HHS Public Access
Author manuscript
J Speech Lang Hear Res. Author manuscript; available in PMC 2016 October 22.

Published in final edited form as:
J Speech Lang Hear Res. 1997 December ; 40(6): 1245–1260.

Prevalence of Specific Language Impairment in Kindergarten Children

J. Bruce Tomblin, **Nancy L. Records**, **Paula Buckwalter**, **Xuyang Zhang**, **Elaine Smith**, and **Marlea O'Brien**
The University of Iowa Iowa City

Abstract

This epidemiologic study estimated the prevalence of specific language impairment (SLI) in monolingual English-speaking kindergarten children. From a stratified cluster sample in rural, urban, and suburban areas in the upper midwest, 7,218 children were screened. The language screening failure rate was 26.2%. Children who failed the screening and a similar number of controls were then administered a diagnostic battery ($n = 2,084$) that provided for a diagnosis of SLI using common diagnostic standards. Results provided an estimated overall prevalence rate of 7.4%. The prevalence estimate for boys was 8% and for girls 6%. Variation in prevalence was found among children of different racial/cultural backgrounds; however, these background variables were found to be correlated with parental education, which was also associated with SLI. The parents of 29% of the children identified as SLI reported they had previously been informed that their child had a speech or language problem.

The prevalence estimates obtained fell within recent estimates for SLI, but demonstrated that this condition is more prevalent among females than has been previously reported. Also, the clinical identification of these children remains low among kindergarteners.

Keywords

specific language impairment; prevalence; epidemiology; children

Specific language impairment (SLI) is a form of developmental language impairment in which children demonstrate unexpected difficulties with the acquisition of spoken language. There is substantial literature now showing that children with SLI are at considerable risk for social and behavioral problems (Beitchman, Nair, Clegg, & Ferguson, 1986; Cantwell & Baker, 1987; Paul & Cohen, 1984; Rice, Sell, & Hadley, 1991) as well as educational difficulties (Catts, 1993; Hall & Tomblin, 1978). Within the clinical setting these consequences are often observed for individual clients; however, the educational and social impact of SLI must also be viewed at the population level as a cost to our society in general. This cost is difficult to measure, but one important variable in computing this cost has to do with the prevalence of SLI. This study was designed to provide estimates of the prevalence of SLI within kindergarten children.

Contact author: J. Bruce Tomblin, PhD, Department of Speech Pathology and Audiology, The University of Iowa, Iowa City, IA 52242. J-TOMBLIN@UIOWA.EDU.

Prevalence refers to the proportion of individuals within a population at one point in time that present the condition of interest and is the appropriate measure of the rate of chronic diseases or SLI. As noted above, the prevalence of a condition is important for understanding the magnitude of the impact of the condition on society and its members. Thus, this information is used for public policy and planning purposes. Additionally, variations in the prevalence of disease can be used by those in epidemiology to identify risk factors that predict and potentially cause the disease.

A prerequisite to any study of prevalence is the establishment of a reliable and objective diagnostic system. Aram, Morris, and Hall (1993) have recently summarized many of the issues concerning the diagnosis of SLI. In this paper, the authors noted a general consensus that children with SLI shall not present developmental disabilities such as mental retardation, autism, or neuromotor impairments, nor can they present persistent hearing loss. These conditions have become known as exclusionary conditions for SLI.

Aram, Morris, and Hall (1993) also noted that there is far less consensus regarding the inclusionary conditions that must be present for children to be diagnosed with SLI. In one form or another, though, these inclusionary conditions deal with the criteria for determining that a child presents a language impairment. Stark and Tallal (1981) and Tallal (1988) have argued that the language achievements of children with SLI should fall below expectations based upon nonverbal IQ. Recently, however, several authors (Aram, Morris, & Hall, 1993; Bishop, 1994; Cole, Dale, & Mills, 1990; Lahey, 1990) have questioned the value of a nonverbal discrepancy criterion on both theoretical and methodological grounds, and presented empirical evidence that this discrepancy criterion has little prognostic or etiologic utility.

An alternative to nonverbal discrepancy standards are those that use chronological age referencing. For many years, language impairment has been defined principally by a discrepancy between the child’s language achievement and chronological age expectations provided by norms for the language measures employed in the diagnosis (Bangs, 1968; Cole, 1982; Lahey, 1988; Lee, 1974). In fact, the most explicit diagnostic standard for SLI developed by Stark and Tallal (1981) required that there be a CA discrepancy as well as a nonverbal discrepancy. In response to her concerns about nonverbal mental age referencing, Lahey (1990) recommended that chronological age be used as the principal basis for judging language expectations in children.

In addition to the unsettled issue of a reference standard, Aram, Morris, and Hall (1993) also noted that there has been considerable variation in the method through which discrepancies (CA or nonverbal) are determined, and in the magnitude of discrepancies required for a diagnosis of language impairment. In recent years, standard scores representing standard deviations from a population mean have been favored over age equivalence scores, but the magnitude of the deviation in standard scores necessary for language impairment has not been settled. Bloom and Lahey (1978) and Whitehurst and Fischel (1994) recommended a cutoff of 2 standard deviations (*SD*) from the mean (approximately 3rd percentile), whereas Fey (1985), Lee (1974), and Paul (1995) have suggested the 10th percentile. Records and Tomblin (1994) found that practicing clinicians generally used performance in the region between the 10th and 16th percentile for distinguishing between language impairment and normal performance. Likewise, Aram, Morris, and Hall (1993) reported that a 1 *SD* cutoff using MLU as a measure of language provided the best match to the standards used by practicing clinicians referring to their research program.

Prevalence of SLI

Within this context of uncertainty about the diagnosis of SLI, it is not surprising to find little information about the prevalence of this condition. During the past 20 years, there have been six epidemiologic studies of young children's speech and language problems that have provided some estimates of the rate of language impairment among children (Beitchman, Nair, Clegg, & Patel, 1986; Randall, Reynell, & Curwen, 1974; Richman, Stevenson, & Grahm, 1982; Silva, 1980; Silva, McGee, & Williams, 1983; Stevenson & Richman, 1976).

Two of these prevalence studies provided some information concerning the rate of language impairment in children who were without concomitant developmental and sensory disorders. Randall, Reynell, and Curwen (1974) reported the results of a speech and language assessment of a birth cohort living in a London borough and who could be located when they were 3 years old. Using a criterion of performance 2 SD below the mean on the Reynell Developmental Language Scales, 5 (2.5%) of the 176 children tested were determined to be language impaired. Of the children who were language impaired, 2 did not present exclusionary conditions and therefore might be viewed as SLI.

Stevenson and Richman (1976) reported the prevalence of specific expressive language delay in 705 3-year-old British children using several different diagnostic systems. The prevalence rate of these children for having expressive language ages 30 months or more below CA was 3.1%. They adopted an alternate standard that employed a nonverbal IQ discrepancy standard. In this case, children needed to have an expressive language age that was equal to or less than 2/3 of their nonverbal mental age. Only 1.42% of the children met this criterion. However, some of these children presented exclusionary conditions and only .57% did not have such conditions. This estimate may be taken as an estimate of the prevalence of expressive SLI using a nonverbal discrepancy criterion. The restriction of this diagnosis to expressive language limits its value to estimating the prevalence of SLI in general, since receptive language achievements are also included in most schemes for SLI diagnosis. Although it is generally believed that the majority of children with SLI will present expressive language problems (Bishop & Edmundson, 1987), the proportion of children with receptive language problems is not known.

Three additional studies also have provided information on the prevalence of speech and language disorders in children, but provide even less information about SLI than those cited above. Fundudis, Kolvin, and Garside (1979) followed a cohort of 3,300 British children from the age of 3 to 7 years. They estimated the prevalence rate of speech and language impairment in this population to be 4% at age 3 and 3% at age 7. The rate of specific speech and language disorders at age 7, which involved the presence of a speech or language disorder in the absence of exclusionary conditions, was reported to be 2.5%. These prevalence rates are difficult to interpret as they include children with speech sound production problems but normal language status. Further, no explicit diagnostic standard for language impairment is provided in this study.

As a part of the Dunedin Multidisciplinary Child Development Study, Silva (1980) and Silva, McGee, and Williams (1983) studied a group of 1,027 3-year-old children in a 4-year longitudinal study. Language impairment in this study was defined as performance at or below the 5th percentile on either the receptive or expressive subtest of the Reynell Developmental Language Scales (Reynell & Huntley, 1977). Using this definition, language impairment was found to occur in 7.6% of the 3-year-old children and 10.4% of those followed to 5 years of age. Although these authors obtained verbal and non-verbal measures of intelligence, they did not report their data in a manner that permitted a determination of the rate of language impairment in intellectually normal children, nor did they report the rate of other exclusionary conditions.

Most recently, Beitchman, Nair, Clegg, and Patel (1986) reported a prevalence rate for receptive and/or expressive language impairment of 12.6% for the 5-year-old children in a region of Ottawa. Language impairment in this case was defined as either performance below 1 standard deviation on the Test of Oral Language Development (TOLD), the Peabody Picture Vocabulary Test (PPVT), or the Goldman-Fristoe Woodcock Auditory memory tests, or alternatively, performance 2 standard deviations below the mean on one of the subtests of the TOLD. This study focused solely on language achievement in these children. Therefore, similar to the work by Silva, it is not possible to determine how many of these children also presented with exclusionary conditions. Thus, an estimate of SLI cannot be obtained from this work.

Recently, the DSM-IV (American Psychiatric Association, 1994) provided some prevalence estimates for SLI. The DSM-IV recognized two forms of SLI, an expressive form and a mixed expressive-receptive form. Although no supportive evidence was given, the prevalence rate for the expressive form was estimated to be between 3% and 5% and the mixed form was 3%. Thus, the prevalence rate for both forms of SLI should be between 6% and 8%.

Prevalence of SLI According to Gender and Race

Because few studies have addressed the prevalence of SLI, it is not surprising that there is also little known about the rate of SLI among racial or gender groups. Most descriptions of this condition claim a greater rate among males than females (American Psychiatric Association, 1994). Support for this view comes from some of the studies of more general forms of speech and language disorder just cited. Stevenson and Richman (1976) reported a male to female sex ratio of 2:1 for language disorder within the 3-year-olds studied. When children with mental retardation were eliminated, the ratio declined but still favored the males. Likewise, in the study cited earlier by Fundudis, Kolvin, and Garside (1979), as well as in another study by Silva (1980), a 2:1 male to female ratio was found for language impairment. Finally, the NINCDS Collaborative Perinatal Study (Lassman, Fisch, Vetter, & La Benz, 1980) also found a higher percentage of females than males passed the 3- and 8-year language measures. Thus, there is considerable evidence that being male appears to nearly double the risk of language disorder. Presumably, this would also apply to children with SLI. In contrast to these results, Beitchman, Nair, Clegg, and Patel (1986) found that speech and language disorders were slightly more common among females than males. Today, there is moderate support for a greater rate of language impairment among males than females; however, even this conclusion may be disputed. Because none of these studies were concerned with SLI, it remains to be determined whether the prevalence rate of SLI is sex modified.

Very similar conclusions can be reached with respect to racial differences and language impairment. In some of the studies just cited (Fundudis, Kolvin, & Garside, 1979; Lassman, Fisch, Vetter, & La Benz, 1980) greater language failure rates were reported among minority members of the populations studied. Vetter, Fay, and Winitz (1980) noted that the greater rate of language failure scores among the Black children of the National Collaborative Perinatal Project could have been the result of culturally sensitive content or methods of the test, or confounded by socioeconomic factors and race. Because these factors have been confounded in all research in which standardized language assessment methods were used, it is not possible to determine the association between race and elevated rates of language impairment. In fact, this appears to be a challenging if not intractable problem because epidemiologic research calls for highly standardized methods that are inherently insensitive to cultural differences. When these methods are applied to a culturally and racially diverse population, those for whom the measurement instruments are least compatible will predictably score more poorly.

It is clear from this literature that little is known about the prevalence of specific language impairment among children during the preschool or early school years. Studies that have been conducted with respect to language impairment have usually been designed primarily to determine the rate of developmental language disorders of any kind. Therefore, measures necessary for the diagnosis of SLI were not taken or the data were not analyzed in such a way as to provide information concerning SLI prevalence. Furthermore, this literature is characterized by small sample sizes; the use, in some cases, of longitudinal birth cohorts that introduce bias through attrition; a dependence on age equivalence scores for test interpretation; and many other methodological problems. For the purposes of public policy in the United States this literature is also problematic because none of these studies provide for information about the prevalence in the population of children in the United States.

In light of the absence of any information concerning the prevalence of SLI in the U.S. population, an epidemiologic study of SLI was initiated by the National Institute on Deafness and Other Communication Disorders at the beginning of this decade in order to determine the prevalence of SLI in a representative sample of kindergarten-age children. This study was also intended to determine this rate in males and females and different racial and ethnic backgrounds. The objective of this paper is to report estimates of the prevalence of SLI obtained from that study.

Methods

Participants and Sampling

This study used a stratified cluster sample of kindergarten children who were monolingual English speakers. The sample was stratified by residential setting and cluster sampled according to school building. The sample was drawn from three regions of the states of Iowa and Illinois. These regions were centered on large metropolitan areas that will hereafter be referred to as "population centers." Each population center was selected for its ability to contribute an urban sample, with the surrounding areas contributing commensurate suburban and rural samples. The three selected population centers were Des Moines, Cedar Rapids/ Waterloo/Cedar Falls, and the "Quad Cities" that straddle the Mississippi River. The Quad Cities are Davenport, IA, Bettendorf, IA, Moline, IL, and Rock Island, IL.

Sampling Strata Definition—The targeted kindergarten children were distributed into three residential strata: urban, suburban, and rural settings. This provided a sample of children across a spectrum of living and demographic conditions. To achieve this stratified sampling, the attendance zones of the school buildings from the four population centers were drawn and designated as being predominately urban, suburban, or rural.

A general rule to determine residential strata for this study was developed by the investigators based on the two variables of population density and distance from the urban center of each city. Areas designated as "urban" were within 2 miles of the center business district. "Urban" also included areas that were between 2–3 miles of the center business district if the population density was 3,000 or more people per square mile. The "suburban" designation was assigned to areas with a population density greater than 2,000 people per square mile and that did not qualify as being urban. "Rural" areas had a population density less than 2,000 persons per square mile.[1] Because of the influence of the Mississippi River on the geographic layout of Rock Island, IL, the following working definitions of residential strata for that population center were based solely on population density: urban was considered to be greater than 3,000 people per square mile; suburban was between 2,000 and 3,000 people per square mile; and rural was less than 2,000 people per square mile.

Sampling of Elementary Schools—The superintendent of each school district in the selected population centers was asked to allow schools in their district to participate during the course of this 2-year study. A total of 41 districts were contacted: 21 (51.22%) superintendents consented to participate, 15 (36.59%) superintendents refused participation, and no response was elicited from 5 (12.19%) districts. It should be noted that only public school districts were sampled; there was no sampling of private schools or children being home schooled.

[1]There were some exceptions to the general rule for strata designation. Some school buildings had 2 different attendance areas (ex: suburban and rural), and the strata was selected by the investigators that best represented the attendance zone. One school was a kindergarten center that was located in a rural area yet was attended by urban children who were bussed to that center. Also, a few schools were designated as suburban despite having a majority of its attendance zone in rural areas because the majority of its student body came from pockets of high density neighborhoods in the attendance zone.

Each participating school building was assigned a residential stratum (urban, suburban, rural) based on population density of its attendance zone and its distance from the city center. All elementary schools were randomly sampled within each stratum and population center to obtain a minimum total sample of 1,000 students in each of the three strata across all population centers for each year. Because the population of Iowa does not contain a substantial number of African Americans, this sampling strategy was modified to oversample the urban strata, because this strata contained the largest proportion of African Americans.

Table 1 presents the number of children who were sampled over the course of the study as age-eligible participants according to the study site and strata.

Screening and Diagnosis

A cross-sectional design employing a two-stage identification procedure was used. In this design, all children sampled were screened with a brief language screening test consisting of selected items from the TOLD-2:P, to identify a group of children with a high likelihood of having some form of language impairment, and a group with a high likelihood of normal language status. All children who failed the screening, and a sample of approximately 33% of those who passed the screening were then recruited for administration of a diagnostic battery for SLI.

Screening Phase—All monolingual English-speaking kindergartners who were between 5 and 6 years of age on September 15th of that academic year in the selected school buildings were eligible to participate in the study. Those children who were known by the school to be from a bilingual or non-English speaking background were excluded. The majority of the eligible children were located in kindergarten classrooms, with some located in special education classrooms. Because some parents of eligible kindergartners delay enrolling their child for a year, a practice referred to herein as "redshirting," it was necessary to return to each school in the subsequent year to identify "redshirted" children. The parents of all children who were age eligible to participate were sent a letter informing them of the nature and purpose of the study. Because this was a comprehensive screening and the procedure was benign, a negative consent procedure was permitted in which parents could inform the investigators if they did not wish to have their child participate. All children for whom no negative consent was received were tested during the language-screening phase of data collection.

The screening procedure involved only a measure of language performance. Based on pilot work, a language screening test was developed that had a very high predictive accuracy for the diagnostic outcome. The screening tool consisted of 40 items from the Picture Vocabulary, Sentence Imitation, and Grammatic Completion subtests of the Test of Language Development–2: Primary (Newcomer & Hammill, 1988; TOLD-2:P). This screening instrument was administered to each child individually, and took approximately 10 minutes to complete.

All testing was conducted at the school buildings. Children were taken individually to available areas in the school building to be screened. Because some of the children in the study were users of African American English (AAE), there was a concern that these children might be falsely identified as having language deficits. In an effort to decrease this error, scoring guidelines were developed for examiner use when screening potential users of AAE. These scoring guidelines contained examples of acceptable AAE responses to the test stimulus items based upon judgments provided by local members of the African American communities within which the study was conducted. These forms were not counted as errors on these subtests for AAE speakers. A child was considered an AAE speaker if the examiner noted examples of these AAE forms in informal conversation with the child or if two or more responses on Grammatic Completion and Sentence Imitation subtests were consistent with AAE. Subsequent to screening, each child who was screened was assigned a status of pass or fail using a discriminant analysis designed to predict the presence or absence of language impairment in the full diagnostic.

Diagnostic Phase—Children were selected to continue in the second phase of testing based on their screening results. All children who failed the screening, and a random sample of children were invited to continue in the diagnostic testing phase. (Figure 1 shows the flow of participants through the screening and diagnostic phases of the study design). The screening passes were sampled at a ratio of 1 child who failed to 1 child who passed the screening.

Once children were selected to continue in the diagnostic testing phase, written parental permission was solicited via a letter for each child's continued participation in the study. If the parents of the selected children did not respond within a reasonable amount of time, a second letter was mailed. If no response was obtained to this follow-up letter, a telephone call was made to determine whether they had received the letters. A procedure was implemented midway through the study to obtain telephone consent. This procedure allowed for the acceptance of verbal consent for participation in the diagnostic phase of testing. Although written consent was always preferred, verbal consent was accepted and tape recorded during a telephone conversation if the parent or guardian preferred this method of consent.

Exclusionary Criteria—There were several exclusionary criteria at the diagnostic testing phase. The NIDCD contract specified that children who do not have English as their primary language or who come from homes in which a language other than English predominates should be excluded from participation. Therefore, prior to the diagnostic testing of selected children, information was obtained from the parents or guardians of all of the selected children regarding the primary language spoken in the home. This information was obtained from a written questionnaire that accompanied the information letter and consent form described above.

The questionnaire data also provided information regarding the child's history of the exclusionary conditions of mental retardation, autism, and neurologic problems. Children who presented these exclusionary conditions were excluded from further participation in the study because they would not be able to serve as either case or control subjects. Further, children who were identified by the examiners during the screening as being blind or as wearing hearing aids were also excluded from further participation for the same reason.

Diagnostic Battery and Protocol—The diagnostic battery included hearing, language, speech, and nonverbal IQ measures. All children participated individually, and diagnostic testing took approximately 2 hours to complete.

Audiometric testing: Because hearing loss was an exclusionary criterion for the diagnosis of SLI, audiometric testing was performed. The purpose of the audiometric test was to determine if the child had a persistent hearing loss in contrast to a loss due to otitis media. Acoustic admittance/impedance audiometry was also conducted to detect otitis media.

Pure tone screening was conducted for 500, 1, 2, and 4 kHz at 20 dB (American Speech-Language-Hearing Association, 1985). If the child failed the pure tone screening in an ear, pure tone thresholds were obtained and a visual inspection of the ear canal was done. Tympanometry was then done with four measures taken: Static Admittance (YA passing range was .22 to .81); Ear Canal Volume (Vea passing range was .42 to .97); Tympanometric Width (Gradient passing range was 59 to 151); and Tympanometric Peak Pressure (TPP passing range was −139 to +11). If any one of the four measures was failed in an ear, the child was considered to have failed the tympanometry testing for that ear.

If a child failed the pure tone screening bilaterally, no further diagnostic procedures were done, and the child was retested, usually after a period of 2 weeks. If the child failed the pure tone screening unilaterally, the diagnostic testing was continued at that time. For the children who failed the pure tone testing unilaterally or bilaterally at the first screening, a letter was sent to the parents or guardians to notify them of the potential hearing problem and to suggest the appropriate audiologic or medical follow-up as based on the results of tympanometry. Upon retesting the children 2 or more weeks later, those with persisting bilateral failures were treated as children with abnormal hearing and were not given the diagnostic test battery.

Performance IQ testing: All children with SLI were required to have a Performance IQ of greater than 85. To determine this, the Block Design and Picture Completion subtests of the Wechsler Preschool and Primary Scale of Intelligence–Revised (Wechsler, 1989; WPPSI) were administered. These two performance subtests have been reported in the literature as being recommended for use as a short form of the WPPSI Performance scale (LoBello, 1991). Summed scale scores for these two tests of greater than or equal to 16, which reflects a performance intelligence score greater than 87, was used as a passing level for nonverbal IQ.

Diagnostic language testing: In addition to demonstrating passing levels of performance on hearing and nonverbal IQ, children with SLI within this study were required to demonstrate a language impairment as defined by Tomblin, Records, and Zhang (1996). In brief, this definition entailed the use of a battery of language measures based upon selected subtests of the Test of Language Development–2:P (TOLD–2:P; Newcomer & Hammill, 1988) and a narrative story task involving narrative comprehension and narrative production (Culatta, Page, & Ellis, 1983).

The narrative production score reflected the number of propositions contained in the original story that the children included in their story recall. The five TOLD–2:P subtests that were administered were Picture Vocabulary, Oral Vocabulary, Grammatic Understanding, Sentence Imitation, and Grammatic Completion.

The Word Articulation subtest was administered in order to provide information about the association between SLI and phonological disorders; however, these results did not contribute to the language diagnosis.

Raw scores for each of the seven language subtests were converted to standard scores based upon local norms and combined to form five composite scores as described by Tomblin, Records, and Zhang (1996). Failure of the language battery occurred when a child obtained two or more composite scores −1.25 *SD* or more from the mean for the child's age group. This diagnostic standard has been termed the Episli standard (Tomblin, Records, & Zhang, 1996). This Episli standard that uses five composite scores for determination of language impairment has been found to be similar to a single composite score of −1.14 *SD* (Tomblin, Records, & Zhang, 1996).

Training and Reliability of Examiners—The screening was conducted by examiners who had either a bachelor's or master's degree in speech-language pathology or education. The hearing and nonverbal intelligence measures of the diagnostic testing were also conducted by these contracted examiners. The language portions of the diagnostic testing were conducted by speech-language pathologists who held clinical certification from the American Speech-Language-Hearing Association. All examiners were trained by the investigators to administer the testing protocol during training sessions held prior to the first year of data collection. Prior to the second year of data collection, all examiners met for a full-day review session to discuss and review all screening and diagnostic testing procedures and scoring guidelines.

Two certified speech-language pathologists served as the quality controllers. These two quality controllers visited each of the field examiners during the screening and diagnostic phases to monitor protocol compliance throughout the study. Reliability measures were also obtained during these visits to monitor consistency in both administration and scoring during the testing. These measures were obtained by having the quality controller score the children's responses at the same time as the examiner, but blind to the examiner's score.

The data from the quality control visits were used to obtain interexaminer reliability for the screening measures and the diagnostic measures. Agreement on pass-fail screening decisions was computed using the phi statistic. The phi value for the screening outcome for 180 children during the first year was .96 and the second year was .93. This reflected a disagreement in the overall screening outcome for 3 (1.67.%) of the children in year one and 5 (4.6%) in year 2. Similarly, the interjudge agreement for the diagnosis of language impairment in 81 children diagnosed over the course of 2 years of the study was three (3.7%) instances of disagreement.

Results

Screening Phase

The study sample was 7,844 children who were age eligible for kindergarten during the year their school was sampled for inclusion in this study. Table 2 provides a summary of the outcomes of these children. Of the 7,844 children sampled, 118 were known by their kindergarten teacher to be non-English speaking, or for whom English was a second language. Of the remaining 7,726 children, parental consent was denied for 161 and 309 were unavailable for testing, usually because their parents did not provide positive consent in those schools that required this at the screening level. Finally, there were 38 children who were inappropriate to screen due to clear handicapping conditions such as frank neurological impairment, mental retardation, deafness, or blindness. Ultimately, 7,218 children remained who were administered the language screening.

These children were nearly equally distributed across the three residential strata such that 33% lived in rural areas, 30% in suburban areas, and 37% in urban areas. Recall that these three levels of living settings were defined for the purposes of this study. The U.S. Census recognizes regions defined as urban and regions outside urban areas (rural). The Census regions are not defined in the same manner as the terms above. Therefore, the distribution of the sample in this study cannot be directly compared with U.S. census data. This comparison is made more difficult because these strata assignments were based upon the characteristic of the child’s school attendance zone, not the child’s place of residence.

In order to compare the participants in this study with National Census data with regard to the urban-rural distribution, it was necessary to assign each child’s home address to a geographic location using the computer program MapInfo (1992–94) onto which 1990 U.S. census zones defining urban and rural regions were projected. As a result, 83.3% of the children in this study resided in urban areas and 16.7 % lived in rural areas. The 1990 U.S. Census (Bureau of the Census, 1991) showed that 74.6% of 5-year-old children lived in urban areas, whereas 25.4% lived in rural areas. Thus, this research sample contains a greater proportion of children from urban areas than was found in the U.S. population.

Of the children who were screened, 51% were boys and 49% were girls. This distribution is the same as that reported for the U.S. in the 1990 census for 5-year-old children. Race characteristics of the screened children were: 83% White, 12.7% Black, 1.6% Asian, 2.1% His-panic, .6% Native American and .3% of other or unknown racial background. Note that the distribution of racial characteristics was based on records used by the school to report race characteristics of the student population. These values were similar to the 1990 U.S. census, where 80% of the population was White, 12% was Black, and 7.5% were from the remaining groups. Thus, the screened sample deviated from the national population characteristic primarily in having fewer Asians, Hispan-ics, and Native Americans. This deviation, however, is probably due to the greater rates of languages other than English being spoken in these homes, and therefore, children from these backgrounds being eliminated due to the requirement of monolingual backgrounds.

Of the 7,218 children who were screened, 26.8% failed and 73.2% passed the language screening test. This passing rate was designed to maximize the sensitivity of the screening instrument, and, thus, the specificity of the test was intentionally allowed to be low. In this way, most children with language impairment would be identified, and screening errors representing false positive children would be corrected at the diagnostic phase. Because a large number of screening passes, and all screening failures, received the language diagnostic battery, the study design allowed for the determination of sensitivity and specificity of the screening instrument. Of the 512 children who failed the language diagnostic, 88% also failed the language screening. Thus, the sensitivity of the screening measure was .88. Of the 1,417 children who passed the language diagnostic, 69% also passed the screening test and, therefore, the specificity of the screening test was .692. The specificity had no impact on the estimation of prevalence rate.

Correction for Bilingualism in the Screening Sample—Although children in the screening population who were known by the school to be bilingual were not screened, this was not sufficient to identify all bilingual children in the sample. The parents of those children who participated in the diagnostic phase were asked if English was the only language spoken in the home. Among the children who failed the screen and who participated in the diagnostic, 5.1% were non-monolingual English speakers by parental report. Therefore, we estimated that, of the 984 children who also failed the screening, but did not participate in the diagnostic testing, 50 (.051 × 984) were bilingual. Therefore, the number of monolingual English-speaking children who failed the screening was estimated to be 26.2%. Similarly, 2.4% of the screening passes who participated were found to be non-monolingual English speakers. We could, therefore, estimate that 98 (.024 × 4,150) children who passed the screening, but did not participate in the diagnostic testing, were non-monolingual English speakers, and thus we estimate that 73.8% monolingual English speaking children passed the screening. Therefore, the estimated total number of monolingual English speaking children sampled and screened for this study was estimated to be 6,994.

Diagnostic Phase

Table 3 provides the outcome of the diagnostic phase of the study. Of the 3,877 children selected for the diagnostic, 53.8% participated in the study. Of these, 949 failed the screen and 1,135 passed. This participation rate was substantially lower than had been expected. Interviews with school personnel indicated that response rates such as this are not uncommon when school authorities seek parental responses to forms. Some also noted that the legal tone of the informed consent material was complex and likely to be difficult to read for some of the parents and/or threatening to them.

Test for Bias Due to Non-Participation—High rates of participation are desirable within epidemiologic research in order to avoid bias in the sample. However, when participation rates are low an effort should be made to determine if those who did participate were different from those who did not participate with regard to the characteristics of interest (Boyle, 1995). This test for bias could be performed within this study using the children's language screening scores. Figure 2 presents the language screening performance of those who agreed to participate and those who did not participate in the diagnostic phase. It can be seen that within the group of those who failed the screen, the children who participated ($\bar{X} = -1.08$, $SD = .37$) and those who did not participate ($\bar{X} = -1.12$, $SD = .38$) were very similar as shown by an effect size of .096, considered to be a very small effect size (Kirk, 1982). This small effect size is also demonstrated by the fact that only .02% of the screening variance is associated with the children's participation status. Even smaller differences were found for those children who passed the screen where those who did participate had an average screening score of .21 ($SD = .52$) and those who did not participate averaged .22 ($SD = .53$). The effect size for this group was .007, and the percent of variance due to participation approached 0 (−.0002%).

There was also little effect of participation on the demographic variables of stratum and race/ethnicity. As noted earlier, 83.3% of the screened population was urban, whereas 84.1% of the diagnostic group was urban. Similarly, 83% of the screened population were White and 12.7% were Black, whereas in the diagnosed sample 83.6% were White and 13.6% were Black. These data suggest that whatever factors influenced participation in the diagnostic phase, they did not generate a bias in the language or basic demographic characteristics of the sample participating in the diagnostic.

Prevalence of SLI

The group of children who were administered the diagnostic battery were not a representative sample of all children. This was because all screening failures, but only a sample of screening passes, were used in the diagnostic phase. Thus, the diagnosed group contained an excess of children with poor language skills. Therefore, the prevalence of SLI could not be determined by simply dividing the number of SLI children identified in the diagnostic phase by the total number diagnosed. Instead, the rate of SLI in the screening failure group and the screening pass group had to be determined separately. These rates were then weighted by percentage of children in the screening pass and fail groups and then the prevalence of SLI was the sum of these two separate prevalence rates. Figure 3 presents the results of this method and shows the prevalence rate for the monolingual English-speaking children in this study was 7.4% (95% confidence interval; 6.3%–8.5%).

The values contained in Figure 3 were computed from data contained in Tables 2 and 3 as follows. Of the 2,084 children available for diagnosis of SLI, 75 were reported by their parents to speak a second language; thus, there were 2,009 monolingual English-speaking children given the diagnostic protocol. Of these 2,009 children, 901 had failed the screening. Within this group of screening failures, 185 (20.5%) were diagnosed as SLI. The diagnostic protocol was given to 1,108 monolingual English-speaking children who had passed the screening. Within this group, 31 (2.8%) were diagnosed as SLI. Recall from Table 2 that of the estimated 6,994 monolingual English-speaking children who were screened, 26.2% failed, whereas 73.8% passed the screening. The prevalence rate for the total screened population was the product of the screening failure rate (.262) and the SLI rate for the screening failure group (.205) summed with the product of the screening pass rate (.738) and the SLI rate for the screening pass group (.028) (see Table 4).

This prevalence value reflected the rate of SLI using the Episli diagnostic standard in which language impairment was based upon a cutoff at −1.25 *SD* on two of the five composite scores. If a cutoff of −2 *SD* were used, as has been suggested by some (Lahey, 1988; Whitehurst & Fischel, 1994), only 16.2% of these children with SLI would have been diagnosed as SLI, thus reducing the prevalence estimate to 1.12%. As noted earlier, some have proposed that children with SLI should have a significant discrepancy between their language and performance IQ. A discrepancy-based diagnosis similar to that employed by Shepard (1980) for learning disability was computed for the children in this study. A significant discrepancy between performance IQ and language was computed using a regression approach. The difference was computed between obtained and predicted language scores based upon a regression of performance IQ onto language composite scores for each of the child's five composite language scores. A significant discrepancy (90% confidence) was defined as a difference that exceeded the standard error of the error distribution of predictions of language scores given a performance IQ score multiplied by −1.28 (Bloomers & Forsyth, 1977). Using the standard that two or more such discrepancies constituted a discrepancy-based diagnosis of language impairment, 204 (94.4%) of the 216 children diagnosed as SLI using the Episli standard also presented a discrepancy-based language impairment. When this discrepancy standard was applied to the total study sample a prevalence estimate of 13.9% was obtained for all kindergarten children.

Thus, a regression discrepancy diagnosis resulted in a greater prevalence rate than did the Episli standard that employed both age referencing and a cutoff point for performance IQ. This elevated rate was due to regression discrepancies between language and performance IQ occurring across the range of performance in both language and nonverbal areas, whereas the Episli restricted the range of both of these performance domains. Thus, children with performance IQs below 85 contributed to 24% of the regression discrepancy-diagnosed children. Children with chronological age-referenced language performance considered normal by the Episli system made up 23% of the regression discrepancy-diagnosed children.

Rate of SLI by Gender

Of the 216 children diagnosed as SLI, 59% were male and 41% were female. Recall that 51% of the children sampled for this study were male and 49% were female. Thus, the prevalence rate was adjusted for this small difference in number of males and females participating. Within males the prevalence rate for SLI was .08 and among females it was .06. The difference between these two proportions of .02 was not significantly different from 0 (95% confidence interval for difference in proportions: $-.003 \leq .02 \leq .04$).

Rate of SLI by Race/Ethnicity

Figure 4 provides the results according to the race and ethnicity of the child examined. There were variations in the prevalence rate of SLI across these groups; however, with the exception of Asian children, these differences were not large. Native American and African American children presented the highest rate of SLI, followed by Hispanic children, and then White children. None of the 70 Asian children examined were found to present SLI.

Care must be exercised in the interpretation of these data because it is well known that the language measures employed were both linguistically and culturally biased. Although an effort was made to reduce this bias by the use of alternate scoring rules for African American English, this method of correction may not eliminate the linguistic biases and does not address cultural factors associated with standardized testing (Westby, 1995). These differences in the rate of SLI among racial groups were also confounded with differences associated with differences in parental SES that also has been found to be associated with SLI in these data (Tomblin, 1996).

Parental Report and SLI

The prevalence rates obtained in this study were based upon a population sample of children who were studied using a systematic sampling and diagnostic method. When such a research method has been used to study other developmental behavior disorders, it has usually been found that the prevalence is greater and the clinical features are more diverse than what is found in a clinically identified sample. This discrepancy between research identified samples and clinically identified samples is usually found to be the result of a complex set of conditions that lead some affected individuals to seek or be provided with clinical services and others to remain outside of the clinical delivery system (Verhulst, 1995). One of these factors may have to do with the severity of the condition, but others may be concerned with associated conditions and culturally influenced expectations about certain subgroups such as males versus females.

The parents of the children participating in the diagnostic phase of this study were asked if they had been told that their child has a speech or language problem, and, if so, if the child had received or was receiving treatment. Twenty-nine percent of the parents of the 216 children with SLI had been informed that their child had a speech or language problem. When these children were divided into those with composite language scores below 2 *SD* (3rd percentile) and those with composite scores at or above this level, it was found that 39% of the parents of the more severe group had been informed, whereas 27% of the less severe group had been informed.

These data show that many kindergarten children with poor language skills have not been identified by this age and that this discrepancy between clinical identification and our research diagnosis is not due to a different threshold of severity in these two identification systems, because the rate of identification in the more severe group was not substantially greater than that within the less severe group.

Discussion

The objective of this study was to obtain an estimate of the prevalence of SLI in monolingual English-speaking kindergarten children. The prevalence estimate obtained was 7.4%, which is higher than many previous estimates, but falls well within the prevalence range of 6% to 8% estimated for SLI by the American Psychiatric Association (1994). This rate of SLI was also very close to the prevalence rate of 7.66% for reading disability in second graders found by Shaywitz, Shaywitz, Fletcher, and Escobar (1990), in one of the few epidemiologic studies of this condition that is known to be a common outcome of kindergarten language impairment (Catts, 1993).

As noted in the introduction, the existing studies of the prevalence of language impairment in children have not employed diagnostic standards that conform to typical features of SLI. Thus, it is very difficult to make comparisons of these results to most other prevalence studies of developmental language impairment. Given that there are few comparable studies against which the prevalence rate obtained from this study can be compared, the validity of these results rests primarily on the methods employed, particularly on the diagnostic standards and the representativeness of the sample.

Diagnostic Standards

The prevalence rate for any condition will be influenced by the diagnostic standards employed in the study, particularly when the diagnosis is based upon norm-referenced cutoff values as was found within the Episli system. The cutoff values for determining language impairment in this system were consistent with those advocated in the literature and comparable to the standard that children have two test scores below the 10th percentile (Paul, 1995). Tomblin, Records, and Zhang (1996) have shown that the Episli diagnostic standard was very similar to a single composite score cutoff at −1.14 *SD*. Records and Tomblin (1994) studied the clinical decisions made by practicing clinicians and found that the −1 *SD* cutoff level was a good representation of the decisions of a majority of these practitioners. Furthermore, Aram, Morris, and Hall (1993) found that a cutoff of −1 *SD* for the measure of MLU was also the best predictor of clinician referral. Therefore, the Episli criterion used in this study for language impairment was likely to be representative of current clinical practice.

Representativeness of the Sample

The children participating in this study all resided in one limited region of the United States. Therefore, it is not possible to claim that these children are fully representative of the U.S. population. However, due to the use of a stratified sampling procedure, the children in this study were more similar to the U.S. population with respect to race and living environment than to the region from which they were drawn. Another factor that allows these results to be generalized to other populations has to do with the suitability of the test norms to the sample studied. As noted above, the prevalence rate obtained was dependent on a norm-referenced interpretation; thus, for an accurate prevalence estimate it is important that the norms are well suited to the population under study. The norms used for the language measures and performance IQ measures in this study fit the population quite well. Thus, if similar language and performance IQ measures were applied to a national sample of children and these tests were normed appropriately for this national population, similar diagnostic results and prevalence rates should be obtained.

Although the diagnostic standard employed in this study appears to be consistent with clinical practice and the prevalence estimates should be representative of kindergarten children who are monolingual English speakers, a large proportion of those children identified as language impaired had not been identified via systems within their schools and community. This discrepancy between community-based identification rates and the current research identification rate could be due to differences in standards of what constitutes acceptable language skill for children of this age. It does not appear, however, that this discrepancy can be attributed simply to different threshold levels for determining “problem” levels of language, because even children with severe levels of language impairment were often not identified.

Tomblin (1996) recently reported that the principal determinant of a parent being told of a speech or language problem in their child was the child’s articulation performance. Scores obtained on the word articulation test and the expressive language composite score could accurately predict 80% of those children with positive speech or language histories. Thus, community identification appears to be heavily weighted by the child’s expressive skills, particularly the child’s phonological skills. This may be due in part to the fact that expressive problems are those that can be observed by parents and others, whereas receptive skills are much less apparent. Also, problems of speech sound production are uniquely and clearly associated with the clinical service of speech-language pathology, and, therefore, children with such difficulties are most likely to be referred for these services. In contrast, difficulties with comprehension may be attributed to factors such as attention, hearing, or intellect. Thus, children who do seem to be having such difficulties may be referred to psychologists, psychiatrists, audiologists, or other professionals, and receive a different type of diagnosis. It is also possible, if not likely, that some of the children diagnosed under the research standard do not and will not confront any negative consequences as a result of the limited language abilities reflected on the measures employed. These children may be children who test poorly, but who, in other contexts, have adequate language skills. We are currently following the children of this study in part to examine the relationship between this psychometrically based diagnosis and subsequent communication and academic performance.

As noted in the introduction, it has been claimed that there are more males than females with language impairment (Fundudis, Kolvin, & Garside, 1979; Silva, 1980; Stevenson & Richman, 1976). Our results showed that boys indeed were more likely to present SLI, but the ratio of boys to girls of 1.33:1 was far from the expected 2:1 ratio. In fact, the relative rate of SLI in boys and girls in this study is similar to the relative rate of reading impairment in the two groups found by Shaywitz et al. (1990). Shaywitz et al. also found that there was a strong gender difference in school-identified reading impairment and they attributed this to the fact that boys presented more associated problems that prompted referral for reading evaluations. Most of the studies that have reported elevated rates of language impairment in males employed population samples, so a referral bias is not likely to explain the differences between these studies and the current results. These studies did, however, employ a broader diagnostic category that encompassed children with exclusionary conditions as well as children with isolated speech impairments. Recall that Stevenson and Richman (1976) found that the male to female ratio declined when children with mental retardation were excluded from their sample of language impaired children.

All children who participated in this study had been designated as being members of one of several racial or ethnic groups by the school officials. The results showing a greater rate of

SLI among most children of minority backgrounds were not surprising, given the cultural and linguistic bias of the clinical instruments employed. We did use alternate scoring rules for children who showed evidence of using AAE, but this did not affect the receptive language measures, nor did it account for the cultural factors found in the examination setting. Of equal importance, these data are not adjusted for the socioeconomic background of the children participating.

The confounding of race/ethnicity with the socioeconomic variables of parental education and income within the U.S. society is widely documented (Bureau of Health Professions, 1991). In a separate analysis of data obtained from this study of risk factors associated with SLI, we have found that the parent's education is a significant risk factor for SLI (Tomblin, 1996). Thus, the fact that SLI occurred at a greater rate among African Americans, Native Americans, and Hispanics than among Whites was very likely due, at least in part, to the lower levels of parental education and income within these groups.

Conclusions

The findings from this study have shown that SLI is a common condition among kindergarten-age children when compared with the prevalence of many developmental disorders. Based upon our prevalence rate of 7.4% we would estimate from the 1990 U.S. Census that 273,025 of the 3,689,533 5-year-old children in the U.S. presented with SLI. The significance of the magnitude of this number must be interpreted in terms of the morbidity associated with this diagnosis. During the past 20 years there have been several studies demonstrating that children with developmental speech and language problems are at considerable risk for difficulties in reading and certain behavior disorders. Reading impairment during the elementary grades has been found to occur at rates anywhere from 25% (Bishop & Adams, 1990) to 79% (Stark & Tallal, 1988), with other studies reporting intermediate rates of between 40% and 60% (Catts, 1991; Wilson & Resucci, 1988). If these results apply to the current sample of children, we can expect that approximately 50% of these children with SLI will present with reading problems during the early school years. This represents nearly a seven-fold increase in the risk for reading impairment over the general population risk of 7.3% using Shaywitz, Shaywitz, Fletcher, and Escobar's (1990) prevalence estimate for reading impairment. This substantial elevation in risk for reading impairment associated with the diagnosis of SLI must be coupled with evidence that these children are also at similar elevated levels of risk for behavior disorders, especially attention deficit disorder (Beitchman, Nair, Clegg, & Ferguson, 1986; Cantwell & Baker, 1991; Tallal, Dukette, & Curtiss, 1989).

Furthermore, the negative consequences associated with SLI have been found to extend into adulthood. Records, Tomblin, and Freese (1992) reported that young adults with SLI had significantly lower income levels than controls without such history. Under the assumption that the children diagnosed in this study have the same liabilities, we must conclude that due to the sizable prevalence rate of SLI and its associated morbidity, there is a considerable aggregate cost to the quality of life of our nation's children and to the economic productivity of its citizens. This is likely to be further aggravated by the fact that our society is rapidly moving from a work force that depends on physical labor to one that relies on cognitive and communication skills. Given this trend, these children with SLI, who in the past could employ their nonverbal capabilities to their benefit, will now face fewer such opportunities and even greater future risk for social and economic penalties.

Acknowledgments

This study was supported by contract NIH-DC-19-90 from the National Institute on Deafness and Other Communication Disorders. The conduct of this study was aided considerably by a valuable research team comprising the following: Chris Anderson, Kathleen Bailey, Jean Beisler, Lisa Ehlert, Connie Ferguson, Diane Highnam, Joni Mack, Chris McLaughlin, Jacqueline Nesvik, Julie Ann Sellen, Shirley Tiemeyer, Vickie Vandike, and Cathy Wignall.

We wish to thank Trudy Burns for her advice concerning research design and statistical analysis, and the parents and children who were participants in this study. We also would like to thank the following school districts and their staff for their willingness to allow us to conduct this work in their facilities: Bettendorf, Bondurant-Farrar, Carbon Cliff-Barstow, Cedar Falls, Colfax-Mingo, Dallas Center-Grimes, Davenport, Denver, Des Moines Independent, Dunkerton, East Moline, La Porte City, North Scott, Prairie, Reinbeck, Rock Island (IL), Wappsi Valley, Waterloo, and West Des Moines.

References

American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4. Washington, DC: Author; 1994.

Aram DM, Morris R, Hall NE. Clinical and research congruence in identifying children with specific language impairment. Journal of Speech and Hearing Research. 1993; 36:580–591. [PubMed: 8331914]

Bangs, TE. Language and learning disorders of the pre-academic child. New York: Appleton-Century-Crofts; 1968.

Beitchman JH, Nair R, Clegg M, Patel PG. Prevalence of speech and language disorders in 5-year-old kindergarten children in the Ottawa-Carleton region. Journal of Speech and Hearing Disorders. 1986; 51:98–110. [PubMed: 3702369]

Beitchman JH, Nair R, Clegg M, Ferguson B. Prevalence of psychiatric disorders in children with speech and language disorders. Journal of the American Academy of Child Psychiatry. 1986; 25:528–535. [PubMed: 3489024]

Bishop DVM. Is specific language impairment a valid diagnostic category? Genetic and psycholinguistic evidence. Philosophical Transactions of the Royal Society of London B: Biological Sciences. 1994; 346:105–111. [PubMed: 7886145]

Bishop DVM, Adams C. A prospective study of the relationship between specific language impairment, phonological disorders and reading retardation. Journal of Child Psychology and Psychiatry. 1990; 31:1027–1050. [PubMed: 2289942]

Bishop DVM, Edmundson A. Language-impaired 4-year-olds: Distinguishing transient from persistent impairment. Journal of Speech and Hearing Disorders. 1987; 52:156–173. [PubMed: 3573746]

Blommers, P.; Forsyth, R. Elementary statistical methods in psychology and education. New York: University Press of America; 1977.

Bloom, L.; Lahey, M. Language development and language disorders. New York: Wiley; 1978.

Boyle, M. Sampling in epidemiological studies. In: Verhulst, FC.; Koot, HM., editors. The epidemiology of child and adolescent psychopathology. New York: Oxford University Press; 1995. p. 66-85.

Bureau of Health Professions. Health status of minorities and low-income groups. Washington, DC: U.S. Government Printing Office; 1991.

Cantwell DP, Baker L. Prevalence and type of psychiatric disorder and developmental disorders in three speech and language groups. Journal of Communication Disorders. 1987; 20:151–160. [PubMed: 2438307]

Catts H. Early identification of dyslexia: Evidence of a follow-up study of speech and language impaired children. Annals of Dyslexia. 1991; 41:163–176. [PubMed: 24233763]

Catts H. The relation between speech-language impairments and reading disabilities. Journal of Speech and Hearing Research. 1993; 36:948–958. [PubMed: 8246483]

Cole, P. Language disorders in preschool children. Englewood Cliffs, NJ: Prentice-Hall; 1982.

Cole KN, Dale PS, Mills PE. Defining language delay in young children by cognitive referencing: Are we saying more than we know? Applied Psycho-linguistics. 1990; 11:291–302.

Culatta B, Page J, Ellis J. Story retelling as a communicative performance screening tool. Language, Speech, and Hearing Services in Schools. 1983; 14:66–74.

Fey, M. Language intervention with young children. San Diego, CA: College-Hill Press; 1985.

Fundudis, T.; Kolvin, I.; Garside, R. Speech retarded and deaf children: Their psychological development. New York: Academic Press; 1979.

Hall PK, Tomblin JB. A follow-up study of children with articulation and language disorders. Journal of Speech and Hearing Disorders. 1978; 43:227–241. [PubMed: 661261]

Kirk, RE. Experimental design: Procedures for the behavioral sciences. Monterey, CA: Brooks/Cole Publishing; 1982.

Lahey, M. Language disorders and language development. New York: MacMillan Publishing; 1988.

Lahey M. Who shall be called language disordered? Some reflections and one perspective. Journal of Speech and Hearing Disorders. 1990; 55:612–620. [PubMed: 2232742]

Lassman, FM.; Fisch, RO.; Vetter, DK.; La Benz, ES. Early correlates of speech, language, and hearing. Littleton, MA: PSG Publishing; 1980.

Lee, L. Developmental sentence analysis. Evanston, IL: Northwestern University Press; 1974.

LoBello SG. A short form of the Wechsler Preschool and Primary Scale of Intelligence–Revised. Journal of School Psychology. 1991; 29:229–236.

MapInfo. MapInfo users guide. Troy, NY: MapInfo Corp; 1992–1994.

Newcomer, P.; Hammill, D. Test of Language Development–2 Primary. Austin, TX: Pro-Ed; 1988.

Paul, R. Language disorders from infancy through adolescence: Assessment and intervention. St Louis, MO: Mosby; 1995.

Paul R, Cohen DJ. Outcomes of severe disorders of language acquisition. Journal of Autism and Developmental Disorders. 1984; 14:405–421. [PubMed: 6084003]

Randall D, Reynell J, Curwen M. A study of language development in a sample of three-year-old children. British Journal of Disorders of Communication. 1974; 9:3–16. [PubMed: 4433458]

Records NL, Tomblin JB. Clinical decision making: Describing the decision rules of practicing speech-language pathologists. Journal of Speech and Hearing Research. 1994; 37:144–156. [PubMed: 8170120]

Records NL, Tomblin JB, Freese PR. Quality of life in adults with histories of specific language impairment. American Journal of Speech-Language Pathology. 1992; 1:44–53.

Reynell, J.; Huntley, M. Reynell Developmental Language Scales. Windsor, England: NFER Publishing; 1977.

Rice ML, Sell MA, Hadley PA. Social interactions of speech and language impaired children. Journal of Speech and Hearing Research. 1991; 34:1299–1307. [PubMed: 1787712]

Richman, N.; Stevenson, J.; Grahm, P. Pre-school to school: A behavioral study. London: Academic Press; 1982.

Shaywitz SE, Shaywitz B, Fletcher J, Escobar M. Prevalence of reading disability in boys and girls: Results of the Connecticut longitudinal study. Journal of the American Medical Association. 1990; 264:998–1002. [PubMed: 2376893]

Shepard L. An evaluation of the regression discrepancy method for identifying children with learning disabilities. Journal of Special Education. 1980; 14:79–91.

Silva PA. The prevalence, stability and significance of developmental language delay in preschool children. Developmental Medicine and Child Neurology. 1980; 22:768–777. [PubMed: 7450301]

Silva PA, McGee R, Williams S. Developmental language delay from three to seven years and its significance for low intelligence and reading difficulties at age seven. Developmental Medicine and Child Neurology. 1983; 25:783–793. [PubMed: 6653911]

Stark R, Tallal P. Selection of children with specific language deficits. Journal of Speech and Hearing Disorders. 1981; 46:114–122. [PubMed: 7253588]

Stark, R.; Tallal, P. Language, speech, and reading disorders in children: Neuropsychological studies. San Diego, CA: College-Hill; 1988.

Stevenson J, Richman N. The prevalence of language delay in a population of three-year-old children and its association with general retardation. Developmental Medicine and Child Neurology. 1976; 18:431–441. [PubMed: 955307]

Tallal, P. Developmental language disorders. In: Kavanaugh, JF.; Truss, TJ., editors. Learning disabilities: Proceedings of the national conference. Maryland: York Press; 1988. p. 181-272.

Tallal P, Dukette D, Curtiss S. Behavioral/ emotional profiles of preschool language-impaired children. Development and Psychopathology. 1989; 1:51–67.

Tomblin, JB. Risk factors associated with specific language disorder. In: Wolraich, M.; Routh, DK., editors. Developmental and behavioral pediatrics. Philadelphia: Jessica Kingsley Publishers; 1992. p. 131-158.

Tomblin, JB. The big picture of SLI: Epidemiology of SLI. Paper presented at the Symposium on Research in Child Language Disorders; Madison, WI. 1996.

Tomblin JB, Records NL, Zhang X. A system for the diagnosis of specific language impairment in kindergarten children. Journal of Speech and Hearing Research. 1996; 39:1284–1294. [PubMed: 8959613]

U.S. Bureau of the Census. Census of population and housing (1990): Summary tape file 3 technical documentation. Washington DC: Author; 1991.

Verhulst, F. The epidemiology of child and adolescent psychopathology: Strengths and weaknesses. In: Verhulst, F.; Koot, H., editors. The epidemiology of child and adolescent psychopathology. Oxford: Oxford University Press; 1995. p. 1-21.

Vetter, D.; Fay, W.; Winitz, H. Language. In: Lassman, F.; Fisch, R.; Vetter, D.; La Benz, E., editors. Early correlates of speech, language, and hearing. Littleton, MA: PSG Publishing; 1980. p. 266-329.

Wechsler, D. WPPSI-R Manual: Wechsler Preschool and Primary Scale of Intelligence–Revised. New York: Psychological Corporation; 1989.

Westby, C. Multicultural issues. In: Tomblin, JB.; Morris, HL.; Spriestersbach, DC., editors. Diagnosis in speech-language pathology. San Diego, CA: Singular Publishing; 1995. p. 29-51.

Whitehurst G, Fischel J. Practitioner review: Early developmental language delay: What, if anything, should the clinician do about it? Journal of Child Psychology and Psychiatry. 1994; 35:613–648. [PubMed: 8040218]

Wilson, B.; Resucci, D. The early identification of developmental language disorders and the prediction of the acquisition of reading skills. In: Masland, R.; Masland, M., editors. Preschool prevention of reading failure. Parkton, MD: York; 1988. p. 187-203.

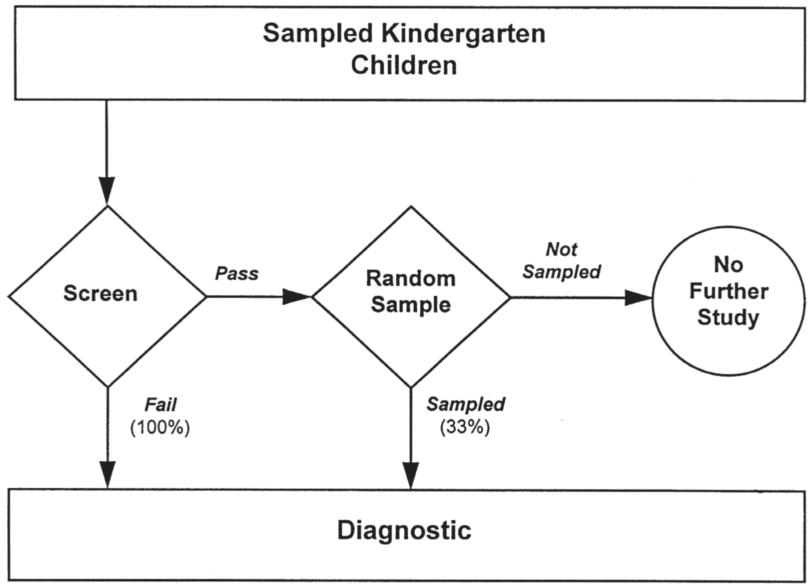

Figure 1.
A diagram of flow of participants through the screening and diagnostic phases of the study design.

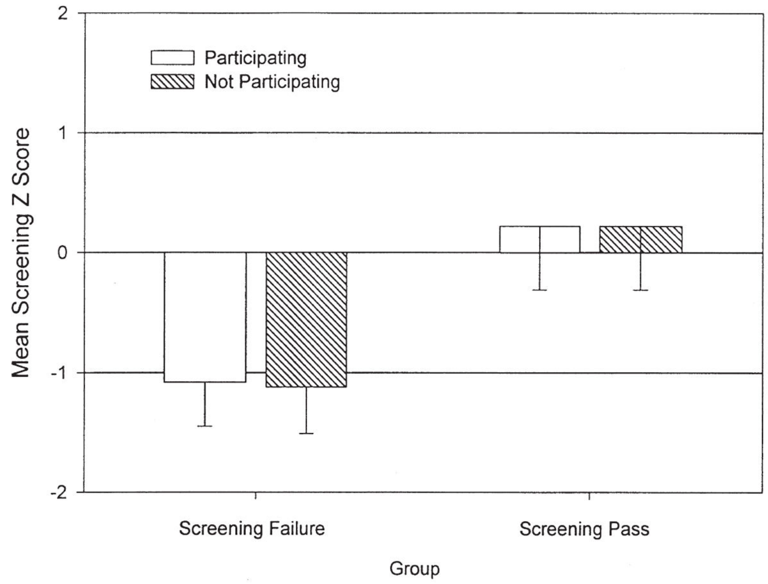

Figure 2.
Means and standard deviations on the language screening test of children who participated and children who did not participate in the diagnostic phase.

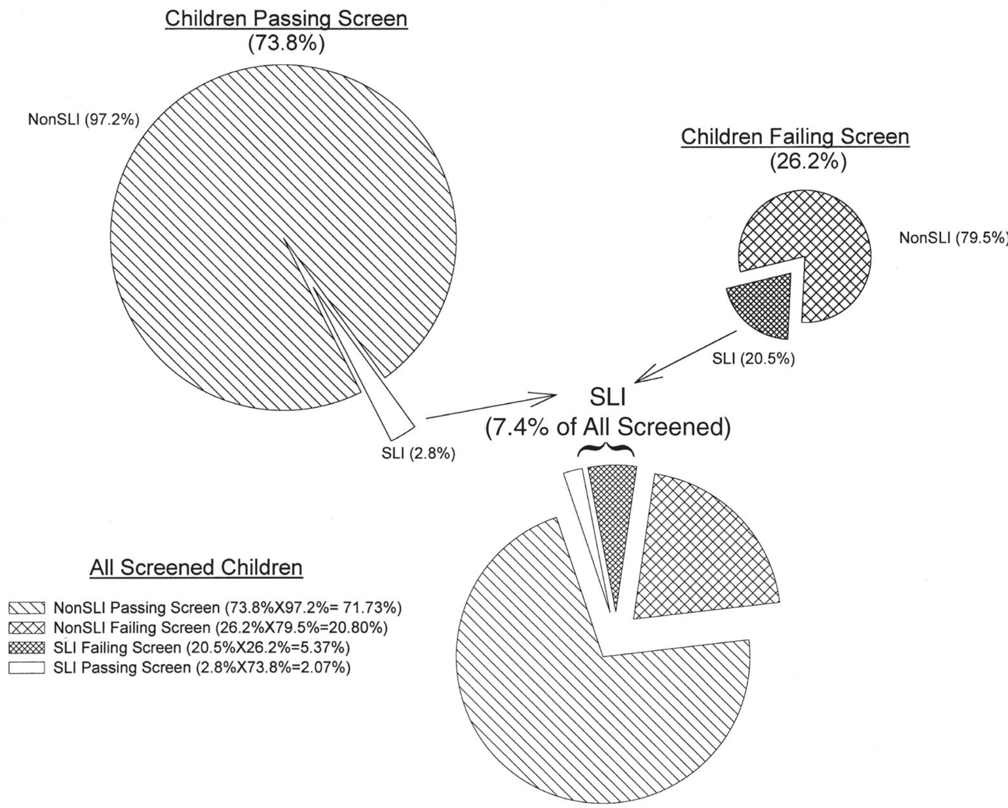

Figure 3.

Prevalence rates of SLI among children who passed and failed the language screening and the resulting estimated prevalence rate for the sample of children screened.

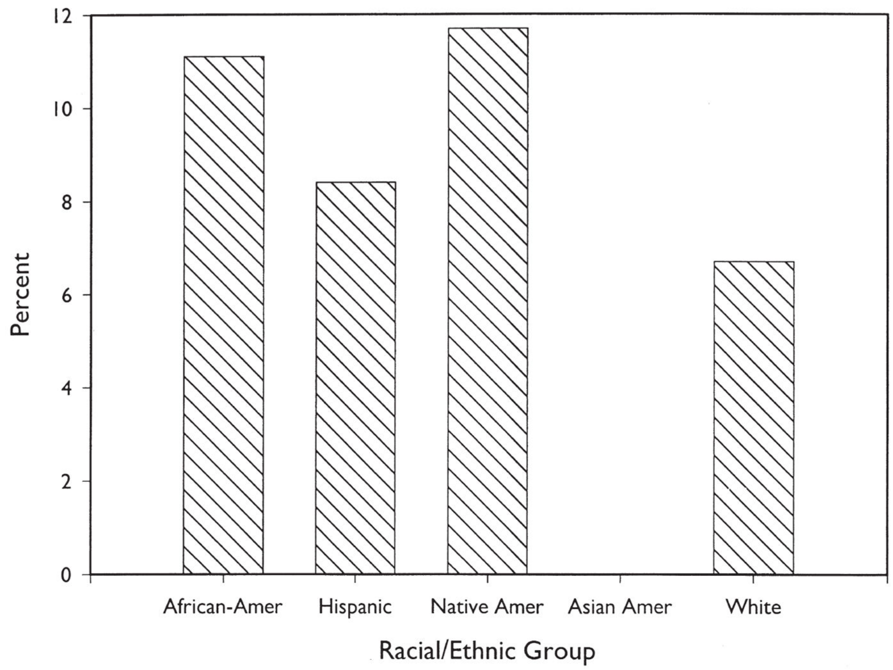

Figure 4.
Prevalence of SLI across racial/ethnic groups.

Table 1

Number of participants by study site and residential strata.

	Strata		
Site	**Rural**	**Suburban**	**Urban**
Des Moines	655	789	754
Waterloo/Cedar Rapids	888	665	957
Quad Cities	814	695	1001

Table 2

Number of children sampled, number screened, and results of screening according to language background.

Total number of age-eligible children		**7,844**
Children known to be bilingual	118	
Children not available for screening	470	
Children with severe exclusionary conditions	38	
Number of participants in screening		7,218
Number passing screen	5,285	
Number failing screen	1,933	
Estimated monolingual English-speaking children screened		6,994
Estimated monolingual passes	5,159 (73.9%)	
Estimated monolingual failures	1,835 (26.2%)	

Table 3

Number of children selected for diagnosis, number participating in diagnosis, and number of children diagnosed as SLI.

Age-eligible children sampled for diagnosis		**3,877**
Children consenting		2,084
Monolingual English-speaking children participating in diagnosis		2,009
Screening passes	1,108	
Screening fails	901	
Number of children diagnosed as SLI		216
Screening passes with SLI	31	
Screening fails with SLI	185	

Table 4

Summary of rates of specific language impairment within each screening group and resulting prevalence for SLI.

	Screening group		
	Pass	**Fail**	**Sum**
All children screened	.738	.262	
Prevalence of SLI	.028	.205	
Weighted prevalence of SLI	.02066	.05371	.074

Note. Weighted prevalence rates are the product of values in row 1 and row 2 and reflect the proportion of all screened children with SLI within each screening group. The sum of these weighted prevalence rates is the prevalence rate for the total screened sample. The 95% confidence interval for this total prevalence rate is 6.3%–8.5%.