Linguistic skills in relation to neurological findings at 8 years of age in children born preterm

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The linguistic skills of 8-year-old children born preterm (n = 42) with birthweight < 1750 grams from a 1-year birth cohort for 1985-86 in northern Finland were studied with three different language tests, namely the Illinois Test of Psycholinguistic Abilities (ITPA), the Token Test for Children (TTC) and the Morphological Test (MT) for Finnish children. Full-term control children (n = 42) with birthweight ≥ 2500 grams from the same birth cohort were matched individually with their preterm pairs for age, sex, twinship, mother’s education, place of residence, birth order and family type. The preterm children’s language abilities were studied in relation to their neurological status and to the periventricular leukomalacia (PVL) findings of magnetic resonance imaging (MRI). The preterm children with minor neurodevelopmental dysfunctions (MND) scored worst and differed significantly from their matched controls in TTC. They also differed significantly from other preterm subgroups, namely healthy preterm and preterm children with cerebral palsy (CP), in verbal comprehension measured by TTC. PVL findings were not associated with performance in the language ability tests. A closer and regular follow-up of language development in the MND-disabled group among the low-birthweight preterm children is recommended.

Key words: preterm children, language, neurological impairment, school age.

INTRODUCTION

During the last two decades the improved survival rates of ever smaller preterm infants have resulted in increasing problems with cognitive development among them – mainly due to neurological deficits (11, 27). Aram et al. (1) found that even when major neurological deficits are excluded, differences in language development between preterm and full-term children may still remain, and these are based on more general developmental problems.

It is obvious that cerebral palsy (CP) as a major neurological disability is a condition in which poor speech and language development is common. On the other hand, however, preterm children suspected of having mild neurological disabilities such as minor neurodevelopmental dysfunction (MND) are also considered to be at a greater risk for language deficits compared to neurologically healthy preterm and full-term children (10, 20). Low-birthweight infants and toddlers have been found to be significantly delayed in language expression and comprehension in many studies (3, 10, 22, 34, 41) but observations on language deficits among school-age preterm children are not consistent (21, 30, 44, 45). Some studies do not support a claim that preterm children are at risk for specific language impairments (SLI) any more than full-term children (1, 29). The verbal comprehension of very low-birthweight (VLBW) preterm children has, however, been reported to be poorer than that of full-term children (1, 9, 22, 40).

The influence of the child’s socioeconomic status on language development has been reported in many studies (6, 13, 18, 19, 41). On the other hand, the cognitive deficiencies of VLBW children may overcome environmental factors by age, developmental deficits therefore becoming evident at early school age (36, 42).

The incidence of periventricular leukomalacia (PVL) has been reported to be up to 32% (31) among preterm and/or low birthweight children and it is in
relation to neurodevelopmental status, but its association with linguistic skills is uncertain. PVL, which is a typical finding in preterm children, refers to a necrosis of the cerebral white matter with a characteristic distribution in the white matter adjacent to the external angles of the lateral ventricles (37). In our earlier studies, the same preterm children examined in this study displaying PVL in magnetic resonance imaging (MRI) were reported to experience more difficulties in tasks requiring spatial and visuo-perceptual abilities (31, 32). Disturbances in spatial and visuo-perceptual abilities can be expected to also reflect on their linguistic skills.

The aim of the present study was therefore to examine the psycholinguistic skills, verbal comprehension and morphological abilities of children born preterm as measured by three standardized language tests at 8 years of age in relation to their neurological status and especially to PVL findings in MRI.

The main objectives were to investigate:

(a) whether there are more language disabilities among preterm children with neurologic impairment than among preterm children considered healthy in a clinical neurological assessment.
(b) whether or not there is an association between language abilities and PVL findings in MRI.

MATERIAL AND METHODS

Study population

The sample consisted of 42 preterm children with a birthweight < 1750 grams and 42 full-term children who had weighed ≥ 2500 grams at birth as has been described earlier by Yliherva et al. (44, 45) and Olseén et al. (31, 32). These children were recruited from a prospective 1-year birth cohort from northern Finland, comprising the two northernmost provinces of Finland (12). Ninety-nine percent of the pregnant women (9362) were included in the cohort, and the expected dates of birth fell between July 1, 1985 and June 30, 1986. The mothers gave birth to 9479 children, of whom 75 were live-born with a birthweight less than 1750 g, and 55 (73%) were still alive at 8 years of age. Fourteen of these children could not be included: one with CP was not found, one child with severe intellectual disability with Rett syndrome and one with Duchenne dystrophy were excluded, four lived too far away from where the research was carried out, and the parents of seven children refused to participate. Originally included preterm child with Duchenne dystrophy and his matched control child were excluded from the analysis due to impossibility to categorise the child with Duchenne into neurologically healthy or unhealthy in terms of MND criteria. The sample is described in Table 1. Eleven of the excluded children had no major handicap, and eight of them were attending mainstream education, although one child was undergoing a special education program.

The clinical neurological examination was performed by a blinded pediatric neurologist and was based on items from Towne (39), together with Fog’s test (7). Criteria for MND included aberrant tongue movements, deviations in heel walking and in performance on Fogs test, as well as clumsiness in finger opposition and behavioral disturbances (31). In addition to these five factors problems in balance were taken into account when classification of minor neurodevelopmental dysfunction was made. A child with a deviation from normal demonstrated three of these six signs classified in the group of children minor neurodevelopmental dysfunction (31).

All children had normal hearing as measured by pure-tone audiogram.

The full-term control children were chosen at random from the same birth cohort and matched at the beginning of the present study i.e. at age 8 years individually using the following criteria: sex, age (± 3 months), being a twin, mother’s education, place of residence (urban or rural), birth order, and family type (full vs. single-parent family). None of the control children had any major handicap, but three had MND.

<table>
<thead>
<tr>
<th>Table 1. Description of the study population</th>
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<tr>
<td>Birthweight:</td>
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<tr>
<td>Mean</td>
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<tr>
<td>(740–1740 g)</td>
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<td>Range</td>
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<td>(2560–4200 g)</td>
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<td>Gestation weeks:</td>
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<td>Range</td>
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<td>(37–43)</td>
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<tr>
<td>Cerebral palsy</td>
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<tr>
<td>4 (4)*</td>
</tr>
<tr>
<td>Minor neuro-developmental dysfunction</td>
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<tr>
<td>13 (3)*</td>
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<tr>
<td>Neurologically healthy by clinical examination</td>
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<tr>
<td>24 (6)*</td>
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<tr>
<td>Duchenne muscular dystrophy</td>
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<td>1 (0)*</td>
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*Number in brackets gives the numbers of the children with periventricular leukomalacia (PVL) by diagnostic category. Magnetic resonance was performed to all 41 preterm (one refused) and the first 24 full term children. PVL was not found among the full term children.
Magnetic resonance imaging (MRI)

All preterm children except one \((n = 41)\) and the first 24 matched random controls underwent MRI (1.0 Tesla scanner). The control children did not differ from the rest of the controls with respect to clinical neurological status \((32)\). The images were visually analysed, with special attention to white matter signal abnormalities. PVL was observed in 13 preterm cases and considered severe in 2, moderate in 3, and mild in 8 children \((31)\) but none in control cases. The numbers of PVL by the different preterm groups are presented in Table 1.

Language assessment

Three language tests were administered: the Illinois Test of Psycholinguistic Abilities (ITPA) standardized for Finnish children by Kuusinen and Bläfield \((15, 16, 33)\), the Morphological Test (MT) in Finnish Language by Lyytinen \((25, 26)\) and the Token Test for Children (TTC) by DiSimoni \((4)\).

ITPA is a comprehensive diagnostic test for children from 3 to 9 years of age. It is developed to measure the psycholinguistic abilities related to learning disabilities \((14)\). The ITPA test has been noted to correlate highly with clinical evaluations made by a physician \((2)\). The subtests of ITPA measure the information processing skills based mainly on auditory and visual channels \((16)\). The auditory subtests are auditory reception, auditory sequential memory, auditory association, auditory closure and sound blending. Visual subtests are visual reception, visual sequential memory, visual association and visual closure. There are also subtests of verbal and manual expressions and grammatical closure. The scores in ITPA can be counted as raw or scale scores. The norm for scale scores is based on raw scores adjusted for age. Based on the scale scores, it is possible to draw a performance profile for each child. The normal mean scale score is 36 \((±6)\). Scores < 30 have been shown to indicate learning difficulties at school, and scores < 24 are significantly low and atypical for school-aged children \((33)\). In the present study, a cut-off point < 30 was used to screen poor performances among preterm and full-term children.

The Token Test for Children includes 61 tasks with progressively longer and more complex instructions and abstract concepts (form, size, color). The 61 tasks are divided into five categories (I-V). In the first (I) category each instruction includes one verb, adjective and noun. In the second category (II) the size is added in the instructions. In the third category (III) a child has to keep in mind size and color of two tokens and in the fourth category (IV) size, color and shape of two tokens. The fifth category (V), quite different from I–IV, includes instructions with different suffixes, conjunctions and adverbs. The TTC requires relatively good verbal comprehension, short-term memory and good concentration ability. It is mainly used in combination with other tests. The mean total score for 8-year-old children in TTC is 54.9 \((SD, 3.54)\) The means and standard deviations given in the original TTC assessment \((4)\) are comparable to those recorded for Finnish-speaking children \((17)\).

The Morphological Test has been designed to examine how Finnish speaking children master adverbial, comparative and superlative forms, present and past tense and elative case. In this test, the child is asked to decline nouns and adjectives and to conjugate verbs. An examiner provides the stimulus word based on given pictures. All the stimulus words used in the test are so-called nonsense words. A child must be able to inflect or conjugate the nonsense words based on the morphological rules of the Finnish language. Comparative and superlative forms are particularly difficult for the Finnish speaking children even at school age \((26)\). Consonantal gradation is also difficult and demands well-developed linguistic skills. The MT measures both linguistic processes and metalinguistic knowledge \((24)\). The MT helps to obtain information on the operative rules children use in their thinking. In the MT, the mean for 9-year-old children is 78.60 \((SD, 6.90)\) \((25)\).

The three speech-language pathologists who tested the children were unaware of the children’s birth or developmental history. The principles and interpretations concerning the test situations were agreed upon beforehand. In addition, consensus meetings were held whenever difficult questions arose. The first 10 ITPA subtests (ITPA10) were administered to all the 42 preterms and their controls \((total N = 84)\). All 12 subtests (ITPA12) were administered to 38 preterms and their controls \((total N = 76)\). The numbers by different subtests varied e.g. due to compliance of the child and the examination conditions. Total test scores of ten subtests were available in 24 healthy preterm cases, 13 preterm cases with MND and four preterm cases with CP and their individually matched control pairs, one child with Duchenne dystrophy with his control excluded due to impossibility to categorise the child with Duchenne into neurologically healthy or unhealthy in terms of MND criterias. The test scores of twelve ITPA subtests were available in all except two healthy preterm, one preterm with MND and one with CP. The TTC was administered to 37 preterms along with their controls \((total N = 74)\). The test scores of 22 healthy preterm children, 12 preterm children with MND, and three preterm children with CP and their matched pairs.
Table 2. *ITPA raw and scale score means (according to 10 and 12 subtests) and standard deviations (SD) of clinically neurologically healthy preterm children, preterm children with CP and MND and their individually matched controls*

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<tr>
<td>Mean</td>
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<td>282.8</td>
<td>272.5</td>
<td>288.0</td>
<td>253.3</td>
<td>274.9</td>
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<td>27.9</td>
<td>30.1</td>
<td>22.6</td>
<td>18.5</td>
<td>30.7</td>
<td>35.7</td>
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<tr>
<td>Mean</td>
<td>316.1</td>
<td>322.3</td>
<td>290.0</td>
<td>332.0</td>
<td>291.2</td>
<td>314.3</td>
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<td>29.3</td>
<td>35.3</td>
<td>29.1</td>
<td>21.9</td>
<td>39.7</td>
<td>41.3</td>
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<tr>
<td>Mean</td>
<td>356.9</td>
<td>365.3</td>
<td>342.0</td>
<td>371.5</td>
<td>334.9</td>
<td>358.8</td>
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<tr>
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<td>33.0</td>
<td>25.7</td>
<td>30.0</td>
<td>35.8</td>
<td>39.7</td>
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<tr>
<td>Mean</td>
<td>426.3</td>
<td>439.0</td>
<td>410.3</td>
<td>444.3</td>
<td>408.2</td>
<td>431.3</td>
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<tr>
<td>SD</td>
<td>37.3</td>
<td>39.7</td>
<td>32.2</td>
<td>19.4</td>
<td>45.5</td>
<td>46.9</td>
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*The lower the score, the poorer the performance.

ITPA = Illinois Test of Psycholinguistic Abilities, CP = cerebral palsy, MND = minor neurodevelopmental dysfunction.

could be included to the analysis. The MT was administered to 36 preterms and their controls (total N = 72, 21 healthy preterm, 12 with MND and 3 with CP and their controls).

Statistical methods

SPSS for Windows version 9.0 was used for data analysis. First, the test score means and standard deviations for different preterm subgroups and their matched control groups were calculated. Next, the means of the differences and their 95% confidence intervals (CI) were calculated to compare performance between the preterm subgroups and their individually matched control pairs in the three language tests. The statistical significance was tested using the paired t-test. When the linguistic test scores were analysed, the Kruskal-Wallis test was applied for comparisons between the subgroups of preterm children after first calculating the difference between each control and preterm child pair and then the group means for the differences. The subgroups of preterm children were also compared to each other using the same test. The differences in frequencies between the preterm subgroups and their matched pairs in the ITPA subtests 1–12 were analysed using the McNemar test for matched samples. The Fisher’s exact probability test was used to study the association between the linguistic findings and the finding of PVL. PVL and its association to all subtests of ITPA, TTC and MT as well as the total scores of the tests was studied. The variables were treated dichotomously, the ITPA cut-off point was 30 as mentioned earlier.

The study has been approved by the Ethics Committee of the Faculty of Medicine at the University of Oulu and written consent was signed by the parents.

RESULTS

Psycholinguistic abilities in the subgroups of preterm children

In a comparison between the different subgroups of preterm children and their controls, the healthy preterm children and the preterm children with MND and CP always achieved slightly poorer total raw and scale scores in the psycholinguistic test, although the scores were within the normal range nor did they exhibit a statistical difference (Table 2). It is noteworthy, however, that the preterm children with MND scored clearly lower scores than their controls, but perhaps as a result of the small sample size this did not achieve statistical significance.

The differences according to each subtest of ITPA between the preterm subgroups and their matched controls were also analyzed and did not indicate any statistical differences. In visual closure, preterm children with MND showed a tendency to perform poorer than their controls (p = 0.063) but this difference was not statistically significant. When the three subgroups of the preterm children, namely healthy, MND and CP, were compared to each other no differences were found.
Verbal comprehension in the subgroups of preterm children

The Token Test for Children measures verbal comprehension. The preterm children with MND scored significantly lower compared to their controls \((p = 0.004)\) while the preterm children with CP scored significantly better compared to their controls (Table 3 Table 4). When the preterm groups were compared to each other there was a small overlap of the CIs (Table 4). The MND children differed significantly from the healthy preterm children and the preterm children with CP due to their poorest performance in TTC \((p = 0.001)\).

In the total TTC (Fig. 1), the proportion of failed answers was 13.9% for the preterm children and 11.9% for the control children. The healthy preterm children’s proportion of failed answers was 13.5% (12% for their controls). Three preterm children with CP were assessed by TTC, and their proportion of failed answers was 7.1% (14.2% for their controls). The corresponding figure for the MND children’s total failed answers was 22.4% (10.4% for their controls), clearly higher than for the other groups (Fig. 1). The MND preterm children also scored worst in the Token subtests IV (failed answers 40%) and V (failed answers 36.3%). Their performance was significantly lower than their controls in these subtests while the other groups did not differ significantly from their controls.

The subtest IV in TTC includes relatively long and complex sentences with different names of shapes, sizes and colors. It demands a good short-term memory and concentration ability.

Subtest V includes sentences with different suffixes and both spatial and temporal concepts. The preterm children with MND scored poorest in most of the items in subtest V. In four of the 21 sentences the percentage of failed answers was > 50%. The most difficult sentences included spatial concepts such as behind, in front of, between, etc. Temporal processing was also difficult for them (e.g. “After picking up the green square, touch the white circle.”).

Morphological skills in the subgroups of preterm children

The Morphological Test measures morphological competence in the Finnish language. The MT measures how well children are able to use the right morphological endings in nonsense words. The total MT sum scores of the preterm subgroups and their matched control groups did not differ significantly from each other (Tables 3 and 4).

Contrary to the results obtained in the TTC preterm children with CP failed in many tasks in the MT subtests 2 (31.1%), 3 (48.9%) and 4 (24.4%) as well as in the total test (23.7% vs. 19.3% of the total control children’s group) (Fig. 2), but the statistical estimates are unstable due to the small numbers of cases, although the number of tasks tested is higher. The subtests 2 and 3, which included comparative and superlative forms, are usually the most difficult, even for school-aged children.

Language abilities in relation to the MRI findings of PVL

No associations were found between the language-related subtests in the psycholinguistic test, ITPA, and PVL in MRI. Contrary to expectations, children with PVL even performed better than those without it. Of the preterm children, 30.8% with PVL had difficulties in visual reception (using cut-off point < 30), while 44.4% of preterm children without PVL had similar difficulties. The corresponding percentages for visual sequential memory were 15.4% and 7.4% and those for visual closure 30.8% and 40.7%, respectively.

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<td>54.7</td>
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<tr>
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<td>4.0</td>
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<td>4.2</td>
<td>8.2</td>
<td>3.9</td>
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<tr>
<td>Mean</td>
<td>74.3</td>
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<tr>
<td>SD</td>
<td>5.2</td>
<td>10.2</td>
<td>18.0</td>
<td>10.0</td>
<td>5.7</td>
<td>15.3</td>
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</tbody>
</table>

*The lower the score, the poorer the performance.

TTC = Token Test for Children, MT = the Morphological Test, CP = cerebral palsy, MND = minor neurodevelopmental dysfunction.

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Table 4. The means and 95% confidence intervals (CI) of the differences in the TTC and MT total scores between the control-preterm pairs in the different subgroups of the preterm children*

<table>
<thead>
<tr>
<th></th>
<th>Healthy preterm children (N = 21–22)</th>
<th>Preterm children with CP (N = 3)</th>
<th>Preterm children with MND (N = 12)</th>
</tr>
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<tr>
<td>Tests</td>
<td>Mean of the diff. 95% CI</td>
<td>Mean of the diff. 95% CI</td>
<td>Mean of the diff. 95% CI</td>
</tr>
<tr>
<td>TTC</td>
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<td>-7.5 - 13.9, -1.1**</td>
<td>7.4 - 1.6, 13.2**</td>
</tr>
<tr>
<td>MT</td>
<td>-2.0 - 6.4, 2.5</td>
<td>1.7 - 28.7, 32.0</td>
<td>-2.9 - 14.6, 8.8</td>
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</table>

*The higher the score the poorer the performance compared to the control group. The linguistic test scores were analysed using the Kruskal-Wallis test in the comparisons between the subgroups of preterm children, after first calculating the difference between each control and preterm child pair and then the group means for the differences. **significant difference at level $p < 0.05$.

TTC = Token Test for Children, MT = the Morphological Test, CP = cerebral palsy, MND = minor neurodevelopmental dysfunction, Mean of the diff. = Mean of the difference.

There was no association between PVL findings and performance in either the TTC or MT.

DISCUSSION

Our study sample represents a population-based school-age group of preterm children and their carefully matched controls with comprehensive clinical examinations. On one hand, the design is the strength of the study, improving the generability and reliability of the observations, but on the other it inevitably leads to unstable estimates of associations i.e. a low power of the study when the number of cases in subgroups is small. To our knowledge, however this is the first study on the associations between neurological outcome including MRI and psycholinguistic skills in a sample of school-aged children followed up since pregnancy and based on a large, homogenous, and geographically defined population. The poor performance of the preterm children with MND emerged in this study, and, the difference to matched controls was statistically significant in verbal comprehension. The difference in language abilities between healthy preterm children and their controls was not significant, although the healthy preterm children’s scores were inferior. The differences between the preterm subgroups did not reach statistical significance with the exception of verbal comprehension in which the preterm children with MND scored significantly worst. The missing associations might be explained by a low number of cases in the subgroups or might not actually exist as it is highly possible that the differences reported in language development in previous studies might, for instance, have been caused by confounding socioeconomic factors which were carefully controlled in our study design. This interpretation is supported by Largo et al. (18, 19), as well as in many other reports (6, 8, 13, 34, 35, 41). In spite of some weaknesses, the present study shows clearly poorer linguistic skills in the preterm children, in particular among those with MND. Linguistic skills were not either associated with the occurrence of PVL but due to low numbers this result should be interpreted cautiously.

In our previous study, preterm children had particular problems in ITPA at the automatic level and in the visual-motor communication channel (44, 45), which are problems known to be associated with reading disability at school age (14). In the present study the healthy preterm children and the preterm children with neurological impairment scored poorer than their controls in the ITPA, although within the normal range. In a previous study (32), preterm children were found to experience more learning disabilities in reading and writing than did control chil-

![Fig. 1. Proportion of failed answers in the TTC among the different preterm subgroups (subtests I-V and total scores) and the total proportion of failed answers among the control children (total scores of TTC). TTC = Token Test for Children, CP = cerebral palsy, MND = minor neurodevelopmental dysfunction.](image)
Fig. 2. Proportion of failed answers in the MT among the different preterm subgroups (subtests 1-6 and the total scores) and the total proportion of failed answers among the control children (total scores of MT). MT = the Morphological Test, MT1 = adverb, MT2 = comparative form, MT3 = superlative form, MT4 = present tense, MT5 = past tense, MT6 = relative case, MT total = total scores in MT.

In short, in our previous study the ITPA screened the preterm children at-risk for learning disabilities (44). Preterm children with MND scored lowest in the total ITPA test, but especially in the subtest of visual closure. Children develop visual closure and speed of perception during the process of learning to read (14). The time limit for visual closure may have impaired the test results of the children with MND, who were reported to have attention deficits in the previous studies (32). These factors indicate that particularly preterm children with MND and problems in psycholinguistic development are at risk for learning disorders, especially in reading and writing at school age (32, 44). This is why preterm children with MND should also be addressed in rehabilitation at an early age.

The Token Test for Children has been demonstrated to be a valid and sensitive indicator of verbal comprehension in both children and adults (4). Difficulties in verbal comprehension were most obvious among the preterm children with MND. They had similar difficulties as children with dysphasia, namely an inability to interpret the rapid stream of acoustic information which characterizes speech (38). Also, problems in concentration cause poor results in TTC which is particularly obvious in preterm children with MND according to previous study (32). In addition, the TTC demands a relatively good short-term memory (4, 17). In our previous report (45) the preterm children did not differ from their matched control full-term children in auditory sequential memory. Instead, they differed significantly from their matched peers in visual sequential memory, which might influence their poor performance in TTC. One reason for difficulties in verbal comprehension even at school age might be derived from the neonatal period. In the neonatal intensive care unit, preterm infants experience stress and excessive auditory stimulation, which they have difficulties to cope with (43). They also show signs of self-regulation or organization to avoid or cope with environmental stressors (5, 23, 43). There are a good deal of studies on preterm children's difficulties in verbal comprehension at preschool age (9, 22, 40). It is noteworthy, however, as the present study shows, that preterm children, especially those with MND, continue to experience these problems at school age. A possible connection between early environmental stressors and later problems in speech perception should be examined in more detail in future studies.

The Morphological Test was the most difficult for preterm children with CP. In particular, preterm children with diplegic and hemiplegic syndromes have difficulties in using complex grammatical structures (28). In the present study, two of the CP children had diplegia, while one had hemiplegia and one tetraplegia. Sensomotor processes influence the capacity to master morphological rules at an early age (25). For infants and toddlers, everyday situations and activities are important for language learning. Preterm children with CP have difficulties with motor activities and perception, which may have an effect on language development, especially on the ability to understand and use morphological suffixes (28). Surprisingly, preterm children with CP performed better than their controls in TTC. We must be cautious, however, in any interpretation of performance of the preterm children with CP in this study due to the small number of the case-control sets.

The most visual subtests of the psycholinguistic ITPA test, which had differentiated between preterm and full-term groups in our previous study (45), did not correlate with the PVL findings. This observation is in agreement with a study by Olsén et al. (32), where the preterm children with and without PVL scored lower than their controls in visuospatial subtests. The authors concluded that the changes of the brain involved were so subtle that they possibly could not be visualised on MRI.

Preterm children with CP may need multisensory morphological training in speech therapy. However, how can we train preterm children with MND who have problems in verbal comprehension? Early speech therapy together with special instruction and
special arrangements at school such as smaller group sizes could help these children to avoid learning problems at school age. The visual-motor channel should be related to the auditory channel in speech therapy. An improvement of the child’s ability to interpret rapid temporal features in auditory as well as in visual perception might also prevent possible learning disorders. Behavioral characteristics relating to attention deficit disorders should be taken into account in the rehabilitation of preterm children with MND.

CONCLUSION

Healthy preterm, and preterm children with MND or CP scored poorer than their control pairs in most tasks in the psycholinguistic ITPA test, although the performance was within normal range. Preterm children with MND scored the poorest, even though the difference was not significant. Preterm children with MND experienced the most problems in verbal comprehension, measured by TTC, and scored significantly poorer than their matched control pairs or other preterm children. Preterm children with CP did relatively well in many of the tests but had the most difficulties with the morphological suffixes. In conclusion, preterm children with MND need to be followed more precisely before school age to prevent problems in language development and learning. In our study PVL in MRI did not indicate or rule out the linguistic problems in preterm children.

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SAMMANFATTNING

**Förhållandet mellan språkutvecklingen och neurologiska forskningsrön hos underviktiga och prematura barn vid 8 års ålder**

Undersökningen syftade till att avväga förhållandet mellan språkutvecklingen och den neurologiska statusen hos underviktiga och för tidigt födda barn vid 8 års ålder inom 1985–1986 års föddekoorthi in norra Finland.


Därutöver utfördes magnetiska bildgenereringar (magnetic resonance imaging = MRI) med speciell hänsyn till periventrikulära leukomalasi (PVL), som typiskt förekommer i samband med prematuritet. Även förhållandet mellan PVL och språkutveckling undersökt. De prematura barnen fördelades i tre neurologiska grupper; friska, lindrigt neurologiska...
(minor neurodevelopmental dysfunction = MND) samt svårt neurologiska (cerebral palsy = CP). I jämförelse med de matchade barnen konstaterades, att barnen i de tre neurologiska grupperna alltid hade genomsnittligt sämre poäng i ITPA testen. Deras poäng var emellertid inom normalfördelningen. Därefter klarade sig MND -barnen signifikant sämre än sina matchade par i Barnens Token testen. Därtill var deras poäng signifikant sämre än hos de friska och CP-handikappade prematura barnen. De CD-handikappade barnen i sin tur klarade sig signifikant bättre än sina matchade par i Token testen, men därefter tydligt sämre i Morfologi testen. På grund av det ringa antalet CP-handikappade barn (n = 3) kan resultaten emellertid inte betraktas som pålitliga. Vidare konstaterades det ingen korrelation mellan PVL-undersökingsrönen och språkutvecklingen.

**YHTEENVETO**

_Kahdeksanvuotiaiden, ennenäikaisina syntyneiden lasten kielessäntynytöt yhteydet neurologisiin löydöksiin_