EARLY RISK FACTORS FOR PRESCHOOL SPEECH AND LANGUAGE IMPAIRMENTS

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ABSTRACT

Statewide birth certificate and exceptionality records were integrated to examine potential risk factors for isolated speech impairment (SI), specific language impairment (SLI), and combined speech and language impairment (SI/LI) in preschool-aged children. Developmental epidemiological methods were used to determine risk by comparing the rate of occurrence of factors between a sample of 12,799 children with SI, SLI, or SI/LI and a comparison group of 950,744 children. Multiple birth, presence of a newborn condition, presence of a congenital abnormality, maternal age greater than 35 years, and presence of a maternal medical history factor were associated with increased risk for SI, SLI, and SI/LI. Prematurity and low birth weight were significant risk factors for SLI and SI/LI but not for SI. Prenatal exposure to alcohol was a significant risk factor for SI but not SLI and SI/LI. Low maternal education and unwed marital status were associated with a decreased risk for speech and/or language impairments indicating a potential identification bias. The present study demonstrates the potential for identifying children at birth who are at increased risk for speech and language impairments. Early screening of children at the highest risk would identify those children most in need of intervention and is an initial step toward the prevention of speech and language disorders.

INTRODUCTION

Speech and language impairments are among the most prevalent childhood disabilities. The high prevalence and high economic cost of speech and language disorders make the prevention of these disabilities a major public health challenge (Ruben, 2000) and a primary objective of Speech-Language Pathologists (American Speech-Language-Hearing Association, 1991; American Speech-Language-Hearing Association, 2002). The need for additional research on the risk factors for speech and language impairments has been recognized by the American Speech-Language-Hearing Association (1991) as well as by researchers in the area (Cole & Marge, 1985; Law, Boyle, Harris, Harkness, & Nye, 2000a; Longemann & Baum, 1998). Early identification of children at risk for speech and language impairments is crucial to the provision of the early intervention services necessary to limit the negative effects of speech and language disorders (Ramey & Campbell, 1984). It has been estimated that early monitoring of children at risk could lead to the identification of most children with speech and/or language impairments by 24-30 months of age (Tomblin, Hardy, & Hein, 1991).

The present study addresses this need by utilizing extant birth certificate record data to identify the factors associated with increased risk for speech and/or language impairments. Due to the prevalence of speech and language impairments, the idea of screening all children for these impairments has been presented. Universal screening, however, does not appear to be a cost-effective way to identify children with speech or language impairments (Law, Boyle, Harris, Harkness, & Nye, 2000b). Utilization of data provided on birth certificate records provides a viable alternative to universal screening. Children at high risk could be identified at very low cost and screenings could be targeted to just those children. Such an approach would not result in the exclusive identification of children with primary speech or language difficulties, but it would be likely to identify those most in need of intervention and could result in a more efficient use of resources (Andrews, Goldberg, Wellen, Pittman, & Struening, 1995; Law et al., 2000b).

The focus on preschool-aged children in the present study will allow for the identification of the characteristics of children who develop these impairments at an early age, the group most in need of early intervention. A better understanding of the risks associated with speech and language impairments will enable the development of more effective prevention, identification, and intervention strategies.

METHOD

Data Sources and Integration

Data from the Florida Department of Health birth certificate records (1994 through 1998) were integrated with preschool exceptionality records from the Children's Registry and Information System (CHRIS) database.

The CHRIS database contains referral, screening, evaluation, and eligibility information for preschool children who receive services in Florida under Part B of the Individuals with Disabilities Education Act (IDEA). The CHRIS database program is utilized statewide at Florida Diagnostic and Learning Resources System (FDLRS) centers. FDLRS is a network of nineteen state and federally funded associate centers which assist local school systems in meeting the requirements of IDEA by locating preschool-aged children who are potentially eligible for services under IDEA and linking those children with needed services.

The integration of databases was accomplished using deterministic data linkage techniques whereby a child's unique record was identified in both databases and joined across datasets to establish one record. Records were linked based on an exact match of child's last name, first name, and date of birth. If any of the matching variables differed, the pair was considered a non-match and was not included in the linked sample.

Sample

The sample consisted of children born in Florida who were identified in the CHRIS database with a primary exceptionality of speech or language impairment. Gender, race, and ethnicity information are provided in Table 1. Classification of speech and language impairments was based on the diagnostic criteria specified in the Florida Statutes and State Board of Education Rules (Florida Department of Education, 2002). Final eligibility decisions were based on an eligibility staffing committee consisting of a minimum of three professional personnel including a certified speech-language pathologist. The specific disability definitions used for the present study were as follows:

- **Isolated speech impairment (SI):** a primary exceptionality of speech impairment and no secondary exceptionality (n = 6,835).
- **Specific language impairment (SLI):** a primary exceptionality of language impairment and no secondary exceptionality (n = 2,357).
- **Combined speech and language impairment (SI/LI):** a primary exceptionality of speech impairment with a secondary exceptionality of language impairment or a primary exceptionality of language impairment with a secondary exceptionality of speech impairment (n = 3,607).
- **Comparison group:** No primary exceptionality or primary exceptionality other than speech or language impairment (n = 946,177).

Risk Factors

Risk factor data were obtained from birth certificate records and reflect the status of the child or mother at the time of the child's birth. The specific risk factors studied are presented below.

Child Factors	Maternal Factors
• **Gestational age < 37 weeks** • **Birth weight < 2500g** • **5-minute Apgar score < 7** • **Multiple birth** • **Presence of a newborn condition** (e.g., anemia, fetal alcohol syndrome, assisted ventilation) • **Presence of a congenital abnormality** (e.g., cleft lip/palate, chromosomal abnormalities, abnormalities of the circulatory system, abnormalities of the central nervous system)	• **Educational attainment ≤ 12 years** • **Age of > 35 years** • **Unwed marital status** • **Tobacco use during pregnancy** • **Alcohol use during pregnancy** • **Presence of medical history factors** (e.g., anemia, cardiac disease, lung disease, diabetes, genital herpes) • **Presence of complications of labor and/or delivery** (e.g., premature rupture of membranes, placenta previa, cord prolapse, fetal distress)

The present study utilized risk ratios (RR) to evaluate the level of risk associated with the factors examined. The RR represents the increased probability of the occurrence of an adverse outcome, given exposure to a particular risk factor, relative to a comparison group(Mason, Scott, Chapman, & Tu, 2000; Redden, Mulvihill, Wallander, & Hovinga, 2000). RRs are computed as the ratio of risk of disability outcome among those exposed to a risk factor with the risk among those not exposed to the risk factor. A RR of 1.0 indicates equal levels of risk for an outcome (e.g., speech impairment) between the groups being compared (e.g., being born premature versus full-term). A RR less than 1.0 represents a decreased risk and a RR greater than 1.0 represents an increased risk for an outcome. In the current study, each risk category was compared to the anticipated lowest risk group, which was assigned a RR of 1.0.

Ninety-five percent confidence intervals were calculated for each risk ratio. These intervals indicate the lower and upper limit of the RR which contains the true parameter 95% of the time over unlimited repetitions of the study, assuming there was no bias. Thus, RRs for which either confidence limit was equal to or crossed 1.0 were not considered meaningful because they did not reach the conventional 5 percent level of significance. In these cases, one cannot be confident that the rate of disability was truly different from the rate found in the comparison group. In addition to providing information regarding statistical significance, the width of the confidence interval provides an indication of the precision of the RR estimate. Confidence intervals with large ranges between the lower and upper bounds represent less precise estimates and are usually indicative of a small sample size in the disability group, comparison group, or both.

RESULTS AND DISCUSSION

The results are presented in Table 2, Table 3, and Figure 1. The present study revealed that multiple birth, presence of a newborn condition, presence of a congenital abnormality, maternal age greater than 35 years, and presence of a medical history factor were associated with increased risk for speech and language impairments, as isolated disabilities or in combination.

The most notable differences between disability groups were found for prematurity and low birthweight. Children born before 37 weeks gestation or weighing less than 2500 grams were at increased risk for SLI and SI/LI but not for SI. Little research has been conducted on the relation of gestational age and birthweight with SI, but the present study indicated that these factors were not associated with SI in preschool-aged children.

Several results of the present study were opposite to those expected, most notably low maternal education, unwed marital status, low Apgar score, and maternal tobacco use during pregnancy. Low maternal education has been identified as a risk factor for speech and language impairments in numerous studies (Campbell et al., 2003; Hammer, Tomblin, Zhang, & Weiss 2001; Lassmann, LaBenz, & LaBenz, 1980; Stanton-Chapman, Chapman, Bainbridge, & Scott, 2002; Tomblin, Smith, & Zhang, 1997). At least two studies, however, report no increase in risk for SLI associated with low levels of maternal education (Tomblin, 1996; Tomblin et al., 1991). The results of the present study did not indicate an increased risk for speech and/or language impairment among children whose mothers had a high school education or less at the time of the child's birth.

Interestingly though, the likelihood of a child being classified as SI or SI/LI increased with higher educational attainment. While higher levels of education do not likely pose an increased biological or environmental risk to the child, these findings may indicate a bias towards the identification of SI in more educated, higher-income families. The additional finding that the likelihood of impairment increased for children of mothers who were married is consistent with this interpretation. While factors such as maternal education and marital status may not have a direct relation to the development of speech problems, they are indicators of family income and overall socio-economic status (Hernandez, 1997).

Low Apgar score was not found to be a significant risk factor for SLI or SI/LI in the present study. Previous research has been inconsistent with regard to the relation of Apgar scores to speech and language impairments. In addition, low Apgar score was associated with a decreased likelihood of SI. This may be a reflection of the tendency for children with low Apgar scores to be classified with other disabilities such as mental retardation, emotional handicaps, and learning disabilities (Scott, Mason, & Gonzalez, 2000; Stanton-Chapman, Chapman, & Scott, 2001).

Maternal tobacco use during pregnancy was found to significantly increase risk for SI/LI but not SI, and to actually decrease risk for SLI. Previous research has indicated an association between prenatal exposure to tobacco and SLI, however, when parental education was controlled for, these significant associations no longer existed indicating that prenatal exposure to tobacco was not independently associated with SLI (Tomblin, 1996; Tomblin, Hammer, & Zhang, 1998; Tomblin et al., 1997). The findings in the present study indicating decreased risk for SLI associated with prenatal exposure to tobacco are difficult to interpret and merit further study.

CONCLUSIONS

The present study contributes to the existing body of research on SLI and is one of the very few studies of risk factors for SI. Separate evaluation of isolated speech impairment and specific language impairment allowed for the identification of differences in the factors that increased a child's likelihood of having only one of these disorders. The differences in risk factors associated with these disabilities suggest separate etiologies and support the development of separate risk profiles for each disorder. As such, tactics used for early identification should be customized for speech and language impairments.

Awareness of the factors that place a child at increased risk for speech and/or language impairments is essential to the early identification and prevention of these impairments. Early screening of children at the highest risk would identify those children most in need of intervention and is an initial step toward the prevention of speech and language disorders.

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Table 1.
Gender, Race, and Ethnicity Information for Preschool-Aged Children in the SI, LI, SI/LI, and Comparison Groups

	SI		SLI		SI/LI		Comparison	
	n	%	n	%	n	%	n	%
Gender								
Male	4,622	67.6	1671	70.9	2535	70.3	482,279	51.0
Female	2,213	32.4	686	29.1	1072	29.7	463,875	49.0
Unknown	0	0.0	0	0.0	0	0.0	23	<0.1
Race								
Caucasian	5,897	86.3	1722	73.1	2827	78.4	689,691	72.9
African American	830	12.1	580	24.6	731	20.3	228,375	24.1
Asian/Pacific Islander	73	1.0	43	1.8	36	1.0	21,498	2.3
Other	33	0.5	11	0.5	13	0.4	5,989	0.6
Unknown	2	<0.1	1	<0.1	0	0.0	624	0.1
Maternal Ethnicity								
Non-Hispanic	6,225	91.1	1636	69.4	3031	84.0	743,215	78.5
Hispanic	586	8.6	647	27.5	530	14.7	178,096	18.8
Haitian	21	0.3	73	3.1	44	1.2	24,166	2.6
Unknown	3	<0.1	1	<0.1	2	<0.1	700	0.1

Note. SI = isolated speech impairment; SLI = specific language impairment; SI/LI = combined speech and language impairments

Table 2.
Distribution of Risk Characteristics Among Children in the SI, SLI, SI/LI and Comparison Groups

	SI		SLI		SI/LI		Comparison	
	n	%	n	%	n	%	n	%
Gestational Age								
<37 weeks	674	9.9	298	12.6	434	12.0	90,701	9.6
≥ 37 weeks	6,142	89.9	2,054	87.1	3,168	87.8	853,720	90.2
Unknown	19	0.3	5	0.2	5	0.1	1,756	0.2
Birth Weight								
LBW (< 2500g)	536	7.8	253	10.7	330	9.1	74,719	7.9
NBW (≥ 2500g)	6,298	92.1	2,103	89.2	3,276	90.8	871,205	92.1
Unknown	1	0.0	1	0.0	1	0.0	253	0.0
5-Minute APGAR								
<7	58	0.8	30	1.3	38	1.1	11,545	1.2
≥ 7	6,764	99.0	2,324	98.6	3,563	98.8	932,365	98.5
Unknown	13	0.2	3	0.1	6	0.2	2,267	0.2
Multiple Birth								
Yes	294	4.3	141	6.0	134	3.7	24,949	2.6
No	6,540	95.7	2,216	94.0	3,473	96.3	921,203	97.4
Unknown	1	0.0	0	0.0	0	0.0	25	0.0
Newborn Conditions								
Yes	527	7.7	208	8.8	328	9.1	62,808	6.6
No	6,301	92.2	2,148	91.1	3,279	90.9	882,800	93.3
Unknown	7	0.1	1	0.0	0	0.0	569	0.1
Congenital Abnormalities								
Yes	108	1.6	36	1.5	74	2.1	8,864	0.9
No	6,720	98.3	2,320	98.4	3,533	97.9	936,739	99.0
Unknown	7	0.1	1	0.0	0	0.0	574	0.1
Maternal Education								
≤ 12years	3,048	44.6	1,317	55.9	1,971	54.6	540,837	57.2
>12 years	3,769	55.1	1,026	43.5	1,626	45.1	401,542	42.4
Unknown	18	0.3	14	0.6	10	0.3	3,798	0.4

Maternal Age								
≤ 35 years	6,001	87.8	2,078	88.2	3,211	89.0	855,578	90.4
>35 years	834	12.2	278	11.8	395	11.0	90,426	9.6
Unknown	0	0.0	1	0.0	1	0.0	173	0.0
Mother Married								
Yes	5,417	79.3	1,654	70.2	2,499	69.3	610,239	64.5
No	1,415	20.7	703	29.8	1,107	30.7	335,726	35.5
Unknown	3	0.0	0	0.0	1	0.0	212	0.0
Tobacco Use								
Yes	888	13.0	219	9.3	487	13.5	116,328	12.3
No	5,944	87.0	2,132	90.5	3,118	86.4	828,910	87.6
Unknown	3	0.0	6	0.3	2	0.1	939	0.1
Alcohol Use								
Yes	81	1.2	19	0.8	27	0.7	8,633	0.9
No	6,751	98.8	2,332	98.9	3,578	99.2	936,584	99.0
Unknown	3	0.0	6	0.3	2	0.1	960	0.1
Medical History Factors								
Yes	1,746	25.5	607	25.8	967	26.8	223,604	23.6
No	5,082	74.4	1,749	74.2	2,640	73.2	721,957	76.3
Unknown	7	0.1	1	0.0	0	0.0	616	0.1
Labor Complications								
Yes	2,124	31.1	779	33.1	1,180	32.7	293,746	31.0
No	4,702	68.8	1,577	66.9	2,427	67.3	651,893	68.9
Unknown	9	0.1	1	0.0	0	0.0	538	0.1

Note. SI = isolated speech impairment; SLI = specific language impairment; SI/LI = combined speech and language impairments

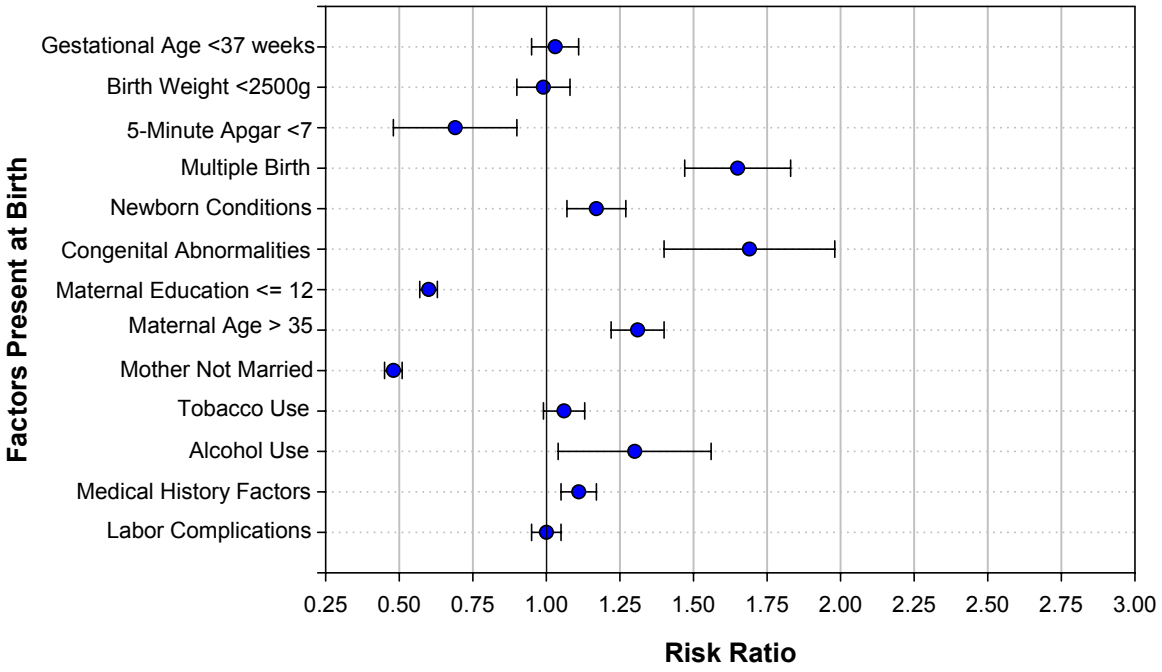
Table 3.
Risk Ratios Associated with Factors Present at Birth on Rates of SI, SLI, and SI/LI in Preschool-Aged Children

	SI		SLI		SI/LI	
	RR	**95% CI**	**RR**	**95% CI**	**RR**	**95% CI**
Gestational Age						
<37 weeks	1.03	0.95-1.12	1.36	1.21-1.54	1.29	1.17-1.42
≥ 37 weeks	1.00		1.00		1.00	
Birth Weight						
LBW (< 2499g)	0.99	.91-1.08	1.40	1.23-1.60	1.17	1.05-1.31
NBW (≥ 2500g)	1.00		1.00		1.00	
5-Minute APGAR						
< 7	0.69	0.54-0.90	1.04	0.73-1.49	0.86	0.63-1.19
≥ 7	1.00		1.00		1.00	
Multiple Birth						
Yes	1.65	1.47-1.86	2.34	1.98-2.78	1.42	1.20-1.69
No	1.00		1.00		1.00	
Newborn Conditions						
Yes	1.17	1.07-1.28	1.36	1.18-1.57	1.40	1.25-1.57
No	1.00		1.00		1.00	
Congenital Abnormalities						
Yes	1.69	1.40-2.04	1.64	1.18-2.27	2.20	1.75-2.77
No	1.00		1.00		1.00	
Maternal Education						
≤ 12 years	0.60	0.57-0.63	0.95	0.88-1.03	0.90	0.84-0.96
>12 years	1.00		1.00		1.00	
Maternal Age						
≤ 35 years	1.00		1.00		1.00	
>35 years	1.31	1.22-1.41	1.26	1.12-1.43	1.16	1.05-1.54

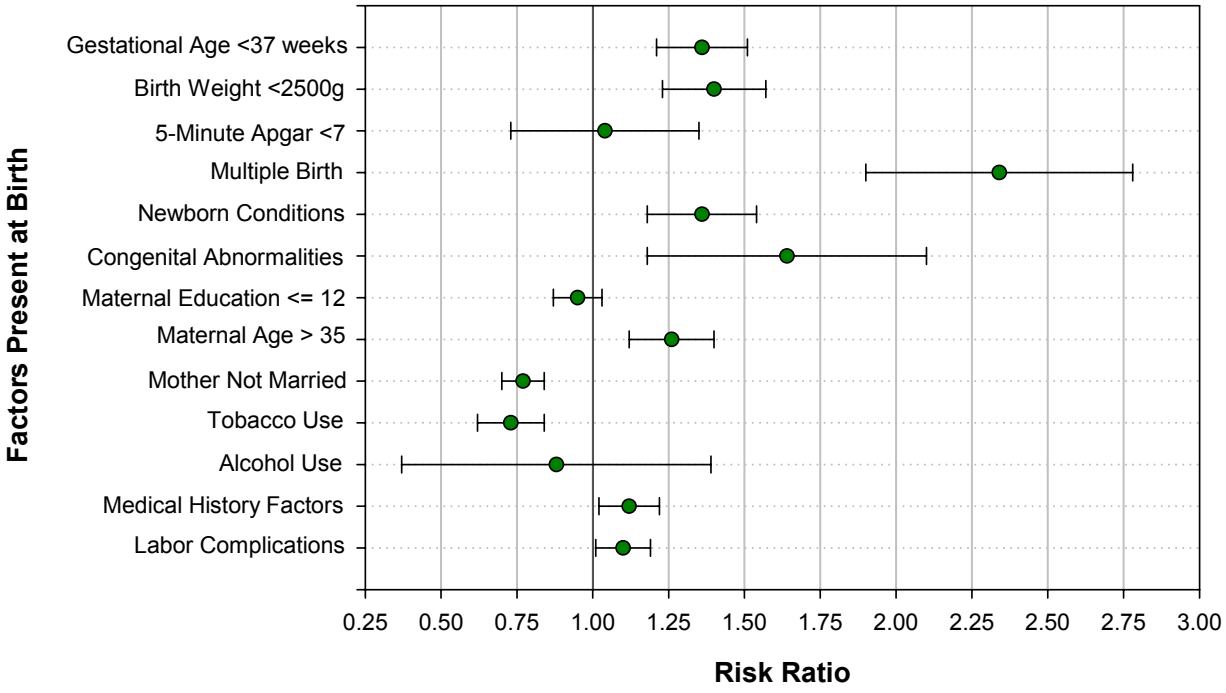
Mother Married						
Yes	1.00		1.00		1.00	
No	0.48	0.45-0.51	0.77	0.71-0.84	0.81	0.75-0.86
Tobacco Use						
Yes	1.06	0.99-1.14	0.73	0.64-0.84	1.11	1.01-1.22
No	1.00		1.00		1.00	
Alcohol Use						
Yes	1.30	1.04-1.62	0.88	0.56-1.39	0.82	0.56-1.20
No	1.00		1.00		1.00	
Medical History Factors						
Yes	1.11	1.05-1.17	1.12	1.02-1.23	1.18	1.10-1.27
No	1.00		1.00		1.00	
Labor Complications						
Yes	1.00	0.95-1.05	1.10	1.01-1.19	1.08	1.01-1.16
No	1.00		1.00		1.00	

Note. SI = isolated speech impairment; SLI = specific language impairment; SI/LI = combined speech and language impairments; RR = risk ratio
CI = confidence interval

a) Speech Impairment



b) Specific Language Impairment



c) Combined Speech and Language Impairment

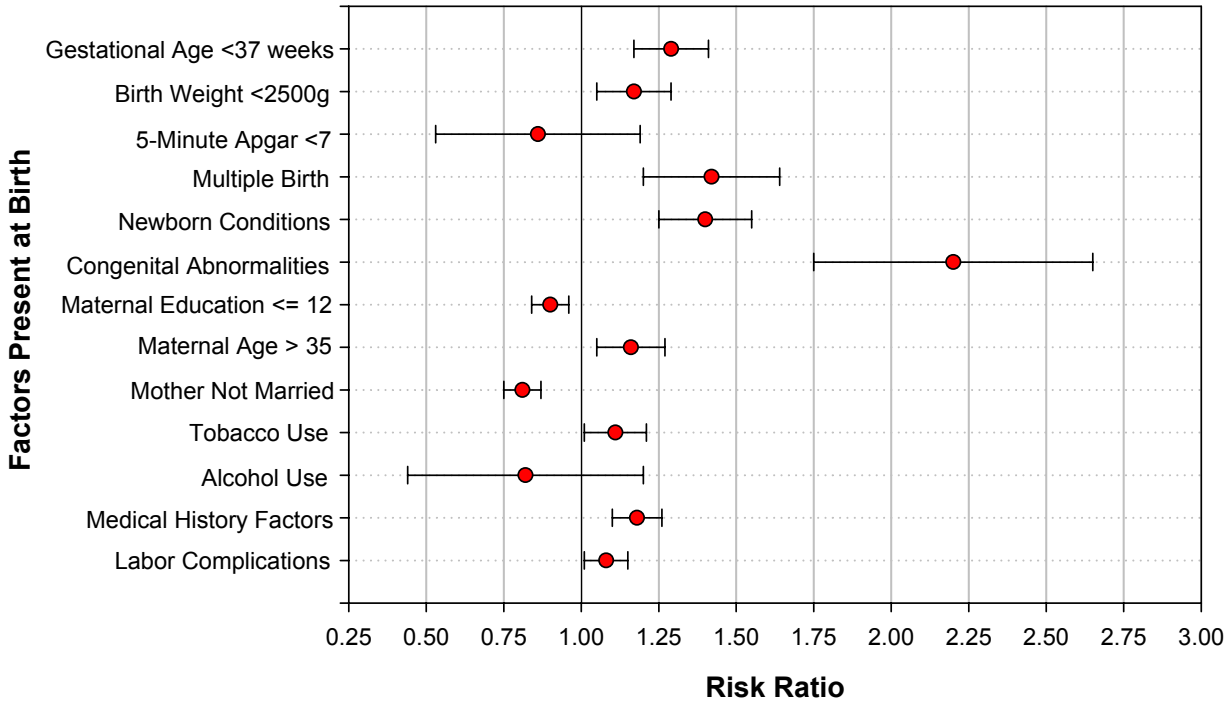


Figure 1.
Risk Ratios with 95% Confidence Intervals Associated with Factors Present at Birth on Rates of Speech Impairment, Specific Language Impairment, and Combined Speech and Language Impairment