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**Development problems were common five years after positive screening for language disorders and, or, autism at 2.5 years of age**

**Running title: Language disorders, autism and on-going development**

Carmela Miniscalco (carmela.miniscalco@gnc.gu.se)<sup>1</sup>, Elisabeth Fernell<sup>1</sup>, Lucy Thompson<sup>1</sup>, Eva Sandberg<sup>2</sup>, Björn Kadesjö<sup>1</sup>, Christopher Gillberg<sup>1</sup>

1. Gillberg Neuropsychiatry Centre, Institute of Neuroscience and Physiology, University of Gothenburg, Sweden;
2. Department of Paediatric Speech and Language Pathology, Queen Silvia Children's Hospital, Gothenburg, Sweden

Correspondence to:

C Miniscalco, Gillberg Neuropsychiatry Centre

University of Gothenburg, Kungsgatan 12, SE-411 19 Gothenburg, Sweden.

Tel + 46 (0)703911260

Fax +46 (0)31109030|

email: Carmela.Miniscalco@gnc.gu.se

## **ABSTRACT**

**Aim:** This study identified whether children who had screened positive for either developmental language disorder (DLD) or autism spectrum disorder (ASD) at the age of 2.5 years had neurodevelopmental assessments five years later.

**Methods:** Our study cohort were 288 children born from 1 July 2008 to 20 June 2009 who screened positive for DLD and, or, ASD at 2.5 years. Of these, 237 children were referred to, and assessed, at the Paediatric Speech and Language Pathology clinic (n = 176) or the Child Neuropsychiatry Clinic (n = 61) at the Queen Silvia Children's Hospital, Gothenburg, Sweden. Clinical registers covering all relevant outpatient clinics were reviewed five years later with regard to established diagnoses.

**Results:** When the 237 were followed up five years later, 96 (40%) had established neurodevelopmental disorders or problems, often beyond DLD and ASD. Co-existing problems were common in this cohort and multidisciplinary assessments were indicated. The other 60% did not appear in subsequent clinic records. It is likely that this 40% was a minimum rate and that more children will be referred for developmental problems later.

**Conclusion:** Five years after they had been screened positive for DLD and, or autism at 2.5 years, 40% of our cohort had remaining or other developmental problems.

**Keywords:** Autism spectrum disorder, Developmental disorder, Developmental language disorder, Outcome, Screening

## **Abbreviations**

ADHD, attention deficit hyperactivity disorder; ASD, autism spectrum disorder; CHC, child healthcare centre; DLD, developmental language disorder; ESSENCE, early symptomatic syndromes eliciting neurodevelopmental clinical examinations; ICD-10, International Classification of Diseases – Tenth revision; SLP, speech and language pathologist.

## **Key notes**

- We focused on 237 children who had screened positive for either developmental language disorder (DLD) or autism spectrum disorder (ASD) at 2.5 years of age.
- Our five-year follow-up study found that 40% had established neurodevelopmental disorders or problems, often beyond DLD and ASD, but we believe that more children will be referred for developmental problems at a later stage.
- Co-existing problems were common and multidisciplinary assessments were indicated.

## **INTRODUCTION**

Children with developmental language disorder (DLD) fail to acquire language at the expected and typical rate and present with language difficulties as their most salient challenge. The biological causes of the disorder are largely unknown, except for a hereditary component, and no other diagnostic label is appropriate at the time of identification. Lack of agreement about the criteria and terminology for children's language difficulties affects access to services, as well as hindering research and practice. To address this need, Bishop et al. described the criteria for the term language disorder (1) and terminology (2). Language disorder was used to describe a profile of difficulties that causes functional impairment in everyday life and is associated with a poor prognosis. The term, developmental language disorder (DLD) was chosen for use when the language disorder was not associated with a known biomedical aetiology. It was also agreed that the presence of neurobiological or environmental risk factors does not preclude a diagnosis of DLD, that DLD can co-occur with other neurodevelopmental disorders, such as attention deficit hyperactivity disorder (ADHD) and that DLD does not require a mismatch between verbal and nonverbal ability.

Language disorders in children under three years of age are a risk marker for continuing language and other neurodevelopmental and neuropsychiatric disorders, such as autism spectrum disorder (ASD), intellectual disability ADHD (3–6). One study estimated that approximately two children in every pre-school or school group of 30 will have language disorder severe enough to hinder their academic achievement (7). At school age, the primary DLD can co- exists with literacy disorders such as dyslexia or poor reading comprehension.

Delayed expressive language is relatively easy to identify, but some children are also delayed in receptive language and social communication. When children who have difficulties developing language are identified in the early years, it is not possible to determine whether the language problem will turn out to be transient, or persistent, or if DLD will eventually turn out to be associated with other developmental disorders. Risk factors for persistent problems include the overall initial severity, whether the language difficulties are general across expressive and receptive language domains and communication and whether they are other cognitive and developmental problems (8).

In Sweden, four-year old children with expressive DLD have been identified for more than 50 years by language screening programmes performed at Child Healthcare Centres (CHCs), which target 95–99% of the eligible population (9). Since the late 1990s, there have also been two different scientifically evaluated language screening methods in use for assessing children at 2.5 (10–12) and three years (13). These screening methods correspond to the recommendation of the Swedish National Board of Health and Welfare, that all the activities and methods within the Swedish CHC system should be evidence-based or best practice according to clinical experience.

It has been argued that there has been a lack of evidence regarding optimal DLD screening. It is not generally agreed which instrument to use, age to screen, what the effectiveness of screening in primary care settings is or what the long-term benefits of interventions and adverse effects of screening and interventions are (3). Wilson and Jungner (14) pointed out that there should be effective interventions available for those identified and added that there was evidence that early treatment led to better outcomes than late treatment. However, little evidence has been found to support improved language or behaviour following screening, either immediately or at the age of three

years (15). Consequently, the policy from the UK National Screening Committee (16) is that screening for speech and language delay should not be offered. A similar recommendation is contained in the US Preventive Services Task Force Recommendation Statement. The evidence is insufficient to recommend, or rule out the routine use of a brief, formal screening instruments in primary care to detect speech and language delay in children up to five years of age (17). Thus, the feasibility and benefit of general language screening is still questioned from an international perspective.

The vast heterogeneity in children with DLD is related to different aetiologies, severities and types of co-existing developmental disorders, including ASD, probably goes some way towards explaining the difficulties of predicting long-term outcomes and evaluating the role of early intervention. The US Preventive Services Task Force found insufficient evidence of the potential benefits and harmful effects to recommend for, or against, ASD screening of children below three years of age (18). Instead the review called for more research.

A previous Swedish study (11) reported that it was possible to identify children with DLD at 2.5–3 years of age through a general language screening programme performed by CHC nurses. Children who screened positive on the DLD screening test were at high risk of having DLD according to blind assessments carried out by speech and language pathologists (SLPs) when the children were six years old (19). When these children with DLD were examined at seven years of age by a multidisciplinary team, comprising an SLP, paediatrician or child psychiatrist, neuropsychologist and special educational teacher, 60–70% had ASD, ADHD or learning problems (10). In addition, these children still had language problems, which were now presenting as problems with story retelling (20), non-word repetition and reading (21). Thus, speech

and language screening at age 2.5 years identified children with primary DLD and DLD associated with other neurodevelopmental disorders when a broad clinical assessment was performed at seven to eight years of age.

The findings of early onset co-existing developmental disorders and symptoms agree with what has been referred to as early symptomatic syndromes eliciting neurodevelopmental clinical examinations (ESSENCE) (22). The concept of ESSENCE draws attention to the fact that the effectiveness of screening for DLD and ASD, and the long-term benefits of intervention, have to consider the very substantial heterogeneity of children identified by language screening at 2.5 years. Children with language and other neurodevelopmental disorders, such as ASD, will often vary considerably with regard to any number of other developmental traits that may be shared with other diagnostic groups. These other developmental traits may well be as important for prognosis and treatment as the core symptoms that defined the group (23).

Due to the evidence that a positive language screening at 2.5 years of age often indicates other possible neurodevelopmental symptoms or diagnoses (10,22), DLD and ASD screenings were introduced to CHCs in Gothenburg, Sweden, about 10 years ago (24).

The aim of this study was to carry out a clinical follow-up of all 2.5-year-old children who had screened positive for either DLD or autism at CHCs in Gothenburg in 2011 and to estimate their developmental outcome five years later.

## **METHODS**

### **Study area**

Gothenburg is the second largest city in Sweden, with a total population of 526 084 inhabitants in 2016 and more than 6000 births per year (9). There are 49 CHCs that provide health surveillance for children from birth up to six years of age. These CHCs cover different socio-economic areas and there are high rates of bilingual and multilingual families. In Gothenburg 49% of children born in 2008 and 2009 were either born outside Sweden or born in Sweden with one or both parents born abroad (25).

### **Study population**

This study focused on all children born from July 1, 2008 to June 30, 2009 who had screened positive for DLD and ASD at the age of 2.5 years in 2011. The children were all referred to, and assessed at, the Department of Paediatric Speech and Language Pathology or the Child Neuropsychiatry Clinic at Queen Silvia Children's Hospital, Gothenburg, Sweden. Statistics from the CHC revealed that 6463 children were offered the 2.5-year screening (9) and we estimate that 5887 children participated, based on the numbers who took part in two full birth cohorts and were screened for learning disabilities and ASD. There were 6132 in 2008 and 5643 in 2009, so we added these numbers and divided them by two, as the screening period covered the second half of 2008 and the first half of 2009.

### **Screening programme at age 2.5 years**

In January 2009, a new screening programme was introduced to the CHCs in the Gothenburg area at the age of 2.5 years. The screening procedure consisted of two

screening procedures performed during the same visit to the CHC nurse. These were DLD screening (10,11) and ASD screening (24,26), using the Modified Checklist for Autism in Toddlers (27,28), and an observation of joint attention (24).

Children who only screened positive for DLD were referred to the speech and language pathology clinic for language assessment and possible intervention. In the meantime, children who were screened ASD screen positive, most of whom were also DLD screen positive, were referred to the neuropsychiatry clinic for multidisciplinary assessment. The neuropsychiatry clinic assessed almost all of the eligible pre-school children below five years of age with suspected autism or ADHD in the study region (24,26).

Children who were screen negative were not referred to any clinic.

Before the 2.5-year screening started in 2009, all CHC nurses, physicians and psychologists at the CHCs participated in targeted language and ASD training in order to increase their awareness about both conditions. They also took part in repeated training sessions about the screening methods (24).

### **DLD screening**

The 2.5-year language screening consisted of two parts. The parents answered a parental questionnaire, with seven questions about the child's language development and parents' concerns about language development and about whether the child has any oral motor difficulties, such as drooling or problems chewing. The CHC nurse performed a direct observation of the child's language and communication skills according to a protocol. The whole assessment took about 15 minutes and led to one of three outcomes. The first was screen-positive with marked problems and these comprised either a vocabulary of <25 single words, a lack of two-word utterances or

poor verbal comprehension, for example when the CHC nurse asked the child to put a doll in a bag. The second was screen positive with mild problems, comprising a vocabulary of 25–50 single words and poor co-operation despite seemingly adequate verbal comprehension. The third was screen negative (10), when the child had did not have marked or mild problems.

Children with marked problems were referred to the speech and language pathology clinic and for a hearing assessment and the children with mild problems were offered a re-assessment at the CHC at the age of three years. This re-assessment also consisted of a direct observation of the child and a parental questionnaire. Children who used <50 words, or who lacked three-word-utterances or had poor comprehension, were referred for a language assessment at the speech and language pathology clinic (10,24). The CHC nurses were given specific guidelines on how to screen children from multilingual families and the recommendation was to screen them children in Swedish if they had a basic Swedish language level (29). If not, they needed to be tested in their mother tongue, either with the help from their parents or an interpreter.

### **Language assessment at the speech and language pathology clinic**

All incoming referrals from the language screening to the speech and language pathology were scrutinised and reviewed according to the screening referral criteria. During the visits to the clinic, the SLP assessed the child's speech and language and communication development with different standardised tests and observation methods, according to the department's guidelines. The tests and materials consisted of toys and play material that were considered culturally appropriate for children aged 2.5 to three years growing up in Sweden. Both Swedish and the mother tongue were assessed by the SLP, sometimes with the help of an interpreter and sometimes with

help from the parents. The SLP considered the child's language abilities in both languages when assigning an International Classification of Diseases - Tenth revision (ICD-10) language disorder diagnosis (30).

Children who exclusively screened positive for DLD visited the speech and language pathology clinic one to three times for a diagnostic assessment within three months and met one of the 13 experienced SLP's at the clinic. The SLP considered whether a child with positive language screening met the criteria for a DLD based on ICD-10 (30), namely a specific developmental disorders of speech and language. These were a phonological (articulatory) disorder (F80.0); an expressive disorder, that comprised problems with language production, such as phonology plus grammar (F80.1) or mixed receptive-expressive, which is problems with language comprehension and production (F80.2). These main categories can then be subdivided into more specified diagnoses depending on which linguistic domain is affected. A diagnosis of unspecified speech and language disorder (F80.9) was assigned when there were obvious developmental problems combined with, and beyond, a speech and language disorder.

When no specific language disorder diagnosis could be established during the SLP assessment, the child was classified as a late talker (Table 1).

### **ASD screening**

The autism screening was performed by use of the Modified Checklist for Autism in Toddlers (27,28), and the trained CHC nurses observed the child's joint attention abilities (24). The positive predictive value for the combination of this autism checklist and the observation of joint attention abilities has been found to be 90% and it appears that the two instruments complement each other and optimise the early

detection of autism. A positive autism screening outcome was recorded if the child did not pass two or more of the five questions in the joint attention observation and, or, the parent stated that the child failed to meet two of the seven crucial questions in the autism checklist or three of the 23 questions in the autism checklist (28).

### **Assessment of autism and other developmental disorders**

Children who were screened positive for ASD were referred to the neuropsychiatry clinic to receive an assessment from a multidisciplinary team consisting of a child psychiatrist or paediatrician, child psychologist, speech and language pathologist and a special educational teacher. A review of clinical data from the neuropsychiatry clinic, which was collected since ASD screening was introduced in 2009, revealed that more than 90% of ASD screen positive children had also screened positive in the parallel conducted language screening (unpublished data). All children were assessed with gold standard tests, clinical observations and questionnaires (31). Clinical conjoint diagnoses were only assigned if the children were socially or developmentally disabled by their problems (31).

### **Participants**

Figure 1 provides an overview of the two pathways for the cohort of 5887 children estimated to have participated in the screening. A total of 227 children were initially found to be only DLD screen positive and were referred to the speech and language pathology clinic during 2011 (Fig. 1). The exact number of children who were screened positive for ASD in 2011 was not registered by the CHCs, but 61 incoming referrals from the CHC to the neuropsychiatry clinic were identified. These children were ASD screen positive and about 85% of these were also likely to be DLD screen

positive, according to the SLP assessment at the neuropsychiatry clinic (personal communication).

### **Attrition and study groups**

Of the 227 referrals, 18 were screened negative children when scrutinised. Of the remaining 209 accepted referrals, 123 came from the 2.5-year language screening and 86 from the re-assessment at age three years as they had mild problems at the first screening. The parents of 33 children cancelled the appointment at the speech and language pathology clinic: 17 from the 2.5-year screening and 16 children from the follow up at the age of three. The parents of 176 language screen identified children accepted a clinical language assessment in 2011. In addition, 61 children with positive ASD screening, who had been referred to the neuropsychiatry clinic from the CHC, were assessed in 2011. These 237 children were the main focus of the present study.

>>> Insert Figure 1 about here <<<

### **Review of clinical records**

In order to retrieve information about the participating 176 children from the DLD screen positive group, who were subsequently referred to the neuropsychiatry clinic or other clinics after the assessment at the speech and language pathology, the clinical registers covering the neuropsychiatry clinic, other child and adolescent psychiatry outpatient clinics and the child neurology outpatient clinic in the region were reviewed in June 2016.

The same procedure was used to follow up the 61 children with positive ASD screening who were assessed at the neuropsychiatry clinic. These children's records were also reviewed with regard to established diagnoses.

### **Statistical methods**

This was a descriptive explorative study. Chi-square tests (with Yates's correction whenever appropriate) were used to examine patterns in the data.

### **Ethics**

The study was approved by the Ethics Committee at the Medical Faculty at the University of Gothenburg (ref no 525-11 and 494-08).

## **RESULTS**

Of the 6463 eligible children, we estimate that 5887 (91%) participated in the 2.5-year screening. The vast majority, 5599 (95%) screened negative for DLD and, or ASD. Of the remainder, 227 (4%) screened positive for just DLD and 61 (1%) screened positive for ASD (Fig. 1). In all, about 5% of the population was identified by the 2.5-year DLD or ASD screening.

Of the 227 children who screened positive for DLD, according to the CHCs, 176 (135 boys), came to the speech and language pathology for a language assessment in 2011. Of these 176 children, 83 (47%) were from monolingual Swedish speaking families and 93 (53%) of the children had at least one parent, or both, who spoke another native language than Swedish.

In addition, 61 children (47 boys) came to the neuropsychiatry clinic assessment due to suspected autism, according to the autism screening. Of these 26 (43%) came from

monolingual Swedish speaking families and 35 (57%) had at least one parent, or both, who spoke a native language other than Swedish.

### **Children who only screened DLD positive**

We found that 108 (61%) of the 176 positive language screen children fulfilled diagnoses of specific developmental disorders of speech and language (ICD-10) (Table 1) at the first assessment. A large proportion, 68 (39%), of the 108 children were considered late talkers. They were identified with language problems by the language screening, but did not fulfil an ICD-10 language disorder diagnosis at the language assessment, performed by a SLP, within the next three months.

>>>> Insert Table 1 about here <<<<

There were some gender differences regarding language diagnoses (Table 1). More boys (90/135, 67%) than girls (18/41, 44%) were diagnosed with an ICD-10 language disorder, while a greater proportion of girls (23/41, 56%) than boys (45/135, 33%) were late talkers (chi-square (1, N = 176) = 6–87,  $p < 0.01$ ).

### **Intervention and measures after the first language examination**

All language assessed children, including late talkers and those with DLD, were recommended various interventions after the first language examination: 55% were recommended check-ups within one to six months, 28% were recommended direct intervention and the parents of 2% of the children participated in a parent education programme at the speech and language pathology clinic. Thus, the majority (85%) of the identified children had further contact with the speech and language pathology clinic during the pre-school years. In 15% of cases the SLP finished the contact after the language assessment, but information about how to support the child's language

development was provided to all parents and to nearly 60% of the child's pre-school teachers.

### **Neurodevelopmental diagnoses five years after positive language screening**

The register review identified 35/176 (20%) children who had been referred for further neurodevelopmental, neuropsychiatric assessment after contact with the speech and language pathology clinic and 4/35 (11%) were girls. At these multidisciplinary assessments the 35 children were given a number of different diagnoses (Table 2): 31 (88%) had a language disorder, which was mainly mixed receptive-expressive, 15 (43%) had ASD, 13 (37%) had definite autistic traits without meeting the full criteria for ASD in the Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition, 15 (43%) had ADHD, 10 (28%) had intellectual disability with an intelligence quotient of 51–70 and another seven (20%) had borderline intellectual functioning with an intelligence quotient of 71–84. Co-existence of disorders was common (Table 2).

The percentages of the 35 children with each type of language diagnosis in 2011 who were subsequently found in clinical records were: none for oral-motor disorders, four (11%) for expressive disorders, five (14%) for mixed expressive-receptive disorders, 18 (51%) for unspecified speech and language disorder and eight (23%) for no ICD-10 diagnosis (Table 2).

>>>>> Insert Table 2 about here <<<<<

Furthermore, 18/34 of those originally screened and diagnosed as having unspecified language disorders (Table 1) were still known to services five years later, compared to only 5/27 (Table 1) initially diagnosed as having a mixed receptive-expressive disorder, an indication of a severe generalised language development problem.

Of the 68 (45 boys) children considered to be late talkers at the first SLP assessment, eight (12%) children (seven boys) had a further neurodevelopmental assessment five years later (Table 2) and seven had at least one, or combinations, of: autistic traits, ASD, ADHD or intellectual disability. For the remaining 60 children classified as late talker at the first SLP assessment, the outcome was unknown.

### **The ASD screen positive group**

According to the CHCs annual reports around 1% of all children were positive in the ASD screening, but the exact number of referrals was not registered for 2011 (9). We do know that 61 children came to the neuropsychiatry clinic, referred from the CHC, for an ASD assessment in 2011 according to the hospital's records and database. Given that these multidisciplinary assessments often take a couple of months, many children did not receive their diagnoses until 2012 and a child's intellectual level, in many cases, must be established by two separate assessments with a gap of at least one year between, we consider it was valid to report the diagnoses in these ASD screen positive children five years after identification. This also brought the timescale in line with the follow up of the DLD screen positive group. We found that 41/61 (67%) of the children ASD with or without other neurodevelopmental diagnoses, such as intellectual disability, ADHD and DLD, and five (8%) children had no ASD diagnosis, but had other neurodevelopmental diagnoses five year after screening. A further 15/61 (24%) had no neurodevelopmental diagnoses according to the clinical registers covering the neuropsychiatry clinic, or other child and adolescent psychiatry outpatient clinics, in 2016. However, they all had clinically relevant neurodevelopmental symptoms noted

in their records, that indicated ESSENCE (22), although they did not meet defined diagnostic criteria.

### **Combined DLD and ASD screen positive groups**

Of the 237 children who had screened positive for DLD and, or autism and thereafter been clinically assessed, 96 (40%) had different types of established neurodevelopmental disorders or problems five years later.

## **DISCUSSION**

In this study, which used combined language and autism screening during the 2.5-year visit to the children's CHCs, 4% screened positive for just DLD and 1% screened positive for ASD. However, the majority of the ASD screen positive children were also DLD screen positive. Of the children with just a positive language screening, 20% (35/176) had definite complex neurodevelopmental problems at their follow-up visit five years later. These children had not been identified in the parallel autism screening performed at the same CHC visit. Of the 61 children, with positive ASD screening, all had developmental disorders or problems five years later. This means that at least 40% (96/237) of all screen positive children had persisting DLD or other neurodevelopmental disorders before the age of eight. It can be expected that there could be additional children in 141 children with an unknown outcome who may have presented with milder ESSENCE problems at the time of this follow up. Some children may also have moved from the region or had problems that were adequately dealt with in school or by their local paediatrician. Alternatively, they may have improved and were no longer cause for concern. There is an on-going debate about the efficacy of early language screening in primary care before the age of three. This is due to a lack

of good-quality evidence for screening methods and effective interventions in these ages and also whether there are beneficial effects for the child in the longer term. However, there is agreement that these children should be identified, because late talkers and DLD, in particular, in pre-schoolers are often markers of other neurodevelopmental disorders (3–5,22,32,33).

The present study offers new evidence from a whole- population cohort screened over a full one-year period and followed up five years later through access to clinical registries. There are few countries in the world where children are screened for both language delays and ASD in the pre-school years with very good uptake, estimated at 95% in Gothenburg (9). This, coupled with the ability to follow up using registry data, means we were able to make reasonably robust conclusions about the implications of the findings for children in other comparable populations.

Previous research from our centre has shown that it was possible to reliably identify 2.5-year-old children with DLD with the language screening method (11) and that 60–70% of children identified had additional neurodevelopmental disorders five years later (10). In the present study, one-fifth of the children who screened positive for DLD but not ASD had additional ASD, ADHD and learning problems when they were systematically assessed by a multidisciplinary team before the age of eight. In the combined group of children who had screened positive for DLD and, or autism at 2.5 years and been clinically assessed, nearly half (40%) had additional developmental disorders or problems when they were followed up at around eight years of age. Interestingly, all 176 DLD screen positive children in the current study had been registered as ASD screen negative at the age of 2.5 years and only failed the language screening. Thus, they were not likely to have been missed ASD cases at 2.5 years.

Instead, their autism symptoms became more prominent as the child's speech and language developed.

It was not possible at the time of identification to know if the DLD was isolated or if other cognitive and developmental skills were affected (8). Previous research has shown early identified language delay to be persistent, Buschmann et al. (5) studied a group of two-year-old late talking children, who were identified by paediatricians and assessed within a few months of identification, and found ASD in 4%, intellectual disability and borderline intellectual functioning in 18% and persistent expressive DLD in 78%. DLD at two years of age proved to represent a sensitive marker for different developmental problems.

An important clinical finding in our study was that 60% of the DLD screen positive children had a definite ICD-10 specific developmental disorder of speech and language at their first SLP assessment and this was significantly more common in boys. The remaining 40% of the children had transient language problems who were late talkers and had started to use spoken words and sentences at the time of their first SLP assessment. However, eight of the 35 children who underwent at least one neuropsychiatric assessment at the neuropsychiatry clinic five years later had only been considered to be late talkers at their first SLP assessment. Thus, the late talkers may also need watchful surveillance during the preschool period.

The boy-girl ratio of the 176 in the positive DLD screen group was 3:1 (135 boys: 41 girls) which was in line with Norbury et al. (7) for children with DLD and additional difficulties. Yet, the proportion of boys and girls who were assigned a language disorder diagnosis was lower, 2:1 (67 boys: 33 girls), but not as low as earlier screening studies, which reported almost equal proportions (7). However, these later studies

screened somewhat older children, such those aged 4–5. Interestingly, more than half of the girls identified by the DLD screening were considered to be late talkers, compared to the one-third of the DLD positive screen boys. These gender differences may indicate that the DLD screen at the age of 2.5 years under identified girls, but those that were identified were less likely than boys to be assigned a language disorder diagnosis. The girl in our study who was considered to be late talker at her first SLP assessment, number seven in Table 2, had mixed receptive expressive language disorder, autism and intellectual disability five years later.

A multinational and multidisciplinary Delphi consensus study published in 2016 proposed that specific language disorders should be labelled DLD with more consistent criteria. It was agreed that the presence of neurobiological or environmental risk factors, does not preclude a diagnosis of DLD, that DLD can co-occur with other neurodevelopmental disorders and DLD does not require a mismatch between verbal and nonverbal ability (1).

The group of children identified at the language screening was heterogeneous. Only speech and language therapy was insufficient to meet these children's long-term needs. This strongly suggests that measures to assess different developmental disorders, at least on a yearly basis, should be available for all children who screen positive for DLD at 2.5 years.

The rate of identified coexisting developmental disorders among the DLD screen positive children in the present study, which relied on data from records, was considerably lower than our previous study (10), which was only based on language screening and assessed by a multi-disciplinary team. We found that 30 of the 35 children with identified neurodevelopmental diagnoses at the age of eight years, and

who had only screened positive for DLD, not ASD, had a receptive-expressive language disorder at follow up. Of these 30 children, 13 (43%) were diagnosed with ASD five years later. This figure corresponded to findings from a follow-up study of 38 individuals who had been diagnosed with language disorders in childhood, with 13 (34%) meeting the criteria for ASD (32). It also agreed with our previous study, which showed that 90% of children who attended a special preschool with DLD as a referral criterion, had other definite developmental problems (33). Intellectual disability or borderline intellectual functioning was present in half of the 35 children who had had a multi-disciplinary assessment at the age of eight years and it was common that these were combined with one to four other diagnoses. This result further supports the value of the language screening and its role in screening for ESSENCE. In most cases the SLP initiated the referral for further assessments, often in collaboration with the CHC nurse and, or, the paediatrician. In some cases, the SLP had to motivate the parents long before they accepted their child's need for further assessment. If a systematic assessment of all eight-year-old children with a history of language delay at age 2.5 years had been performed, we expect that more children would have been shown to suffer from additional developmental problems. Hence, we can expect many more children with persistent DLD, not yet comprehensively assessed, to be diagnosed with additional developmental problems in the present study group.

Early identification of language delay is an indicator of persistent and diverse developmental problems. Understanding which children will be transient late talker problems and which will have more persistent and overlapping problems can only happen with a combination of good quality screening and regular follow-up visits. This study has shown that SLPs play a key role in identifying children requiring further neuropsychiatric or neurodevelopmental assessments, because the coexisting

symptoms may become more and more apparent as the child's language skills improve. Currently, in Sweden, most SLPs work at clinics that are distinct from other paediatric and child psychiatric clinics. This study, and many others, suggest the value of establishing ESSENCE clinics with a number of different professionals working together in multidisciplinary teams to meet these children's comprehensive needs for neurodevelopmental assessments, intervention and follow up.

The strengths of the study were that a one-year cohort of 237 children who screened positive and were clinically assessed for DLD and, or, ASD were followed up five years later. At this follow-up, 96 children had persisting and additional neurodevelopmental problems beyond DLD and autism. However, a systematic, clinical assessment of all the remaining 141 children could not be performed, which was a study limitation. No information could be obtained for these 141 children, including a number who may have presented with milder ESSENCE problems, or no such problems, but the attrition constitutes a limitation of the study.

## **CONCLUSION**

Children who screened positive for DLD and, or, autism at 2.5 years constituted a heterogeneous group and will need multidisciplinary assessments and follow-up visits to identify coexisting neurodevelopmental disorders. This would best be facilitated if ESSENCE clinics were established, with different professionals working together.

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## **CONFLICT OF INTEREST**

The authors have no conflicts of interest to report.

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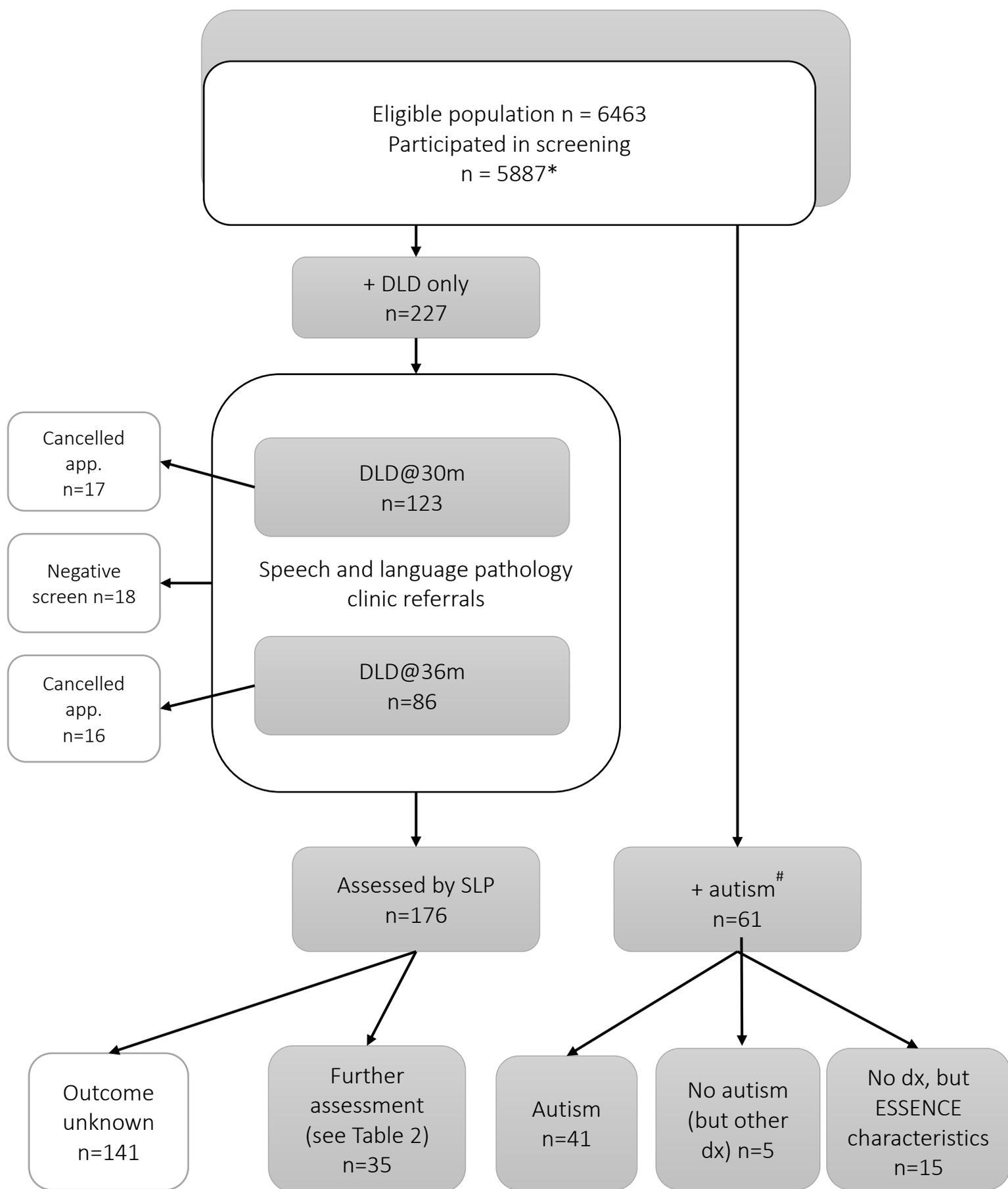
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Figure 1: Flow-chart showing pathways of those screened positive for DLD or autism in 2011



\* estimate

# identified retrospectively for this study, likely to include DLD as secondary concern

DLD: developmental language disorder

dx: diagnosis

ESSENCE: Early Symptomatic Syndromes Eliciting Neurodevelopmental Clinical Examination

PSLP: Department of Paediatric Speech and Language Pathology

**Table 1** Distribution of ICD-10 Specific developmental disorders of speech and language disorder diagnoses and Language Delay in 176 2.5-3 year-old children identified by 2.5-year language screening in 2011

<b>ICD-10 Diagnosis</b>		<b>Girls n (%)</b>	<b>Boys n (%)</b>	<b>Total number of children n (%)</b>
F80.0	<b>Phonological Disorder</b>	0	0	0
F80.0B	Oral motor Disorder	1 (2)	4 (3)	5 (3)
F80.1	<b>Expressive Language Disorder</b>	7 (17)	34 (25)	41 (23)
F80.2B	<b>Mixed Receptive-Expressive Language Disorder</b>	4 (9)	23 (17)	27 (15)
F80.2C	Pragmatic Language Disorder	0	1 (1)	1 (1)
F80.9	<b>Unspecified Speech and Language Disorder</b>	6 (15)	28 (21)	34 (19)
<b>No ICD-10 Diagnosis</b>				
<b>Late talkers</b>		23 (56)	45 (33)	68 (39)
<b>Total</b>		<b>41</b>	<b>135</b>	<b>176</b>

**Table 2** Language and other neuropsychiatric diagnoses in 35 children five years after the 2.5-3-year language screening identified them

<b>ID</b> (girl: ♀)	<b>Identified at screening age</b>	<b>First given Language Diagnosis</b>	<b>Latest given Language Diagnosis</b>	<b>Number of NP- assessments</b>	<b>ASD</b>	<b>ADHD</b>	<b>Intellectual level</b>
<b>1</b> (♀)	2.5	Mixed receptive- expressive Disorder	Mixed receptive- expressive Disorder	2	Autistic like condition	ADHD	BIF
<b>2</b>	2.5	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder Apraxia?	1	Autistic traits	No	BIF
<b>3</b>	2.5	Expressive Language Disorder	Phonological Disorder	2	ASD	ADHD	AIF
<b>4</b>	2.5	<b>No diagnosis</b> *	Mixed receptive- expressive Disorder	1	No	ADHD? No diagnosis assigned, but described	BIF
<b>5</b>	2.5	Mixed receptive- expressive Disorder	Mixed receptive- expressive Disorder + Apraxia	3	Autism	ADHD	AIF
<b>6</b>	2.5	Mixed receptive- expressive Disorder	Mixed receptive- expressive Disorder	1	Autistic like condition	No	AIF
<b>7</b> (♀)	2.5	<b>No diagnosis</b> *	Mixed receptive- expressive Disorder	2	Autism	No	ID

<b>ID</b> (girl: ♀)	<b>Identified at screening age</b>	<b>First given Language Diagnosis</b>	<b>Latest given Language Diagnosis</b>	<b>Number of NP- assessments</b>	<b>ASD</b>	<b>ADHD</b>	<b>Intellectual level</b>
<b>8</b>	2.5	<b>No diagnosis</b> *	Mixed receptive- expressive Disorder	2	Autistic traits	No	AIF
<b>9</b>	2.5	Mixed receptive- expressive Disorder	Mixed receptive- expressive Disorder	1	No	No	ID
<b>10</b>	2.5	Mixed receptive- expressive Disorder	Mixed receptive- expressive Disorder	1	Autistic traits	No	AIF
<b>11</b>	2.5	<b>No diagnosis</b> *	Mixed receptive- expressive Disorder	2	Autistic traits	ADHD	AIF
<b>12</b>	2.5	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder	1	Minor Autistic traits	ADHD? No diagnosis assigned, but described	AIF
<b>13</b>	2.5	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder	2	Autistic traits	ADHD	AIF
<b>14</b>	2.5	Expressive Language Disorder	Mixed receptive- expressive Disorder	1	Autistic traits	No	AIF
<b>15</b>	2.5	<b>No diagnosis</b> *	<b>No diagnosis</b> *	1	No	No	AIF
<b>16</b>	2.5	<b>No diagnosis</b> *	Mixed receptive- expressive Disorder	1	ASD	No	AIF

<b>ID</b> (girl: ♀)	<b>Identified at screening age</b>	<b>First given Language Diagnosis</b>	<b>Latest given Language Diagnosis</b>	<b>Number of NP- assessments</b>	<b>ASD</b>	<b>ADHD</b>	<b>Intellectual level</b>
<b>17</b>	2.5	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder	2	Autistic traits	ADHD	AIF
<b>18</b>	2.5	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder	1	Autistic traits	ADHD	BIF
<b>19</b>	2.5	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder	1	ASD	ADHD	ID
<b>20</b>	2.5	Unspecified Speech and Language Disorder	<b>No diagnosis</b> *	1	ASD	ADHD	AIF
<b>21</b>	2.5	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder	1	ASD	No	ID
<b>22</b>	2.5	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder	1	Autistic traits	No	BIF
<b>23</b>	2.5	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder	1	ASD	ADHD	AIF
<b>24</b>	2.5	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder			Suspected ADHD according to the referral	AIF
<b>25</b>	2.5	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder	1	No	No	BIF
<b>26</b>	3	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder	1	ASD	ADHD	AIF

<b>ID</b> (girl: ♀)	<b>Identified at screening age</b>	<b>First given Language Diagnosis</b>	<b>Latest given Language Diagnosis</b>	<b>Number of NP- assessments</b>	<b>ASD</b>	<b>ADHD</b>	<b>Intellectual level</b>
<b>27</b>	3	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder + Apraxia	1	ASD	No	AIF
<b>28</b> (♀)	3	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder	1	ASD	No	ID
<b>29</b> (♀)	3	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder	2	ASD	No	BIF
<b>30</b>	3	<b>No diagnosis *</b>	<b>No diagnosis *</b>	1	No	No	ID
<b>31</b>	3	Expressive Language Disorder	Mixed receptive- expressive Disorder	1	Autistic traits	ADHD	ID
<b>32</b>	3	<b>No diagnosis *</b>	<b>No diagnosis *</b>		Autistic traits		
<b>33</b>	3	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder	2	ASD	No	ID
<b>34</b>	3	Unspecified Speech and Language Disorder	Mixed receptive- expressive Disorder	2	No	No	AIF
<b>35</b>	3	Expressive Language Disorder	Mixed receptive- expressive Disorder	1	Autistic traits	No	ID
<b>Total</b>	35						

ADHD = attention-deficit/hyperactivity disorder; AIF = average intellectual functioning (IQ  $\geq$  85); ASD = autism spectrum disorder; BIF borderline intellectual functioning (IQ = 71-84); ID = intellectual disability (IQ = 51-70).

\*No diagnosis, i.e., late talker