Behavioural and emotional problems and physical activity in early school-age children born preterm

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A thesis submitted by
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in partial fulfilment of the requirements for the degree of
Master of Science in Psychology
Umeå University
June, 2017
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Abbreviations

PT Preterm
FT Full term
EPT Extremely Preterm
VPT Very Preterm
MPT Moderate Preterm
GA Gestational Age
BW Birth Weight
PA Physical Activity
CBCL Child Behaviour Checklist
Behavioural and emotional problems and physical activity in early school-age children born preterm

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The aim of this study was to investigate the associations and differences regarding behaviour- and emotional problems and physical activity (PA) in early school-age children born preterm in comparison to children born full term. The sample consisted of 131 children at age 6-9 (mean age 7.8, including 54 % girls). The participants were divided into four groups depending on weeks of gestational age (GA): extremely preterm (EPT; 22-27 weeks), very preterm (VPT; 28-33 weeks), moderate preterm (MPT; 34-37 weeks) and the control group born at full term (FT; 38-42 weeks). The data were received from parent’s ratings on the questionnaire Child Behaviour Checklist (CBCL). The result showed that children born EPT were rated as having significantly more symptoms of depression, ADHD and conduct disorders, compared to the children born VPT, MPT and FT. The children born EPT also participated more in individual sports rather than team sports and in particular for those children with high ratings on ADHD Scale and Oppositional Defiant Scale. In conclusion, children born EPT seem to have more symptoms on behavioural and emotional problems and therefore more attention is needed to define appropriate interventions for this group to prevent and treat these problems. Even though PA didn’t manifestly decrease with lower GA in this sample it’s likely that bigger differences will show when the children grow older and more investigations are needed to examine the impact of PA among children born PT.

Keywords: preterm, children, emotional problems, behavioural problems, physical activity, CBCL.
The frequency of premature births has been fairly constant in Sweden for the last decade and in 2015, 5.8% of all living births were preterm (PT; <37 weeks of gestation) (Socialstyrelsen, 2015). Children born PT has been associated with increased risks for behavioural problems, as well as higher prevalence of psychiatric disorders (Johnson & Marlow, 2014; de Jong, Verhoeven & van Baar., 2012). The risk of psychiatric diseases at the age of 7 years has been estimated to three times bigger among very preterm (VPT; children born < 30 weeks of gestational age (GA) or had a birth weight (BW) < 1250g) compared to full term (FT) children (Treyvaud et al., 2013). Georgsdottir, Haraldsson & Dagbjartssons (2013) study showed that when extremely low BW (<1000g) children survivors grew into teenagers, they and their parents reported more behavioural difficulties than those FT. Also, Lo, Lee, Luna & Feldman (2011), showed more behavioural difficulties for PT children (24-36 weeks of GA) than for FT children at age 9-16. A study conducted in Sweden found that, when at 11 years of age, children born extremely preterm (EPT; <26 weeks of GA) were rated, both by parents and teachers, as having more difficulties than FT children, both regarding internalizing, attention and somatic problems (Farooqi, 2007). Hence, findings regarding internalizing and attention problems goes in line with the outcomes from a systematic review and meta-analysis including 41 articles (Mathewson et al., 2017). The study also showed that children, 5-11 year, born at extremely low BW (< 1000 g) or EPT (<28 weeks of GA) were at greater risk of developing conduct problems, oppositional problems and externalizing symptoms (Mathewson et al., 2017). The result differs from earlier studies, which showed no high rates of externalizing behaviour such as delinquency and aggression for PT children compared to PT children (Farooqi, 2007) and no difference for conduct disorders (Treyvaud et al., 2013). Significant higher prevalence for internalizing symptoms such as depression and anxiety among children born PT when at school age compared to FT born peers, were shown by a meta-analysis, included 16 studies focusing on behavioural problems (Bhutta, Cleves, Casey, Cradock & Anand, 2002). According to Rogers et al. (2014) PT children born at 34-36 weeks of GA showed more anxiety symptoms than PT children, when investigated at age 5-12 years. Additionally, Treyvaud et al. (2013) found that for VPT children born < 30 weeks of GA or with BW < 1250g, anxiety syndromes were the most common diagnoses at age 7. Other studies have shown that PT children at school age showed more attention difficulties, and diagnosis of ADHD than did FT (Bul & Van baar, 2012; Johnson et al., 2010). Van de Weijer-Bergsma, Wijnroks and Jongmans (2008) review, including 26 studies, showed that PT infants had more trouble with executive attention and less sustained attention compared to FT, and as the children reached preschool age the attention problems seemed to become more apparent. Attention difficulties (e.g. ADD and ADHD), which are overrepresented among PT children in early school age, has shown to have a negative impact on school achievement (Jaekel, Wolke & Bartmann, 2013).

Outcomes from a longitudinal study showed that PT children born between the gestational age-range of 27-34, showed more somatic problems than those born at term, both in childhood, later adolescence and early adulthood (Tideman, Ley, Jerre & Forslunds, 2001). Also, Klassen et al. (2004) found that EPT children (<27 GA) had lower scores on physical ability, both compared to less PT children and healthy FT children. Poole et al. (2015b) showed that children with extremely low BW (<1000g) were at higher risk than normal BW children for problems with motor coordination in childhood and that these problems continued even in their mid-30s. Furthermore, Poole et al. (2015a) found that motor coordination difficulties in childhood correlated with depression and anxiety later in life. Young adults and adolescents born PT participated less in physical activity (PA) than did peers born FT (Dahan-Oliel, Mazer & Majnemer, 2012; Saigal et al., 2007). Also, Dahan-Oliel et al. (2014) found that participation in PA for PT adolescents, born <20 GA, were not very frequent and less than what’s recommended by North American guidelines. In contrast, differences in PA between PT and FT have not been found for children 5-11 years (Dahan-Oliel et al., 2012). In addition, Tikanmaki et al. (2016) found that young adults born PT self-rated themselves as to be less fit than did the control groups, even though there were no differences found on cardiorespiratory exercise. The same study revealed that young adults born both early and late PT, was found to have lower muscular fitness than the control group. Also, a study conducted in Sweden found that parents to children born EPT (<26 weeks of GA), rated their children significantly below average in sport performance (Farooqi, 2007). Actually, PA has a multitude of secondary health effects and has been given more attention in the intervention literature lately (Fite & Vitulano, 2011).

A longitudinal study, which followed children from 6 to 8 years of age, showed that moderate to vigorous PA predict fewer depressive symptoms two years later, and therefore suggested that
PA can be used as part of method to prevent childhood depression (Zahl, Steinsbekk & Wichstrøm, 2017). The results from a recent review, including eight studies, showed that PA for older adults were associated with decreased anxiety (Mochcovitch, Deslandes, Freire, Garcia & Nardi, 2016). Another review by Stonerock, Hoffman, Smith and Blumenthal (2015), including 12 RCT studies and 5 meta-analyses conclude that PA can be a helpful treatment for adult anxiety even though more research is needed to ensure its effectiveness. PA has also shown to have beneficial effect on several areas of dysfunction among symptoms and impairments of ADHD, according a review including eight studies (Hoza, Martin, Pirog & Shoulbergs, 2016). Even though further research in the area is needed, reviews by Hoza et al. (2016) and Reeves and Bailey (2016) state that PA intervention may be used to weaken symptoms of ADHD. In addition, PA has been associated with less proactive aggression (Fite & Vitulano, 2011) and Nelson and Gordon-Larsen (2006) found that adolescents participating in PA were less likely to take part in risk behaviours, such as delinquency.

In general, the research findings have steadily shown that PT children are associated with more psychiatric and behavioural problems such as anxiety, attention problems and depression than FT children. Furthermore, increasing PA has been positively associated with less depression and anxiety, as well as less symptoms of ADHD and some symptoms of conduct disorder. However, there is still a lack of research on whether PA associates with oppositional defiant disorder and somatic disorders. Moreover, so far, most studies have focused on children born with a very low birth weight or very preterm (VPT). Few have investigated whether different behavioural problems might be associated with different GA. There is also a lack of knowledge regarding extent and quality of PA among PT children differ from FT children, and particularly at younger ages and at early school-age. Therefore, it is important to evaluate the implications of different GAs when investigate the association of PA and behavioural and emotional problems.

The main aim of this study is to investigate the associations and differences regarding behaviour and emotional problems and PA in early school-age children born PT in comparison to children born FT. Based on previous theories and empirical findings we expect to find a negative association between behavioural and emotional problems and a decreasing GA for the PT born children. Furthermore, we expect to find an association between decreasing PA and aggregate amount and severity of behavioural problems and that these problems may also interact with GA in the group of children born PT.

Method

Participants

The data where received from a quasi-longitudinal ongoing research project at the Department of Psychology, University of Umeå (PI: L Rönnqvist). The project is studying the associations between the development of and deviations in the brain as well as sensory motor, cognitive, and behavioural functions, in children born PT, and in comparison, to children born FT. All participating children were born at the maternal unit, or transported to the neonatal unit (i.e. some of the children born PT), at Norrland’s University Hospital in Umeå. The control group were children born FT matched with the PT regarding sex and age. The participants included in this study consisted of 131 children in total and tested when at their early school-age; mean age 7.8 (range 6.2-8.8 years). For the analyses, the children were divided into four groups: 67 control born at term (29 girls and 38 boys, GA > 37-42 weeks), 14 EPT (6 girls and 8 boys, GA: 23-27 weeks), 17 VPT (5 girls and 12 boys, GA: 28-33 weeks) and 33 moderate preterm (MPT, 14 girls and 19 boys, GA: 34-36 weeks). For participant’s demographics, see table 1.
Table 1
Description of the participants (mean and range: min-max), birth weight (BW), gestational age (GA), and age of testing.

<table>
<thead>
<tr>
<th>Measure</th>
<th>EPT (N = 14)</th>
<th></th>
<th></th>
<th>VPT (N = 17)</th>
<th></th>
<th></th>
<th>MPT (N = 32)</th>
<th></th>
<th></th>
<th>FT (N = 67)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Min-Max</td>
<td></td>
<td>Mean</td>
<td>Min-Max</td>
<td></td>
<td>Mean</td>
<td>Min-Max</td>
<td></td>
<td>Mean</td>
<td>Min-Max</td>
</tr>
<tr>
<td>GA</td>
<td>26.0</td>
<td>22.9-27.4</td>
<td></td>
<td>30.8</td>
<td>28.3-33.1</td>
<td></td>
<td>34.3</td>
<td>33.4-35.4</td>
<td></td>
<td>40.3</td>
<td>38.0-41.9</td>
</tr>
<tr>
<td>BW</td>
<td>764.1</td>
<td>404-992</td>
<td></td>
<td>1519.9</td>
<td>1054-2371</td>
<td></td>
<td>2256.9</td>
<td>1367-3484</td>
<td></td>
<td>3702.9</td>
<td>2910-4790</td>
</tr>
<tr>
<td>Age at testing</td>
<td>7.5</td>
<td>7.0-8.2</td>
<td></td>
<td>7.9</td>
<td>6.2-8.7</td>
<td></td>
<td>7.8</td>
<td>6.3-8.8</td>
<td></td>
<td>7.9</td>
<td>6.2-8.8</td>
</tr>
</tbody>
</table>

Note: EPT = extremely preterm, VPT = very preterm, MPT = moderate preterm, FT = full term, BW = birth weight, GA = gestational age

Instrument

The instrument Child Behaviour Check List (CBCL) is a questionnaire made for caregivers to complete about the child 6-18 years and is a well-used measurement of child psychopathology (Achenbach & Rescorla, 2001). The results of the questionnaire can be converted to six DSM-oriented scales, which are based on the congruity between the problem items and the DSM diagnostic categories (Achenbach & Rescorla, 2001). The DSM-oriented scales, based on the criteria of the Diagnostic and the Statistical Manual of the Mental Disorders, fourth edition, revises (DSM-IV-R): affective disorder (10 items), anxiety disorders (6 items), ADHD (13 items), conduct disorder (13 items), oppositional defiant disorder (5 items) and somatic disorders (7 items) (Achenbach & Rescorla, 2001). A higher score reflects parent's report of greater presence and severity of symptoms in the child or youth. T-scores > 69 (Scales Related to DSM-IV Disorders) indicate clinically significant concerns (Achenbach & Rescorla, 2001). The DSM-oriented scales have a significant correspondence with related DSM-IV diagnoses (Bellina et al., 2013), though according to Achenbach and Rescorla (2001), DSM itself need to be consulted to settle a DSM diagnosis for the child.

Nakamura, Ebesutani, Bernstein and Chorpita (2009) describe the DSM-oriented scales as follow: Affective Problem Scale includes Dysthymic and Major Depressive Disorders. The Anxiety Problem Scale includes Generalized Anxiety Disorder, Separation Anxiety Disorder and Specific Phobia. The Attention/Deficit/Hyperactivity Problem Scale includes Hyperactive-Impulsive and Inattentive subtypes. The Conduct Problem Scale include Conduct Disorder, the Oppositional Defiant Problem Scale include Oppositional Defiant Problems and Somatic Problem Scale include Somatization and Somatoform.

The instrument has been studied psychometrically where the overall test - retest reliability has been established as rs = 0.95 and the internal consistency (Cronbach’s alpha) varies between 0.78 and 0.97 (Achenbach & Rescorla, 2001). The DSM-oriented scales also showed a high reliability through the test-retest with a mean rs = .88 and the internal consistency (Cronbach’s alpha) ranged from .72 to .91 (Achenbach & Rescorla, 2001). Content validity as well as criterion related validity of the scales is strongly supported (Achenbach & Rescorla, 2001). Also, Nakamura et al. (2009) showed support for the reliability and validity for the DSM-oriented scales for youth. Parents answers on CBCL have been shown to correspond on most DSM-oriented scales with the children’s answer on Youth Self-Report, which measure the same topics as CBCL (Van Lieshout, Boyle, Schmidt, Saigal and Ferro, 2015)

Furthermore, in the questionnaire the caregivers rate what sports their child likes to take part in, how much time the child spends sporting and how skilful the child performs, the last two items rates from 0-2 where 0 being below average, 1 being average and 2 being above average compared to peers (Achenbach & Rescorla, 2001). These question, together with items about amount of sports (no sport, one sport, two sports and three or more sports) that the children practice and participate in, as well as the kind of sports (team, individual or both) constitute what we describe as the child’s physical activity (PA).
The CBCL has been translated and is standardised for Swedish conditions and is shown to have good validity and reliability (Larsson & Frisk, 1999; Broberg et al., 2001). In this study, the Swedish version of the CBCL was used.

Procedure and statistical analysis

The association between GA and BW were examined by using Pearson product-moment correlation coefficient. Pearson Correlation was also conducted to define the correlation between the DSM-oriented scales (i.e., Affective, Anxiety, Somatic, Attention-Deficit/Hyperactivity, Oppositional, and Conduct Scales) and GA, dividing the sample into two groups; PT and FT. Descriptive statistics were produced to describe the associations regarding sport performance and how much time the children spent on sports in relation to GA. Furthermore, separate one-way between-group ANOVA was conducted to explore the impact of the subgroups (EPT, VPT, MPT and FT) of GA on behavioural/emotional problems as described by the CBCL DSM-oriented scales. Separate one-way ANOVA was also conducted to explore the impact of subgroups of amount of sports and kind of sport. In addition, separate two-way between-group ANOVAs was conducted to explore the impact of subgroups of GA and PA on the DSM scales. PA was measured through two items from the DSM scales; amount of sports and what kind of sport. The Post-hoc analyse, Scheffe, was further conducted to examine possible interaction effects, the differences between the subgroups as well as the quality of PA.

Result

The correlation outcomes analysis between GA (at birth) and the DSM-Oriented scales for the group of children born PT and full term respectively is shown in table 2. First, there was a strong positive correlation between GA and BW, $N = 131, r = .944, p < 0.001$, showing that on average, the earlier the children were born the lower BW. Thus, in the further analyses we chosen to use the variable GA as a measure of PT. Negative correlations between the children's GA and all six DSM scales that measures emotional and behavioural problems were found in the PT group. The results were significant for children born PT for the Affective Scale ($N=63, r=-.569, p<0.000$), ADHD Scale ($N=63, r=-.383, p=0.002$), Oppositional Defiant Scale ($N=63, r=-.28, p=0.026$) and Conduct Scale ($N=63, r=-.335, p=.007$), which shows that on average, symptoms of depression, ADHD, oppositional defiant problems and conduct disorders were more common among children born prematurely. No significant correlations were found between GA and the DSM scales for the children born at term (see table 2).

<table>
<thead>
<tr>
<th>Scale</th>
<th>PT (N =63)</th>
<th>FT (N=67)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affective</td>
<td>-0.569**</td>
<td>-0.087</td>
</tr>
<tr>
<td>Anxiety</td>
<td>-0.124</td>
<td>-0.095</td>
</tr>
<tr>
<td>Somatic</td>
<td>-0.169</td>
<td>-0.23</td>
</tr>
<tr>
<td>ADHD</td>
<td>-0.383**</td>
<td>-0.069</td>
</tr>
<tr>
<td>Opposition</td>
<td>-0.280*</td>
<td>-0.082</td>
</tr>
<tr>
<td>Conduct</td>
<td>-0.335**</td>
<td>-0.109</td>
</tr>
</tbody>
</table>

Note: PA = preterm, FT = full term
* $p <0.05$, ** $p <0.01$ (2-tailed)

Separate one-way ANOVA was conducted to explore the impact of subgroups regarding the six DSM scales, measured by CBCL. There was a statistically significant effect for the Affective Scale, ADHD Scale and Conduct Scale (see table 3). The post hoc test Scheffe showed that the difference only appeared between EPT and the other groups. For Affective Scale, the mean score for EPT ($M= 72.86$) was significantly ($p < .05$) different from VPT ($M = 53.88$), MPT ($M = 51.47$) and FT ($M$
For ADHD Scale, the mean score for EPT (M = 69.64) was significantly (p < .05) different from MPT (M = 56.97) and FT (M = 56.09) but not from VPT (M = 53.88). For Conduct Scale, the mean score for EPT (M = 6.71) was significantly (p < .05) different from VPT (M = 54.65), MPT (M = 54.22) and FT (M = 56.13). Separate one-way ANOVA was also conducted to explore the impact of subgroups regarding amount of sports and kind of sport. There was no statistically significant effect (see table 3).

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Means and SD, of the respective subgroups (EPT, VPT, MPT and FT), DSM scales scorings, amount of sports and main effect of group (ANOVA outcomes).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EPT (N = 14)</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Affective</td>
<td>72.86a</td>
</tr>
<tr>
<td>Anxiety</td>
<td>61.29</td>
</tr>
<tr>
<td>Somatic</td>
<td>64.21</td>
</tr>
<tr>
<td>ADHD</td>
<td>69.64b</td>
</tr>
<tr>
<td>Opposit</td>
<td>69.36</td>
</tr>
<tr>
<td>Conduct</td>
<td>66.71c</td>
</tr>
<tr>
<td>Amount</td>
<td>2.07</td>
</tr>
<tr>
<td>of sports</td>
<td></td>
</tr>
</tbody>
</table>

Note: EPT = extremely preterm, VPT = very preterm, MPT = moderate preterm, FT = full term, SD = standard deviation
* p <.05, ** p <.001

Separate two-way ANOVAs were conducted to explore the impact of the subgroups, 4 (EPT, VPT, MPT, FT) and amount of sport, 3 (no sport, one sport, two sports and three or more sports) of the six DSM-oriented scales. Statistically main effects were found for group on the Affective Scale, F (3, 114) = 15.893, p = .000, eta = .295, as well as for amount of sports on Affective Scale, F (3, 114) = 2.523, p = .045, eta = .081. Post-hoc comparison using Scheffe showed that the difference between the subgroups was significant (p < .05) between EPT (M = 72.86) compared to VPT (M = 53.88), MPT (M = 51.47) and FT (M = 56.09) (see table 3). There was no significant difference between the subgroups VPT, MPT and FT. Statistically main effects were also found for group on ADHD Scale, F (3, 114) = 5.120, p = .002, eta = .12, but not for amount of sports on ADHD. Post-hoc comparison using Scheffe showed that the difference between the subgroups was significant (p < .05) between EPT (M = 69.64) compared to MPT (M = 56.97) and FT (M = 56.17) (see table 3). There was no significant difference between EPT and VPT, or between the subgroups VPT, MPT and FT. A significant main effect was also found for group on Conduct Scale, F (3, 114) = 4.022, p = .009, eta = .06, but not for amount of sports on Conduct Scale. Post-hoc comparison using Scheffe showed that the difference between the subgroups was significant (p < .05) between EPT (M = 66.71) compared to VPT (M = 54.65), MPT (M = 54.22) and FT (M = 56.13), no significant difference between the subgroups VPT, MPT and FT. There was no significant main effect for group, nor for the category amount of sports for any of the respective DSM-scales Anxiety, Somatic, and the Oppositional Defiant Scale. Additionally, no significant interaction effects were found between group and amount of sports for any of these DSM scales.

Separate two-way ANOVAs were conducted to explore the impact of the subgroups (EPT, VPT, MPT, FT) and kind of sports (individual, team, both) on symptoms of the six DSM-oriented scales. A significant main effect of group was found on Affective Scale, F (3, 102) = 13.2, p = .000, eta=...
Post-hoc comparison using Scheffe showed the difference was significant (p < .05) between EPT (M = 72.86) compared to VPT (M = 53.88), MPT (M = 51.47) and FT (M = 56.09) (see table 3). There was no significant difference when comparing the subgroups VPT, MPT and FT with each other. Statistically main effects were found for the subgroups on ADHD, F (3, 102) = 4.90, p = .009, eta = .126. There was a statistically significant interaction effect between the subgroups and kind of sport on ADHD Scale, F (6, 102) = 2.988, p = .010, eta = .15. Post-hoc comparison using Scheffe showed the difference between the subgroups was significant (p < .05) between EPT (M = 69.64) in comparison to VPT (M = 58.88), MPT (M = 56.97) and FT (M = 56.17) (see table 3). The Scheffe post-hoc test showed that this difference was only significant for EPT, which participated more in individual sports compared to other groups (see figure 1b). There was a statistically significant interaction effect between the subgroups and kind of sport on the Oppositional Defiant Scale, F (6, 102) = 2.437, p = .030, eta = .125. The post hoc Scheffe showed that the difference was only significant for EPT, which participated more in individual sports compared to other groups (see figure 1e). There was no significant main effect of kind of sport and no significant main effect for group on the respective Anxiety Scale, Somatic Scale or the Conduct Scale (see figure 1; c, d, f).

When investigating parent’s ratings of how good their children performed on sports depending on the subgroups (EPT, VPT, MPT, FT) it showed that, on average, the earlier GA the lower rates on how good they performed compared to peers (see figure 2). The sample size decreased with more number of sports (see table 4).

Table 4
Summary of the number of including participants from the parent’s ratings regarding the number of respective individual/team sports, and obtainable for respectively subgroups (EPT, VPT, MPT and FT).

<table>
<thead>
<tr>
<th></th>
<th>TSS</th>
<th>Sport 1</th>
<th></th>
<th>TSS</th>
<th>Sport 2</th>
<th></th>
<th>TSS</th>
<th>Sport 3</th>
</tr>
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<tbody>
<tr>
<td>EPT (N = 14)</td>
<td>12</td>
<td>12</td>
<td>7/7</td>
<td>8</td>
<td>8</td>
<td>5/5</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>VPT (N = 17)</td>
<td>15</td>
<td>15</td>
<td>10/5</td>
<td>11</td>
<td>9</td>
<td>7/4</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>MPT (N = 33)</td>
<td>26</td>
<td>24</td>
<td>13/15</td>
<td>22</td>
<td>20</td>
<td>14/8</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>FT (N = 67)</td>
<td>54</td>
<td>52</td>
<td>17/41</td>
<td>46</td>
<td>45</td>
<td>20/29</td>
<td>29</td>
<td>28</td>
</tr>
</tbody>
</table>

Note: TSS = time spent on sport, SP = sport performance, I/T = individual/team, EPT = extremely preterm, VPT = very preterm, MPT = moderate preterm, FT = full term
Figure 1 (a, b, c, d, e, f). Mean differences (vertical bars donate 95% CI) for the DSM outcomes (parent ratings), as an effect of group (EPT, VPT, MPT and FT) and kind of sports (individual, team and both) for respective a) Affective Scale, b) ADHD Scale, c) Conduct Scale, d) Somatic Scale, e) Oppositional Defiant Scale, and f) Anxiety Scale.

Note: EPT = extremely preterm, VPT = very preterm, MPT = moderate preterm, FT = full term
Figure 2. Means and descriptive outcomes of parent’s ratings (how skilful the child performs rates from 0-2 where 0 being below average, 1 being average and 2 being above average compared to peers) of sport performance dependent of subgroups (EPT, VPT, MPT, FT). Note: EPT = extremely preterm, VPT = very preterm, MPT = moderate preterm, FT = full term

When parents rated how much time their children spent on sports in comparison to peers no consistent pattern were seen between the subgroups (see figure 3).

Figure 3. Means and descriptive outcomes of parent’s ratings (how much time the child spends on sports rates from 0-2 where 0 being below average, 1 being average and 2 being above average compared to peers) of how much time the children spent on sport depending on subgroups (EPT, VPT, MPT, FT). Note: EPT = extremely preterm, VPT = very preterm, MPT = moderate preterm, FT = full term
Discussion

This study examined the associations and possible differences between behaviour and emotional problems and PA among PT born children compared to FT born children, when at early school age. In accordance with our primary hypothesis - negative associations between behavioural and emotional problems and the children’s GA among PT children was confirmed. Lower GA was related to more symptoms of depression, ADHD, oppositional defiant problems and conduct disorders. When analysing group comparisons, similar results were found, showing higher symptoms in the EPT group compared with other GA groups on depression, ADHD and conduct disorder. Our second hypothesis, that there would be an association between decreasing PA and aggregate amount and severity of behavioural problems and that these problems would cover with GA, was partly confirmed. Lower GA resulted in higher symptoms of depression, ADHD, and conduct disorder, though in this study sample of included PT born children, GA did not manifestly interrelate with decreasing PA. However, when including kind of sport, it was found that children born EPT participated more in individual sport rather than team sports compared to the other groups and showed evidently more problems of ADHD and oppositional defiant problems in comparison to children born MPT, VPT and FT.

Lower GA were related to more emotional and behavioural problems, and these findings are in line with previous research that have found that PT children shows more behaviour and psychiatric problems than do FT children (Johnson & Marlow, 2014; de Jong et al., 2012). Previous findings show support for more difficulties among PT than FT children, both symptoms of ADHD (Bul & Van baar, 2012; Johnson et al., 2010; Jaekel et al., 2013) and depression (Bhutta et al., 2002) as well as conduct problems and oppositional problems (Mathewson et al., 2017), which were apparent also in our result. The group associated with highest rates of symptoms were the EPT group and this result confirms by previous findings (Mathewson et al., 2017; Johnson & Marlow, 2014; Farooqi, 2007). An explanation to why PT and especially EPT had highest symptoms can be understood through a recent review which states that the individuals born EPT associates with an adverse neurodevelopment which underlies the long-term outcomes such as development of emotional, social and behavioural problems in this group (Johnson & Marlow, 2017). Though, when it comes to conduct problems previous findings are inconsistent and Treyvaud et al. (2013) found no difference between the prevalence of conduct disorders among VPT and FT at 7 years of age. In contrary, this study shows higher symptoms on conduct disorders among children born PT compared to those born at term. One reason might be that in this study the children were not investigated and diagnosed with help of psychologist as in the study of Treyvaud et al. (2013). There might be the case that children born PT have more symptoms of conduct disorder, still, do not meets the criteria for the diagnosis.

However, previous research has shown differences between PT and FT that we couldn’t confirm in this study, for example that children born PT would have more somatic complaints (Tideman et al., 2001; Klassen et al., 2004; Farooqi, 2007), the reason to the different result might results from the concept somatic problems, which include widely different symptoms. Also, in contrary to our expectations, we couldn’t confirm results from Rogers et al. (2014), Treyvaud et al. (2013) and Bhutta et al. (2002), that children born PT would have more anxiety problems. A meta-analysis by Burnett et al. (2011) showed that the prevalence of diagnosis of anxiety were three times as common for individuals born PT in late childhood, adolescence and young adulthood compared to peers born at term. Therefore, anxiety is likely to develop successively and become more apparent as the children grow older, possible based on that higher requirements and expectations will be justified from both school and friends. It is probable that the PT children in this study, especially those born EPT, might develop more symptoms of anxiety as they grow older. For all DSM scales, except anxiety, the EPT group had more variance than the other groups, which shows that the differences within the group of EPT are greater than within the groups VPT, MPT and FT (see table 3). It is evident that the problems associated with EPT only applies to parts of the group.

When PA, measured through amount of sports, were included in the analyses it induced a small effect on the Affective Scale, although not found for the other DSM scales. None of the groups (EPT, VPT, MPT, FT) participated significantly more in sports, on the contrary there were just minor differences between the groups. Also, parents rating, on how much time their children spent on sports, showed little differences between the groups. Our result goes in line with previous findings by Dahan-Oliel et al. (2012) who found no differences between PT and FT in how much
time the children spend on PA in age 5-11. However, other studies show that when PT children grow into adolescence and adulthood, PT participate less in sports than FT (Dahan-Oliel et al., 2012; Saigal et al., 2007), therefore it is reason to believe that there might be more evident differences when they grow older. Since earlier studies supports the healthy effect of PA concerning different mental difficulties (Zahl et al., 2017; Hoza et al., 2016; Stonerock et al., 2015) we believed that amount of sport would show a difference and hypothesized that decreased PA would associate with increased behavioural problems. However, since the differences between the subgroups were small in the amount and time the children spent on PA, it gives a logical explanation why PA, measured by amount of sport, didn’t had a greater effect on the outcome of the DSM scales.

We also examined if the kind of sport the child participated in could influence any behavioural and emotional problems. Our result showed that kind of sport had a significant effect on ADHD problems and oppositional defiant problems. The difference was particularly evident in the EPT group, were the children with higher rates on the ADHD and Oppositional Defiant Scale also had significantly higher participation in individual sports rather than team sports. To further examine whether kind of sport and GA affect these behavioural problems or if these behaviour problems affect the choice of sport, or if there are other underlying reasons, more research is needed. It is possible that children who have difficulties with attention and defiant also have poorer social abilities and difficulties cooperating with others, and therefore choose individual sports rather than team sports. To our knowledge, studies on the impact of individual versus team sports are limited, but Poole et al. (2015b) study, might contribute to an understanding why EPT choose individual sports rather than team sport. Motor coordination problems were more common for extremely low BW children, which probably also apply for the EPT children in our sample, we believe that motoric problems (e.g. coordination-, balance), could make it harder participating in team activities. Furthermore, our result showed that parents rated their PT children as less competent on sports than did parents to FT children, in the EPT group this was evident for all three sports. That parents to PT children rates their children as less competent than parents to FT children have been shown previous by Farooqui (2007). Since Tikanmaki et al. (2016) found similar differences between PT and FT in young adulthood it is likely that the differences will remain when the children grow older. A recent study showed that children that was participating in individual exercises develops less enjoyment and cohesion comparing to children participating in team sports (Elbe et al., 2017). If children experience less enjoyment and cohesion there is likely to imagine that the children’s motivation to continue the sport subside and that it could lead to quitting. Due to earlier studies (Dahan-Oliel et al., 2012; Saigal et al., 2007) there is reasons to believe that differences in sport participation may be more evident when the children grow older. We argue that the impact of poorer performance (Tikanmaki et al., 2016) and what kind of sport PT children participate in when growing older/adolescents are of interest to investigate further as possible reasons to why the PT might participate less in PA than FT.

Concerning limitations, the way PA were measured implies some risk for not quite accurate results. To more accurate evaluate the importance of PA there would be preferable with repeated measures and an intervention with more precise measurements for how much sports the children performed, accounted in time (hours and minutes) the sport was performed and the aerobic intensity of each activity. Therefore, the suggestion for further research is to have more precise measures of PA and repeated measures from before, during and after the intervention to more accurate examine the causality of the impact of PA on the problem scales. The way emotional and behavioural problems were measured also reflect some limitations. To more accurate examine the problems among the children there would be preferable to conduct investigations to determine diagnoses. Like many studies that investigating consequence of a preterm birth, the sample is relative small and the possibility to generalise from the result is limited. Concerning ecological validity, for this target group and these analysis, 131 children constitutes an adequate sample size, and provides further evidence that children born PT have an increasing risk for long-term behavioural.

In conclusion, the results from this study confirmed our primary hypothesis which shows that behaviour and emotional problems were especially evident for children born EPT, which goes in line with previous research. This indicates the importance of investigate the differences within PT children and not just PT as a whole group. As children born EPT have shown to often have complex difficulties, there would be recommended to increase the knowledge about this target group and the risks associated with it, in preschool and school and facilitate appropriate interventions to support vulnerable children. Also, more support to families with children born
EPT could promote an understanding and supportive environment for the children at risk for behavioural and emotional problems. Further research is needed to determine how such a support could be designed to prevent health problems in this target group. Our result showed that kind of sport, were the most prominent factor when including PA, which included significant differences were EPT participated more in individual sports rather than team sports in comparison to FT. It is a factor that could be of importance in future research as a possible reason why PT children, when they grow older seem to participate less in PA in comparison to FT. Studies that include PA as a factor are few and seldom measured when concerning PT children. However, the multitude of health benefits of PA on emotional and behavioural problems that many studies shows is reason to further investigate the impact on physical activity for PT and also examine the importance of different GA.
References


