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RESEARCH ARTICLE

Kindergarten screening tools filled out by parents and teachers targeting dyslexia. Predictions and developmental trajectories from age 5 to age 15 years

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The concept of early 'efforts' has led to discussions for and against introducing language assessment for all kindergarten children. Evidence-based kindergarten screening tools completed by close caregivers could solve this controversy as the children themselves would only be indirectly involved. The aim of this study was to see whether the scores of such early screening tools aiming at developmental dyslexia could predict school marks of literacy competence 10 years later, and to see whether these screening tools would reveal different dyslexia trajectories. The study is part of the Bergen Longitudinal Dyslexia Study, and the results from individual testing are reported elsewhere. Here, the caregivers' views isolated from the rest of the study are focused. Three tools were used: the RI-5, a questionnaire assessing the risk of dyslexia; the TRAS, a non-standardized observation tool of children's communication skills; and the CCC-2, a questionnaire assessing Developmental Language Disorders. Screening was performed at age 5 (TP1), age 11, (TP2) and age 15 (TP3). At TP2, when dyslexia was identified, 13 children formed the dyslexia group, and the rest formed the control group. At TP3, the RI-5 and CCC-2 turned out to be predictive of literacy competence as measured by school marks. Developmental trajectories were seen through the regroupings and

scorings into a persistent group, a late onset group and a resolving group. Evidence-based preschool screening tools filled out by close caregivers offer valid information on later literacy developmental trajectories.

KEYWORDS
developmental trajectories, early efforts, literacy competence, predictors, screening tools

Key messages/Practitioner points

- Early identification of dyslexia risk factors should be based on research, clinical expertise, and close caregivers' concern
- Close caregivers' early concerns indicate at-risk of developmental dyslexia
- Evidence-based screening tools filled out by close caregivers predict literacy development
- Use of such tools solve the controversy of early individual testing in kindergarten
- Research show evidence of a significant correspondence between early evidence-based risk factors and later school marks

1 | INTRODUCTION

This study focuses on close caregivers' contributions to early identification of dyslexia. Dyslexia is one of the most frequent learning disabilities in schools, often estimated to 5%–10% depending on how the term is defined (Miles, 2004). It is a multifactorial impairment (Pennington & Bishop, 2009; Ring & Black, 2018), and according to the definition by The British Dyslexia Association, it is constitutional, which implies a predisposition from birth, and it affects the development of literacy- and language-related skills, and its effects are likely to be lifelong. Impaired processing speed, phonological processing, working memory and rapid naming are benchmarks that may not match the individual's other cognitive abilities (BDA, 2007; Cooke & Adams, 2007). Several of these benchmarks overlap with the characteristics of developmental language disorder (DLD) (Bishop, Snowling, Thompson, Greenhalgh, & Catalise-consortium, a. t., 2017; Gray et al., 2019) and of mathematic disorders (Butterworth, Varma, & Laurillard, 2011). Comorbidities between these three disorders are often seen (Adlof, 2020; Adlof & Hogan, 2018; Moll, Landerl, Snowling, & Schulte-Körne, 2019; Pennington, 2006).

Although at-risk factors can be identified at a pre-literacy stage, dyslexia, by definition, is an impairment of reading and writing, which evidently cannot be diagnosed until formal literacy training has started. According to Frith (1999), there are two categories of dyslexia: 'false' and 'true' dyslexia. Their common symptoms are reading and writing problems. To sort out what is what, individual testing at the neuro-cognitive level is needed. In 'false' dyslexia, no impairments are seen at this level, while in 'true' dyslexia, cognitive impairments are identified. Irrespective of diagnosis, each child with literacy problems needs help, which must be based on the individual's profile of strengths and weaknesses.

The concept of 'early efforts' is manifested in educational government papers worldwide (Demeuse & Baye, 2007), but has led to discussions involving both kindergarten teachers and parents, as well as researchers. Some argue that early assessment is necessary for early detection, and hence, it should be introduced for all kindergarten children. Others hold that this would change the kindergartens into schools where teaching and evaluations would take over for children's need for free play and social interaction (Pyle, Poliszczuk, & Danniels, 2018).

1.1 | Finding early predictors of dyslexia

Large studies worldwide use a multitude of methods to assess and pinpoint what dyslexia is, and to find measures of prevalence and incidence, and early risk factors (Wagner et al., 2020; Zuk et al., 2020). Evidence of dyslexia is usually based on studies targeting the 'hidden profile of dyslexia,' meaning cognitive- or neurobiological-based theories (Tigka & Magda, 2016). Researchers select samples and are usually involved in diagnostic processes. The cooperation between parent, child and kindergarten teacher is perhaps the most important success factor in early detection and intervention. However, as pointed out by Lopes, Gomes, Oliveira, and Elliott (2020), teachers are seldom involved, although they are the ones closest to see how the child performs and progresses and should hence be the first to observe problems. Likewise, parents are seldom involved, except as acceptors for clinical evaluation and consent authorities for their children to participate in research projects (Abd Rauf, Ismail, Balakrishnan, & Haruna, 2018).

According to Glascoe (2000), evidence-based practice is best characterized if it is composed of three components: research evidence, clinical expertise and patient concerns. As to kindergarten children, caregivers (parents, and kindergarten and schoolteachers) should represent 'patient' (i.e. the child's) concerns. Evidence-based screening tools completed by caregivers can offer important information of the individual child's needs (Bishop & McDonald, 2009; Glascoe, 1997, 2000). Hence, the use of such valid and reliable tools may be a first step out of the early testing dilemma. Longitudinal studies starting with kindergarten children at risk for dyslexia are seen as the best way to find valid and reliable at-risk factors (Adlof & Hogan, 2018; Dehaene, 2009; Goswami, 2003, 2010, 2020). It would be even better if such instruments could predict literacy development in subsequent years (Sim, Thompson, Marryat, Ramparsad, & Wilson, 2019). However, appropriate tools have not been easy to find, since many have been criticized for not meeting psychometric standards (Denman et al., 2017; Sim et al., 2019), or for not focusing on dyslexia specifically, see, that is, Heidlage et al. (2020). Following arguments by Gabrieli (2009), at-risk screening instruments should identify around 20% as at-risk to be able to identify all the 10% true positives.

1.2 | Caregivers' screening tools

A Norwegian cross-sectional study aimed at exploring the outcome of parents' and kindergarten teachers' concern using valid and reliable screening tools assessing risk of developmental dyslexia and comorbidities such as DLD and mathematic disorders (T. Helland, Jones, & Helland, 2017). Three different tools were used: the RI-5 (Risk Index, age 5) aiming at 5-year-old children at risk of developmental dyslexia (T. Helland, 2015), the TRAS (Tidlig registrering av språk [Early registration of language development]), a non-standardized instrument for observing language and social interaction skills in children aged 2–5 years (Espenakk et al., 2003); and the CCC-2 (Children's Communication Checklist), a questionnaire designed to screen for language impairment in children aged 4–16 years (Bishop, 2011). RI-5 is based on the causal, four-level model by Morton and Frith (1995), advocating assessments at behavioural, cognitive, biological and environmental levels, while TRAS and CCC-2 focus on language as consisting of form, use and content. The tools were filled out by parents and kindergarten teachers of 107 five-year-old children. By using the defined cut-off scores for each instrument, 28 (26%) of the children were defined as at-risk by either one, two or all three instruments. Significant, but moderate, correlations were found between the tool scores. However, such concurrent data do not give information as to their predictive value or as to the later development of at-risk children. The conclusion of the study was that a longitudinal design with individual follow-up over the course of literacy training in school could reveal to what degree these instruments can predict dyslexia.

1.3 | The three literacy stages

In general, children go through three literacy stages (Ehri, 1987; Frith, 1986). The *pre-literacy stage* is before formal training starts in school. Typically, some children show no interest in forthcoming school activities, whereas

others engage in literacy games, pretending to read and write. Some children 'break the code' while in kindergarten, but most children do not. The *emergent literacy* stage is when formal literacy is taught. In Norway, literacy training starts in the first grade (age 6) covering the basic skills: reading, writing, arithmetic and English as the second language. The *literacy stage* is when reading and writing have become automatized and are expected to be tools for other academic work. Very often dyslexia is not identified until this stage. Failure in learning to read and write after several years of hard work, despite having received appropriate help, is discouraging, and children with dyslexia may experience secondary emotional problems (Ozernov-Palchik & Gaab, 2016; Shaywitz & Shaywitz, 2020).

1.4 | Sample selection and developmental trajectories

Developmental trajectories in dyslexia can be analysed in several ways, for instance, according to psychological health (Jordan & Dyer, 2017), according to intellectual abilities (Kuppen & Goswami, 2016) or according to protective and compensatory mechanisms (Yu, Zuk, & Gaab, 2018).In line with several other studies (see, i.e., Jin et al., 2020; Peng et al., 2019; Snowling et al., 2019), the focus of this study is on literacy development as depicted by the three stages by analysing close caregivers' evaluation of their children's literacy development through kindergarten to their last year of compulsory school when they were 15 years old.

Oral language precedes literacy, and in the pre-literacy stage, a group of children may present with language delay as DLD or pragmatic problems, which will persist in some and resolve in others (Lyytinen et al., 2006; Snowling & Hulme, 2020; Yu et al., 2018). Moving to the emergent literacy stage, when the children's main task is to learn how to read and write, difficulties will disappear in some children, persist in others and appear in a new group of children. At the literacy stage, when reading and writing are supposed to be automatized, similar complicated pattern may appear. These possible trajectories are depicted in Figure 1.

According to Goswami (2003, 2020), the best way to find early risk factors accounting for these conditions is by longitudinal studies starting at an early age. At-risk groups should be inclusive for later identification of false and true positives, as proposed by 6 (2009).

In all developmental research, sampling is a challenge. In longitudinal dyslexia studies, this problem has been dealt with in different ways (Lopes et al., 2020). One way has been to base samples on well-established risk groups such as clinically referred children with developmental language impairment as reported by Elbro, Dalby, and Maarbjerg (2011). Another way is to base samples on children of parents with dyslexia (Caglar-Ryeng, Eklund, & Nergård-Nilssen, 2019; Lyytinen, Richardson, & Aro, 2019; van der Leij et al., 2013). A third way is to combine these two selection criteria (Snowling, Duff, Nash, & Hulme, 2015; Torppa, Eklund, van Bergen, & Lyytinen, 2015). Population-based selections are demanding but perhaps optimal (Shaywitz et al., 1999; Zambrana, Pons, Eadie, & Ystrom, 2014). All these are examples of longitudinal studies from different countries that convey important insights into language and literacy development. Despite their different approaches to dyslexia, they show that early testing can detect risk of dyslexia and that some at-risk children resolve despite early at-risk signs.

1.5 | The current study

This study was based on data collected from the Bergen Longitudinal Dyslexia Study (https://www.uib.no/en/project/speakup) following a population-based cohort of children from they were 5 years old until they were 11 years old. Three caregivers' screening instruments were used, the RI-5, the TRAS and the CCC-2. The cohort was separated in a typical group and an at-risk group by using the upper quartile of the RI-5 as a cut-off for being at-risk of dyslexia. By an individual blind-testing procedure when the children were 11 years old, half of the at-risk group was identified as false positives, whereas the other half was diagnosed with dyslexia (true positives). This identification was in line with the

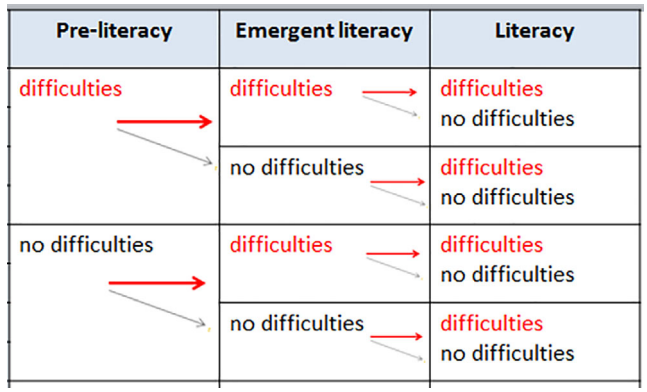

FIGURE 1 Possible trajectories during the three literacy stages [Colour figure can be viewed at wileyonlinelibrary.com]

earlier referred dyslexia definition by the BDA (2007). The false positives of the at-risk group and the typical group were then merged into a control group. Since then, much data from individual testing have been analysed retrospectively from several perspectives and published with the design control versus dyslexia, showing significant group differences in reading and writing (T. Helland, Plante, & Hugdahl, 2011; Morken & Helland, 2013) neuro-cognitive abilities 2015; (T. Helland & Morken, 2016; T. Helland, Tjus, Hovden, Ofte, & Heimann, 2011) and brain data (Clark et al., 2014; Morken, Helland, Hugdahl, & Specht, 2014, 2017; Specht et al., 2009). Despite many publications from the project, the information from the participating caregivers' screening tools has not yet been fully evaluated. Therefore, all participants from the original cohort of five-year-olds were addressed anew 10 years later to respond to an identical screening tool as the ones used when the children were five years old, 11 years old and finally 15 years old. This would add new information to the previous evaluation of screening tools filled out by caregivers (parents and teachers) in a 10 years' perspective and add information as to academic achievements.

In accordance with the idea of evidence-based practice (Glascoe, 2000), the aim of the current study was twofold. The first aim was to assess to what degree preschool screening tools to be filled out by close caregivers would predict their children's written and oral school marks at age 15. It was hypothesized that RI-5, aiming at risk of dyslexia, would predict written marks, whereas TRAS and CCC-2, aiming at DLD, would predict oral marks. However, a sharp difference was not expected, since both oral and written achievements in school depend on language and literacy skills in general.

The second aim was to assess to what degree these tools would reveal the same significant differences between the dyslexia group and the control group as were seen in the individual testing, and further disclose developmental literacy trajectories over these 10 years as resolving, late onset and persistent. It was hypothesized that the significant group differences from the testing would be mirrored in the screening scores and that further analyses of possible comorbid DLD/dyslexia would convey further insight into resolved, late onset or persistent dyslexia.

2 | METHOD

2.1 | Background information

2.1.1 | The Norwegian school system

Norwegian kindergartens are a mix of public and private with minor differences in activities. All kindergartens have assemblies, with singing, storytelling or story reading, free play indoors and outdoors, and meals (breakfast, lunch and fruit). Overall, there is little emphasis on formal teaching.

The Norwegian school system is mainly public and open for all. It is compulsory from age 6 (first grade) to age 15 (10th grade) with an overall educational ideology of active student inclusion and individually adapted education (Ministry of Churches, Education and Research, 1996; Ministry of Education, 2019-2020). Primary school goes from the first to seventh grade and lower secondary school from the eighth to tenth grade. It should be noted that in accordance with school curriculum, literacy training started in second grade when this project started. This has later been changed to the first grade. Students who have completed primary school and lower secondary school are entitled to 3 years of upper secondary school. Through regular meetings with schoolteachers, parents are kept informed about their child's achievements. On most occasions, the child takes part in these meetings. When the children in this study were in the fifth grade, they took part in national tests where the results were communicated back to the schools. Individual results from these tests are not available, but overall results from the communities in the current study were comparable to national means (Norwegian Directorate for Education and Training, 2011; Norwegian Directorate for Education and Training, 2015; Norwegian Directorate of Education, 2009).

The three subjects, Norwegian (L1), English (L2) and mathematics (M), are taught from the first grade on, but marks are not introduced until lower secondary school. Then, two marks are given in each of the two subjects L1 and L2, one for written competence and one for oral competence, whereas in mathematics, only a written competence is evaluated. Mainly, oral competence in L1 and L2 is measured by the ability to listen to, summarise and point out relevant information from oral presentations, take part in discussions, present topics in a relevant way and evaluate one's own and others' oral presentations. Written competence in L1 and L2 is evaluated along similar criteria, however, related to multiple genres of paper-based or digital texts through reading, comprehension and interpretation, and accordingly expressed in own written texts emphasizing creativity, argumentation, vocabulary and orthography. As to mathematics, both text assignments and basic skills are relevant in this connection. At the end of the 10th school year, the students sit formal exams with four separate marks for the two languages: L1 oral mark and L1 written mark, L2 oral mark and L2 written mark, and one mark for mathematics, based on written tests (see the method part for a further description of the marking system in Norwegian schools). The scale is from 0 to 6, with six indicating an outstanding achievement (Norwegian Directorate for Education and Training, 2011). The marks referred in the present study were teachers' evaluations in fall of the 10th grade, half a year before the formal examinations.

On a national basis, mean marks awarded for classwork in written skills for this cohort were as follows: Norwegian, 3.8; English, 3.9; and mathematics, 3.5. For oral Norwegian, marks were 4.2 and, for oral English, 4.2 (Norwegian Directorate for Education and Training, 2015). According to Südkamp, Kaiser, and Möller (2012), the accuracy of schoolteachers' judgements is in general high and reliable.

2.1.2 | The Bergen Longitudinal Dyslexia Study

Data are drawn from the Bergen Longitudinal Dyslexia Study, which in 2003 invited all parents of 5-year-old children from 10 pre-selected kindergartens spread around four municipalities of western Norway to participate. Approval to conduct the study was granted from the Norwegian Regional Committees for Medical and Health Research Ethics.

Parents of 109 of 120 eligible 5-year-olds consented to take part in the study. Due to criteria of exclusion at project start (impaired sight or hearing, intellectual disability according to DSM-IV criteria (APA, 1994) and diagnoses of any other impairment included in the DSM-IV (various impairments such as Attention Deficit Hyperactivity Disorder [ADHD], autism spectrum disorders [ASD] and neurological impairments as reported by parents) four children were excluded. All participants had to have Norwegian as their first language.

The RI-5 (see description of the RI-5 in the 'Screening tools' section) was constructed for the project. A high RI-5 score indicated high risk, whereas a low score indicated low or no risk. Due to earlier research on dyslexia and gender, an equal number of boys and girls were assigned to the at-risk group, with a lower at-risk inclusion cut-off score for girls than for boys. The cut-off was set at the upper quartile for boys and girls separately. This procedure resulted in an at-risk group of 26 children, whereas 26 children matched for age and gender with no identified risk served as a typical

group. With reference to estimates of prevalence, 10% of the original 105 participants were expected to be identified with dyslexia. It was therefore estimated that approximately 10 subjects would have dyslexia and that these subjects would be found within the at-risk group. Please see Helland et al., (2011) for a thorough description.

The typical and at-risk groups were tested with Wechsler Preschool and Primary Scale of Intelligence (WPSSI-R) (Wechsler, 2002) at age 5 with a mean full-scale score of 103.77 (*SD* 13.67) and with the Wechsler Intelligence Scale for Children (WISC-III) (Wechsler, 2002) at age 8 with a mean full-scale score of 100.37 (*SD* 14.41) with no significant difference between groups.

An overview of the project is shown in Table 1. The participants took part in a specially designed intervention program for 3 months every spring when they were 5 years old (kindergarten) and 6 years old (first grade, no literacy training in accordance with school curriculum) and for 2 months when they were 7 years old (second grade, start of formal literacy training). The intervention program was after kindergarten/school hours and did not interfere with literacy training in school. From each session, the performance and motivation of the child was logged by the trainers, and in general, all children responded positively (Sværi, Andersen, & Helland, 2015). The outcome of training during the 3 years is analysed in detail in T. Helland, Tjus, et al. (2011). Individual testing took place yearly in the fall and included tests of language comprehension and production, reading and writing, neuro-cognitive functions (short-term memory, working memory, long-term memory, dichotic listening, rapid naming, visuo-spatial skills), brain scanning sessions (fMRI, ages 6, 8 and 11) and one session in research-based balance laboratory. At the age of 11 (sixth grade), all children had achieved reading and writing skills at a functional level.

Informants' screening tools were used at three time points (TPs). TP1 was at project start when the children were 5 years old, TP2 was when the children were 11 years old, and TP3 was when they were 15 years old.

2.2 | Participants

2.2.1 | Groups in the present study

Based on the BDA (2007) definition of dyslexia and the applied assessment batteries (nonword reading, word reading, text reading, word spelling, sentence dictation correct spelling, time applied, L2 [English] word spelling) at age 11, 13 children (five boys and eight girls) received a dyslexia diagnosis in accordance with the earlier referred definition by BDA. Twelve came from the at-risk group and one from the typical group. No gender differences were seen in the test results. These 13 formed the dyslexia group, and the false positives from the at-risk group and the typical group were collapsed into the control group ($N = 28$) (Helland et al., 2011). As pointed out in the 'Introduction' section, the validity of this regrouping is reported in several studies.

Data from 41 of the original group of 52 participants were possible to retrace through the 10 years from ages 5 to 15. This included all the 13 children in the dyslexia group and 28 children in the control group. This study investigated further the two subgroups that constituted the control group. The subgroup of children from the original typical group was labelled control 1 (c1, $n = 17$), and the false positives from the original at-risk group with no signs of dyslexia at age 11 were labelled control 2 (c2, $n = 11$).

2.3 | Measures

2.3.1 | Screening tools

Mean scores with ranges and standard deviation (*SD*) for the screening tools and marks are shown in Table 2. The sample selection in the Bergen Longitudinal Dyslexia Study was based on RI-5 and was extended with two age-adjusted versions (RI-11 and RI-15) to follow up the longitudinal design of the study.

TABLE 1 Overview of the Bergen Longitudinal Dyslexia Study

The Bergen Longitudinal Dyslexia Study											
1. Literacy stage	Pre-literacy	Emergent literacy				Literacy					
2. Age	5	6	7	8	9	10	11	12	13	14	15
3. School stage	Kindergarten	Primary school							Lower secondary school		
4. Grade	-	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Ninth	10th
5. Screening	RI-5						TP2				TP3
	TP1						RI-11				RI-15
	TRAS						CCC-2				Marks
6. Other project activities	Testing	Testing	Testing	Testing			Testing				
	Training	Training	Training								
	fMRI			fMRI			fMRI				

Note: Valid numbers for the present study per time points are shown in Table 2.
Abbreviations: CCC-2, children's communication checklist; RI-5, 11, 15, Risk-Index, ages 5, 11 and 15; TP, time points; TRAS, tidlig registrering av språk. [Early registration of language development].

TABLE 2 Collapsed screening scores for all groups in the present study by time points (TP), mean, range, standard deviations (*SD*)

Tool	Valid N	Mean	Minimum	Maximum	*SD*
TP1					
RI-5[a]	41	13.87	0.00	47.50	11.58
TRAS	41	21.22	11.00	24.00	3.08
TP2					
RI-11[a]	41	14.05	0.00	44.44	11.03
CCC-2	41	76.06	30.00	104.00	18.65
TP3					
RI-15[a]	41	14.09	0.00	34.80	8.44
Written marks	41	3.63	2.00	5.67	0.85
Oral marks	41	3.82	2.00	5.50	0.69

[a]Higher score means higher risk.

RI-5 stands for *Risk Index aiming at 5-year-old children at risk of developmental dyslexia*. The questionnaire was constructed to select an at-risk group and a matched, typical group for the study. Consistent with studies showing an incidence of 5%–17% of dyslexia in the population (Shaywitz & Shaywitz, 2001; Siegel, 2006) and the screening recommendations by Gabrieli (2009), the at-risk children should be found within the upper quartile of the RI-5 score, thus targeting twice as many as would be expected to be identified with dyslexia.

Four criteria for the construction of the questionnaire were set: first, it should be theory-based; second, it should target the dyslexia endophenotype; third, it should be easy to fill out also for parents with dyslexia; and fourth, it should collect information at symptomatic, cognitive, biological and environmental levels, as outlined in the causal model by Morton and Frith (1995). The levels were mirrored in clusters of questions, here labelled 'domains.' Two versions of the questionnaire were completed for each child. One version was for the parents, and one version was for the kindergarten teachers. The number of questions within each domain varied from three to eight with three response categories: 'yes,' 'do not know' and 'no.' The six domains were as follows:

Domain 1. Health (parents: six questions; kindergarten teachers: four questions).

Domain 2. Asthma, allergies and left handedness (three questions).

Domain 3. Motor skills (parents: eight questions; kindergarten teachers: six questions).

Domain 4. Language (four questions).

Domain 5. Special needs education (three questions).

Domain 6. Heredity: dyslexia, language impairment, mathematic impairment in close biological family (parents only: three questions).

When scored, the responses were scored as 'typical' (0 points) and 'atypical' (1 point). Also, there was a score for 'do not know' giving 1/2 points, to mark that this may reflect minor deviances. This response was given for 3.9% of the total number of responses. To ensure equal weighting, the scores within each domain were summed and averaged. Thus, the maximum score of each domain was 1 point, meaning deviances within all questions. The risk index age 5 (RI-5) was calculated as a percentage score: (summed scores/12 $\times$ 100). As described by Pennington and Bishop (2009), risk factors are subtle and multifactorial, and should not be expected to reach a total score of 100%, but rather indicate impairments within each or some of the domains. The minimum was 0 point, meaning no risk. Since the RI-5 scores turned out to be lower in the girls than the boys and no gender differences had been reported in dyslexia epidemiological studies (Shaywitz & Shaywitz, 2001; Wadsworth, DeFries, Stevenson, Gilger, & Pennington, 2006), the cut-off score was calculated separately by gender. A low RI-5 score indicates no or minor problems, whereas a high score indicates a risk of developing dyslexia. For further information of the R1-5, see T. Helland (2015).

After regrouping into a dyslexia group, the RI-5 score ranged from 17 to 47.5 in boys and from 9.7 to 47.0 points in girls. Inter-rater correlations on the RI-5 (parents vs. teachers) ranged from .71 to .84 (Pearsons *r*), with a calculated measure of sensitivity of .87 and specificity of .97. The RI-5 scores correlated significantly with reading and spelling scores from the test battery at ages 8 and 11.

The RI-11 was used when the children were 11 years old to validate the findings of the RI-5. The questions and scoring system were identical to the ones in the RI-5, however, with an age adjustment for questions within the motor domain. The RI-11 was completed by parents only, because by this time, the children had changed schoolteachers several times. However, regular meetings between parents and teachers kept the parents updated on their children's standing. Since the children attended many of these meetings, it is reasonable to think that this communication is reflected in parents' RI-11-responses.

The RI-15 was used when the children were 15 years old to validate the findings of the RI-5 and RI-11, again with age-adjusted questions on motor skills. The scoring system remained the same as in RI-5 and RI-11, with no teacher version. This time parents and pupils were asked to fill out the questionnaire together. In addition to filling out the RI-15, the pupils were also asked how they had thrived during their schoolyears. They all reported well-being with no group differences. Most of the dyslexia group conveyed an intention of applying to a vocational school, whereas most of the control group wanted to apply for programmes for general studies (Kyrvestad, 2014).

Since then, the RI-5 has been described and validated in several studies (Clark et al., 2014; T. Helland & Morken, 2016; T. Helland, Plante, & Hugdahl, 2011; T. Helland, Tjus, et al., 2011; Morken & Helland, 2013; Morken et al., 2014, 2017; Specht et al., 2009) and has been developed into the screening tool Risk Index 5 (RI-5, Norwegian, English and Sami versions) for clinical and research use (T. Helland, 2015).

TRAS (early registration of language development). (Espenakk et al., 2003; Horn, Espenakk, Ottem, & Solheim, 2011) is a non-standardized instrument for observing language and social interaction skills in children aged 2–5 years. It is filled out by kindergarten teachers and is widely implemented in kindergartens in Norway as well as in other Scandinavian countries. The tool has two main aims: (a) enhancing kindergarten teachers' awareness of child language development and (b) early detection of children at risk. The TRAS form builds on Bloom and Lahey's (1978) model of language as consisting of content, form and use. TRAS has eight areas where content is assessed by the observation of language comprehension and language awareness; form is assessed by observation of pronunciation, word production and sentence production; and use is assessed by observation of interaction, communication and attention. Each area has three items to be filled in for different age spans, 2–3 years, 3–4 years and 4–5 years. A three-level scoring system for each area is suggested; if the behaviour in question is mastered, the designated form area is coloured; if it is partly mastered, it is scratched; and if the behaviour is not mastered, the area is left open. However, as no quantitative scoring instructions are provided, values of 1, 0.5 and 0, respectively, were assigned to these 'colour categories' in the present study. A TRAS-total score (based on all areas) of maximum 24 could be obtained, indicating no problems. Since TRAS was first published at the start of the Bergen Longitudinal Dyslexia Study, only scoring for the last year in kindergarten was obtained. The cut-off score of TRAS-total corresponding to the 15th percentile (a raw score of 20) used in T. Helland et al. (2017) was also applied in this study.

TRAS is described as an initial observation tool with no quantifications. However, significant correlations between the sum scores of TRAS and the Test for Reception of Grammar (TROG-R, Bishop, 1989): Pearson $r = .375$, and TRAS and the British Picture Vocabulary Scale (BPVS) (Dunn, Dunn, & Styles, 2003): Pearson $r = .239$ are reported (Horn et al., 2011).

CCC-2 (Children's Communication Checklist. Second Edition, Norwegian version: Bishop, 2011) is a questionnaire to be completed by parents (or others who know the child well) designed to screen for language impairment in children aged 4–16 years. It has been widely used in international research and clinical practice since its first English publication (CCC) (Bishop, 1998). CCC-2 (Bishop, 2003) poses questions on caregivers' evaluation of the child's language as to content, form and use. It was put in use very soon after the Norwegian version was published (Bishop, 2011), which was midways in the Bergen Longitudinal Dyslexia Study at TP2. The instrument consists of 70 items grouped into 10 subscales: four scales assessing structural aspects of language, four scales assessing pragmatic aspects and two scales assessing behaviours likely to be impaired in children with ASD. Each item is scored on a four-point scale where the

parents are asked to quantify how often the described behaviour is observed (0 = seldom or never; 1 = at least once a week; 2 = once or twice a day; and 3 = several times a day or always). A high raw score reflects poor performance. The raw scores are converted to scaled scores with a mean of 10 and a standard deviation (*SD*) of 3. A General Communication Composite (GCC), which is the measure reported in this study, is calculated by summing the scaled scores of the eight first subscales of the CCC-2 – with higher scores indicating better performance.

Cut-off at or below 54 on the scaled score of the CCC-2, corresponding to the 10th percentile of the standardization sample, identifies language impairment. The instrument presents with internal consistency values ranging from .73 to .89 and inter-rater reliability between parents and kindergarten teachers ranging from .44 to .76. (W. A. Helland, Biringer, Helland, & Heimann, 2009).

2.4 | Literacy competence as dependent variables at age 15

Graded marks are divided into oral and written marks in the Norwegian school system. Comorbid DLD and dyslexia is shown to affect both L1 and L2 learning (Helland & Kaasa, 2005; Sparks, 2012; van Setten et al., 2017). Measures of literacy competence were *school marks awarded for classwork* in L1 (written and oral), in L2 (written and oral) and in mathematics (written). Collapsed marks in written competence (L1, L2 and mathematics) and oral competence (L1 and L2) were used in this study.

2.4.1 | Statistics

To assess the *relationship between the scores* (screenings, marks), correlations were used for all scores at TP1 (age 5, kindergarten), TP2 (age 11, sixth grade, primary school) and TP3 (age 15, ninth grade, lower secondary school) with Pearson's *r* (positive or negative) of .10–.30 considered small, .30–.50 medium and .50–1.00 large.

To assess *predictive* values, multiple regression analyses (stepwise) were used with RI-5, TRAS and CCC-2 as predictors, and with written marks and oral marks as dependent variables.

To assess *group differences*, independent T-tests with the groups (2: control vs. dyslexia) by scores (screenings, marks), and one-way ANOVA with the groups (3: c1 vs. c2 vs. dyslexia) by scores (screenings, marks) with the LSD test for planned comparisons. An overall alpha level was set at $p < .05$, and for the control by dyslexia group analyses, Cohen's *d* was used as measures of effect size, with .20 considered small, .50 medium and .80 large.

To assess *cases with possible comorbidities* of DLD, dyslexia counts below cut-off scores on the CCC-2 were compared to TRAS scores and RI-5 scores, especially raw scores from Domains 4 (language) and 5 (need for special education).

To assess the *distribution* of gender, heredity and below cut-off scores in TRAS and CCC-, chi-square analyses were performed first as control versus dyslexia, and second as c1 and c2, respectively, versus dyslexia. One-way ANOVA was used to assess RI-5 scores by the group (control, dyslexia) and gender (M, F).

Missing single marks were seen in two subjects from the control group and three from the dyslexia group. Preliminary analyses with and without substitutions by mean scores (groups and subgroups) revealed no effects, and substitutions by means were therefore used.

3 | RESULTS

3.1 | Correlations

The correlations are shown in Table 3. There was a variation in strength from large (five correlations) to medium (12 correlations) to small (four correlations).

TABLE 3 Correlations between the screening tools and school marks

Time points		TP1		TP2		TP3		
	Tools	**RI-5**	**TRAS**	**RI-11**	**CCC-2**	**RI-15**	**Written marks**	**Oral marks**
TP1	*RI-5*	1.0000						
		p = -						
	TRAS	**−.4763**	1.0000					
		p = .002	p = -					
TP2	*RI-11*	**.7422**	**−.5406**	1.0000				
		p = .000	**p = .000**	p = -				
	CCC-2	**−.3428**	**.4501**	**−.6154**	1.0000			
		p = .028	**p = .003**	**p = .000**	p = -			
TP3	*RI-15*	**.4716**	**−.3525**	**.4896**	**−.3696**	1.0000		
		p = .002	**p = .024**	**p = .001**	**p = .017**	p = -		
	Written marks	**−.4539**	.2997	**−.3591**	**.5126**	**−.4382**	1.0000	
		p = .003	p = .057	**p = .021**	**p = .001**	**p = .004**	p = -	
	Oral marks	−.1995	.1624	−.1428	**.4059**	**−.3948**	**.8198**	1.0000
		p = .211	p = .310	p = .373	**p = .008**	**p = .011**	**p = .000**	p = -

Note: Pearson's *r*. Significant *p*-values are marked in bold. Negative correlations: high RI-5 correlates negatively with school marks.

In sum, CCC-2 and RI-15 correlated significantly with all scores, RI-5 and RI-11 correlated significantly with all screening scores and written marks. The negative correlation between the RI scores and the school marks means that higher RI scores correspond to lower school marks. TRAS correlated significantly with all screening scores but not with any of the two school marks. The intercorrelation between the written and oral marks was high.

3.2 | Predictions

To assess early predictions, multiple regression analyses were used measuring the contribution of all three screening tools RI-5, TRAS and CCC-2 to the written and oral marks. This is shown in Table 4.

As to written marks, both CCC-2 and RI-5 emerged as significant predictors with an R^2-value of .350, thus accounting for 35% of the variance. As to oral marks, CCC-2 emerged as a sole predictor with an R^2-value of .165, thus accounting for 16.5% of the variance. Tolerance test and VIF (variable inflection factor) did not indicate multicollinearity.

3.2.1 | Scores by groups at TP1, TP2 and TP3

Between-groups analyses are shown in Table 5. Please notice that high RI scores and low scores in the other variables indicate problems.

T-tests with the design group (2: Con, Dys) by scores (screening, marks) showed following results:

TP1: RI-5: t = 3,867, p = .0004; TRAS: t = −2,086, p = .04.

TP2: RI-11: t = 4,005, p = .0003; CCC-2: t = −2,041, p = .05.

TP3: RI-15: t = 2,709, p = .01; written marks: −2,745, p = 01: oral marks: t = −0,740, p = .464, n.s.

TABLE 4 Multiple regression analyses (stepwise) with RI-5, TRAS and CCC-2 as predictors, and written and oral marks as dependent variables

Model		B	SE	Beta	t	Sign	R^2	Counting for variance%
Prediction of written marks								
1	CCC-2	.023	.006	.513	3.728	.001	.263	26%
2	CCC-2	.018	.006	.405	2.907	.006	.350	35%
	RI-5	−.023	.010	−.315	−2.265	.029		
Prediction of oral marks								
1	CCC-2	.015	.005	.406	2.774	.008	.165	16.5%

Large effect sizes (Cohen's d) were seen on the three RI scores and on the written marks, and medium effects on TRAS and CCC-2. A small effect size was seen in the Oral marks.

One-way ANOVA with the design groups (3: c1, c2, Dys) by scores (screening, marks) showed the following results,

TP1. RI-5: $F_{(2,38)} = 19{,}94$, $p < .0001$, the follow-up test showed that this effect was due to significantly higher scores in c2 versus c1 ($p = .001$) and in Dys versus c1 ($p < .0001$).

TRAS: $F_{(2,38)} = 3{,}585$, $p < .04$, the follow-up test showed that this effect was due to significantly higher scores in c1 versus Dys ($p < .05$).

TP2. RI-11: $F_{(2,38)} = 19{,}31$, $p < .0001$, the follow-up test showed that this effect was due to significantly higher scores in c2 versus c1 ($p = .001$) and versus Dys versus c1 ($p < .0001$). CCC-2: $F_{(2,38)} = 2{,}691$, $p = .08$. Since the p-value was close to significant follow-up test was tentatively used, showing a significant effect due to higher scores in c1 versus Dys ($p = .03$).

TP3. RI-15: $F_{(2,38)} = 5{,}623$, $p = .008$, the follow-up test showed that this was due to significantly higher scores in Dys versus c1 ($p = .002$). Written marks: $F_{(2,38)} = 5{,}038$, $p = .01$; the follow-up test showed that this was due to significantly lower marks in Dys versus c1 ($p < .003$). Oral marks: $F_{(2,38)} = 0{,}400$, $p = .67$, n.s.

3.3 | Counts distribution by gender, heredity and under cut-off scores in TRAS and CCC-2

Table 6 shows the frequency of gender, heredity and below cut-off scores on TRAS and CCC-2 in the groups control (c1 and c2) and dyslexia. Chi-square analyses showed no differences between control and dyslexia as to gender distributions or as to TRAS scores below cut-off ($p = .278$). Significant higher frequencies in dyslexia versus control were seen in heredity: x^2 (1, 41) = 4.011, $p = .045$, and in CCC-2 scores below cut-off: x^2 (1,41) = 6.53, $p = .01$. Also, there was a significant difference in heredity between the c1 and c2 subgroups: x^2 (1,28) = 10.812, $p = .001$.

Inspection of individual screening scores showed that cases in the control group with scores below cut-off on TRAS and CCC-2 were not identical, whereas cases with scores below norm on both TRAS and CCC-2 were identical in dyslexia. Furthermore, an overall comparison can be seen in the gradual increase in frequency percentages by groups as to heredity and language (TRAS and CCC-2).

3.4 | Developmental trajectories

Table 7 gives an overview of the initial groups and a subgrouping of the dyslexia group. A total of seven children scored below cut-off on the CCC-2. Five of these were from the dyslexia group and had scores below cut-off on

TABLE 5 Scores by groups at TP1, TP2 and TP3

	Dyslexia		Control		*t*-test	Cohen's d	Control subgroups				One-way ANOVAs		
	Mean $N = 13$	*SD*	Mean $N = 28$	*SD*	Con versus Dys	Con versus Dys	c1 Mean $n = 17$	*SD*	c2 Mean $n = 11$	*SD*	c1 versus c2	c2 versus Dys	c1 versus Dys
TP1													
RI-5	22.71	13.18	9.77	8.16	***	1.286	4.37	3.02	18.11	6.23	***		****
TRAS	19.81	4.20	21.73	2.27	*	0.569	22.59	1.55	20.77	2.62			*
TP2													
RI-11	22.68	11.66	10.04	8.21	***	1.254	5.14	4.33	17.60	6.95	***		****
CCC-2	67.67	22.60	79.11	15.93	*	0.585	82.94	11.19	75.36	20.13			*
TP3													
RI-15	18.96	7.83	11.83	7.85	**	0.909	9.27	8.06	15.15	6.50			**
W marks	3.13	0.77	3.86	0.79	**	0.941	4.04	0.90	3.58	0.51			**
O marks	3.70	0.77	3.87	0.65		0.238	3.93	0.81	3.79	0.31			

TABLE 6 Frequency of gender, heredity, TRAS and CCC-2 and scores below norm by groups

Group	Gender	*n*	Heredity	TRAS under norm	CCC-2 under norm
Control total		28	10	5	2
c1	M	11	1	1	0
	F	6	1	0	0
c1 total		17	2	1	0
c2	M	5	3	4	0
	F	6	5	0	2
c2 total		11	8	4	2
Dyslexia total		13	9	5	5
Dyslexia	M	5	5	3	3
	F	8	4	2	2
All		41	19	10	7

TABLE 7 Overview, development by groups from age 5 to 15 years

				Age 15, range	
Age 5 screening	Age 11 dyslexia identified		Category	Written marks	Oral marks
Typical	Control	c1	Typical	2.7–5.7	2.5–5.5
		c2	Resolved	2.3–4.3	3.5–4.5
At-risk	Dyslexia	Dyslexia	Late onset	2.0–4.7	2.5–4.6
		Dyslexia/DLD	Persistent	2.0–3.1	2.0–3.4

TRAS and an RI-5 mean score of 21.7 (*SD* 7.5) with high raw scores on Domain 4 Language and Domain 5 Special education indicating impairment. This indicates that five subjects had **comorbid** dyslexia and DLD.

4 | DISCUSSION

The main aim of this study was first to assess whether kindergarten and school screening tools filled out by close caregivers could predict school achievements associated with dyslexia after 10 years of schooling. It was hypothesized that RI-5, assessing preschool risk of dyslexia, would predict written marks, whereas TRAS and CCC-2, assessing communication skills and DLD, would predict oral marks. The results showed that both the RI-5 and CCC-2 predicted written marks, whereas CCC-2 alone predicted oral marks. A second aim was to see whether the significant differences between the control and dyslexia groups from the individual testing reported in earlier published studies were mirrored in the screening scores. The results showed that similar developmental trajectories were disclosed by the screening tools.

4.1 | Predictions

The RI-5 was the basis for the population-based selection of participants in the present study, with emphasis on close caregivers' concerns (Glascoe, 1997) and equal gender distribution (Shaywitz, Shaywitz, Fletcher, & Escobar, 1990). At TP1, the RI-5 score was used to identify 26 at-risk children from the original group of

105 participants. By the individual testing at TP2, 13 children (12%) were identified with dyslexia. This was a slightly higher percentage than expected, but still much in accordance with the inferences that pre-literate screening tools should identify about 20% as at-risk to be able to find the 10% true positives (Gabrieli, 2009).

Its predictive value of school marks seen at TP3 underlines the findings at TP2. Again, this was expected since the RI-5 score combines parents' and kindergarten teachers' independent responses to questions targeting evidence-based dyslexia benchmarks. Parents know the unique child's development from birth, whereas the kindergarten teacher sees how the child develops in relation to other children, which should guarantee early valid and reliable information, in accordance with best evidence-based practise (Glascoe, 2000). Dyslexia is a lifelong condition, and given the main objective of the RI-5, its predictive value of written rather than oral marks is in line not only with its intentions but also with how written competence was defined by school authorities.

As expected, the CCC-2 proved to be a predictor of oral competence. That it also predicted written competence was not as expected, but can be understood in several ways. First, in the Norwegian school system written and oral competences are evaluated along very similar literacy criteria, and language skills are fundamental to both oral and written marks, which correlated strongly in this study. Second, the CCC-2 was the only screening tool that correlated significantly with all other scores, indicating a strong standing. Third, CCC-2 was used at TP2 only, when the children were 11 years old. At this age, any child's development and achievements should be clarified to a larger extent than at the age of five. Due to the standardized properties of the screening tool itself, it is reasonable to infer that if assessed with CCC-2 in kindergarten, the same result would appear. This inference was supported by the compliance with both the TRAS scores and RI-5 subscores (Domain 4, language; Domain 5, special needs education) at age five. Thus, that some of the children in the Dyslexia group were identified with DLD by the CCC-2 is in line with other studies of comorbidities (Adlof, 2020; Alonzo, McIlraith, Catts, & Hogan, 2020; Snowling et al., 2015).

Although the TRAS correlated significantly with the other two screening tools, it did not correlate with any of the school marks or demonstrate any predictive value. This should not be surprising, since TRAS is a non-standardized observation tool with a wider scope and not as specific as RI-5 and CCC-2. This may also be the reason why it identified problems in more children (also in the control group) than the other two tools.

4.2 | Developmental trajectories

The result showed that the screening scores revealed developmental trajectories in line with what has been described in other studies as resolved, late onset and persistent (Jin et al., 2020; Jordan & Dyer, 2017; Lyytinen et al., 2006; Peng et al., 2019). Also, the significant group differences in the screening scores matched the significant group differences seen in the earlier reported testing results from the Bergen Longitudinal Dyslexia Study comprising all the four levels: symptomatic, neuro-cognitive, biological and environmental (Frith, 1986; Morton & Frith, 1995). The differences were evident in the three RI scores from TP1, TP2 and TP3, with higher significance and effect sizes compared to the two other tools.

Using an inclusive risk-factor score as suggested by Gabrieli (2009) offered an opportunity to distinguish false from true positives. Although the c2 subgroup was defined as false positive, the Risk Index score in c2 remained high with no difference to the dyslexia group and significantly higher than in c1 both at TP1 and at TP2. The c2 subgroup and the dyslexia group had inseparable risk factors, but they developed differently. According to the individual testing of dyslexia 'benchmarks' as defined by BDA (2007) and reported elsewhere, no typical dyslexia benchmarks were seen in c2. Thus, it is reasonable to identify these 11 c2 subjects from the original at-risk group as '*resolving*'. Two cases that were below cut-off on CCC-2 in the c2 subgroup should be assessed further for DLD only.

Despite the similar risk factors in c2 and the Dyslexia group, a special feature of the Dyslexia group emerged in that 5 of the 13 cases scored below cut-off on CCC-2. The same five cases were also identified by the TRAS and in RI-5. This leaves eight subjects with no identified early language impairment, but with dyslexia benchmarks only, which should be compatible with a '*late onset*' trajectory, as proposed by Snowling et al. (2015).

The relationship between dyslexia and DLD has been discussed in numerous studies (Alonzo et al., 2020; Bishop & Snowling, 2004; Snowling, Bishop, & Stothard, 2000; Snowling, Hayiou-Thomas, Nash, & Hulme, 2020; Snowling & Hulme, 2020). Questions have been asked whether these are separate conditions or variations of identical underlying problems. Recent studies have pointed to comorbidities, but to differentiation as to intervention (Alonzo et al., 2020; Snowling et al., 2020). This underlines the importance of including early DLD as an at-risk factor of dyslexia, especially since DLD has been shown to affect reading skills negatively in some, but not all, individuals (Lopes et al., 2020; Peterson & Pennington, 2015; Snowling & Hulme, 2020; Thompson et al., 2015). In line with Snowling et al. (2015) and Zambrana et al. (2014), the five cases with comorbid DLD and dyslexia could be categorized as '*persistent*'.

The developmental trajectories were further assessed by the frequency analyses of the two biological 'markers' gender and heredity. There was no effect of gender in any of the groups. Gender differences have been seen in many studies of dyslexia, especially in clinically based studies, with a higher prevalence and more impairments in males (Berninger, Nielsen, Abbott, Wijsman, & Raskind, 2008; Brandlistuen, Flatø, Stoltenberg, Helland, & Wang, 2020). Population-based studies, on the other hand, have found no gender differences in prevalence (Wadsworth et al., 2006), but differences in onset time, where girls have been identified later than boys (Brandlistuen et al., 2020; Zambrana et al., 2014). Due to the RI-5 gender-based inclusion score at TP1, with a lower cut-off score for inclusion in girls than in boys, the defined risk onset time was equal in the genders. However, if the inclusion score had been the same for both genders, more boys than girls would have been in the at-risk group. In this respect, girls would have been identified with a later onset time, or perhaps not identified at all.

In the present study, 'heredity' was defined if dyslexia, language impairment and/or mathematic difficulties were reported in close biological family. As earlier described, the phenotype of dyslexia in clinical categories is multifactorial, which also points to comorbidities (Bailey, Oh, Farkas, Morgan, & Hillemeier, 2020; Bishop, 2015; Bishop & Hayiou-Thomas, 2008). The frequency of reported heredity was higher in both c2 and the Dyslexia group compared to c1. It was reported in about 70% of the participants in the two groups in contrast to about 11% in the c1 group. One may hold that this is a less precise measure than what is often used in studies where heredity is identified by parents who themselves have been tested for dyslexia, but it still conveys relevant information in a clinical setting and is a current research topic (Willcutt et al., 2019). Although heredity is a risk factor, it is not a determinative, since not all children with familial occurrence develop dyslexia, and dyslexia is seen in individuals with no familial occurrence (Bishop, 2015; Peterson & Pennington, 2015). But it is seen as a sign of vulnerability, as shown in studies based on heredity (Caglar-Ryeng et al., 2019; Lyytinen et al., 2019; van der Leij et al., 2013).

In sum, these risk factors point to vulnerability as to literacy development, and questions have been raised why some at-risk children do not develop dyslexia and why others do. In this study, neither gender nor heredity seemed to be protective factors since the incidence of these factors did not distinguish between the dyslexia group and the c2 subgroup within the control group.

The mechanisms behind resolved literacy impairment have been explained in different ways and remain unclear. Some research points to compensation and other to protective factors. The compensation theory points to cognitive deficits being present but compensated for during development by strategies or processes associated with cognitive strengths (Raskind, Goldberg, Higgins, & Herman, 1999; van Viersen, de Bree, & de Jong, 2019; Zuk et al., 2020). In a meta study by Haft, Myers, and Hoeft (2016), oral language skills, fine motor skills and executive functions were listed as protective factors in pre-readers at risk of dyslexia, whereas potential factors contributing to cognitive resilience were language functions as morphological awareness, vocabulary and executive functions. This shows that a child's literacy performance may float around the clinical threshold throughout development in both late onset and resolving cases. As shown in Table 7, the ranked school marks at TP3 indicate decreasing marks from high in c1 to lower in the dyslexia/DLD or 'persistent' subgroup, with no sharp borderlines between subgroups.

After 10 years the participants in the present study reported that they liked school. In accordance with school regulations and independent of the present project, some children had received special education and special rights

at, that is exams at times (Kyrvestad, 2014). The well-being reported by the students and their parents may be attributed to the Hawthorn effect of being followed and observed in a project. However, this effect should not be substantial since the participants were spread across 10 different kindergartens and schools in four different geographical regions of the country. Consequently, it may be reasonable to relate some of the good results of the present project to the training sessions given to the children from they were 5 to 7 years old (T. Helland, Tjus, et al., 2011). In sum, this study supports the view that early, evidence-based intervention and positive school experiences are protective factors against maladjustment due to literacy problems.

4.3 | Limitations of the study

The Bergen Longitudinal Dyslexia Study identified 13 of 105 children as having dyslexia when the participants were 11 years old. This was a slightly higher number than expected, but a small number for statistical purposes. Therefore, the statistical analyses should be tentative, also in this extended study limited to 41 participants in total. Although the project contained both a control group and a dyslexia group, an external control group would have strengthened the validity of the study. However, as in all studies of vulnerable groups, this would raise a wide range of problems concerning ethics, research design and motivation on behalf of the participants. Longitudinal studies, especially with children involved, are demanding, both as to human and financial resources. Another limitation is that the CCC-2 was not available in a Norwegian version at TP1. Screening with this instrument at project start would have strengthened its predictive value.

In sum, the weakness of the study lies foremost in its sample size and early identification as to language background, whereas the strength lies in its multitude of assessments over time.

4.4 | Concluding remarks

The early screening performed by close caregivers underlined the differences between the control and the dyslexia groups as shown in the individual testing part of the project reported in earlier studies. Research has shown that dyslexia is a life-lasting condition, which often affects education, work opportunities and social life (Elbro et al., 2011; Raskind et al., 1999). There is a general agreement that early identification and early evidence-based intervention is the most efficient way to mitigate literacy problems and to avoid long-lasting problems. The results of this study indicate that developmental trajectories as persistent, late onset and resolved impairment can be seen early, and should be applicable to practical work in teaching and intervention planning. Adults with DLD and/or dyslexia seem to face similar problems as they did during childhood (Del Tufo & Earle, 2020), and differentiation of early skills may mediate unfortunate development.

Given the limitations of the study, the main conclusion was that the screening tools filled out by close caregivers add important information on how to find valid early predictors and trajectories of developmental dyslexia. This should represent a step forward in the at times heated debate on early efforts.

DATA AVAILABILITY STATEMENT

Data available on request due to privacy/ethical restrictions. The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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