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Identification of biological and environmental risk factors for language delay: The Let's Talk STEPS study

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ABSTRACT

The aim of this population-based study was to identify demographic factors for language delays at an early age. The risk analysis covered 11 biological and 8 environmental factors. The mothers' concerns regarding language development were also examined. A total of 226 children from a Finnish cohort study were invited to participate in language assessments at 36 months. The test results for word finding and language comprehension were compared with parental questionnaires about children's vocabulary at 13 and 24 months.

Regression analysis revealed that the father's social class ($t = -2.79$, $p = 0.006$) and working full time ($t = -2.86$, $p = 0.005$) significantly predicted children's language delay. In addition, language comprehension was significantly predicted by the mother's social class ($t = -2.06$, $p = 0.041$) and by gender, with an advantage to girls ($t = -2.71$, $p = 0.008$). Vocabulary at 24 months was a powerful predictor for lexical development ($t = 4.58$, $p < 0.0001$) and language comprehension ($t = 4.85$, $p < 0.0001$) at 36 months. Mothers' concerns were correlated with children's limited lexicons as early as 24 months ($r = 0.31$, $p < 0.0001$) and poor language comprehension ($r = -0.35$, $p < 0.0001$) at 36 months. Mothers were especially concerned if the parents needed special education during school years.

At the population-level, gender was the most powerful biological factor in predicting language delays. Similarly, both parents' social status had predictive value for the child's language development. In addition, it was found that the mother's concern about her child's slow language acquisition should be taken into account when making decisions regarding special support.

1. Introduction

Despite our growing knowledge of children's language acquisition, there still remains an open question as to which risk factors should be taken into account when making decisions about the need to support language development early in life. Very little is known about the father's role in children's language learning, or about the relevance of mothers' concerns. Well-defined demographic factors, together with language screening and outcome measures, may help clinicians to allocate relevant health care resources to children with special needs.

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During the second year of life, language emerges rapidly as the mode of communication. By 24 months, most children have acquired a basic vocabulary of 50 words and speak several two-word phrases (Rescorla, 1989). Many earlier studies have reported a significant gender effect, with girls showing more advanced language skills compared to boys (Lyytinen, Poikkeus, Laakso, Eklund, & Lyytinen, 2001; Fenson et al., 1993; Henrichs et al., 2011). Children who have not reached a 50-word expressive vocabulary are atypically slow in language acquisition. Most language-delayed children are found to catch up with their age mates and to have approximately normal language skills at 5 or 6 years of age (Rescorla, 2011). Follow-up studies have shown, however, that children who are language-delayed at the age of 5 often score significantly below their peers in reading and language-related skills when they reach school age (Rescorla, 2009).

Many studies have shown that language-delayed children are a heterogeneous group, and predicting the course of language development is therefore difficult (Reilly et al., 2007; Zubrick, Taylor, Rice, & Slegers, 2007; Rescorla, 2011; Henrichs et al., 2011). In a population-based study, Reilly et al. (2007) identified 20% of children as late talkers at 2 years of age. Their predictive model, which was based on demographic factors, explained 7% of the variance. In a large-scale epidemiological study by Zubrick et al. (2007), 13% of children were identified as late talkers at 2 years of age. In that study, neurobiological and genetic mechanisms were powerful explanatory factors for the course of language development.

Biological factors affect early language development in many ways. It has been found that children who have a family history of language disorders achieve lower scores in language assessments compared to children without any familial language disabilities (Choudhury & Benasich, 2003). The incidence of the reported heredity of language delay varies greatly, from 24% to 73% (Bishop, Price, Dale, & Plomin, 2003; Dionne, Dale, Boivin, & Plomin, 2003). Biological risk factors impart important data, beginning during pregnancy and including the child's individual development during pre-school years. Early gestational age (Weindrich, Jennen-Steinmetz, Laucht, Esser, & Schmidt, 1998), low Apgar scores for the newborn (Stanton-Chapman, Chapman, Bainbridge, & Scott, 2002), and being male (Cambell et al., 2003; Tallal, Ross, & Curtis, 1989) are child-related biological factors that are reported to have a strong effect on language acquisition.

The main environmental factors that impact language acquisition are the mother's educational level, number of siblings, socio-economic status of the family, family income and cultural heritage (Hackman & Farah, 2009; Horwitz et al., 2003; Henrichs et al., 2011; Hoff, 2006; Zubrick et al., 2007). Much is known about the factors related to mothers in children's early language skills (for reviews, see Law, Boyle, Harris, Harkness, & Nye, 2000; Nelson, Nygren, Walker, & Panoscha, 2006). In contrast, few researchers have highlighted the father's role in children's early language development (Leech, Salo, Rowe, & Cabrera, 2013; Pancsofar & Vernon-Feagans, 2010). Horwitz et al. (2003) found low maternal education, low maternal expressiveness and high parenting stress to be the strongest predictors of expressive language delays at 18–23 months. The socio-economic status of the family is reported to be an important indicator of early language ability, even at the neurocognitive and neurofunctional level (Hackman & Farah, 2009; Tomalski et al., 2013). Poor familial employment circumstances may lead to an economic situation that, in turn, can be detrimental to the already disadvantaged child's later development.

Parent report instruments, such as the MacArthur Communicative Developmental Inventories (CDI) (Fenson et al., 2007) used in the present study, provide a valuable source of information about a child's early language development (Saudino et al., 1998). Vocabulary check-lists have certain advantages as a screening method. Check-lists are based on the child's current language status, thus reducing the demands placed on the reporter's memory.

While designing this study, we hypothesized that childhood language disorders are present from the early stages of development and that there are both biological and environmental factors that are related to delayed language acquisition. The aims of the present study were to (1) explore the biological and environmental risk factors for language delay, (2) describe the father's role in early language development, and (3) analyze the relationship between parent-reported vocabulary development, language test results and the mother's concern regarding her child's language development.

2. Subjects and methods

This study utilizes data collected within a Finnish cohort study titled Steps to the Healthy Development and Well-being of Children (the STEPS study) (Lagström et al., 2013). The STEPS study is an ongoing population-based and multidisciplinary study that investigates children's physical, psychological and social development, starting from pregnancy and continuing until adolescence. The study population has two levels: (1) the cohort group ($N = 9811$ mothers, $N = 9936$ children), and (2) the intensive follow-up group ($N = 1797$ mothers, $N = 1827$ children, of whom 30 pairs are twins). The cohort group consists of all children born in the Hospital District of Southwest Finland between January 2008 and April 2010 and their monolingual Finnish or Swedish speaking parents. Information about the entire study cohort is based on pregnancy monitoring data from maternity clinics, as well as data from the National Longitudinal Census Files and child welfare clinics. Children with severe developmental illnesses or impairments (e.g., cerebral palsy or certain neurological diseases) were excluded from the cohort. The follow-up group is described in detail in our earlier paper (Lagström et al., 2013).

2.1. Subjects

For the Let's Talk STEPS (LT STEPS) sub-study, a group of 226 children (120 boys, 106 girls) was randomly selected from the STEPS intensive follow-up group ($N = 1827$), excluding Swedish speaking mothers ($N = 74$) (Fig. 1). Children of this subgroup were invited to language assessments at the Turku University Clinic of Speech and Language Pathology. Some children

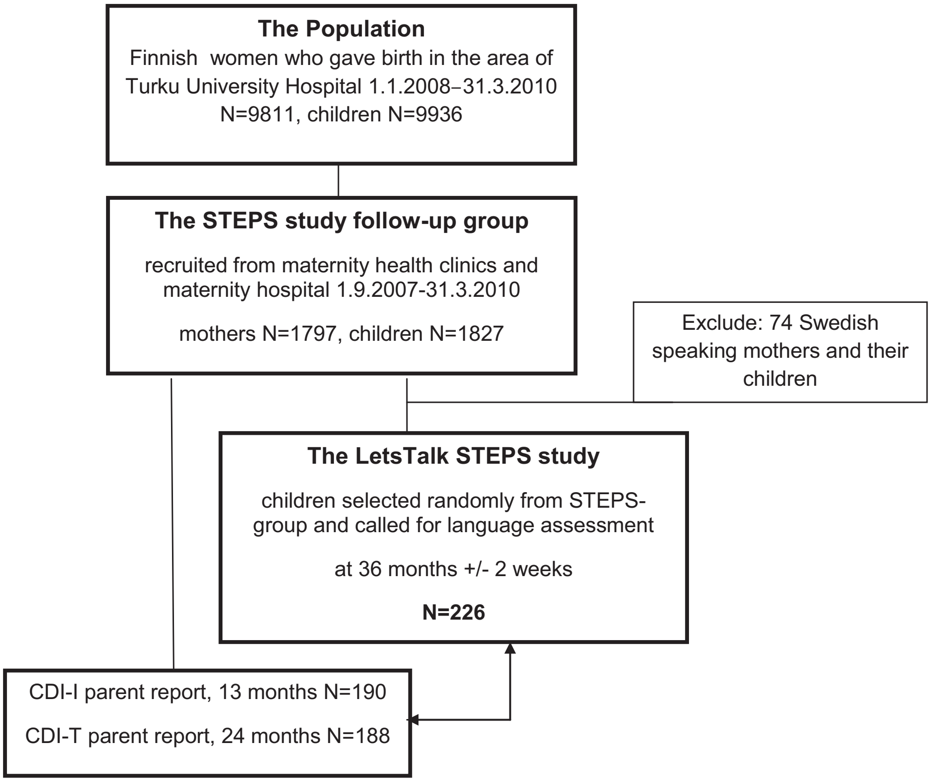

Fig. 1. The flow chart describing the selection process of the study.

refused testing or did not complete the test formulas. Final statistical analyses thus involved the word finding test results for 217 children and language comprehension test results for 218 children. The family was provided with written feedback of the child's assessment results. In the case of a severe language delay, the parents were instructed to contact their local health care center.

2.2. Methods

The systematic demographic data collection was based on multiple sources and started during pregnancy (Lagström et al., 2013). Demographic data on the families were updated during yearly visits at the research center. Information stored in electronic health records was available from maternity and child welfare clinics within the study region. During pregnancy, mothers (at gestational weeks 10–15) and both parents (at gestational week 20) answered questionnaires concerning the language development of family members and parents' special education needs during their school years.

The biological factors related to the newborn were as follows: gestational weeks at birth, mode of delivery, birth weight, 1-min and 5-min Apgar scores and gender. Gestational weeks and birth weight were divided in 3 categories using the cut-off scores of <10th percentile and >90th percentile. For gestational weeks, the subgroups were: <270 days ($N = 20$), 270–292 days ($N = 183$), and >292 days ($N = 23$). For birth weight, the subgroups were <3030 g ($N = 22$), 3030–4130 g ($N = 181$), and >4130 g ($N = 23$). Parents' late language learning and need for special education during schooling were analyzed as markers of the possible genetic origin of the language delay. At 36 months, we asked if the child had any special illnesses (allergy, asthma, diabetes, epilepsy, general developmental delay, cerebral palsy, defected vision or audition, some other serious disease) that might have affected the child's development. In addition, it was asked if the mother was worried about the child's language learning.

Environmental factors followed up in the LT-STEPS study were family structure, maternal and paternal highest completed education, social class, employment of the parents during pregnancy, and economic well-being of the family. The factor 'family structure' had two classes: 1 = all family members are biological relatives and 2 = extended family. For education, we used the following dichotomy: 1 = low educational level (no vocational training, an occupational course, an institute-level degree, a college level degree), and 2 = high educational level (technical/other college degree, Bachelor's or Master's degree, licentiate or doctorate degree). The classification is based on the definitions of Statistics Finland. For social status, we used a cut-off score of <10th percentile (lower status: service trade, farmer, construction worker or other low walk of life). The monthly net income of the household was reported at the time the child was 36 months old. For family income, we used the following dichotomy: 1 = low and 2 = high (cut-off score <25th percentile = less than 2000 €/month/household; the risk-of-poverty at 2012 in Finland was 1170 €/month/person).

The language assessment data of vocabulary development came from the follow-up group of the STEPS study (Lagström et al., 2013). The MacArthur Communicative Development Inventories (CDI, Finnish version and normative data, Lyytinen, 1999) were used to measure the children's receptive and expressive vocabulary at 13 months (CDI-I, infants) and expressive vocabulary at 24 months (CDI-T, toddlers). The CDI word checklists were mailed to the parents, who also had the option to complete the CDI online. The CDI scores were available for the children participating in the LT-STEPS study at 13 months ($n = 190/226$) and at 24 months ($n = 188/226$). These measures were used to form two groups, namely a delayed language (DL) group and typical language (TL) group, using a cutoff score of <10th percentile.

At 36 months, the Renfrew Word Finding Vocabulary Test, RWF (Renfrew, 1995) was used to assess the children's lexical development and the Reynell Developmental Language Scales (RDLS III) to assess language comprehension (Edwards et al., 1985). To categorize a child as language-delayed at 36 months, we used <1.5 SD for the RWF. The RDLS III test manual's cut-off <80 standard points was applied to identify language-delayed children for language comprehension. At the end of the assessment, there was a 10-min play session for the child and mother with structured toy selection. This play session was both videotaped and audio-recorded for further language analyses.

2.3. Ethics approval

The Ministry of Social Affairs and Health and the Ethics Committee of the Hospital District of Southwest Finland approved the STEPS Study (February 2007). The Ethics Committee of the University of Turku approved the Let's Talk STEPS study (March 2011). The parents provided their written informed consent and were informed of their right to withdraw from the study at any point. The description of the scientific data file is formulated according to the guidelines issued by the Office of the Data Protection Ombudsman. The data are stored at the Turku Institute for Child and Youth Research (CYRI), University of Turku.

2.4. Statistics

Pearson's correlation coefficients were calculated between vocabulary measures (CDI-I and CDI-T), lexical skills (RWF), language comprehension (RDLS-III) and mother's concern. Biological and environmental risk factors for language skills at 36 months were analyzed with Student's t-test for independent samples, or, in case of factors with more than two categories, with One-Way ANOVA. Of the biological factors, gestational weeks and birth weight were divided into three categories using cut-off scores of <10th percentile and >90th percentile. The prevalence of an atypically small vocabulary (using the 10th percentile cut-off score) between the age of 13, 24 and 36 months were analyzed with Chi-Square test. The data related to mothers' concerns and risk factors had quite small cell frequencies, and these analysis were worked out with Fisher's exact test. Multiple linear regression analyses were used to explore the predictive value of those biological, environmental and vocabulary factors which were found to be statistically related to children's language skills at 36 months. Data were analyzed using SAS version 9.3 (SAS Institute, Cary, NC, USA). The statistical level of significance was set at 0.05 in all analyses.

3. Results

3.1. Results from the language assessments

We found large individual differences in early vocabulary skills. At 13 months, the range of receptive vocabulary was 0–314 words (mean/median 3/94) and the range of expressive vocabulary was 0–42 words (mean/median 2/27). At 24 months, the range of expressive vocabulary was 0–587 words (mean/median 50/327). A year later, at 36 months, the range of acquired words at the RWF test was 2–33 (mean/median 18/19), and scores of language comprehension on the RDSL-III test ranged from 58 to 125 (mean/median 107/107).

The CDI-I receptive vocabulary at 13 months correlated significantly with the expressive vocabulary of the same age group ($r = 0.28$, $p < 0.0001$; Table 1) and the CDI-T expressive vocabulary at 24 months ($r = 0.27$, $p = 0.001$). In addition, a significant correlation was found between the CDI-I receptive vocabulary and the test results of word finding RWF at 36 months ($r = 0.15$, $p = 0.043$) and language comprehension RDLS-III at the same age ($r = 0.18$, $p = 0.013$). The expressive vocabulary at 13 months correlated significantly with language comprehension RDLS-III at 36 months ($r = 0.25$, $p = 0.001$). Regression analyses indicated that the expressive vocabulary at 24 months was the main parameter that induced good progress in language assessment results at 36 months (Table 2).

There were two language measures that correlated with mothers' concerns (Table 1): limited expressive vocabulary at 24 months ($r = -0.31$, $p < 0.0001$) and a low score on the RDLS-III language comprehension test at 36 months ($r = -35$, $p = 0.0001$). We also wanted to know which biological or environmental risk factors might arouse mothers' worry. Three biological factors *had statistical relationship with* mothers' concerns: male gender (Chi-square, $\chi^2 = 5.2699$, $p = 0.022$), atypical delivery ($\chi^2 = 3.8312$, $p = 0.050$) and parents' participation in special education during their own school years ($\chi^2 = 6.8275$, $p = 0.009$). Surprisingly, the mother's or father's own late language acquisition did not arouse mothers' concerns.

At 13 months, the prevalence of an atypically small receptive vocabulary was found in 9.5% ($N = 18/190$) of children. At 24 months, the expressive vocabulary was atypically small in 9.6% ($N = 18/188$) of the study subjects. At 36 months, the DL

Table 1
Pearson correlations and p-values between vocabulary measures (CDI-I and CDI-T), lexical skills (RWF), language comprehension (RDLS-III) and mothers' concerns.

Language measure	CDI-I receptive vocabulary at 13 months	CDI-I expressive vocabulary at 13 months	CDI-T expressive vocabulary at 24 months	Renfrew Word finding at 36 months	Reynell Language Scales III, language comprehension	Mother's concern at 36 months
I		0.283	0.274	0.150	0.182	0.045
		<0.0001	0.0005	0.043	0.013	0.568
II			0.334	0.115	0.254	−0.149
			<0.0001	0.120	0.0005	0.061
III				0.400	0.447	−0.311
				<0.0001	<0.0001	<0.0001
IV					0.463	−0.126
					<0.0001	0.0901
V						−0.350
						<0.0001

I CDI-I receptive vocabulary at 13 months; II CDI-I expressive vocabulary at 13 months; III CDI-T expressive vocabulary at 24 months; IV Renfrew Word finding at 36 months; V Reynell Language Scales III, language comprehension at 36 months.

Table 2
Multiple linear regression analyses between vocabulary skills at 13 and 24 months and lexical skills (RWF) and language comprehension (RDLS-III) at 36 months.

Vocabulary factors	Language index Renfrew word finding[a]			
	ß	Standard Error	*t* Value	*p*
Expressive vocabulary_13 months	−23.6	21.6	−1.09	0.276
Receptive vocabulary_13 months	4.62	2.79	1.66	0.099
Expressive vocabulary_24 months	8.25	1.80	4.58	<0.0001
	Language index Reynell language comprehension[b]			
	ß	Standard Error	*t* Value	*p*
Expressive vocabulary_13 months	49.7	41.5	1.20	0.233
Receptive vocabulary_13 months	6.00	5.20	1.16	0.250
Expressive vocabulary_24 months	16.3	3.36	4.85	<0.0001

Model characteristics: [a] $F(3, 150) = 10.00$, $p < 0.0001$, adjusted $R^2 = 0.1499$.
[b] $F(3, 151) = 13.08$, $p < 0.0001$, adjusted $R^2 = 0.1904$.

(delayed language) group consisted of 8.8% ($N = 19/218$) of the children. These children had not reached age-typical skills in word finding ($N = 9$) or language comprehension ($N = 7$) or both ($N = 3$). If the child belonged to the DL group at 24 months, he or she had a 26% probability of also having poor language skills at 36 months, compared with an 8% probability for the child from TL (typical language) group. The difference between the DL and the TL group was statistically significant (Fisher's exact test, $p = 0.024$). Twelve (63%) of the language-delayed children had some disorders running in families: 3 mothers and 3 fathers had learning problems at school, 6 mothers and 7 fathers needed special education, and in 4 cases, the family history showed language-related problems among more-distant relatives.

3.2. The identification of risk factors

A total of 19 risk factors (11 biological and 8 environmental factors) together with mothers' concerns were analyzed to identify their statistical relationship with a given child's language skills at 36 months. Of the various biological factors, a statistical relationship was found between gender and language comprehension (RDLS-III) (advantage to girls; $t = -3.56$, $p = 0.001$) (Table 3). The two possible factors indicating heredity, namely the parents' own late language learning and need for special education at school, were not statistically related with the child's language test results at 36 months. Data regarding children's illnesses had no statistical significance at the population level. Of the environmental factors (Table 4), parents' education (advantage to the children with higher educated parents; mother, $t = -2.14$, $p = 0.034$, father, $t = -2.22$, $p = 0.028$) and social class (advantage to the children with parents from higher social status, mother, $t = 3.16$, $p = 0.002$ father, $t = 2.51$, $p = 0.013$) induced better skills in language comprehension. Furthermore, the higher the father's social class, the better was the child's vocabulary at 36 months ($t = 2.29$, $p = 0.023$). Interestingly, if the father was out of work during the early developmental years, the child had a larger vocabulary than if the father was working the entire day outside the home ($t = -2.07$, $p = 0.039$).

Multiple regression analyses were calculated to explore the predictive value of the biological and environmental risk factors. The child's lexical skills (RWF) at 36 months were poorer in those families in which the father came from a low social class ($t = -2.79$, $p = 0.006$) and worked full time ($t = -2.86$, $p = 0.005$). In addition, the mother's low social class predicted low

Table 3
Biological risk factors for language skills at 36 months; the analyses of dichotic factors based on Fisher's exact test of independent samples (*t*), and the gestational weeks and the birth weight were analyzed with one-way analysis of variance, ANOVA (F) (in parentheses: standard deviation, SD, and standard error of the mean, SE).

Biological factors	RDLS III, comprehension Mean (SD/SE)	F/*t*	*p*	RWF, word finding Mean (SD/SE)	*F*/*t*	*p*
Gestational weeks	105.1 (9.8/2.19)	*F* = 0.04	0.963	18.7 (5.4/1.21)	*F* = 2.33	0.1
<270 days *N* = 20	104.9 (11.2/0.83)			17.8 (5.9/0.44)		
270–292 days *N* = 183	105.6 (12.7/2.65)			20.6 (4.7/0.98)		
>292 days *N* = 23						
Birth weight	104.9 (11.3/2.41)	*F* = 0.31	0.734	16.7 (6.8/1.45)	*F* = 0.70	0.496
<3030 g *N* = 22	104.8 (11.4/0.85)			18.3 (5.8/0.43)		
3030–4130 g *N* = 181	106.9 (8.8/1.83)					
>4131 *N* = 23						
Atypical delivery	104.6 (11.3/0.88)	*t* = –0.96	0.336	18.3 (5.5/0.43)	*t* = 0.67	0.505
No *N* = 166	106.3 (10.8/1.50)			17.7 (6.8/0.93)		
Yes *N* = 52						
Apgar 1 min	108.4 (6.9/1.84)	*t* = 1.16	0.249	16.9 (6.8/1.82)	*t* = –0.80	0.427
<7 *N* = 14	104.8 (11.49/0.80			18.2 (5.7/0.40)		
7–10 *N* = 203						
Apgar 5 min	105.9 (6.7/2.02)	*t* = 0.27	0.788	16.8 (7.0/2.11)	*t* = –0.76	0.446
<8 *N* = 207	105.0 (11.4/0.79)			18.2 (5.8/0.40)		
8–10 *N* = 11						
Gender	102.5 (12.1/1.14)	*t* = –3.56	<0.001	18.1 (6.3/0.60)	*t* = –0.07	0.946
Boy *N* = 113	107.7 (9.4/0.92)			18.2 (5.2/0.51)		
Girl *N* = 105						
Mother late talker	104.9 (11.2/0.77)	*t* = –0.82	0.413	18.2 (5.9/0.41)	*t* = 0.59	0.559
No *N* = 211	108.4 (8.6/3.25)			16.9 (2.3/0.88)		
Yes *N* = 7						
Father late talker	105.1 (11.1/0.76)	*t* = 0.28	0.779	18.2 (5.8/0.40)	*t* = 0.48	0.632
No *N* = 211	103.9 (13.9/5.26)			17.0 (5.4/2.21)		
Yes *N* = 7						
Mother/father late talker	104.9 (11.2/0.78)	*t* = –0.39	0.699	18.2 (5.9/0.41)	*t* = 0.77	0.443
No *N* = 204	106.1 (11.4/3.04)			16.9 (3.9/1.07)		
Yes *N* = 14						
Mother/father special education	106.0 (10.8/0.95)	*t* = 1.57	0.115	18.3 (5.4/0.48)	*t* = 0.57	0.552
No *N* = 128	103.6 (11.6/1.22)			17.8 (6.4/0.67)		
Yes *N* = 90						
Child's illnesses	104.7 (11.5/0.91)	*t* = –0.92	0.358	18.0 (6.0/0.48)	*t* = –1.50	0.135
No *N* = 160	106.9 (8.4/1.69)			19.9 (4.2/0.87)		
Yes *N* = 25						

test scores in language comprehension (RDLS-III) ($t = -2.06$, $p = 0.041$). Gender was the only biological factor that predicted poor skills in language comprehension at 36 months ($t = 2.71$, $p = 0.008$) (Table 5).

4. Discussion

Demographic information together with language measures are needed to allocate health care resources to children at risk of language delay. We analyzed a total of 19 biological and environmental factors to explore their predictive value for children's language acquisition from 13 to 36 months. Male gender was the only biological factor that predicted poor language comprehension at the age of 36 months. It is commonly noted that males are over-represented in language-delayed populations (for review, see Law et al., 2000). In our study, none of the biological factors could predict children's lexical development. The results were somewhat dissimilar with earlier studies, which underline the strong effect of child-related biological factors on language development (e.g., Weindrich et al., 1998; Stanton-Chapman et al., 2002). The discrepancy may be explained by the fact that we examined population-based data in which children with severe illnesses or impairments (e.g., cerebral palsy or certain neurological diseases) were excluded. Environmental factors were found to predict early language development more strongly than the biological factors.

Table 4
Environmental risk factors for language skills at 36 months; the analyses based on Fisher's exact test of independent samples (*t*) (in parentheses: standard deviation, SD, standard error of the mean, SE).

Environmental factors	RDLS III, comprehension mean (SD/SE)	*t*	*p*	RWF, word finding mean (SD/SE)	*t*	*p*
Family structure		1.08	0.281		1.29	0.199
Biological *N* = 186	105.3 (11.2/0.82)			18.3 (5.8/0.43)		
Others *N* = 18	102.3 (12.8/3.03)			16.4 (5.8/1.38)		
Mother's education		−2.14	0.034*		−0.83	0.408
Low *N* = 61	102.5 (12.5/1.60)			17.8 (5.6/0.73)		
High *N* = 153	106.1 (10.5/0.85)			18.3 (5.9/0.47)		
Father's education		−2.22	0.028*		−1.28	0.201
Low *N* = 108	103.4 (10.7/1.03)			17.6 (6.0/0.58)		
High *N* = 104	106.8 (11.5/1.13)			18.6 (6.0/0.55)		
Mother's social status		3.16	0.002**		1.59	0.114
Low *N* = 48	100.5 (13.7/1.98)			17.0 (6.8/1.00)		
High *N* = 144	106.5 (10.4/0.84)			18.5 (5.5/0.46)		
Father's social status		2.51	0.013*		2.29	0.023*
Low *N* = 61	101.8 (11.8/1.15)			16.4 (6.1/0.79)		
High *N* = 114	106.4 (11.2/1.05)			18.5 (5.6/0.53)		
Mother working		−1.45	0.148		−0.55	0.585
No *N* = 38	107.4 (9.6/1.55)			18.6 (4.4/0.72)		
Yes *N* = 176	104.6 (11.4/0.86)			18.0 (6.1/0.46)		
Father working		−0.51	0.614		−2.07	0.039*
No *N* = 24	106.2 (9.3/1.89)			20.4 (6.1/1.24)		
Yes *N* = 188	104.9 (11.4/0.84)			17.8 (5.7/0.42)		
Family income		−0.77	0.444		1.5	0.136
Low *N* = 35	108.4 (6.9/1.50)			19.4 (6.4/1.10)		
High *N* = 177	104.8 (11.4/0.87)			17.8 (5.6/0.42)		

Table 5
Multiple linear regression analyses between biological and environmental risk factors and children's lexical skills (RWF) and language comprehension (RDLS-III) at 36 months.

Environmental and biological risk factors	Language index Renfrew word finding[a]			
	ß	Standard error	*t* Value	*p*
Father's lower social class	−2.56	0.92	−2.79	0.006
Father's employment	−4.43	1.55	−2.86	0.005
	Language index Reynell language comprehension[b]			
	ß	Standard error	*t* Value	*p*
Gender boy	−5.05	1.86	−2.71	0.008
Mother's lower educational level	−1.49	2.51	−0.59	0.554
Father's lower educational level	−0.71	2.15	−0.33	0.741
Father's lower social class	−2.02	2.24	−0.90	0.369
Mother's lower social class	−5.30	2.57	−2.06	0.041

Model characteristics: [a] $F\,(2, 170) = 6.82$, $p = 0.0014$, adjusted $R^2 = 0.0634$.
[b] $F\,(5, 154) = 4.87$, $p = 0.0004$, adjusted $R^2 = 0.1084$.

Of the environmental factors, both parents' education and social class correlated positively with the child's language comprehension. Regression analyses showed that the mother's social status had predictive value on the child's language comprehension at 36 month of age. This result is in agreement with earlier reports (for reviews, see Law et al., 2000; Nelson et al., 2006). The father's educational level and social class was also correlated with the child's language comprehension; however, these factors did not reach predictive value at the population level.

We were especially interested in fathers' roles in children's early communication and language development, a research question that has been addressed infrequently by earlier studies (Leech et al., 2013; Pancsofar & Vernon-Feagans, 2010). Our new finding is that the child's lexical skills were higher when the father was at home at least part-time during the early developmental years. Extant studies (Leech et al., 2013) have shown that fathers use more questions and require clarification when talking with their young children, which may partly explain our results. Both the diversity and quantity of vocabulary inputs are important factors for children's language acquisition (Rowe, 2012). Furthermore, we found that the father's social status and working from home were predictive factors for children's lexical development. The results may emphasize the changing and less stereotyped role of the father as a supportive and active person in their children's development.

One aim of this study was to examine whether mothers can reliably assess language skills and possible delays in their child's development. We found that mothers' concerns about their children's delayed language correlated significantly with a limited expressive vocabulary at 24 months and poor language comprehension at 36 months. These findings confirm the validity of mothers' concerns about children's language delays. It is known that parents' need for special education during school years is a risk factor for their children's language delay (Lyytinen et al., 2001). In our study, we found that the parents' own participation in special education during school years aroused the mother's concern. This result may indicate that those mothers who needed special education during their school years or had this information regarding the father's school years, pay closer attention to their children's language development. Interestingly, the mother's or father's own late language learning did not arouse the feeling of worry. Thus, our results showed that mothers' concerns are a valid sign of language delays and that family history is an important indicator of language disorders.

Language-delayed children are quite a heterogeneous group (Rescorla, 2011; Rescorla & Achenbach, 2002). Typical development as such is nonlinear and is not constant. In our results, variability in the developmental course of expressive language was apparent. At 13 months, many children had not acquired any words. At 24 months, there were still children without any expressive words, with the variance between the children being even greater than at the age of 13 months. Our results are consistent with earlier reports (Henrichs et al., 2011; Rescorla & Schwartz, 1990) showing that expressive language at age 2 is a significant predictor of outcomes at 3 years of age.

In our data, 8.8% of the 3-year-old children were categorized as language-delayed. The incidence is somewhat lower than that reported by Reilly et al. (2007; 20%) or Zubrick et al. (2007; 13%) for 2-year-old children. Klee et al. (1998) compared the screening results of three studies and concluded that approximately 15% of 24-month-old children may screen positive, but only approximately 3–8% have language impairment later at preschool age, as was found in our study.

The strength of our study lies in its randomly determined sample derived from a large population cohort. The population-based sample was keenly followed at the research center, and the demographic data were collected with care and unity. The sample size allowed us to identify a large number of possible predictors and risk factors for language development. The ongoing cohort made it possible to use a retrospective study design, which in our study, allowed us to follow children's language development from 13 to 36 months. Children were invited to a clinical language assessment at 36 months to test their lexical skills and language comprehension, the two main indicators of future language learning; however, a wider test-battery may have provided a more comprehensive and reliable picture of language development and delays. One limitation of the present study is that the early screening was only based on parent reports, although there are many studies showing their validity and reliability (Camaioni, Castelli, Lombardi, & Volterra, 1991; Dale, Bates, Reznick, & Morisset, 1989). Further studies using brain imaging methods may deepen our understanding of both biological and environmental factors affecting language acquisition at an early age.

In conclusion, our results indicate that (a) gender was the most powerful biological factor in predicting language comprehension, (b) the father's social and working status had predictive value for the child's lexical development, and (c) the mother's social status predicted language comprehension. In addition, a poor expressive vocabulary at 24 months was already correlated with language delay at 36 months, and mothers' concerns about their children's slow language acquisition were a relevant indicator for the need for special support.

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