

## Sound Outcomes: First Voice speech and language data

*High-level overview of the findings from the data set*



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## 1. Overview

First Voice maintains a large data set on the outcomes of more than 500 children with hearing loss enrolled in its members' listening and spoken language early intervention services. This is the largest data set for children with hearing loss receiving listening and spoken language early intervention in Australia and New Zealand. Outcome data are collected yearly, enabling First Voice to conduct large-scale research to evaluate and improve services and outcomes for children with hearing loss.

The Sound Outcomes project collated the 2013 data, which included 696 children. This high-level summary report presents the key outcomes from this analysis.

### Key findings

#### Demographics

- The mean age of children in the data set was 3.34 years ( $SD=1.50$  years).
- The primary language for 80.4% of the children was English.
- 11.4% were identified as having an additional disability that impacted on their learning.
- In relation to the primary caregivers, the majority (58.5%) had completed university or equivalent as their highest level of education.

#### The hearing loss

- The mean age at diagnosis was 0.63 years ( $SD=1.02$  years).
- Aetiology was most frequently reported as not being tested (26.0%), followed by congenital non-genetic (25.4%) and genetic non-syndromic (18.5%).
- The severity of the hearing loss in the better ear was predominantly moderate (22.9%), followed by mild (18.8%), moderately severe (15.7%), profound (15.1%), normal (14.2%) and severe (13.2%).
- Children were reported to have the following types of aiding:
  - Bilateral hearing aids - 47.6%
  - Bilateral cochlear implants - 22.5%
  - Bimodal aiding (cochlear implant and hearing aid) – 8.5%
  - Unilateral hearing aid – 7.5%
  - Unilateral bone anchored hearing aid – 6.7%
  - Bilateral bone anchored hearing aid – 1.5%
  - Unilateral cochlear implant – 0.6%
  - Bimodal aiding (bone anchored hearing aid and hearing aid) – 0.3%
  - Bimodal aiding (hearing aid and auditory brainstem implant) – 0.2%
  - No device – 4.6%
- Age at fitting of first HA (including BAHA) was  $M=1.26$  years ( $SD=1.25$  years) and age of fitting of second HA was  $M=1.29$  years ( $SD=1.27$  years). Age at first implant was  $M=1.74$  years ( $SD=1.23$  years) and age at second implant was  $M=2.01$  years ( $SD=1.42$  years).

*Key findings continued on next page*

## Key findings (continued)

### Listening and spoken language outcomes

- The mean language, vocabulary and speech standard scores fell within the average range for typical hearing peers. Most children also had scores within or above the average range for typical hearing children for language (74.4%-75.6%), vocabulary (79.6%) and speech performance (71.5%).
  - When looking at **language**, the mean auditory comprehension standard score (SS) of 95.34 (*SD*=19.21) fell within the average range for typical hearing peers (i.e. SS between 85 and 115). The majority of children (74.4%) also achieved SS within the average range or above. For expressive communication, the mean SS of 96.85 (*SD*=18.89) was also within the average range, with the majority of children (75.4%) having SS within the average range or above. The mean SS for total language of 96.56 (*SD*=19.22) was also within the average range, and 75.6% of the children had a SS within the average range or above. For **vocabulary**, the mean SS was 97.56 (*SD*=17.13) and 79.6% of the children were within the average range or above. On **speech performance**, the mean SS was 92.47 (*SD*=15.79) and 71.5% of children had a SS within the average range or above.
- When children with additional disabilities were removed from the analysis, the number of children within or above the average range for typical hearing children increased, except for speech performance (language performance=77.9%-80.2%; vocabulary performance=83.1%; speech performance=73.1%).
  - For **language**, the mean auditory comprehension SS of 97.03 (*SD*=18.38) fell within the average range for typical hearing peers (i.e. SS between 85 and 115). The majority of children (77.9%) also achieved SS within the average range or above. For expressive communication, the mean SS of 98.53 (*SD*=18.07) was also within the average range, with the majority of children (80.2%) having SS within the average range or above. The mean SS for total language of 98.34 (*SD*=18.23) was also within the average range, and 79.6% of the children had a SS within the average range or above. For **vocabulary**, the mean SS was 99.18 (*SD*=16.10) and 83.1% of the children were within the average range or above. On **speech performance**, the mean SS was 93.29 (*SD*=15.18) and 73.1% of children had a SS within the average range or above.

## 2. Background

### 2.1 First Voice

First Voice is the regional body for centres providing listening and spoken language early intervention for children with hearing loss in Australia and New Zealand. Member and affiliated centres include Cora Barclay Centre (South Australia), Hear and Say (Queensland), The Hearing House (New Zealand), The Shepherd Centre (New South Wales and the Australian Capital Territory), Taralye (Victoria) and Telethon Speech and Hearing (Western Australia). First Voice collects outcome data yearly for children enrolled in their listening and spoken language early intervention with the purpose of evaluating and improving services and outcomes for children with hearing loss.

### 2.2 Outcomes of children with hearing loss enrolled in listening and spoken language early intervention

Research outcomes for children with hearing loss in listening and spoken language early intervention have been promising. Dornan and colleagues (2007, 2009; 2010) compared

the development of a group of 19 children with hearing loss in a listening and spoken language program over a 50-month period, with language age-matched children with typical hearing. No significant differences were reported between the two groups in speech, language, and self-esteem over the study period, as well as similar reading and mathematical skills. These findings are in keeping with other reports of optimal speech and language development with listening and spoken language early intervention (Fulcher, Purcell, Baker, & Munro, 2012; Hogan, Stoke, White, Tyszkiewicz, & Woolgar, 2008; Rhoades & Chisolm, 2000). It has been suggested that listening and spoken language early intervention, in combination with early diagnosis of the hearing loss and appropriate aiding, help to stimulate auditory brain development. This allows children to make meaning of what they hear and lays down the neural pathways for the normal development of speech and language (Chermak, Bellis, & Musiek, 2007; Cole & Flexer, 2007). To further develop the evidence for listening and spoken language early intervention it is important for large-scale studies, such as Sound Connections and Sound Outcomes, to investigate and track longitudinally the outcomes of children with hearing loss in this type of early intervention.

As part of the Sound Connections project, First Voice benchmarked the listening, spoken language and social inclusion outcomes of children with hearing loss enrolled in a listening and spoken language early intervention program against typical hearing children (Constantinescu, Phillips, Davis, Dornan, & Hogan, Manuscript submitted for publication). This project reported that children with hearing loss, aged 4-5 years, enrolled in listening and spoken language early intervention:

- usually showed language, vocabulary and speech skills commensurate with their typical hearing peers; and
- usually demonstrated comparable, if not better social inclusion than typical hearing peers in relation to educational and social outcomes (Constantinescu et al., Manuscript submitted for publication).

Analysis of the 2013 First Voice data (presented below) further supports the finding from the Sound Connections project that children enrolled in listening and spoken language early intervention usually show language, vocabulary and speech skills commensurate with their typical hearing peers.

### 3. Findings from the data

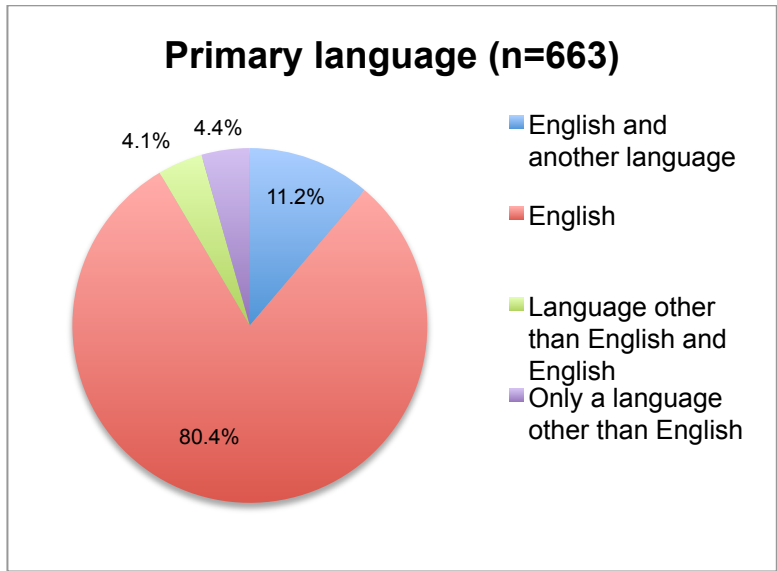
#### 3.1 Demographics

In 2013, centres provided data for 696 children (see Table 1 for specific numbers for each centre). The mean **age** of these children was 3.34 years ( $SD=1.50$  years), with 48.9% **female** and 51.1% **male**. This gender breakdown is similar to that of the Longitudinal Outcomes of Children with Hearing Impairment (LOCHI) in which 54% of the children are male (National Acoustic Laboratories, 2014).

**Table 1 Number of children from each centre**

<b>Centre</b>	<b>Number of children (%)</b>
Cora Barclay Centre	68 (9.8%)
Hear and Say	195 (28.0%)
The Hearing House	36 (5.2%)
The Shepherd Centre	228 (32.8%)
Taralye	82 (11.8%)
Telethon Speech and Hearing	87 (12.5%)

The **primary language** was English (80.4%), followed by predominantly English and also another language (11.2%), only a language other than English (4.4%) and predominantly a language other than English and also English (4.1%) (see Figure 1).



**Figure 1 Primary language**

Figure 2 summarises the **primary caregiver’s highest level of education** with 58.5% having completed university or equivalent.

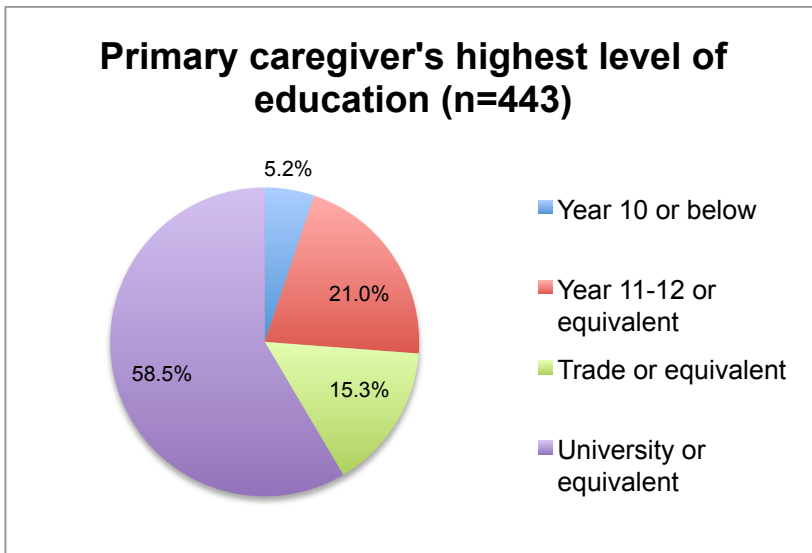


Figure 2 Primary caregiver's highest level of education

Of the children in the data set, 11.4% (n=75) were identified as having an **additional disability that impacts on learning** (see Figure 3). Specifically, 49.3% were reported to have both an intellectual and physical disability, 27.5% to have an intellectual disability and 23.2% to have a physical disability.

This percentage is lower than that in the LOCHI study which reported that 25% of the children have an additional disability (National Acoustic Laboratories, 2014). The two data sets may have different criteria for identifying additional disabilities, which may contribute to this difference.

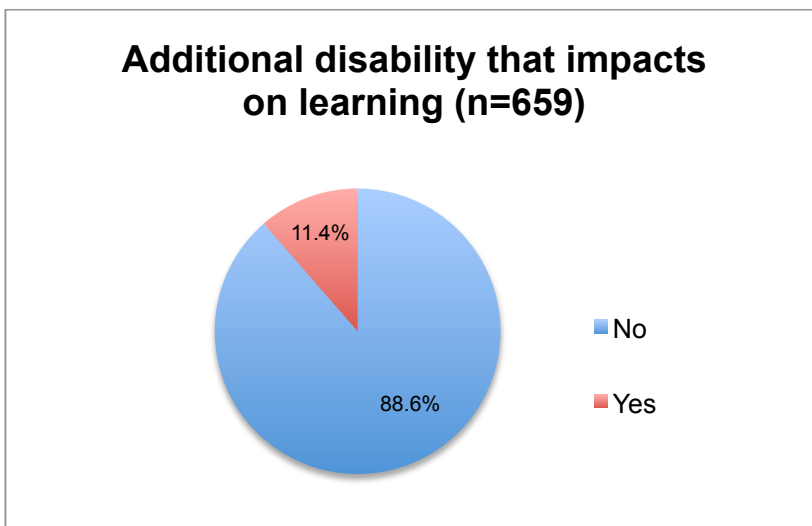
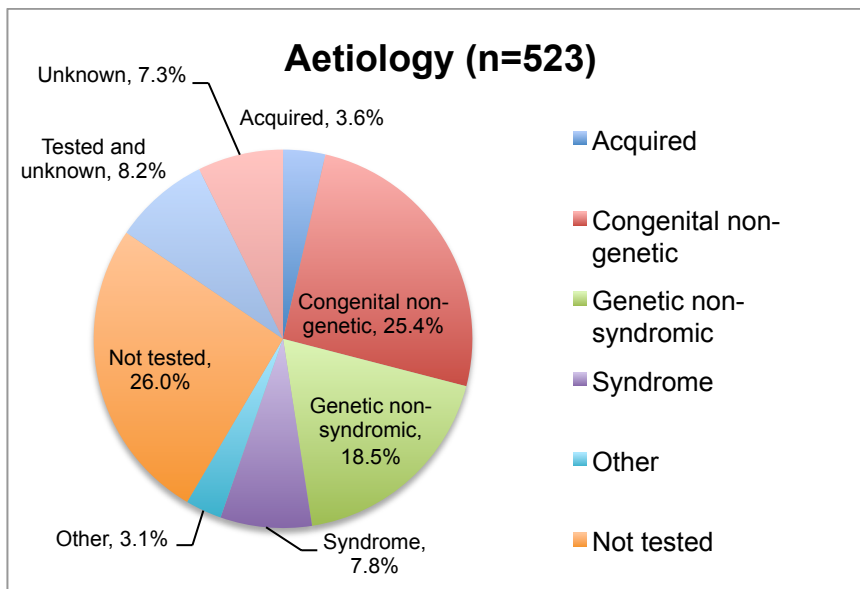


Figure 3 Additional disability that impacts on learning

### 3.2 The hearing loss

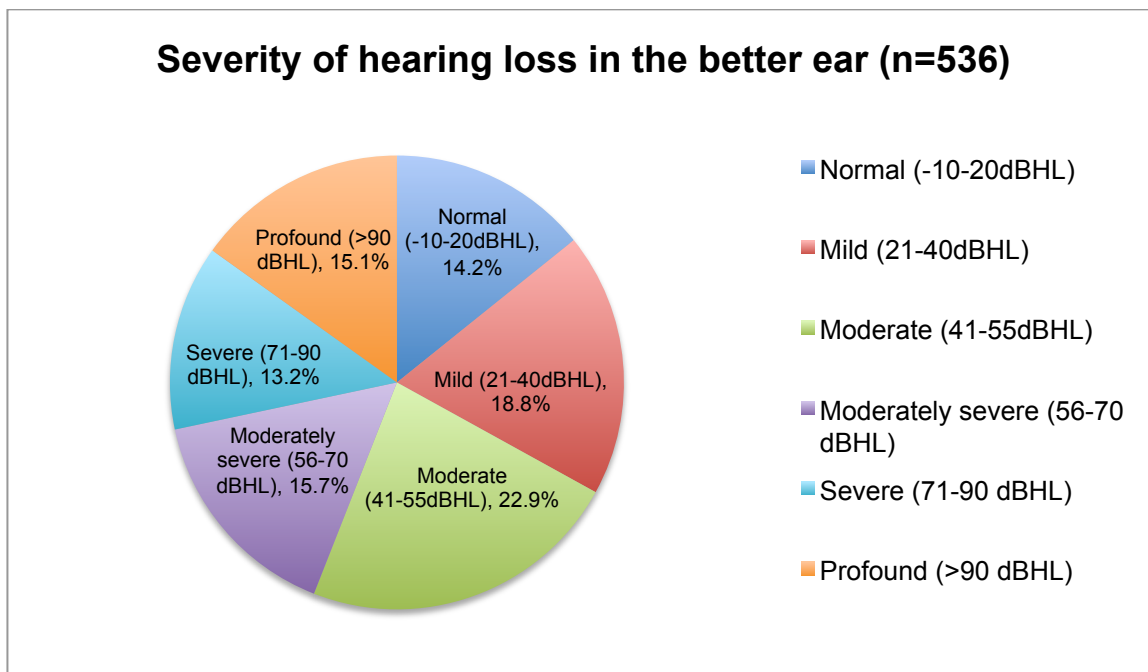
The mean **age at diagnosis** was 0.63 years ( $SD=1.02$  years). The **aetiology** of hearing loss (see Figure 4) was mostly not tested (26.0%), followed by congenital non-genetic (25.4%) and genetic non-syndromic (18.5%).





**Figure 4 Aetiology of hearing loss**

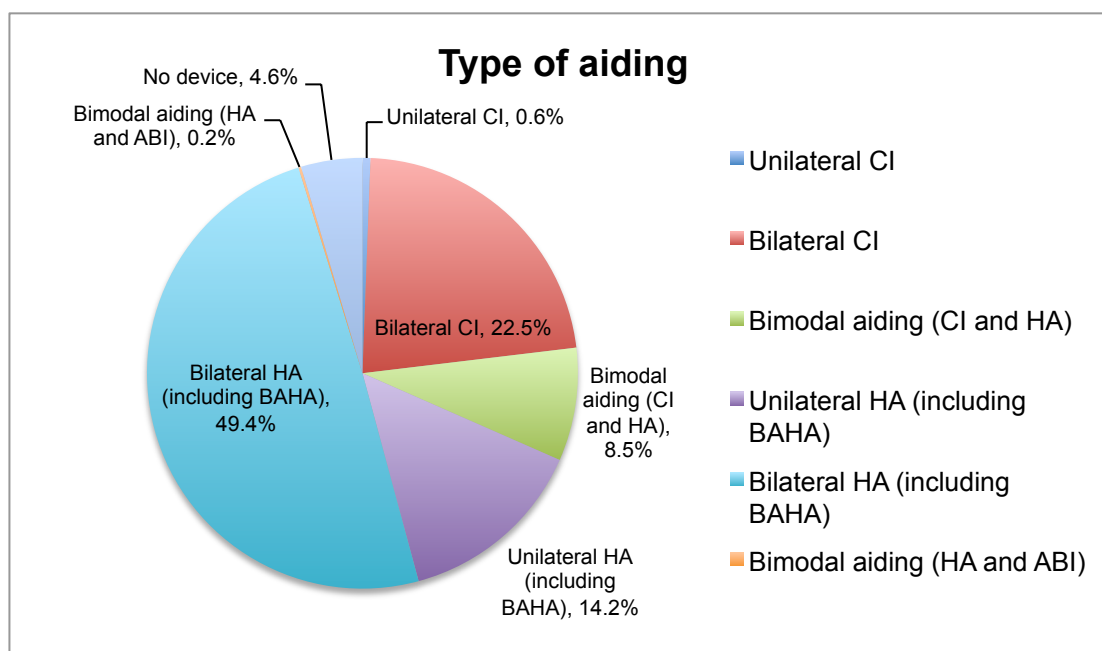
The **severity of hearing loss** in the better ear (see Figure 5) was predominantly moderate (22.9%), followed by mild (18.8%), moderately severe (15.7%), profound (15.1%), normal (14.2%) and severe (13.2%). It is difficult to compare these figures to the severity of hearing loss of children in the LOCHI study because different categories have been used and different dBHL may be used for this categorisation. In the LOCHI study 16% of children have been reported to have a mild hearing loss, 35% a moderate loss, 20% a severe loss and 29% a profound loss (National Acoustic Laboratories, 2014).



**Figure 5 Severity of hearing loss in the better ear**

In relation to **type of aiding** (see Figure 6), children in the data set most commonly had bilateral hearing aids (HA) (including bone anchored hearing aids [BAHA]; 49.4%), followed by bilateral cochlear implants (CI; 22.5%), bimodal aiding (CI and HA; 8.5%), unilateral HA (including BAHA; 14.2%), unilateral CI (0.6%) and bimodal aiding (HA and auditory brainstem implant; 0.2%). There were 4.6% of children who had no device. **Age**

at fitting of first HA (including BAHA) was  $M=1.26$  years ( $SD=1.25$  years) and age of fitting of second HA was  $M=1.29$  years ( $SD=1.27$  years). Age at first implant was  $M=1.74$  years ( $SD=1.23$  years) and age at second implant was  $M=2.01$  years ( $SD=1.42$  years).



**Figure 6 Type of aiding**

Note. HA=hearing aid; CI=cochlear implant; BAHA=bone anchored hearing aid; ABI=auditory brainstem implant,  $M$ =mean,  $SD$ =standard deviation.

### 3.3 Enrolment in listening and spoken language early intervention

Children in the data set were enrolled in listening and spoken language early intervention at a mean age of 1.18 years ( $SD=1.20$  years) and had been in the program an average of 2.12 years ( $SD=1.20$  years).

### 3.4 Listening and spoken language outcomes

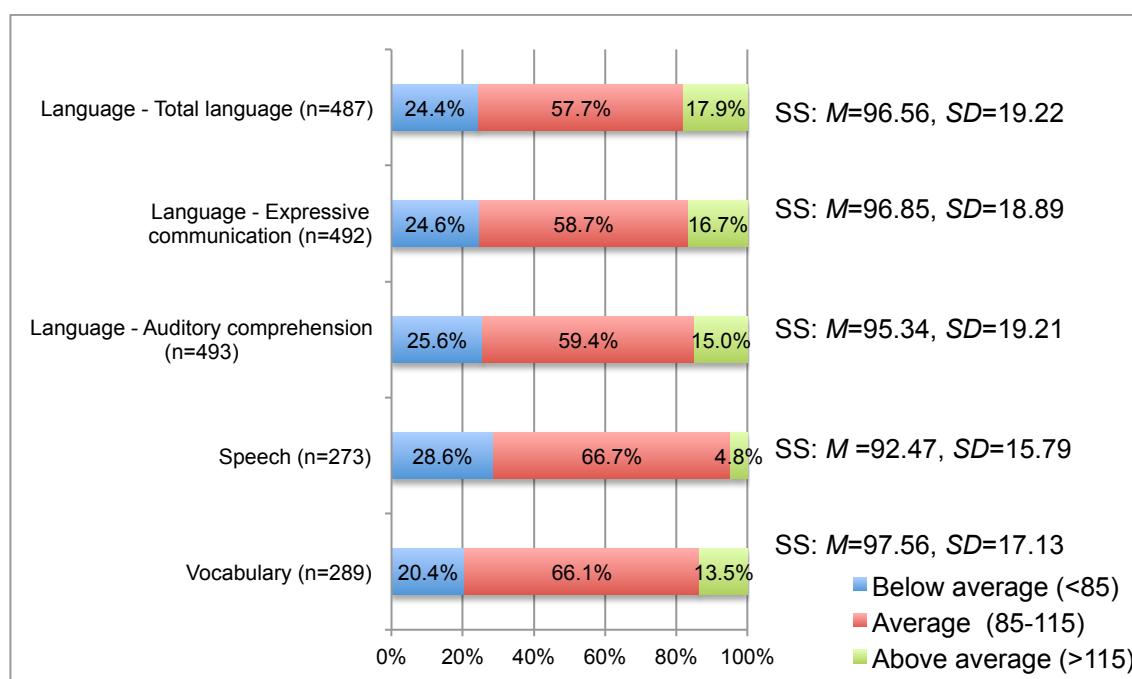
#### Approach to measurement

Following the First Voice assessment protocol, language measures of auditory comprehension, expressive communication and total language ability of the children were assessed using the Preschool Language Scale-4 (PLS-4; Zimmerman, Steiner, & Pond, 2002), the Clinical Evaluation of Language Fundamentals-Preschool 2nd Edition (CELF-P2; Wiig, Secord, & Semel, 2004), or the Clinical Evaluation of Language Fundamentals-4 (CELF-4; Semel, Wiig, & Secord, 2006) (as appropriate and dependent on the child's age and language development post optimal amplification). The Goldman-Fristoe Test of Articulation-2 (GFTA-2; Goldman & Fristoe, 2001) was used to provide a measure of speech ability, and vocabulary was measured using the Peabody Picture Vocabulary Test-4 (PPVT-4; Dunn & Dunn, 2007).

#### Outcomes including children with additional disabilities

An overview of the language, speech and vocabulary performance of the whole data set (including children with additional disabilities) is provided in Figure 7. When looking at **language**, the mean auditory comprehension standard score (SS) of 95.34 ( $SD=19.21$ ) fell within the average range for typical hearing peers (i.e. SS between 85 and 115). The

majority of children (74.4%) also achieved SS within the average range or above. For expressive communication, the mean SS of 96.85 ( $SD=18.89$ ) was also within the average range, with the majority of children (75.4%) having SS within the average range or above. The mean SS for total language of 96.56 ( $SD=19.22$ ) was also within the average range, and 75.6% of the children had a SS within the average range or above. For **vocabulary**, the mean SS was 97.56 ( $SD=17.13$ ) and 79.6% of the children were within the average range or above. On **speech performance**, the mean SS was 92.47 ( $SD=15.79$ ) and 71.5% of children had a SS within the average range or above.



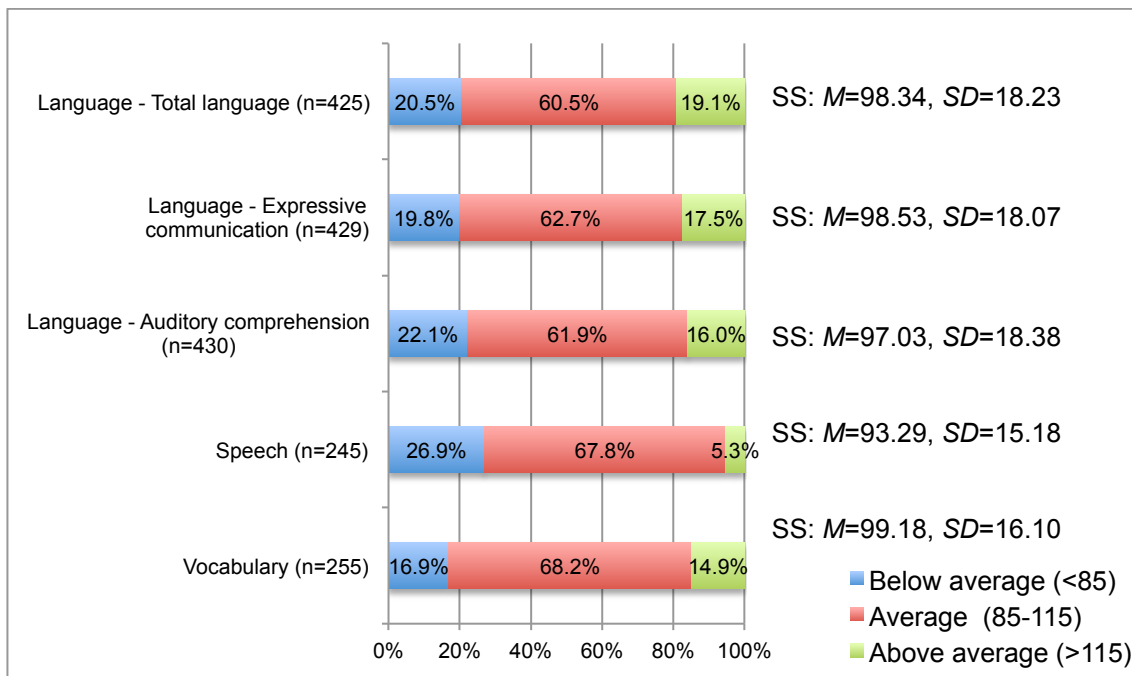
**Figure 7 Language, speech and vocabulary performance (including children with additional disabilities)**

Note. n=number of children; SS=standard score; M=mean; SD=standard deviation

#### Outcomes excluding children with additional disabilities

Removing the children with additional disabilities from the analysis resulted in an increase in mean SS, except for speech performance. The language, speech and vocabulary performance of the data set (excluding children with additional disabilities) are summarised in Figure 8.

For **language**, the mean auditory comprehension SS of 97.03 ( $SD=18.38$ ) fell within the average range for typical hearing peers (i.e. SS between 85 and 115). The majority of children (77.9%) also achieved SS within the average range or above. For expressive communication, the mean SS of 98.53 ( $SD=18.07$ ) was also within the average range, with the majority of children (80.2%) having SS within the average range or above. The mean SS for total language of 98.34 ( $SD=18.23$ ) was also within the average range, and 79.6% of the children had a SS within the average range or above. For **vocabulary**, the mean SS was 99.18 ( $SD=16.10$ ) and 83.1% of the children were within the average range or above. On **speech performance**, the mean SS was 93.29 ( $SD=15.18$ ) and 73.1% of children had a SS within the average range or above.



**Figure 8 Language, speech and vocabulary performance (excluding children with additional disabilities)**

Note. n=number of children; SS=standard score; M=mean; SD=standard deviation

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