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RESEARCH ARTICLE

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Description and prediction of reading decoding skills in Swedish children with Developmental Language Disorder

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ABSTRACT

Aim: Research is lacking in terms of reading decoding skills among clinical samples of Swedish-speaking children with Developmental Language Disorder (DLD).
Method: The present cross-sectional study included a sample of 61 children (8-12 years) with DLD attending school language units, years 1 to 5. Our purpose was to study reading decoding skills and predictors for decoding, such as a phonological processing skill (nonword repetition), working memory, and a family history of literacy problems.
Results: The results on a combined measure of the word and nonword decoding indicated that only 18% of the children had age-adequate decoding skills. The proportion of age-adequate decoders did not change noticeably with the school year. The participants' decoding skills showed larger deviations to test norm means with higher school years. Hierarchical regression analysis showed that the best predictors of decoding skills were measures of working memory and nonword repetition, followed by school year. These factors significantly contributed to the variance in decoding among our sample of children with DLD. A family history of literacy problems made no contribution to the variance.
Conclusions: The findings emphasize the necessity of assessing and following up on literacy development in children with DLD.

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Developmental language disorder; reading impairment; decoding skills; dyslexia; working memory; phonological processing; school year; family history

Introduction

Developmental Language Disorder (DLD), previously called Specific Language Impairment (SLI), is a common neurodevelopmental disorder that affects about 7–8% of children and adolescents [1], with the most severe form being present in about 2%. DLD is characterized by deficits in aspects of language form, content, and use, and occurs in the absence of other clinical explanations such as acquired brain injury or hearing impairment. The language problems tend to be persistent over time and can interfere with social and academic functioning in everyday life [2]. Reading Impairment (RI) is defined as a failure to decode written words (commonly referred to as the core feature of dyslexia) and/or poor reading comprehension, despite sufficient opportunities to participate in formal teaching [3]. The prevalence of RI is about 5–10% in general populations [4,5] depending on the definition criteria and on the type of orthography. In alphabetic orthographies, the prevalence of dyslexia is higher in languages with a non-transparent orthography, such as English, and lower in languages with a transparent orthography, such as Italian or Finnish [6]. The grade of transparency of phoneme-grapheme correspondence in the orthography of a language influences children's early development of decoding skills, though, by the end of the second school year, this influence on decoding skills seems to even out [7].

DLD and RI have been reported to co-occur at 55–90% in clinical samples [8–11] and at a lower rate of about 20–40% in population-based samples [12,13]. The co-occurrence depends on the varying criteria used for the classification of DLD and RI, respectively. Previous studies on RI in children with DLD are, to a large extent, based on English-speaking participants [8,11,13], and a surprisingly limited amount of cross-linguistic work has been done on the development and difficulties of decoding in children with DLD.

The present study is the first to report on decoding skills in a clinical sample of Swedish-speaking school-age children with DLD. The Swedish orthography is more transparent than the English one, though less than that of, for example, Italian or Finnish. Studies of reading skills in Swedish-speaking children with DLD are lacking, with a few exceptions [14,15]. In Hansson et al. (2004), Swedish-speaking children with a history of DLD (age 9–12 years) were outperformed by typical controls and also by a group of same age-peers with hearing impairment on word and nonword decoding skills and reading comprehension. A limitation of this previous study was the small sample size and the fact

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that the participants' DLD status was not confirmed when they were of school-age.

The first aim of the present study was to identify reading decoding skills in a comprehensive sample of Swedish children attending full-time school language units for children with severe DLD. During the recruitment of participants in the present study, we learned that only three (4.9%) of 61 participants had been clinically diagnosed with dyslexia. This surprised us based on the well-known high co-occurrence of these two conditions. Importantly, not all children with DLD have difficulties in learning to read [11,16]. However, in a longitudinal study on Finnish-speaking children with DLD in school years 1–3 [17], the authors reported that word decoding skills remained poor over the school years. To the best of our knowledge, there are no similar studies with the focus on decoding skills in Swedish children with DLD representing different school years. Within the first aim of this study, we investigated whether the proportion of age-adequate decoders in the DLD group changed with the school year.

In alphabetic orthographies, early decoding skills are highly dependent on phonological abilities [18,19], which suggests that phonological deficits are underlying poor word decoding in such orthographies [20]. However, the relationship is considered reciprocal, as the process of learning to read, in itself, helps to improve phonological processing skills [7]. Nonword repetition (NWR) is a task that has been suggested to measure an implicit aspect of phonological processing, that is, phonological short-term memory [21]. NWR has been found to be associated with inherited DLD [22] and with RI [23,24] and has been suggested as a common cognitive phenotype for both DLD and RI [25]. Several studies have found that English-speaking children with co-occurring DLD and dyslexia show poorer NWR skills than do children with only DLD or only dyslexia [13,16,19]. In a Swedish study [26], NWR correlated significantly with both accuracy and speed in word decoding among children with DLD. In a previous report [27] using the same participants with DLD as in the current study, poor NWR (below −2 SD) was reported in 92% of the sample with DLD but only in 2.3% typically developing controls, and, thus, was suggested as being a clinical marker of Swedish DLD. Furthermore, poor readers with a positive family history (FH) have been reported to have poorer NWR than poor readers *without* literacy problems in their FH [28].

Also, less phonologically taxing working memory tasks have been found to be associated with word and nonword decoding [29]. In a previous study of Swedish-speaking children with a history of DLD, a test of complex working memory correlated significantly with the speed of word and nonword decoding [14]. Complex working memory is typically assessed in terms of the performance of tasks that tap the simultaneous processing and storing of verbal information (e.g. words or figures). The process of converting each grapheme to a phoneme in written language and the simultaneous recall of each phoneme in the word is required for the child to be able to correctly read it out loud. The second aim of the present study is to elucidate the association of NWR and a complex working memory test, the Competing Language Processing Test (CLPT) [30] with reading decoding skills in our participants with DLD.

It has also been suggested that children's reading development is affected by external factors, such as the home literacy environment [31] and socioeconomic status [32], as well as by the quality and quantity of formal instruction [33]. The effects of environmental factors on the family in terms of reading development can be difficult to disentangle from genetic liability. However, in a recent study from the Netherlands [34], family design and a twin design were combined to explore the influence of genetic factors and cultural transmission of reading skills. The authors found that variation in reading ability is, to a large extent, caused by genetic factors and is not due to cultural transmission. Importantly, the genetic factor will be more pronounced in samples from contexts in which the education system is equal, and thereby decrease the environmental variations [35]. Kalnak et al. [27] reported that 63.9% of participants with DLD (the same sample as in the present study) had a positive FH of literacy problems in one or both biological parents. Moreover, a high co-occurrence of language and literacy problems was found in the parents: 55.3% of the parents with language problems also had literacy problems, while 43.8% of the parents with literacy problems also reported language problems [27]. The finding of the co-occurrence of language and reading impairments is in line with the results of previous FH studies [36] as well as of twin studies [37,38], suggesting the existence of common underlying mechanisms. Indeed, common genetic markers for RI and DLD have been reported [39–41]. The third aim of the present study is to investigate the association between decoding skills and an FH of literacy problems in our sample with DLD. More explicitly, we wish to explore the extent to which the variance in the decoding skills of children with DLD can be explained by FH, NWR, and CLPT. The novelty of the present paper lies in its study of these factors in a comprehensive clinical sample of Swedish-speaking school-age children with DLD.

Aims

In the present cross-sectional study, we aim to explore the reading decoding skills of a population of 61 Swedish-speaking children with DLD, aged 8–12 years, attending school years 1–5 in language units for children with severe DLD. The research questions are:

1. How do Swedish children with DLD in school years 1-5 perform on word and nonword decoding tasks in relation to norms? What is the proportion of children with age-adequate decoding skills per school year? Are demographic factors such as gender, school year, and parents' level of education associated with the decoding skills of our sample?
2. Are NWR, complex working memory, and FH associated with the participants' decoding skills?
3. How well can measures of demographic factors and NWR, working memory, and FH explain the variance in decoding skills in our sample?

Material and methods

Participants

This study is based on 61 children with DLD (15 females, 46 males), 8–12 years (mean age 9.3, SD 1.2), recruited from school language units in Stockholm, Sweden [27,42,43]. Children are usually referred to these schools at the age of six by clinical speech-language pathologists or psychologists due to pervasive and persistent DLD. During the admission process, the children are assessed by the schools' speech-language pathologist, psychologist, and teacher. The general admission requirement for these schools is DLD, defined as a language disorder being the primary developmental problem of the child, that is, excluding autism spectrum disorder and an intellectual disability disorder.

The following study inclusion criteria were used: DLD at the time of admission to the school and remaining at the time of recruitment to our study (i.e. we did not invite children whose DLD diagnosis had been questioned by the school or had changed after admission to the school); non-verbal IQ within or above average at the time of school admission; normal hearing and vision; and monolingual Swedish-speaking. The participants had a mean non-verbal IQ of 99.34 (SD 14.4) as measured by Raven's Coloured Matrices [44] at the time of participation in the present study. Three participants (4.9%) had, in addition to DLD, a diagnosis of dyslexia, while four (6.6%) had been diagnosed with ADHD. We have information about parents' highest level of education for all 61 children, except for one father. The level of education was distributed across three groups as follows: elementary school (14%), upper secondary school (48%), and higher education/university studies (38%). The distribution of the educational levels of the parents corresponds to the distribution in the general Swedish population (www.scb.se).

Material and procedure

Cognitive-linguistic assessments

The following measures were included and analyzed in the present study: word and nonword decoding, NWR, complex working memory, and FH. The measures included were individually administered to all participants in a quiet room at their schools. The assessments were administered by the first author, an experienced speech-language pathologist, and were audio/video-recorded for later analysis. For all measures, the cut-off level of poor performance was defined as a score at or below the 10th percentile, that is, 1.28 SD below the mean of test reference data.

Word and nonword decoding was assessed using a Swedish version [45] of Test of Word Reading Efficiency (TOWRE) [46]. TOWRE consists of two timed subtests that assess word decoding and nonword decoding. Each subtest consists of two lists of, in total, 208 words and 126 nonwords. Children are instructed to accurately read out loud as many words/nonwords as possible for a duration of 45 s per list. There are Swedish age reference norms for school years 1-5 based on typically developing children in each year [47,48].

The NWR test in the computer-based test battery Sound Information Processing System [48] was used. The NWR test consists of 24 nonwords containing three or four syllables. The nonwords were presented one at a time by a female voice from a computer. The instruction was to repeat each nonword after having heard it. For each of the nonwords, the responses were scored as either correct or incorrect [49]. Age norms from typically developing children [27] were used.

The CLPT was used to test complex working memory capacity or the simultaneous processing and storing of linguistic information [30, Swedish version in 50]. The CLPT consists of statements arranged in six blocks, containing one to six statements. Each statement is either false ("Carrots can dance") or true ("Fire burns paper"). The participants were first asked to make judgments of semantic acceptability by answering "yes" or "no" after each statement in a block. Upon the completion of a block, the participants were instructed to verbally recall (repeat) the last word/s of each statement in any order. Each correctly recalled word received a score of one. Prior to the test, each child completed a pre-test exercise with two statements. Age norms from typically developing children were used [50–52].

Family history interview

FH interviews were administered by the first author of this study, with the parents of the participants. The parents were asked if they had a history of, or current difficulties within, several categories of language-related diagnoses and problems, previously published in [42]. Each interview lasted for an average of 30 min (15–40 min). An FH of literacy problems in the parents was defined as a diagnosis of dyslexia or difficulties in learning to read that was not due to insufficient schooling. In the present study, an FH of literacy problems was classified into two categories based on whether or not the child with DLD had parents with literacy problems. We have information regarding the FH for all participants' parents.

Statistical analysis

The results were analyzed using the statistical software IBM SPSS Statistics 25. Descriptive numeric data were expressed as means and standard deviation. Categorical data were expressed as frequencies. Pearson's Correlation coefficient was used to investigate the association between continuous variables. Spearman's Rho was used to investigate associations between categorical variables. *t*-Tests were used to investigate the differences between the decoding skills per school year. Hierarchical multiple regression was used to examine the relationship between four independent variables and decoding skills, to isolate predictors which have a significant influence on the decoding composite score. The level of significance was set at .05.

Ethical approval

The study was approved by the local ethics committee in Stockholm (Reference no. 2008/543-31/3; 2012/1938-32). Written informed consent was obtained from the parents and oral informed consent was obtained from each child at the time of the assessment.

Results

Our first aim was to investigate the decoding skills in our sample with DLD in relation to test norms and to determine the proportion of participants with age-adequate decoding skills per school year. The participants' average performances in terms of word and nonword decoding varied between 1.7 and 2.8 standard deviations below the norm average per school year (Table 1). To grasp the participants' levels of severity in terms of difficulty in decoding, performance in school years 3 and 4 is comparable to norms for typically developing children in school year 1, regarding both correctly decoded words and nonwords, and also regarding the magnitude of the difference between the two decoding skills. We found that the difference between word and nonword decoding in the participants was significant from year 2 (see Table 1), as in test norms. The magnitude of the effect size of the difference in word and nonword decoding was medium in the first two school years, and large in school years 3–5 (Table 1). The word and nonword decoding measures were significantly and strongly correlated (r = .908, p < .001) and, therefore, were collapsed into a decoding composite score in all further analyses.

Regarding the proportion of age-adequate decoders (i.e. performance above the 10th percentile per school year) in the sample and the question of whether the proportion was different for each grade, we found that 11 children (18%) out of 61 were age-adequate decoders, while 50 children were not. The poor decoders had a mean decoding z-score of −2.90 (0.90 SD; min = −4.9; max = −1.41), while the age-adequate decoders had a mean decoding z-score of −0.31 (0.62 SD; min = −0.97; max = 1.41). The poor decoders and the age-adequate decoders did not differ in NWR z-score (t(59) = -0.814, p=.419). However, they differed on the CLPT z-score (t(59) = -2.964, p=.004) , and the magnitude of the difference was large (d=1.04). There was a higher percentage of participants with a positive family history among the poor decoders (82.0%, n=41) than among the age-adequate decoders (72.7%, n=8). When we inspected the proportion of poor decoders per school year (Table 2), we found no indication of a change with the school year; still, in year 5, 80% had poor decoding skills as compared to norms. However, the study is cross-sectional and the results cannot explain the longitudinal development of decoding.

Associations between decoding skills and demographic factors

First, the decoding z-score did not correlate with gender (p = .244) or parents' level of education (mothers, p = .224; fathers, p = .637, parents' highest, p = .249), while school year showed a positive correlation with the decoding composite rawscore (p ≤ .001, r = 0.555) (Table 3). This means that gender and parents' level of education were not associated with the decoding standard score, and also that the participants decoded more words and nonwords correctly in the higher school years. Accordingly, the within-group comparison seems to indicate a possible improvement in decoding with the number of years in school. Unfortunately, when compared to norms (see Table 1), the decoding skills in our sample with DLD show a larger deviation from norm means with higher school years. This indicates that the gap widens with each school year.

Table 1. Participants' decoding mean rawscore (SD) and mean z-score (SD) for the number of correct items on word decoding and nonword decoding tasks in TOWRE.

	Word decoding		Nonword decoding		Comparison	
School year	Rawscore (SD)	z-score[a]	Rawscore (SD)	z-score[a]	p	D
1 (n = 6)	17.0 (27)	−1.9	5.2 (8)	−1.8	n.s.	0.59
2 (n = 19)	42.9 (33)	−1.8	26.9 (24)	−1.7	<.001	0.55
3 (n = 15)	50.3 (33)	−2.6	27.3 (18)	−2.8	<.001	0.87
4 (n = 11)	72.6 (16)	−2.7	42.6 (20)	−2.6	<.001	1.66
5 (n = 10)	87.6 (26)	−2.3	45.5 (19)	−2.5	<.001	1.85

Data are given as p-values and Cohen's D effect sizes for the difference between word decoding and nonword decoding per year.
[a]z-Score = standard deviations from the norm mean based on school years; the mean z-score = 0.0.

Table 2. Number (%) of participants with a poor or adequate decoding score*.

School year	Poor decoders	Adequate decoders
1	5 (83%)	1 (17%)
2	14 (74%)	5 (26%)
3	13 (87%)	2 (13%)
4	10 (91%)	1 (9%)
5	8 (80%)	2 (20%)
all	50 (82%)	11 (18%)

*The cut-off for poor decoding was −1.0 SD based on a composite score of word and nonword decoding.

Associations with NWR, CLPT, and FH

Next, we analyzed the association between decoding and NWR, CLPT, and FH, respectively. We found a positive moderate correlation between decoding skills and NWR (p ≤ .001, r = 0.466) as well as with CLPT (p ≤ .001, r = 0.601). An FH of literacy problems was negatively correlated with the decoding composite score (p = .038, r = −0.267), that is, a positive FH was associated with lower results on the decoding task. The participants with a positive FH (n = 39) scored in average lower on the decoding composite score (mean z-score = −2.23, SD = 1.2) than the participants with a negative FH (n = 22; mean z-score = −1.56, SD = 1.4), though the difference was not statistically significant (t(59) = 1.949, p = .056).

Predictors of decoding skills in children with DLD

Hierarchical multiple regression was used to assess the ability of the two measures (NWR and CLPT) to predict

Table 3. Correlation analysis of the decoding composite score with demographic factors, FH, and the cognitive measures NWR and CLPT.

Factor	Decoding composite score
School year	$p \le .001$, $r = 0.555$
Gender[a]	$p = .244$
Father's education[a]	$p = .637$
Mother's education[a]	$p = .244$
Parents' education[a]	$p = .249$
Family history	$p = .038$, $r = -0.267$
NWR	$p \le .001$, $r = .466$
CLPT	$p \le .001$, $r = .601$

[a]Correlation based on the decoding composite *z*-score.

Table 4. Summary of hierarchical regression analysis for variables predicting decoding skills in children with Developmental Language Disorders ($n = 61$).

Predictors	R^2	Adj. R^2	*B*	*t*	*p*
Step 1	.344	.322			<.001
School year			0.432	4.850	<.001
Family history			−0.194	−1.799	.077
Step 2	.549	.517			<.001
School year			0.267	2.535	.014
Family history			−1.57	−1.697	.095
CLPT			0.356	3.353	.001
NWR			0.306	3.234	.002

decoding skills, as measured with TOWRE, in the sample of 61 children with DLD, after controlling for the influence of school grade and FH (Table 4). Gender and parental education were not included as predictors because they did not significantly correlate with the decoding measure. Preliminary analyses were conducted to ensure that there were no violations of the assumption of normality, linearity, multi-collinearity, and homoscedasticity. School year and FH were entered at Step 1, explaining 32.2% of the variance in decoding ($F(2, 58) = 15.233$, $p < .001$). In the first model, the measure "school year" was statistically significant, though FH was not. After entry of CLPT and NWR in Step 2, the total variance explained by the model as a whole was 51.7% ($F(4, 56) = 17.029$, $p < .001$). The two measures (CLPT and NWR) explained an additional 20% of the variance in decoding after we controlled for school grade and FH; this contribution was statistically significant. In the final model, the control variable "school grade" and the two independent measures (CLPT and NWR) were all statistically significant, with CLPT recording a higher beta value (beta $= 0.356$, $p = .001$) than NWR (beta $= 0.306$, $p = .002$) and school grade (beta $= 0.267$, $p = .014$). In sum, we found that CLPT, NWR, and school year significantly contributes to the variance in decoding in our sample of children with DLD. In our model, CLPT is the strongest predictor of decoding, closely followed by NWR and school year. The variable FH offers no contribution to the variance.

Discussion

In the present research, 61 children with DLD, who were attending school language units, years 1 to 5, were included in a cross-sectional study. The purpose was to study decoding skills and predictors of decoding. The results of a combined measure of word and nonword decoding indicated that only 18% of the children had age-adequate decoding skills. The proportion of age-adequate decoders did not change noticeably with the school year. The gap in the participants' decoding skills widened to norm means throughout the school years, which told us that the higher the school grade, the larger the deviation from typically developing peers.

Hierarchical regression analysis showed that, in our model, the best predictors of decoding skills were measures of complex working memory and phonological short-term memory, followed by school year. Gender and parental level of education were not significantly correlated with decoding skills.

Thus, our results indicate that a considerable proportion of Swedish children with severe DLD have poor decoding skills. This is in line with the results of previous studies based on clinical samples of children with DLD. For example, poor decoding was documented in 75% of 9-year-olds who had DLD and who were attending language units in the US [53] and in 69% of 11-year-olds who had DLD and who were attending language units in the UK [11]. The co-occurrence of DLD and poor decoding skills in school-age children inevitably have consequences such as poor academic achievement, despite the children's attendance of special schools [54].

It is intriguing that only three out of the 61 participants were diagnosed with dyslexia at the time of inclusion in the present study. The schools from which the participants were recruited have significant experience with children who have DLD. The schools might expect poor reading skills in these children and offer an appropriate reading intervention without the need for a formal dyslexia diagnosis. Moreover, admission to a special school demands a formal diagnosis in Sweden, while reading interventions do not. And, in Sweden clinical assessments of RI are usually carried out earliest from the 2nd or 3rd school year, seldom before. This could possibly contribute to the low number of participants with a dyslexia diagnosis in our sample. Another possible explanation is, that in clinical praxis a DLD diagnosis can be assumed to exclude RI diagnoses when occurring with broader language deficits [55]. The consequence of such an approach is that dyslexia risks being under-diagnosed and, possibly, also under-treated, in children with DLD. If we rather assume that dyslexia and DLD are two separate but highly co-occurring conditions [19], the decoding difficulties in children with DLD should be formally acknowledged with a diagnosis of dyslexia. Taken together, despite the presence of four or even five years of full-time schooling in a special educational setting, the proportion of children with poor reading decoding skills remains high. The finding in the present study of substantially poor decoding skills in such a large majority of participants with DLD, concludes with several issues to be investigated in future studies: There is a need to investigate if the diagnostic assessment follow-ups of these children include assessments of written language skills. Also, these children should be offered intensive reading intervention and their response to intervention should be examined, as well as their warrant of special educational rights, following RI, should be looked over.

The association between decoding and NWR is in line with previous findings [13,19,56]. This is not surprising; rather, it is expected in clinical samples with DLD [19]. NWR is a clinical marker for DLD in several languages, including Swedish [27], and, NWR is a measure of phonological processing considered to have a reciprocal association with word decoding [57]. The association between decoding skills and complex working memory was also expected given the earlier results regarding Swedish-speaking children with DLD [14,15]. However, poor performance on a working memory task is not necessarily causing a disorder, it could be a consequence. Once reading starts to be established, reading experience may contribute to the development of working memory skills [58]. A true challenge in reading instruction, and also an implication of these associations, is to avoid the simultaneous overload of decoding, comprehension, and recall.

Our study does not corroborate studies that found a significant correlation between reading and parental level of education, whereas, a positive FH was significantly associated with poor decoding skills in the child. The association was weak, which could be an effect of a restriction of range in our sample with severe DLD. It has been reported that parents' reading performance is the strongest predictor of children's reading outcomes [59,60]. About 64% of the participants in the present study had at least one parent with literacy problems. Accordingly, this has important clinical implications. An understanding of an FH of, for example, literacy problems, should include an early screening of factors important for reading development and the prevention of RI in children with DLD and also influence clinical strategies of intervention, and consultation with the parents [61].

It has been emphasized that instructional factors, such as the quality and type of reading instruction, should not be ignored when one is studying RI in children [33]. The present study lacks data regarding reading instruction. In Sweden, special schools for children with DLD have smaller classes and a high number of school staff members (teachers, special education teachers, speech-language pathologists, and classroom assistants) per child, aimed to provide better pre-requisites of learning than what a mainstream school can offer to these children. However, attending a special school does not necessarily guarantee a high quality of reading instruction, that is, adequate focus on phonological and morphological elements of word structure knowledge, as direct and explicit targeting of their decoding problems.

Methodological considerations

This study lacks data regarding the quality and quantity of the reading instructions in the schools from where the participants were recruited, which is diagnostically crucial to consider. This means that in the present study the difficulties with poor decoding in 82% of the participants could be explained by, for example, poor reading instruction. A further draw-back is that the test of complex working memory requires linguistic processing (semantic acceptability judgments) of sentences, which may have confounded results from children with DLD. Another limitation to this study of RI in DLD, is the lack of reading comprehension data, which would add to the understanding of the participants' reading skills. And, what about the 18% of the participants who showed age-adequate performance on the decoding measure: Who are these children? We found that they perform similar to the poor decoders on NWR, show higher results on CLPT, and, they have a slightly lower prevalence of a positive family history. These may be the children who demonstrate the profile of a specific comprehension deficit [16,19], or they are just relatively better at decoding.

The sample of 61 children with DLD attending school language units is a rather comprehensive sample, especially in a country like Sweden. A drawback of our study is that there are few participants *in each school year*. The present cross-sectional study was based on a clinical sample and not a representative population sample, so neither generalizations to the population of school-age children with DLD, or to their development can be made.

Conclusions

In this cross-sectional study, we found a high level (82%) of Swedish children with DLD that have significant difficulties in the accurate and effective decoding of written language. These children's struggle with decoding implies there are limited resources that support comprehension and recall of the texts they read. The proportion of poor decoders is similar for each school year, although the performance gap between children with DLD and typically developing children seems to widen with each ensuing school year. This larger deviation from test norms with higher school year is a true challenge, since, across school years, reading proficiency becomes increasingly important for children's ability to learn and participate in society. It is important that not only individual progress in the number of accurately decoded words and nonwords are measured for children with DLD, for example, in the special schools. Additionally, decoding skills should be compared to norms, so that the child's difficulties can be formally acknowledged (i.e. with a co-occurring dyslexia diagnosis, if appropriate) and practically cared for, for example, by being offered targeted reading intervention. Working memory and NWR were strong predictors of decoding, while gender and parents' level of education were not. These findings indicate the necessity of diagnostic reading assessments and the continuous need for reading intervention in Swedish children with DLD. The findings have important implications for prevention and intervention, emphasizing the necessity of diagnostic assessments of literacy skills in children involved in school language units. A family approach, that involves counseling and support to families, is recommended considering the high prevalence of literacy problems in the parents and the association between a positive FH and poor decoding skills in the children with DLD.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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