.1			
Toxemia						3.652	.056	.190
	Yes	31	35.2	6	16.2			
	No	57	64.8	31	83.8			
Anemia						.153	.695	.075
	Yes	6	6.8	1	2.9			
	No	82	93.2	33	97.1			

Table 3. WISC results at the age of 9 (mean and SD) and the statistical comparisons between the groups. Significant differences bolded.

	LBW n= 88	Control n= 71	p-value	Eta squared
IQ total	111.9 (12.5)	120.5 (12.1)	**<.001**	**.109**
IQ verbal	109.4 (12.3)	116.9 (12.1)	**<.001**	**.086**
IQ performance	112.2 (13.7)	120.4 (13.5)	**<.001**	**.080**

Table 4. Results from Outcome-Questionnaire at the age of 30. Significant differences bolded.

		LBW n= 88	Control n= 71	χ2	p-value	phi
Education				7.41	**.007**	**-.238**
	University-level	40.3% (27)	59.7% (40)			
	College-level	60.3% (41)	36.5% (23)			
	Comphrehensive school	0% (0)	0% (0)			
Learning Difficulties		25.0% (22)	12.9% (9)	2.92	.088	.152
Unemployment		20.7% (18)	18.3% (13)	.030	.862	.030
Health				9.46	**.009**	**.244**
	Good	28.4% (25)	52.1% (37)			
	Moderate	61.4% (54)	39.4% (28)			
	Poor	10.2% (9)	8.5% (6)			
Symptoms				1.77	.413	.106
	No	27.7% (44)	27.0% (43)			
	1	34.1% (30)	26.8% (19)			
	>1	15.9% (14)	12.7% (9)			
Life Dissatisfaction		35.6% (31)	21.1% (15)	3.31	.069	.159

Association Between Neuropsychological Performance at the Age of 9 and Outcome at the Age of 30

There was a significant association between the performance-level on WISC at the age of 9 and educational status at the age of 30 both in the LBW-group (Table 5.) and controls (Table 6.). There was no significant association between the performance-level and employment at the age of 30 in either group.

Neuropsychological Performance and Gestational Weeks

There was a positive correlation between neuropsychological performance at the age of 9 and gestational weeks, $r= .25$, $n= 159$, $p< .001$, with better performance on WISC at age of 9 associated with more gestational weeks (Figure 1.). With LBW children only, the correlation was not significant $r= -.077$, $n= 88$, $p= .48$.

There was a positive correlation between the average grades of high school diploma and gestational weeks, $r= .22$, $n= 159$, $p< .01$ (Figure 2.), with higher average grades associated with more gestational weeks. With LBW children only the correlation was not significant $r= -.022$, $n= 88$, $p= .84$.

DISCUSSION

The aim of this study was to examine the effects of LBW on neuropsychological outcome at the age of 9, and to the educational and occupational outcome as well as psychological wellbeing at the age of 30. A second aim was to inspect if difficulties in neuropsychological performance at the age of 9 are differently associated with educational and occupational outcome later in life in LBW children compared to controls. Finally, the study examines whether there is a linear association between gestational weeks and neuropsychological outcome. The results indicated that LBW group had poorer WISC performance in childhood, lower average grades of high school diploma, lower educational status and poorer health status in adulthood compared to controls. Poor test performance in WISC was found to be associated with lower educational but not occupational status similarly in both groups. There was a weak positive correlation between both the WISC performance, and the average grades of high school diploma, and gestational weeks. However, this correlation vanished in both comparisons with LBW group only.

Table 5. Neuropsychological performance-level and education-level and employment in LBW-group. Significant differences bolded

		0-25% % (n)	>25% % (n)	χ2	p	phi
Education				9.81	**.002**	**-.41**
	University-level	9.5 (2)	46.8 (22)			
	College-level	90.5 (19)	53.2 (25)			
	Comphrehensive	0.0 (0)	0.0 (0)			
Employment				.00	1.00	-.03
	Yes	80.6 (25)	78.6 (44)			
	No	19.4 (6)	21.4 (12)			

Table 6. Neuropsychological performance-level and education-level and employment in controls. Significant differences bolded.

		0-25% % (n)	>25% % (n)	χ2	p	phi
Education				4.16	**.041**	**-.30**
	University-level	30.0 (3)	69.8 (37)			
	College-level	70.0 (7)	30.2 (16)			
	Comphrehensive	0.0 (0)	0.0 (0)			
Employment				3.56	0.59	.27
	Yes	58.3 (7)	86.4. (51)			
	No	41.7 (5)	13.6 (8)			

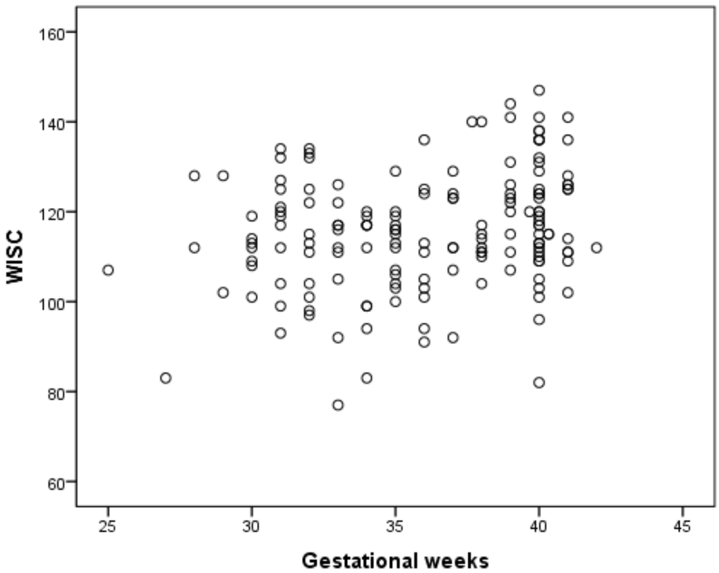

Figure 1. *Total IQ and gestational weeks*

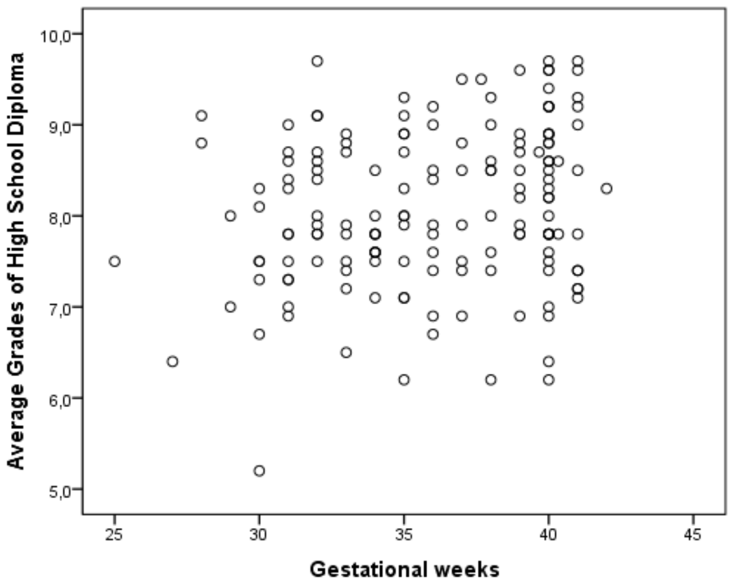

Figure 2. *Average Grades of High School Diploma and Gestational weeks*

Cognitive Performance at the Age 9

In our study LBW children had lower cognitive overall ability than controls at the age of nine years. This finding is in line with previous studies showing lower cognitive performance in preterm born children (Allotey et al., 2017; Baron et al., 2014). LBW children scored slightly worse in WISC than controls, the mean difference between LBW and control group being 7.5-8.6 points, which is clinically small but meaningful difference. However, LBW children's performance was on average at normal age level. The good performance of LBW children in WISC most likely reflects the fact that we excluded children with grave neurological disabilities from our study. The results from neuropsychological assessment indicate on average slightly worse starting point for later school years for LBW group.

School Performance

LBW children had lower average grades of high school diploma than controls and the difference was quite significant (0.5). On the average LBW group did quite good (7.9) on the scale of 4-10. There was a similar trend in school performance at high school than in cognitive performance at the age of nine: There was a small but significant disadvantage for the LBW group in average. This is in line with previous studies indicating that gestational age and birth weight are directly proportional to the cognitive performance at school age (Bhutta et al. 2002) and this disadvantage in cognition might show as worse performance at the high school.

Outcome at the Age of 30

LBW group had lower educational status than control group. This finding is in line with evidence in previous studies indicating lower educational status at school age and lower probability for university education in preterm born children (Chan et al., 2016; Lindström et al., 2007; Moster, Lie & Markestad, 2008). This is consistent with worse performance in high school leading to lower educational status later in life. However, in this present study LBW group did not report more learning difficulties at the age of 30. This might mean that possible learning difficulties have ameliorated, or they do not affect current life anymore. There is also a possibility that people do not recognize their learning difficulties. Self-reports are considered reliable for identifying learning problems like dyslexia but usually the questions do not directly concern about learning difficulties but background factors influencing them (Tamboer & Vorst, 2015). There was also no difference between employment status of the groups, which fit with the finding that preterm born individuals have almost equal chances of being employed than term born, when children with grave neurological findings are excluded (Lindström et al. 2007).

LBW individuals reported poorer health status compared to controls. This is in line with a finding of poorer health related quality of life in preterm born individuals as adults compared to term born controls (Båtsvik et al., 2015). However, LBW group did not differ from controls in the number of symptoms of illness related to psychological wellbeing or life satisfaction. This finding is line with evidence that indicate that risk for mood, anxiety or substance use disorder as adult did not differ between late preterm born children and term born children (Heinonen et al., 2016). According to our findings, LBW group perceived their health status worse than controls but the worse health did not stem from symptoms related to psychological wellbeing.

Association Between Neuropsychological Performance at the Age of 9 and Outcome at the Age of 30

The poor test performance on WISC at the age of nine was associated with lower educational status at the age of 30 in both groups. Cognitive performance as measured with IQ, has been found to be very stable in preterm born children and from 6 years of age predicts performance late into adulthood (Breeman et al. 2015). There has also been found to be strong correlation between IQ at first school years and later academic achievement (Bornstein, Hahn & Wolke, 2013). However, the test performance at the age of nine was not associated with employment indicating that other factors like current life situation might also influence employment status. Cognitive overall performance seems to be quite good indicator of later educational achievement but not for employment.

Neuropsychological Performance and Gestational Weeks

There was a weak correlation between gestational weeks and cognitive performance or average grades of high school diploma with more gestational weeks associated with better neuropsychological performance and better grades. However, this association vanished with LBW-group only. This was quite surprising considering the evidence that degree of prematurity is associated with negative effects on cognition (Allotey et al. 2017). This might be partly explained by rather high mean and narrow distribution of gestational weeks among LBW-group. By choosing the gestational weeks instead of birth weight, we tried to have wider distribution in LBW-group and in that way have the effect of the degree of prematurity visible, but that did not happen. With the development of neonatology, the survival of very and extremely low birth weight infants has been increasing (Horbar et al., 2002) compared to 70's. For example, in our LBW-group, there were only two extremely preterm infants born before gestational week 28, so the effects of extremely premature birth was not present in our sample.

Limitations

In our study cohort the prematurity was based on birth weight (LBW-group), because before the ultrasound the exact measuring of gestational weeks based on maternal recall was imprecise (Lee et al. 2017). However, because of our choice of inclusion based on birth weight, it is likely that not all the children in LBW-group were preterm. According to gestational weeks, 88% of the children in our study were preterm, but some of the children might have been small for gestational age (SGA) with birth weight under two standard deviations below average. SGA has also been associated with cognitive difficulties later in life, for example attentional difficulties (Murray et al. 2016). Even though it is not very likely, some of the participants in the LBW-group might have actually been children with SGA and shown the adverse effects of suboptimal intrauterine growth later in life. This is something that must be kept in mind when considering the application of the results for preterm population.

The follow-up time of this study was very long, meaning that many were lost to follow-up. We did not analyze non-responders, but there is evidence that non-responders might represent those who fare worse than those who participate in the study (Hille et al. 2005; Wolke et al. 2009). When the attrition rates of this study cohort were analyzed, it has been found that attrition was associated with lower socioeconomic status (Launes et al. 2014). This could mean that individuals with worse educational and occupational status have dropped out of study and this might lower the difference between LBW and control groups. Evidence toward this is the fact that no-one in our study had only comprehensive school as education, all had at least secondary education.

In our study the data at the age of 30 was based on self-report only. There is a possibility that the questionnaire did not capture the difficulties associated to prematurity at birth. To fully capture the existence of learning difficulties, there should have been a neuropsychological assessment. For example, Lindström's et al. study (2007) was register based. In register-based studies you have verified data for example of employment status, income and marital status, but many aspects and details of the population are lost. So best way to increase the value of our research for this study cohort is to add neuropsychological assessment to the questionnaires. In the future there will be data available of extensive neuropsychological assessment of this study population and then it will be possible to better analyze the cognitive outcome abilities of this population.

Conclusion

In general, our findings indicate some risks for cognitive and educational outcome and health status associated with LBW and preterm birth. Overall LBW individuals without grave neurological disability seem to be doing quite well at adulthood and they seem to have overcome early disadvantages related to LBW and possible prematurity. Although prematurity is associated with many neurocognitive risks that can have profound effects for adult life, the majority of preterm born children are doing well later in life (Lindström et al., 2007). It is however important to clinically follow preterm individuals in childhood to recognize those at risk for suboptimal development later in life.

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