

Language Outcomes at 7 Years: Early Predictors and Co-Occurring Difficulties

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abstract

OBJECTIVE: To examine at 7 years the language abilities of children, the salience of early life factors and language scores as predictors of language outcome, and co-occurring difficulties

METHODS: A longitudinal cohort study of 1910 infants recruited at age 8 to 10 months. Exposures included early life factors (sex, prematurity, birth weight/order, twin birth, socioeconomic status, non-English speaking background, family history of speech/language difficulties); maternal factors (mental health, vocabulary, education, and age); and child language ability at 2 and 4 years. Outcomes were 7-year standardized receptive or expressive language scores (low language: ≥ 1.25 SD below the mean), and co-occurring difficulties (autism, literacy, social, emotional, and behavioral adjustment, and health-related quality of life).

RESULTS: Almost 19% of children (22/1204; 18.9%) met criteria for low language at 7 years. Early life factors explained 9-13% of variation in language scores, increasing to 39-58% when child language scores at ages 2 and 4 were included. Early life factors moderately discriminated between children with and without low language (area under the curve: 0.68-0.72), strengthening to good discrimination with language scores at ages 2 and 4 (area under the curve: 0.85-0.94). Low language at age 7 was associated with concurrent difficulties in literacy, social-emotional and behavioral difficulties, and limitations in school and psychosocial functioning.

CONCLUSIONS: Child language ability at 4 years more accurately predicted low language at 7 than a range of early child, family, and environmental factors. Low language at 7 years was associated with a higher prevalence of co-occurring difficulties.

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WHAT'S KNOWN ON THIS SUBJECT: Fluctuating preschool language abilities present challenges for identifying children at risk for later language impairment. Child, family, and environmental factors explain a limited amount of variability in language ability at 4 years, and prediction of low language status is limited.

WHAT THIS STUDY ADDS: Language ability at 4 years predicted language outcomes at 7 years more saliently than child, family, and environmental factors. At 7, low language was associated with higher rates of social-emotional, behavioral, and literacy difficulties and health-related quality of life limitations.

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Robust language development is needed to meet the increasing social-relational and academic demands on children transitioning to formal schooling.¹ Yet 7% to 20% of children experience low language in the preschool and early school years^{2,3} and are at heightened risk of difficulties with literacy, academic attainments, and social-emotional and behavioral (SEB) adjustment.⁴⁻⁸ These children are also at elevated risk of experiencing poor mental health⁹ and periods of unemployment in adulthood.^{10,11}

However, we lack a detailed understanding of the natural history of language development from the preschool to the early school years, and it remains unclear at what age co-occurring difficulties emerge for children with low language. Therefore, identifying when and how best to intervene remains challenging.

Because of the instability in child language development in the preschool years, neither screening nor 1-time direct assessments are sufficiently reliable to identify children at risk of persisting difficulties.¹²⁻¹⁴ At least half of children with low expressive language abilities at 2 years catch up with their peers by 4 or 5 years, and many 4-year-olds presenting with low language have previously attained language scores falling within the typical range at 2 years.³ Furthermore, of those presenting with low language at 7 years, in a community-based study 46% previously attained typical language scores at 4, and conversely 39% of children with low language at 4 years had typical language by 7 years.¹⁵ Therefore, a diagnostic approach, dichotomizing children into those with and without language difficulties, risks both overserving and underserving even between 4 and 7 years.

One approach has been to identify early risk and protective factors

associated with later language outcomes to inform the design of primary preventive interventions¹⁶ and targeted secondary prevention. Early life factors measured in infancy explain only a small amount of variance in language abilities at 4 years but more than is explained at 2 years. Socioeconomic status (SES) has emerged as an increasingly important predictor of language and low language status between these 2 ages,^{3,17} suggesting that the salience of early life factors may change over a child's developmental trajectory. Whether the effects of early life factors increase or decrease between 4 and 7 years is unknown.

Little is known about the impact of low language on the individual's functioning and health-related quality of life (HRQL),¹⁸ the nature and degree of HRQL limitations experienced, or the incidence of co-occurring conditions. Yet this is critical information needed to inform appropriate preventive interventions. The burden of these difficulties in the population of children with low language, as opposed to only those clinically referred, remains poorly quantified.¹⁹

In a community-ascertained cohort^{3,17} the aims of this study were (1) to quantify the contribution of early life factors to 7-year language outcomes, specifically receptive and expressive language scores and low language status; (2) to determine whether these early life factors maintain salience once 2- and 4-year language abilities are considered; and (3) document co-occurring diagnoses of autism and difficulties in literacy, HRQL, and SEB adjustment in 7-year-old children with low language.

METHODS

Sampling and Participants

The Early Language in Victoria Study (ELVS) cohort was drawn from the population of infants aged 7.5 to 10

months living in 6 local government areas of Melbourne, Australia, in 2003, selected to represent high, medium, and low SES according to the census-based Socioeconomic Indexes for Areas (SEIFA). A total of 1910 infants were recruited via the Maternal and Child Health Service, with additional recruitment at hearing screening appointments and through press advertising; full details are reported elsewhere.¹⁷ Parents unable to understand English sufficiently to respond to the questionnaires designed for a grade 6 reading level were excluded. Participant retention across the 8 waves of data collection to 7 years is shown in Fig 1. The in-scope sample for this analysis consists of 1204 children with complete direct receptive and expressive language assessment at 7 years. This article extends previously reported outcomes at 1, 2, and 4 years in this cohort.^{3,17}

Measures

Measures were collected via parent report and direct assessments undertaken by trained research assistants.

Early Life Factors

Twelve early life factors identified by the US Preventive Services Taskforce as potentially predictive of language development, and previously explored at 2 and 4 years, are included here. These included child factors: male sex, twin birth, preterm birth, birth order and birth weight; family factors: non-English speaking background (NESB), family history of speech or language difficulties, and SES; and maternal factors: age, mental health, education, and vocabulary.^{17,20}

NESB was defined where families reported that English was not the main language spoken to the child at home. The SEIFA Index of Relative Disadvantage is a census-derived measure of SES standardized for

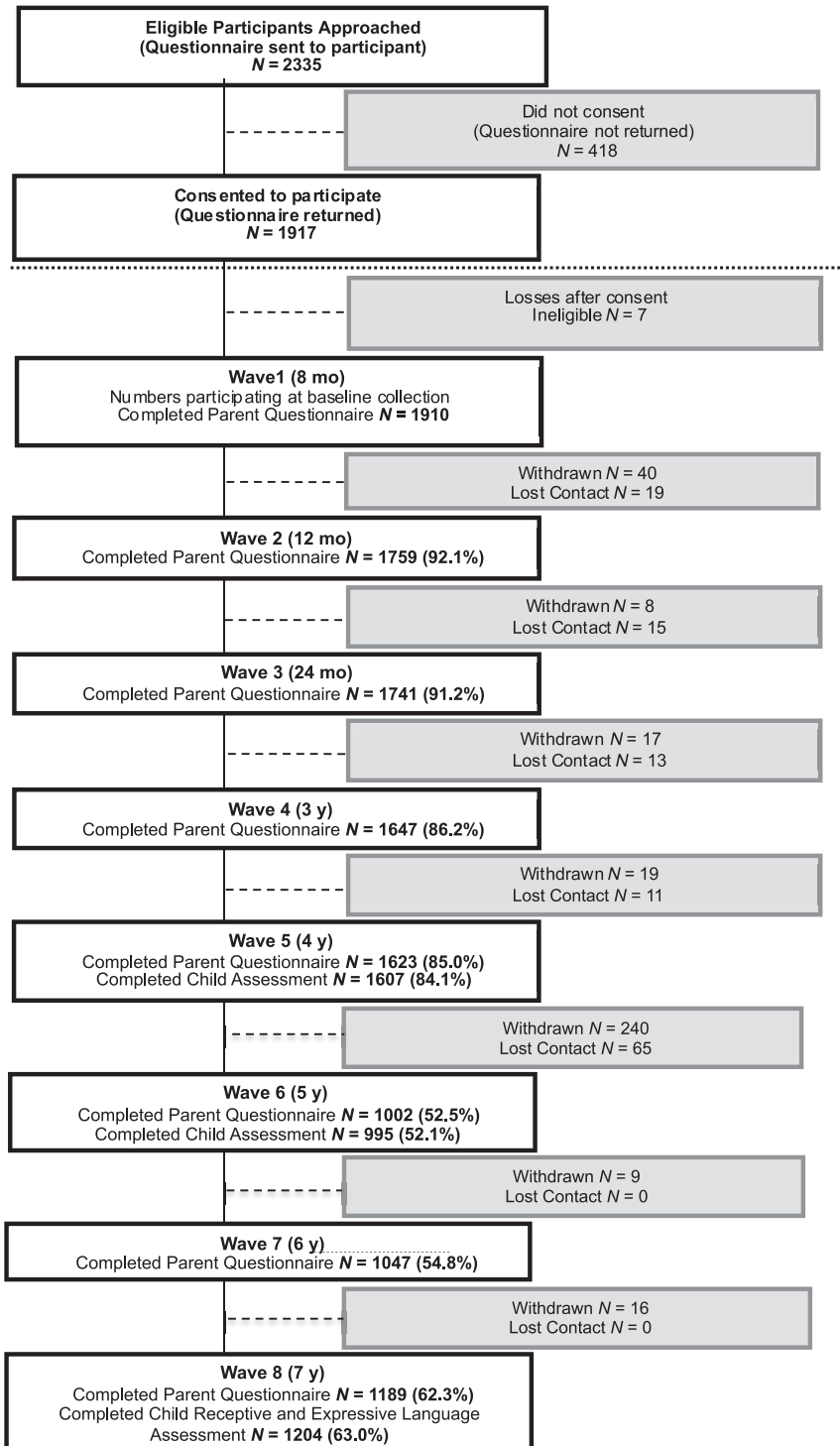


FIGURE 1

Participant flowchart from wave 1 (8 months) to wave 8 (7 years). Denominator for percentages is number participating at baseline ($N = 1910$). Numbers participating, withdrawing and lost to contact are given at each wave. Numbers change at each wave due to families actively withdrawing, becoming lost to contacts or not participating in a particular wave but returning later.

the population of Australia (mean = 1000; SD = 100). Maternal vocabulary was measured via a modified version

of the Mill Hill Vocabulary scale, a multiple-choice test that yields a summed raw score with a maximum

of 44.²¹ Maternal mental health was dichotomized to “no mental health problem” (<4) or “likely mental health problems” (4–24) on the Kessler Psychological Distress Scale (K6).²²

Early Language Measures

At 2 years late talking was determined via parental report of children’s vocabulary knowledge via the MacArthur–Bates Communicative Development Inventory–Words and Sentences.²³ Based on sex-specific norms, late talkers were children with scores falling below the 10th centile.

At 4 years we administered the Clinical Evaluation of Language Fundamentals–Preschool Second Edition,²⁴ yielding receptive and expressive standard scores (mean = 100; SD = 15).

Outcomes

Language at 7 years was measured with the Clinical Evaluation of Language Fundamentals Fourth Edition (CELF-4) Australian Standardization.²⁰ Low language was defined as a receptive or expressive standard score that fell ≥ 1.25 SDs below the published normative population means (ie, ≤ 81). This follows precedent in previous studies in ELVS allowing direct comparison between earlier and later data waves.³ Outcomes were examined for difficulties known to be associated with low language in clinical populations and for which robust measures were included in data collection at 7 years, namely, low nonverbal IQ, diagnosis of an autism spectrum disorder, literacy difficulties, SEB difficulties, and limitations in HRQL. Nonverbal skills were measured with the block design and matrices subtests of the Wechsler Abbreviated Scale of Intelligence,²⁵ with low nonverbal ability defined as a score falling ≥ 1.25 SDs below the published normative population mean.²⁵

Children with a diagnosis of autism spectrum disorder were identified through parental report and confirmed via follow-up telephone interview by the authors (M.P. or P.E.). SEB difficulties were identified via the Strengths and Difficulties Questionnaire,²⁶ and the clinical cutoff points for an “abnormal” score applied. Literacy difficulties were determined with an adapted version of the Wide Range Achievement Test fourth Edition, where scores across reading and spelling subtests were summed and scaled. In the absence of population norms, literacy scores falling ≥ 1.25 SDs below the sample mean were classified as “impaired.” HRQL was measured on the parent-reported Pediatric Quality of Life Scale,²⁷ and “limitations” in HRQL were defined as scores falling ≥ 1 SD below the sample mean, a level found to be similar to that of children with severe or chronic health conditions such as rheumatic conditions and newly diagnosed cancer in a large population sample.²⁸

Analyses

A total of 1204 children completed the receptive and expressive language assessment at 7 years. To quantify the contribution of early life factors to 7-year language outcomes (aim 1), multivariate linear regressions were fitted to the CELF-4 outcomes and the coefficient of determination (R^2) derived. Multivariate logistic regression models were fitted to the binary outcome “low language status,” deriving the area under the curve (AUC). To determine whether these early factors have measurable effects once later language measures are considered (aim 2), these regression analyses were repeated with, in turn, the following predictors: the 12 early life factors described above; the 12 factors plus 2-year-old late-talker status; the 12 factors, 2-year-old late-talker status plus 4-year-old language scores; and 4-year-old language

scores only. The R^2 and AUC values of these models were examined to quantify and compare the ability of the models to predict 7-year language or language status. The proportions with co-occurring difficulties (aim 3) were estimated with 95% confidence intervals (CIs) in 7-year-old children with and without low language, and these proportions were compared via univariable logistic regression.

To investigate whether sample attrition had affected the inferences drawn, the sample of 1204 children with complete language data at 7 years was reweighted to be representative of the initial cohort with regard to the 12 early life factors. Weights were derived from the inverse predicted probabilities of participation estimated by a logistic regression model. Multiple imputation was used to account for missing predictor variables.^{29,30} A series of 50 data sets were derived from chained equations to implement an imputation model including the explanatory and outcome variables considered in the analyses. Because results were similar, we present the findings based on the complete and unweighted data. Analyses were implemented in Stata 13.0 (Stata Corp, Inc, College Station, TX). All analyses were also repeated with the CELF-4 core language score as the outcome. Again results were similar, and so we present only the findings for receptive and expressive language outcomes to enable direct comparison with previous research.³

RESULTS

Participant retention at 7 years is summarized in Fig 1 and the characteristics of the participants ($N = 1204$) and nonparticipants ($N = 706$) are compared in Table 1. Participating families were more likely to be socially advantaged and to have mothers who were more highly educated and less likely to speak a language other than English.

A total of 227 (18.9%) children were categorized as having either low receptive language (198; 16.4%) or low expressive language (111; 9.2%), but of these 82 children (6.8%) had low scores in both domains. This means 29 (2.4%) children had only expressive language difficulties and 116 (9.6%) only receptive difficulties. Therefore, it must be borne in mind when interpreting these data that many children in the receptive and expressive groups had mixed impairments.

In the linear regression analyses examining associations between early life factors and language ability at age 7 (Table 2, aim 1), mean CELF-4 standard scores were higher for girls than boys (4.3 points for receptive and 2.4 for expressive language) and for children of mothers with a university degree when compared with those who did not finish school (3.4 receptive, 4.1 expressive). There was a clear effect of parity; firstborn children had higher language scores, and twin birth was associated with lower expressive language scores (5.6 points lower than singletons). A family history of speech or language difficulties was associated with lower receptive language (2.7 points), and lower SES and poorer maternal vocabulary knowledge were associated with lower language scores. For every 100-unit increase in SEIFA scores, receptive language scores increased by 2.2 points and expressive by 2.3.

Together the early life factors accounted for 9% and 13% of the variation in receptive and expressive language standard scores, respectively, at 7 years (Table 3, aim 2). Together the addition of 2-year late-talker status and 4-year language scores increased the variation explained to 39% for receptive and 58% for expressive language. Language scores alone at 4 years (without the early life factors or late-talker status) produced almost

identical R^2 values, explaining 37% and 56% of 7-year receptive and expressive scores, respectively.

In the logistic regression analyses (Table 2, aim 1) the same factors as for the linear regression, with the exception of twin birth, were significant predictors of 7-year low-language status. The AUC values in Table 3 (aim 2) quantify the ability of the predictor variables to discriminate between 7-year-olds with and without low language. An AUC value of 0.5 indicates chance discrimination, 0.7 to 0.8 moderate, 0.8 to 0.9 good, and 1 indicates perfect discrimination.

The early life factors alone reached only a moderate level of discrimination (receptive 0.68, expressive 0.72).³¹ Together the addition of both 2-year late-talker status and 4-year language scores improved the model's ability to discriminate to a "good" level for receptive language (0.85) and to an "excellent" level for expressive language (0.94). Notably, almost identical AUC values were found when only 4-year language measures were used as predictors (receptive: 0.84; expressive: 0.93), without the addition of the early life factors and late-talker status.

The prevalence of co-occurring difficulties (autism, low nonverbal IQ, literacy difficulties, SEB difficulties) and limitations in HRQL were significantly higher for children with low language at 7 years than for their peers with typical language (Table 4). Two subtypes of socioemotional problems as measured by the Strengths and Difficulties Questionnaire (low prosocial scores and emotional difficulties) were not significantly different between the 2 groups, although prevalence of low prosocial scores was significantly higher for children with low expressive language but not receptive. A high proportion of children with low language also had literacy difficulties (37.2% receptive,

TABLE 1 Characteristics at Baseline and Wave 2 of Children Participating and Lost to Follow-up at 7 y

| Baseline and Wave 2 Characteristics | Did Not Complete at 7 y (N = 706) | Completed at 7 y (N = 1204) | P |
|--|-----------------------------------|-----------------------------|-------|
| Female, % | 46.7 | 51.1 | .07 |
| Twin birth, % | 3.5 | 2.3 | .12 |
| Preterm birth (<36 wk), % | 2.8 | 3.2 | .62 |
| Birth wt (kg), mean ± SD | 3.4 ± 0.6 | 3.5 ± 0.5 | .04 |
| Birth order, % | | | .07 |
| First | 48.9 | 50.8 | |
| Second | 38.2 | 33.7 | |
| Third | 9.9 | 13.1 | |
| Fourth or later | 3.0 | 2.5 | |
| NESB, % | 10.8 | 3.4 | <.001 |
| Maternal education level, % | | | |
| ≤12 y | 28.6 | 20.5 | <.001 |
| 13 y | 41.3 | 39.5 | |
| Degree or postgraduate | 30.1 | 40.1 | |
| SEIFA score, mean ± SD | 1028.2 ± 67.2 | 1040.6 ± 56.1 | <.001 |
| Family history of speech or language difficulties, % | 26.1 | 24.2 | .36 |
| Maternal mental health symptoms, % | 30.0 | 32.6 | .28 |
| Maternal vocabulary score, mean ± SD | 26.2 ± 5.6 | 28.2 ± 4.7 | <.001 |
| Maternal age at baseline, mean ± SD | 31.4 ± 4.8 | 32.1 ± 4.4 | <.001 |

Participants completed direct assessment of both receptive and expressive language at 7 y. Child age at 7 y assessment, mean ± SD, 88.3 ± 2.2 mo. P values were derived through comparisons between those completing 7-y assessment and those lost to follow-up via either χ^2 tests for categorical variables or *t* tests for continuous variables.

48.6% expressive) and limitations in their HRQL in the domains of school (32.1% receptive, 36.0% expressive) and psychosocial functioning (27.6% receptive, 31.3% expressive). It must be noted that only 29 children had isolated expressive language difficulties. Children with only expressive difficulties experienced lower levels of co-occurring difficulties than those with mixed expressive-receptive difficulties. However, given the low numbers, estimates of co-occurrence for these subgroups are not presented here because of concerns regarding reliability.

After multiple imputation to address missing predictors and weighting to reflect the sample characteristics at baseline, no substantive differences were identified in the estimates of the prevalence of comorbidities to those with complete data. For the regression analyses, differences were minimal; however, some effects were diluted when missing data were addressed (eg, SEIFA, family history of speech or language difficulties, and maternal vocabulary).

DISCUSSION

At 7 years a range of early child, family, and maternal factors collectively explained 9% of receptive and 13% of expressive language outcomes. Although it was less than explained at 4 years (19% and 21%),³ it was higher than at 2 years (4% and 7%)¹⁷ in the same cohort. Together, these predictors moderately discriminated between children with typical language and those with low language at 7 years. Whereas late-talker status did not substantially improve discrimination, the addition of language scores at 4 years improved discrimination to "good" or "excellent" levels. Similar levels of discrimination were obtained when only 4-year language scores were used to predict 7-year-old language, suggesting that language abilities are more stable between 4 and 7 than between 2 and 4 years.

Children with low language at 7 years were more likely to have low IQ, autism, SEB difficulties, and literacy difficulties than their peers with typical language, and rates of

TABLE 2 Multiple Variable Linear Regression Analysis of CELF-4 Standard Scores and Logistic Regression Analysis of Language Status at 7 Years With Respect to Early Life Factors

| | Language (N = 1132) ^a | | | | | | Low Language Status (N = 1132) ^a | | | | | |
|---|----------------------------------|--------------|-------|-----------------|---------------|-------|---|--------------|------|------------|--------------|------|
| | Receptive | | | Expressive | | | Receptive | | | Expressive | | |
| | Mean Difference ^b | 95% CI | P | Mean Difference | 95% CI | P | Odds Ratio | 95% CI | P | Odds Ratio | 95% CI | P |
| Child | | | | | | | | | | | | |
| Female | 4.3 | 2.7 to 5.9 | <.001 | 2.4 | 0.9 to 3.9 | .002 | 0.57 | 0.41 to 0.80 | .001 | 0.54 | 0.35 to 0.84 | .007 |
| Twin birth | -3.0 | -8.6 to 2.6 | .29 | -5.6 | -10.9 to -0.2 | .04 | 1.46 | 0.50 to 4.31 | .49 | 1.68 | 0.50 to 5.65 | .40 |
| Preterm birth (<36 wk) | 1.0 | -3.9 to 5.9 | .69 | 0.7 | -4.0 to 5.4 | .78 | 0.95 | 0.36 to 2.54 | .92 | 1.26 | 0.42 to 3.79 | .68 |
| Birth wt (per kg) | 1.2 | -0.5 to 2.9 | .16 | 1.5 | -0.1 to 3.1 | .07 | 0.84 | 0.59 to 1.20 | .35 | 0.73 | 0.47 to 1.14 | .17 |
| Birth order | | | | | | | | | | | | |
| First | Reference | | | Reference | | | Reference | | | Reference | | |
| Second | -1.6 | -3.4 to 0.2 | .07 | -2.9 | -4.6 to -1.2 | .001 | 1.26 | 0.85 to 1.86 | .25 | 1.36 | 0.81 to 2.26 | .24 |
| Third | -4.1 | -6.6 to -1.5 | .002 | -6.3 | -8.7 to -3.9 | <.001 | 1.65 | 0.99 to 2.74 | .06 | 2.22 | 1.19 to 4.13 | .01 |
| Fourth or later | -5.3 | -10.6 to 0.0 | .05 | -8.9 | -14.0 to -3.9 | .001 | 2.11 | 0.82 to 5.44 | .12 | 3.02 | 1.02 to 8.98 | .05 |
| Family | | | | | | | | | | | | |
| NESB | 2.3 | -2.4 to 7.0 | .35 | 0.9 | -3.6 to 5.4 | .68 | 0.63 | 0.23 to 1.77 | .38 | 0.95 | 0.3 to 3.04 | .94 |
| SEIFA score (per 100 points) | 2.2 | 0.7 to 3.6 | .003 | 2.3 | 0.9 to 3.7 | .001 | 0.61 | 0.46 to 0.80 | .001 | 0.58 | 0.41 to 0.82 | .002 |
| Family history of speech or language difficulties | -2.7 | -4.6 to -0.9 | .004 | -1.5 | -3.3 to 0.2 | .09 | 1.46 | 1.00 to 2.11 | .05 | 1.09 | 0.66 to 1.78 | .74 |
| Mother | | | | | | | | | | | | |
| Maternal education level | | | | | | | | | | | | |
| ≤12 y | Reference | | | Reference | | | Reference | | | Reference | | |
| 13 y | 0.9 | -1.2 to 3.1 | .39 | 0.7 | -1.3 to 2.8 | .49 | 0.86 | 0.57 to 1.31 | .49 | 0.89 | 0.53 to 1.48 | .64 |
| Degree or postgraduate | 3.4 | 1.2 to 5.6 | .003 | 4.1 | 2.0 to 6.3 | <.001 | 0.59 | 0.37 to 0.94 | .03 | 0.41 | 0.22 to 0.78 | .006 |
| Maternal mental health symptoms | 0.3 | -1.3 to 2.0 | .69 | 0.4 | -1.2 to 2.0 | .63 | 0.94 | 0.66 to 1.34 | .72 | 1.02 | 0.65 to 1.61 | .92 |
| Maternal vocabulary score (per point) | 0.3 | 0.1 to 0.5 | .003 | 0.4 | 0.3 to 0.6 | <.001 | 0.95 | 0.91 to 0.99 | .01 | 0.95 | 0.90 to 1.0 | .03 |
| Maternal age at baseline (per year) | 0.1 | -0.1 to 0.3 | .35 | 0.2 | 0.0 to 0.3 | .11 | 0.99 | 0.95 to 1.03 | .69 | 1.01 | 0.96 to 1.06 | .71 |

^a Children with complete predictor and outcome data.

^b Mean difference refers to the average difference between the reference group (eg, boys) and the comparator group (eg, girls) in the outcome (eg, receptive language score).

comorbid literacy difficulties were particularly high (37% and 49%). Children with low language were 2 to 3 times more likely than their peers to have SEB difficulties. Given the relationship reported between low language in childhood and later mental health outcomes in adulthood, this concurrent finding at 7 years suggests that this relationship begins early.^{9,10} To our knowledge this is the first time an association between low language abilities and HRQL has been reported in childhood in a community sample.

Using limitations in HRQL in children with chronic and severe health conditions as a benchmark to define a significant limitation in HRQL, it is of significant concern that children with low language were experiencing limitations at more than twice the frequency reported in their peers with typical language.²⁸

A number of factors that were predictive of language outcomes at 4 years (NESB, maternal age, family history of speech or language problems, and birth weight) were not at 7 years in this cohort. One

explanation for these diminished effects may be that universal access to schooling partly compensates for early life factors; for example, children from an NESB catch up with their monolingual peers when given access to English-speaking environments.³² In addition, as young mothers mature, perhaps they are able to provide more supportive home learning environments.^{33,34}

Between 2 and 4 years³ we found an increase in the contribution of social and environmental factors to children's language outcomes.

TABLE 3 Proportion of Variance in CELF-4 Standard Scores Explained and Accuracy of Predictors in Discriminating Between Children With and Without Low Language Status at 7 y

| Model | N ^c | Language ^a | | Low Language Status ^b | | | |
|--|----------------|-----------------------|------------|----------------------------------|--------------|--------|--------------|
| | | Receptive | Expressive | Receptive | Expressive | 95% CI | 95% CI |
| (1) Predictors (n = 12) in infancy only | 1132 | 0.09 | 0.13 | 0.68 | 0.64 to 0.72 | 0.72 | 0.67 to 0.77 |
| (2) As (1) plus late talking status (2-y) | 1084 | 0.14 | 0.20 | 0.72 | 0.68 to 0.76 | 0.82 | 0.78 to 0.86 |
| (3) As (2) plus receptive and expressive language scores (4-y) | 1026 | 0.39 | 0.58 | 0.85 | 0.82 to 0.89 | 0.94 | 0.92 to 0.96 |
| (4) Receptive and expressive language scores only (age 4) | 1132 | 0.37 | 0.56 | 0.84 | 0.81 to 0.88 | 0.93 | 0.91 to 0.95 |

^a Linear regression.

^b Logistic regression.

^c Children with complete predictor and outcome data.

^d AUC value of 0.5 indicates chance discrimination, 0.7–0.8 indicates moderate, 0.8–0.9 indicates good, and 1 indicates perfect discrimination.

However from 4 to 7 years the salience of these factors (eg, SES, maternal education) was substantively unchanged. Age 4 language scores alone yielded similar levels of prediction as models including late-talker status and early life factors. This finding suggests that most of the variability

explained by the early life factors is mediated by a measure of language at 4 years. Therefore, it appears that the associations between the early life factors measured here and a child's relative language abilities have played out by age 4. However, it is important to note that a child's relative language ability at 4 is not

entirely fixed, and factors such as the frequency of being read to and the number of children's books in the home are associated with change in relative ability from 4 to 7 years, albeit with small effects.¹⁶

The strengths of the ELVS include the cohort of children that reflects a broad spectrum of the community, the prospective, longitudinal data collection, repeated robust language measures, and concurrent measures of other aspects of child development. Inevitably sample attrition has occurred, and there are missing data. However, the similarity of findings when inverse probability weighting and multiple imputation were implemented provides assurance that the results presented reflect the original cohort. The inclusion of a child's access to speech pathology interventions and its relationship to child outcome would have strengthened the study. The ELVS

TABLE 4 Prevalence of Co-Occurring Difficulties in Children With Low Language at 7 y Versus Those With Typical Language

| | Total N ^b | Receptive | | | | | Expressive | | | | |
|--|----------------------|-----------|--------------|------|--------------|-------|------------|--------------|------|--------------|-------|
| | | % | 95% CI | % | 95% CI | P | % | 95% CI | % | 95% CI | P |
| Autism | 1204 | 1.6 | 1.0 to 2.6 | 6.1 | 3.5 to 10.4 | <.001 | 1.6 | 1.0 to 2.6 | 9.0 | 4.9 to 16.0 | <.001 |
| Low nonverbal IQ | 1197 | 0.5 | 0.2 to 1.2 | 10.8 | 7.1 to 16.0 | <.001 | 1.2 | 0.7 to 2.0 | 12.0 | 7.1 to 19.7 | <.001 |
| Literacy difficulties | 1199 | 9.5 | 7.8 to 11.4 | 37.2 | 30.7 to 44.2 | <.001 | 10.6 | 8.9 to 12.5 | 48.6 | 39.3 to 58.0 | <.001 |
| Social-emotional and behavioral difficulties | | | | | | | | | | | |
| Emotional symptoms | 1070 | 7.6 | 6.0 to 9.5 | 12.3 | 8.0 to 18.3 | .05 | 7.8 | 6.3 to 9.7 | 13.5 | 8.0 to 22.0 | .06 |
| Conduct problems | 1070 | 7.3 | 5.8 to 9.2 | 17.2 | 12.1 to 23.8 | .001 | 7.9 | 6.4 to 9.8 | 17.7 | 11.3 to 26.7 | .002 |
| Hyperactivity or inattention | 1070 | 7.4 | 5.8 to 9.3 | 20.9 | 15.3 to 27.8 | <.001 | 8.3 | 6.7 to 10.2 | 20.8 | 13.8 to 30.2 | <.001 |
| Peer problems | 1069 | 5.1 | 3.8 to 6.7 | 12.3 | 8.0 to 18.3 | .001 | 5.7 | 4.4 to 7.3 | 11.5 | 6.4 to 19.6 | .03 |
| Low prosocial behavior | 1070 | 2.2 | 1.4 to 3.4 | 4.9 | 2.5 to 9.5 | .05 | 2.2 | 1.4 to 3.3 | 7.3 | 3.5 to 14.6 | .005 |
| Total difficulties | 1070 | 3.9 | 2.8 to 5.3 | 14.7 | 10.1 to 21.1 | <.001 | 4.4 | 3.3 to 5.9 | 16.7 | 10.4 to 25.6 | <.001 |
| Quality of life | | | | | | | | | | | |
| Physical health | 1068 | 10.4 | 8.6 to 12.6 | 16.7 | 11.6 to 23.1 | .02 | 10.4 | 8.6 to 12.5 | 20.8 | 13.8 to 30.2 | .003 |
| Emotional functioning | 1069 | 12.4 | 10.4 to 14.7 | 21.5 | 15.8 to 28.5 | .002 | 12.8 | 10.9 to 15.1 | 22.9 | 15.6 to 32.4 | .007 |
| Social functioning | 1069 | 14.0 | 11.9 to 16.4 | 23.9 | 18.0 to 31.1 | .002 | 14.4 | 12.3 to 16.7 | 27.0 | 19.1 to 36.9 | .001 |
| School functioning | 1034 | 12.9 | 10.8 to 15.3 | 32.1 | 25.2 to 39.8 | <.001 | 13.9 | 11.8 to 16.2 | 36.0 | 26.6 to 46.5 | <.001 |
| Psychosocial functioning ^c | 1069 | 13.2 | 11.2 to 15.6 | 27.6 | 21.3 to 35.0 | <.001 | 13.8 | 11.8 to 16.2 | 31.3 | 22.7 to 41.2 | <.001 |
| Total score | 1069 | 12.4 | 10.4 to 14.7 | 27.0 | 20.7 to 34.4 | <.001 | 13.1 | 11.1 to 15.3 | 30.2 | 21.8 to 40.2 | <.001 |

^a In sample of 1204 children with complete expressive and receptive language data at 7 y.

^b Numbers differ because of missing outcome variables and test scoring guidelines with respect to handling missing responses.

^c This is a composite derived from the emotional, social, and school functioning subscales.

data allowed identification of the proportion of children with low language at 4 and 7 years who had received some form of speech pathology intervention (4 years: 38% receptive, 40% expressive; 7 years: 28% receptive, 39% expressive). However, insufficient information were available to draw reliable conclusions as to the amount, type, and quality of the therapy received, precluding its inclusion in analyses.

CONCLUSIONS

Low language at 7 years is prevalent and associated with poor literacy and SEB adjustment. Furthermore, these 7-year-olds experience significant limitations in school and psychosocial functioning at twice the rate reported in peers with typical language.²⁸ Although the results reported here suggest that education and health services could reasonably estimate a child's risk for persisting low language abilities at 7 years based on assessment of his or her language abilities at 4, 1-time language assessments at this age that categorize children as with or without low language have proven insufficiently reliable as the sole means of targeting language interventions.³⁵ In this cohort, 6.2% had low language at 4 but not 7 years, 8.4% at 7 but not at 4 years, and 9.8% at both time points.¹⁵

Future research should be directed toward developing and robustly evaluating child language surveillance and intervention pathways over the early school years. Such pathways should include reliable and low-burden language assessment tools within a holistic surveillance approach, monitoring language development alongside key domains such as literacy and psychosocial functioning. Tiered interventions must be developed and evaluated that are tailored to the severity of language and associated difficulties and risks experienced by the child. Evaluation of such pathways must weigh the relative burden, costs, and benefits of overserving and underserving children, given the instability in children's language status that continues from 4 to 7 years.

We recommend monitoring the progress of children with low language at 4 years through the early school years with respect to language, literacy, and psychosocial functioning. Additionally, where children present with literacy or psychosocial difficulties over this period, their language abilities should be investigated. It is essential that schools recognize the vital role oral language skills play in children's social and emotional adjustment and acquisition of literacy³⁶ and that

they be equipped and supported to promote robust oral language development for all children.

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ABBREVIATIONS

AUC: area under the curve
CELF-4: Clinical Evaluation of Language Fundamentals Fourth Edition
CI: confidence interval
ELVS: Early Language in Victoria Study
HRQL: health-related quality of life
NESB: non-English speaking background
SEB: social-emotional and behavioral
SEIFA: Socioeconomic Indexes for Areas
SES: socioeconomic status

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Language Outcomes at 7 Years: Early Predictors and Co-Occurring Difficulties

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