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Dental behavioural management problems and dental caries prevalence in 3- to 6-year-old Swedish children born preterm

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Background. Today, most children born preterm survive without major impairments. But high frequencies of cognitive and behavioural difficulties arise. Studies on dental behavioural management problems (DBMP) in these children are lacking. In addition, studies on caries prevalence are few and inconclusive.

Aim. This study aims to compare the frequency of behavioural problems and poor compliance with dental treatment in preschool children born preterm with those born full-term. The prevalence of caries was also studied.

Methods. The study group included 187 children born between 23 and 32 weeks of gestation. The control group constituted full-term children matched by age, sex, immigrant background, and dental operator. DBMP, number of dental visits, missed appointments, and caries between ages 3 and 6 were noted.

Results. At age 3, but not at age 6, the prevalence of DBMP at clinical examinations was significantly higher in preterm children compared with the control group. Of the children who received dental treatments during preschool years, preterm children displayed significantly more DBMP. No significant difference in dental visits or in caries prevalence was found. Preterm children, however, missed significantly more dental appointments.

Conclusion. Children born preterm display a higher prevalence of DBMP at dental examinations and treatments during preschool years.

Introduction

Advancements in medical care have enabled more children born preterm to survive and develop as healthy individuals alongside their full-term peers. According to the World Health Organization (WHO) definition, a *preterm infant* is born before gestational week 37 or has a birthweight of less than 2500 g[1]. In Sweden, 5.6% of infants are born before 37 weeks of gestation and 4.8% have a birthweight of less than 2500 g[2]. In Sweden, 0.8% infants are born between 29 and 32 weeks of gestation [defined by WHO as *very preterm* (VPT)] and 0.4% between 23 and 28 weeks of gestation [defined by WHO as *extremely preterm* (EPT)].

Today, the survival rate of Swedish infants born between 33 and 36 weeks of gestation is about 98%[2]. In VPT infants, the survival rate is about 90%, and in EPT infants is about 80%. But these rates vary significantly in different countries; for example, a 17–62% variation has been reported at 24 weeks of gestation[3].

Although most survivors fare well, a significant number of infants demonstrate neurodevelopmental disabilities. The disabilities may affect any of these domains: neurological, motor, cognitive, and behavioural[4]. The risk of developing disabilities increases with decreasing gestational age and birthweight[3].

A recent study review on surviving infants at gestational age of 23–25 weeks reported these variations: impaired mental development, 17–21%; cerebral palsy, 12–15%; blindness, 5–8%; and deafness, 3–5%[5]. In Sweden, 7.7% of infants born before 28 weeks of gestation and 4% of infants born between 28 and 31 weeks of gestation developed cerebral palsy[6]. In addition, premature birth and necessary intrusive neonatal treatments may lead to lung complications[4].

Several follow-up studies evaluated the state of health and development in preterm children,

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many centring on cognitive functions. EPT children displayed a high prevalence of long-term cognitive and behavioural difficulties, including attention deficiencies that adversely affected school achievement[4,6–13]. Furthermore, Marlow *et al.*[13] found that cognitive impairment and general behavioural problems at an early age were more common than neuromotor, neurosensory, hearing, or vision problems in children born before 26 weeks of gestation. In addition, they reported that boys produced consistently lower cognitive scores than girls[13].

In their 10-year follow-up of EPT children, Stjernqvist and Svenningsen[8] found that almost half of the children produced poor school results. Children were more anxious and shy, or more troublesome and aggressive. Seventy-five per cent had an IQ below 100 compared to 30% in full-term controls.

Preterm children also have oral complications. Enamel hypoplasia is more frequent in the primary[14–16] and permanent[17] dentitions. Curzon *et al.*[15] found that 75% of children born before 36 weeks of gestation exhibited primary tooth enamel hypoplasia compared with none of the full-term controls, suggesting that enamel defects predispose these preterm children to dental caries. In addition, a higher frequency of feeding problems has been reported in preterm children[18], which might add to the caries risk. The few studies available on caries frequency, however, have not reported a higher prevalence of caries in this group of children[16,19,20].

Dental examinations and treatments are demanding experiences for young children. Population-based studies show that dental behavioural management problems (DBMP) are common in children, with prevalence figures between 8% and 18% for preschool children[21,22]. Results from Stjernqvist and Svenningsen[8] indicate that preterm children are often more vulnerable to stressful situations than those born full-term. Dental treatments are stressful experiences, and preterm children may display disruptive behaviour more frequently in these situations than other children. But research on DBMP in preterm children is lacking.

In this study, the hypothesis that preterm children display DBMP more frequently than full-term children was tested. The frequency of DBMP and poor compliance to dental treatment was studied in preschool children born between gestational weeks 23 and 28 (EPT), and between weeks 29 and 32 (VPT), and in control children born full-term. In addition, the prevalence of dental caries was studied. All children were of the same age and came from a set area of southern Sweden.

Materials and methods

Subjects

Preterm-born children. All children born between 23 and 32 weeks of gestation from 1994 to 1996 in the catchment area of the university hospitals of Lund and Malmö in southern Sweden were invited to participate in the present study ($n = 192$). After the Swedish National Board of Health and Welfare granted the authors access to the Swedish Medical Birth Registry, all children who met the study's inclusion criteria were identified. The register consists of individual health-related data on newborn children, including previous gestation. The Ethics Committee of the Medical Faculty of Lund University approved the study plan.

Information was posted to the parents to inform them of the study and request their consent. Parents of four children declined, and the dental record of one child was not available for analysis. The target group consisted of 187 children. In all, 144 children meeting the WHO criteria for VPT and 43 for EPT participated. Besides gestational age, data on birthweight and number of siblings was collected from the birth register. Table 1 lists characteristics of the preterm children.

Control children. Each preterm child entering the study was matched with a full-term child by age, sex, immigrant background, and dental operator (Table 1). Providing it met the above criteria, the child directly following the preterm child in the patient register at the same dental clinic was chosen as the control child. Information was posted to the parents to inform them of the study and request their consent, which was obtained for all eligible control children. Through telephone interviews, supplementary

Table 1. Characteristics of the study groups of very preterm (VPT), extremely preterm (EPT), and full-term children.

	Preterm			Full-term control (*n* = 187)
	Total (*n* = 187)	VPT (*n* = 144)	EPT (*n* = 43)	
Sex				
Boys	98 (52%)	74 (51%)	24 (56%)	98 (52%)
Girls	89 (48%)	70 (49%)	19 (44%)	89 (48%)
Twins	49 (26%)	43 (30%)	6 (14%)	4 (2%)
Triplets	6 (3%)	6 (4%)	0 (0%)	0 (0%)
Median gestational age in weeks (range)	30 (23–32)	31 (29–32)	27 (23–28)	≥ 37
Median birth in grams (range)	1436 (604–2430)	1581 (604–2430)	948 (615–1470)	*

*No data available.

information (gestational age, normal birthweight, and number of siblings) was obtained from the parents. Dental records or staff provided information on immigrant background.

Children born between 33 and 36 weeks of gestation were not included in the study, neither as preterms nor as controls.

Review of dental records. The Swedish Public Dental Service provides regular dental care free of charge to all children and adolescents between ages 3 and 19. In the present catchment area, more than 95% participate in this programme. Participating preterm children were regular patients at 53 public and 11 private dental clinics. The clinics were contacted to retrieve dental records for preterm children and the matched control children.

One of the authors (S.B.R.) examined the dental records without knowing to which group the records pertained. From the records, notes on DBMP and number of missed appointments (no-shows or cancellations) for the preschool period (3–6 years) were compiled and data on caries frequency (decayed and filled primary teeth: dft) collected for ages 3 and 6. Dental examinations were studied at the target ages of 3 and 6. Mean age for the dental clinic visit as a 3-year-old was 3.2 [standard deviation (SD) = 0.4] for preterm children and 3.2 (SD = 0.3) for full-term controls. Corresponding mean ages at the 6-year-old visit were 6.1 (SD = 0.5) and 6.1 (SD = 0.4).

Dental record notes on disruptive behaviour that delayed dental examinations or treatments or made dental examinations or treatments impossible served as definition of DBMP[21].

Table 2. Examples of disruptive behaviour during different treatments as noted in dental records (modified from Holst & Crossner[22]).

Child refusing to:
• Enter the treatment room
• Sit in the treatment chair, alone or on parent's lap
• Open mouth for routine dental examination
• Allow hand excavation of open cavities
• Accept local anaesthesia
• Allow dental drilling; cavity preparation not completed
• Accept restorative treatment, temporary cement, extraction, or other treatments

Table 2 lists examples of disruptive behaviour. One or more examples of disruptive behaviour during the preschool years classified a child as having DBMP.

Intra-examiner reproducibility was evaluated about 1 month after the dental records analysis was completed. Ten per cent ($n = 38$) of the records were randomly selected and re-examined for DBMP notes, number of dental visits, and number of missed appointments during the preschool years. Reproducibility rates were as follows: 100% agreement on DBMP notes, 89% agreement on number of dental visits with no individual divergence exceeding one visit, and 97% agreement on missed appointments.

Statistical methods

McNemar's test was used for paired observations to test DBMP differences at dental examinations at ages 3 and 6 and in various dental situations between ages 3 and 6. Chi-squared test was used to compare DBMP in different treatment situations. To contrast the number of dental

Table 3. Dental behavioural management problems (DBMP) at dental examinations in total number of preterm children (gestational age, 23–32 weeks) and in subgroups of very preterm (VPT) and extremely preterm (EPT) children and in full-term controls. Data collected at ages 3 and 6. McNemar's test.

	DBMP	No DBMP	Significance
3 years of age			
Preterm total (n = 163)	36 (22%)	127 (78%)	P = 0.005
Controls (n = 163)	16 (10%)	147 (90%)	
VPT (n = 124)	27 (22%)	97 (78%)	P = 0.017
Controls (n = 124)	12 (10%)	112 (90%)	
EPT (n = 39)	9 (23%)	30 (77%)	NS
Controls (n = 39)	4 (10%)	35 (90%)	
6 years of age			
Preterm total (n = 186)	4 (2%)	182 (98%)	NS
Controls (n = 186)	1 (0.5%)	185 (99.5%)	
VPT (n = 143)	3 (2%)	140 (98%)	NS
Controls (n = 143)	1 (1%)	142 (99%)	
EPT (n = 43)	1 (2%)	42 (98%)	NS
Controls (n = 43)	1 (2%)	42 (98%)	

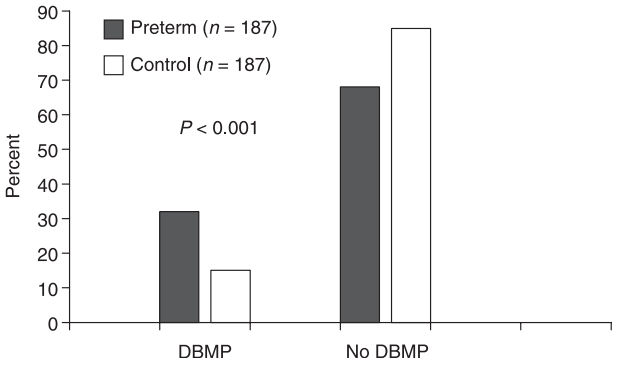

Fig. 1. Dental behavioural management problems (DBMP) at dental examinations and different treatments in preterm children (gestational age, 23–32 weeks) and full-term controls during preschool years (ages 3–6). McNemar's test.

visits, number of missed appointments, and caries prevalence, Student's *t*-test for paired observations was used. Differences at the 5% level of probability were considered significant. The Statistical Package for the Social Sciences (SPSS), version 13.0, was used for all analyses.

Results

The group of preterm children consisted of 48% girls and 52% boys (Table 1). Twenty-six per cent of the preterm children and 2% of the full-term controls were twins, while 3% of the preterm children and none of the full-term children were triplets. According to the dental records, 11 of the preterm children were diagnosed of severe disorders (e.g. cerebral palsy, Down syndrome, mental disabilities), while none of the full-term children were.

Table 4. Dental behavioural management problems (DBMP) during different dental treatments in preterm children (gestational age, 23–32 weeks) and full-term controls. Subgroups of very preterm (VPT) and extremely preterm (EPT) children. Data collected during the preschool years (ages 3–6). Chi-squared test.

	DBMP	No DBMP	Significance
Preterm total (n = 62)	28 (45%)	34 (55%)	P = 0.020
Controls (n = 59)	13 (22%)	46 (78%)	
VPT (n = 47)	21 (45%)	26 (55%)	P = 0.009
Controls (n = 43)	7 (16%)	36 (84%)	
EPT (n = 15)	7 (47%)	8 (53%)	NS
Controls (n = 16)	6 (38%)	10 (62%)	

Dental records for 163 pairs of preterm and full-term children contained dental examination notes at 3 years of age, and for 186 pairs at 6 years of age. Thirty-six (22%) of the 3-year-old preterm children demonstrated DBMP at the dental examination, compared to 16 (10%) of the full-term controls (Table 3). This was a significant difference (P = 0.005). A similarly higher frequency of children with DBMP was displayed in the subgroups of VPT and EPT children, the difference between VPT and full-term children being significant (P = 0.017). At 6 years of age, DBMP at the dental examination had decreased, and no significant differences were noted between preterm children and full-term controls (Table 3).

Sixty-two preterm and 59 full-term children underwent some kind of dental treatment during the preschool years. DBMP during different treatments was significantly more common (P = 0.020) in preterm children than in the full-term controls (Table 4). The VPT subgroup displayed the same pattern (P = 0.009), but not the EPT children. Of the 28 preterm children who displayed DBMP during dental treatments, 16 (57%) were referred to a paediatric dental specialist. The corresponding figure for the 13 controls with DBMP was 10 (77%).

Figure 1 presents children demonstrating DBMP at dental examinations or treatments during the preschool years. DBMP was significantly more common (P < 0.001) in preterm children.

Table 5. Mean number of dental visits and missed appointments in preterm children (gestational age, 23–32 weeks) and full-term controls during the preschool years (ages 3–6). Student's *t*-test.

	Mean	SD	Significance
Dental visits			
Preterm children (n = 187)	5.5	3.4	NS
Controls (n = 187)	5.7	2.9	
Missed appointments			
Preterm children (n = 187)	2.4	2.8	P = 0.001
Controls (n = 187)	1.6	1.9	

SD, standard deviation.

There were no significant differences in DBMP frequency between boys and girls in any of the groups. But DBMP was more common among full-term boys than girls at the dental examination at age 3. No significant DBMP differences were noted at the dental examination or treatment between twin or triplet and single-born preterm children.

No significant differences in mean number of dental office visits during preschool years were found (Table 5). Preterm children, however, missed significantly more dental appointments than their matched, full-term controls (P = 0.001). A similar difference was noted for VPT and EPT children (not shown).

Twelve per cent of preterm and 9% of full-term children developed dental caries at 3 years of age, and 30% of preterm and 27% of full-term children at 6 years of age. Mean dft at age 3 was 0.50 (SD = 1.79) in preterm children and 0.36 (SD = 1.51) in full-term controls. Corresponding figures at 6 years of age were 1.34 (SD = 2.75) and 1.19 (SD = 2.58), respectively. Between-group differences in caries prevalence were nonsignificant.

Discussion

This study showed that DBMP were more common in preterm children aged 3–6 years than in full-term controls. DBMP at dental examinations were also significantly more common in 3-year-old preterm children. Thus, it seems that this group of children, with a reported high prevalence of cognitive and behavioural disturbances[7,8] and other difficulties, requires special attention from the dental service.

To compare the groups under as similar stress conditions as possible, we studied dental examinations separately at the target ages of 3 and 6. At 3 years of age, DBMP at the dental examination were significantly more common in preterm children than in their full-term counterparts. No significant differences between the groups were found at 6 years of age, suggesting that problems at dental examinations are temporary and possibly more common in younger, less mature children. The difference we observed at age 3 should serve as a reminder to organized dental care that although children are called for examinations based on their chronological age, behaviour at this age can still vary widely; the biological age of preterm children is most likely lower and may partly explain the difference in DBMP. Previous studies indicate that young children's acceptance of dental treatment increases with mental development[23].

The VPT and EPT subgroups displayed the same frequency of DBMP at dental examinations. At 3 years of age, however, the difference between VPT children and their controls was significant, while this was not the case with EPT children. Concerning dental treatments EPT and full-term children produced the same results. The lack of statistical differences might reflect the low number of children who participated. The prevalence of EPT children in Sweden is very low, 0.4% according to the National Board of Health and Welfare[2], and the present prevalence of 43 EPT children born between 1994 and 1996 in the present catchment area is in line with this figure.

During the preschool years, preterm children exhibited significantly more DBMP in various dental situations. Besides dental examinations, these included local anaesthesia, polishing, cavity preparation, and extraction. Thus, in more demanding dental situations, preterm children continued to display behavioural impairments after 3 years of age. In a meta-analysis, Bhutta *et al.*[11] showed how preterm birth is associated with lower cognitive scores and an increased risk of various behavioural problems as children develop.

The number of children to undergo dental treatments was similar in the preterm and full-term groups, and both groups displayed the

same mean number of dental visits. Treatment requirements were similar in the two groups, and preterm children were not referred to paediatric dental specialists any more than full-term children. Preterm children did miss more dental appointments (no-shows or cancellations) than the control group. This corresponds with results from previous studies of other groups of children[24,25]. One reason for this may be that because preterm children generally require more medical visits than full-term children, parents may find it more difficult to attend all appointments. The dental team must take this into consideration when planning the care of preterm children.

Twenty-four of the preterm children did not have notes of dental examination in their dental records at 3 years of age. This dropout rate of 13% most likely can be ascribed to a higher frequency of no-shows or cancellations in this group. The impact of this on the frequency of DBMP in the group of preterm children is difficult to demonstrate, but it is possible that the strength of the association is underestimated rather than the opposite.

Enamel hypoplasia is a common finding in preterm children[14–17], and may be a predisposing factor to dental caries[14]. Corresponding with previous studies[16,19], preterm and full-term children in our study groups both displayed identical caries prevalence. At 6 years of age, 70% of preterm children and 73% of the full-term controls were caries free, compared with 70% of 6-year-old children reported by the Swedish National Board of Health and Welfare[26]. Our findings indicate that preterm children do not run a higher risk of developing caries than other children. We noted, however, that fewer preterm children underwent radiographic examinations than their full-term counterparts, possibly indicating that the caries prevalence may be underestimated in this group. Further studies on caries prevalence in preterm children are needed.

The validity of using information from dental records to study DBMP might be disputable. Each dental operator has different attitudes and levels of experience in providing dental care to children. To avoid bias as much as possible, our study design stipulated matched controls who had been examined and treated by the same dental operator as their counterpart at 3 years of age. Although a child's normal operator may have changed during the study (an unusual occurrence), the Swedish Dental Health System most likely assigned the child's matched counterpart to the new operator too.

The dental operator most likely noted disruptive behaviour during the dental appointments in the dental records. But this only reflects the view of the operator and not that of the patient. For the preschool child, parental input would provide reliable insight, as the parent can relate how the child behaves in the dental chair to its behaviour in everyday situations. The present study should be supplemented with a parental interview, which would cover other variables, such as how the child copes with other stressful situations, additional family factors, and medical data.

Conclusion

In conclusion, the present study shows that preterm children display more DBMP at dental examinations and treatment during preschool years than full-term children. Preterm children also miss more dental appointments. Thus, this group of children demands special attention from the dental service at a young age.

What this paper adds

- Preterm children display a higher prevalence of DBMP during preschool years than full-term children.
- Preterm children miss more dental appointments than full-term children.
- Preterm and full-term children display no difference in caries prevalence.

Why this paper is important to paediatric dentists

- With a reported high prevalence of cognitive and behavioural difficulties, preterm children demand special attention from the dental service during preschool years.

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