

REFERENCE	DESIGN	RECRUITMENT	CASE DEFINITION	SUBJECTS	ASSESSMENT TOOLS	RESULTS	AUTHOR'S CONCLUSIONS
Blair J, Peterson M, Viehwed S. The effects of mild sensorineural hearing loss on academic performance of young school-age children. The Volta Review. 1985;87: 87-93.	<p>Case-matched control.</p> <p>Compared children with mild-moderate hearing loss with matched hearing controls and national norms.</p> <p>2-way repeated measures analysis of variance.</p> <p><i>Research Question:</i> Do children with mild-moderate SNHL* differ on standard measures of academic achievement compared with a group of matched hearing controls and national norms?</p>	<p>Subjects selected from records of district audiologist.</p> <p>All from same school district.</p>	<p>20-45dB* in better ear.</p> <p>Most identified after age 5 years.</p> <p>4 wore hearing aids.</p>	<p>Total: N = 48</p> <p>With hearing loss: N = 24</p> <p>Controls: N = 24</p> <p>Age: 1st-4th grades (Actual ages not reported.)</p> <p>All normal IQ.</p> <p>Groups matched on age, sex, socio-economic status, and school experience.</p>	<p>Achievement test scores obtained from district office for previous and current academic years.</p> <p>Iowa Test of Basic Skills used by the district: Comprehensive score and sub-sections: -vocabulary -work analysis -reading -math (concepts and problems)</p>	<p>Scores from students with hearing loss not "noticeably different" from national norms; control students' scores were above national norms.</p> <p>Controls consistently scored higher on all tests.</p> <p>For 2nd grade, the lag was still evident, but not worse than in 1st grade.</p> <p>Differences greater in vocabulary, reading comprehension, and language use than in arithmetic scores.</p> <p>For 4th grade, there were statistically significant differences for all measures.</p>	<p>Permanent mild hearing loss in children during the early school years has a negative effect on academic performance, especially in the area of language.</p> <p>Some evidence suggests negative effect might increase with age.</p>

*SNHL = sensorineural hearing loss; dB = decibel

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Briscoe J, Bishop DV, Norbury CF. Phonological processing, language, and literacy: a comparison of children with mild-to-moderate sensorineural hearing loss and those with specific language impairment. <i>J Child Psychol Psychiatry</i> . 2001;42(3):329–40.	<p>Case-matched control.</p> <p>Compared children with mild–moderate SNHL* with children with SLI* and controls.</p> <p>Univariate analyses of variance for all measures.</p> <p><i>Research Questions:</i> 1) How are phonological discrimination, awareness, and STM* influenced by mild–moderate hearing loss in childhood? 2) Do children with mild–moderate hearing loss resemble children with SLI in level or pattern of phonological skills? 3) Are phonological impairments in children with hearing loss related to other language and literacy attainments?</p>	<p>Children with SNHL from Peripatetic Services for children with hearing loss in 8 regions of Eastern England.</p> <p>Children with SLI from 3 specialist language units in Oxfordshire England and 1 residential school for SLI children in Nottingham, England.</p> <p>Control children from primary schools in Oxfordshire area. Several randomly selected from classrooms of children with SNHL.</p>	<p>PTA* in better ear. .25, .5, 1, 2, 4 kHz.*</p> <p><i>High Frequency:</i> Hearing thresholds >25dB* at frequencies ≤2 kHz, but with PTA < 20dB (N = 3).</p> <p><i>Mild:</i> 20–40dB PTA (N = 13).</p> <p><i>Moderate:</i> 41–70dB PTA (N = 3).</p>	<p>Total: N = 77</p> <p><i>SNHL:</i> N = 19 Mean age 8.66 years (5.91–10.66); mainstreamed; did not use sign language.</p> <p><i>SLI:</i> N = 20 Mean age 8.96 years (7.20–10.91); N = 20.</p> <p><i>Controls:</i> N = 23</p> <p>Control group A: N = 20; chronologically age-matched to SNHL; mean age 8.49 years.</p> <p>Control group B: N = 15; language-age matched to SLI; mean age 7.40 years.</p>	<p>Raven's Coloured Progressive Matrices.</p> <p>British Picture Vocabulary Scales.</p> <p>Test for Reception of Grammar.</p> <p>Recalling Sentences subtest from CELF-R.*</p> <p>Children's Test of Nonword Repetition.</p> <p>Word Finding Test; 3 subscales: - Basic Reading - Reading Comprehension - Objective Reading Dimensions.</p> <p>Graded Non-word Reading Test.</p> <p>Tests of phonological skills and STM.</p>	<p>Children with mild–moderate SNHL were as impaired as normally hearing children with SLI on tests of phonological discrimination, phonological awareness and non-word repetition.</p> <p>The SNHL group did more poorly on tests of phonological STM, phonological discrimination, and phonological awareness than the chronologically age-matched controls.</p> <p>Children with SNHL did not show the pervasive difficulties with language and literacy that characterize SLI.</p>	<p>Study suggests that auditory deficit can compromise phonological skills, especially phonological short-term memory, but this does not invariably lead to serious impairments in verbal memory or literacy.</p>

*SNHL = sensorineural hearing loss; SLI = specific language impaired; STM = short-term memory; PTA = pure tone average; kHz = kilohertz; dB = decibel; CELF-R = Clinical Evaluation of Language Fundamentals-R

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Brown J. Examination of grammatical morphemes in the language of hard-of- hearing children. <i>Volta Review</i> . 1984;86: 229– 38.	<p>Group comparisons. <i>T</i>-test comparing proficiency on production of present progressive 'ing', preposition 'in', article 'a', copula and auxiliary 'be'.</p> <p>Examination of rank- ordered data. Brown's 14 grammatical morphemes analyzed in obligatory contexts.</p> <p><i>Research Questions:</i> Do HH* children differ in their ability to use grammatical morphemes compared with control children of the same language level?</p> <p>What is the specific use of grammatical morphemes of HH children?</p> <p>What is the order of acquisition of grammatical morphemes by HH children?</p>	Not reported.	<p><i>HH Children:</i> PTA* = .5, 1, 2 kHz* in better ear.</p> <p>Mean PTA = 54dB.*</p> <p>Range = 40– 85dB.</p>	<p>Total: N = 20</p> <p><i>With Hearing Loss:</i> N = 10; Age 5 years, 3 months–15 years. Mean age 9 years, 6 months.</p> <p><i>Controls:</i> N = 10; Ages: 1 year, 9 months–6 years, 10 months. Mean age 4 years.</p> <p>All middle socioeconomic status.</p> <p>Matched based on MLU.*</p> <p>MLU for both groups 1.40–8.66; mean 5.60</p> <p>(Detailed table of subjects on page 231).</p>	<p>50 utterance language sample for each subject based on 1st 10 plates from Children's Apperception Test, 1954.</p> <p>Additional probes asked if not enough utterances obtained.</p> <p>Brown's 14 grammatical morphemes analyzed in obligatory contexts.</p> <p>Grammatical morphemes associated with 5 or more obligatory contexts and used by 4 or more children per group were analyzed.</p>	<p>No significant differences between groups for correct use of any grammatical morphemes tested.</p> <p>HH children used grammatical morphemes more accurately.</p> <p>Important to note that HH children were severely delayed compared with controls; Average of 5 ½ years delay.</p> <p>Order of acquisition was the same for both groups.</p> <p>Therefore, the HH child is severely delayed in his/her rate of acquisition despite equivalent language proficiency.</p>	<p>Language of HH children was not atypical, but severely delayed.</p> <p>This suggests the most effective intervention process should be based on a normal developmental sequence for language acquisition.</p>

*HH = hard of hearing; PTA = pure tone average; kHz = kilohertz; dB = decibel; MLU = mean length of utterance

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Davis JM, Elfenbein J, Schum R, Bentler RA. Effects of mild and moderate hearing impairments on language, educational, and psychosocial behavior of children. J Speech Hear Disord. 1986;51(1): 53–62.	<p>2-way analyses of variance (3 levels of hearing loss by 2 levels of age).</p> <p>Correlations among variables also performed.</p> <p>Scores analyzed by: -Degree of hearing loss. -Test condition (quiet or noise). -Aided or unaided.</p> <p><i>Research Question:</i> Are there significant differences among children's characteristics and performance as a function of age and degree of hearing loss?</p>	112 children identified from University of Iowa Speech and Language Clinic or from school districts who met study criteria.	<p>PTA:* .5, 1, 2 kHz.*</p> <p>3 hearing loss groups:</p> <p>Group A: ≤ 44dB* PTA (N = 16).</p> <p>Group B: PTAs 45–60 dB (N = 15).</p> <p>Group C: Loss of ≥ 61dB (N = 9).</p> <p>Each hearing loss group subdivided into age groups < and ≥ 12 years.</p>	<p>Total: N = 40</p> <p>With hearing loss: N = 40</p> <p>Ages: 5–8 years.</p> <p>IQ range: 85–125.</p> <p>All had SNHL* at or shortly after birth (none later than age 2 years).</p> <p>All but 2 children wore hearing aids.</p> <p>Detailed tables of subjects provided.</p> <p>All middle class.</p>	<p><i>Audiology:</i> Air and bone conduction (aided and unaided), SRTs,* impedance.</p> <p><i>Speech/Language:</i> PPVT-R;* Fisher-Logeman Test of Articulation Competence; Grammatical Completion subtest of TOLD;* 2 language samples (1 evoked by story pictures and 1 from interview responses).</p> <p><i>Psychological:</i> WISC-R.*</p> <p><i>Academic</i> (not administered to 5 and 6 year olds): Reading Comprehension subtest of PIAT;* Mathematics test of Woodcock-Johnson Psycho-Educational Battery.</p>	<p>No differences in IQ between SNHL groups (A, B, and C).</p> <p>Differences in IQ between performance (SNHL group <i>above</i> norm) and verbal (SNHL group below norm).</p> <p><i>Vocabulary:</i> No differences between SNHL groups but only 6 of 40 scored above norms.</p> <p><i>Psycho-Educational:</i> No differences between SNHL groups on verbal subtests.</p> <p><i>Academic:</i> No differences between SNHL groups or between age categories; SNHL groups not below norms.</p> <p><i>Correlations:</i> Degree of hearing loss correlated with age at which hearing aid obtained, aided SRTs,* and speech recognition scores. Strongest correlations between audiological measures and verbal ability, and verbal measure and reading and math.</p> <p><i>Personality Tests:</i> All children with SNHL scored higher than norm on scales of aggression and somatization. Children with SNHL rated by parents as having more problems interacting with others, and establishing friendships, and more difficulty in school.</p>	<p>Degree of hearing loss alone did not predict child's language or educational performance.</p> <p>Performance of children with SNHL in this sample did not worsen with age.</p> <p>Regardless of age and degree of hearing loss, children exhibited delays in verbal skills, academic achievement, and social development (verbal measures most directly related to degree of hearing loss).</p> <p>Results showed children with hearing loss were heterogeneous and effects of hearing loss varied from child to child.</p>

*PTA = pure tone average; kHz = kilohertz; dB = decibel; SNHL = sensorineural hearing loss; SRT = speech reception threshold; PPVT-R = Peabody Picture Vocabulary Test-Revised; TOLD = Test of Language Development; WISC-R = Wechsler Intelligence Scale for Children-Revised; PIAT = Peabody Individual Achievement Test

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Elfenbein JL, Hardin-Jones MA, Davis JM. Oral communication skills of children who are hard of hearing. J Speech Hear Res. 1994; 37(1):216–26.	<p>Group comparisons using 2- and 3-way analyses of variance.</p> <p><i>Research Objectives:</i> Describe the oral communication skills of children with mild–severe hearing loss.</p> <p>Determine where their skills lie along a continuum between children who are hearing and children who are deaf.</p>	<p>Participants from a larger study concerning psychoeducational development.</p> <p>Controls recruited from the Iowa City area.</p>	<p>PTA* = .5, 1, 2, kHz* except when differences of 20dB* or more occurred between threshold for adjacent frequencies. Then, PTA = .5 and 1 kHz.</p> <p>3 hearing loss groups; <i>Group A:</i> <45dB <i>Group B:</i> 45–60dB <i>Group C:</i> >60dB. (Table 1, page 217 shows detailed characteristics of the 3 groups of children with hearing loss).</p> <p><i>Controls:</i> All had PTA (.25–8 kHz) ≤ 15 dB.</p>	<p>Total: N = 56</p> <p>With hearing loss: N = 40; aged 5–18 years.</p> <p>Normal IQ and enrolled in a regular classroom.</p> <p>Controls: N = 16.</p> <p>2 age groups for analyses; <12 years and ≥12 years.</p>	<p>Battery of tests, interview, and speech sample via story recall test.</p> <p>Results of speech and expressive language only were reported in the article.</p> <p><i>Speech Skills:</i> Fisher-Logemann Test of Articulation Competence.</p> <p><i>Language Skills:</i> Grammatic Completion subtest of the Test of Language Development.</p>	<p>Age was the only significant factor in total articulation errors produced: Degree of hearing loss and interaction between factors not significant.</p> <p>Even mildest hearing loss resulted in misarticulation of fricatives.</p> <p>Children in hearing loss groups showed that oral language errors were related to degree of loss, but none approached the severity of deficits typically reported for profound loss.</p> <p>All 3 groups of children made significantly more pragmatic errors than control children, but there were no differences between the 3 hearing loss groups.</p> <p>There were no differences between the mildest hearing loss group (A) and the control group on syntactic/semantic errors; but groups B and C were different from controls.</p>	<p>In general, neither the production of speech nor the oral expression of language appeared to be severely affected by hearing loss.</p> <p>However, some errors in speech production were noted in all three groups.</p> <p>Language problems of hard of hearing children should be targeted for remediation or prevention before they progress through school and need more extensive services.</p>

*PTA = pure tone average; kHz = kilohertz; dB = decibel

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Gilbertson M, Kamhi AG. Novel word learning in children with hearing impairment. <i>J Speech Hear Res.</i> 1995;38(3): 630–42.	Case-matched control. Chi-square and correlational analyses. <i>Research Questions:</i> Do children with mild–moderate hearing loss differ from hearing children in acquiring and retaining 4 novel words? Is word learning ability related to hearing level, vocabulary knowledge, phonological processing abilities, and other measures of language?	Not reported.	Mean for 3, 4, and 5 frequency PTAs* provided for all children with hearing loss. Mean 3-frequency PTA = 42dB.* Mean 4-frequency PTA = 46.13dB. Mean 5-frequency PTA = 48.75dB. Unaided SRT* scores in better ear of hearing loss group had mean of 35dB HTL,* and range of 5–65dB HTL.	Total: N = 40 <i>With Hearing Loss:</i> N = 20; mean age 9 years (7 years, 9 months–10 years, 7 months). All aided and mainstreamed. Only children within normal limits on TONI* and Arizona Articulation Proficiency Scale included in study. Children with hearing loss sub-divided into high- and low-functioning based on word-learning paradigm. <i>Controls:</i> N = 20; mean age 6 years, 5 months (5 year, 1 month–9 years, 7 months). ~2½ years younger than hearing loss group to ensure children in both groups had the same receptive vocabulary.	<i>Nonverbal Intelligence:</i> TONI <i>Speech:</i> Arizona Articulation Proficiency Scale and PPVT-R* <i>Language:</i> EOWPVT; * SPELT-II;* GU-TOLD;* Lexical acquisition task. 1 st session: nonverbal intelligence, vocabulary, articulation, and other language tests. 2nd session: lexical acquisition task (acquisition stage and retention stage). 4 nonsense words used.	Control children performed better on production task but no differences in recognition task between controls and children with hearing loss. Phonological processing: Control children performed better on 3-word repetition tasks and children with hearing loss performed better on rapid-naming tasks. For children with hearing loss, performance on word-learning task highly correlated with PPVT-R, EOWPVT, and SPELT-II but not with phonological processing measures. Step-wise multiple regression showed PPVT-R score was sole predictor of word learning task performance. Degree of hearing loss not related to word learning or language performance. Children in higher functioning hearing loss group performed better than lower functioning subgroup on word-learning and nonverbal intelligence.	The high-functioning hearing loss group performed comparably to the control group on all measures. The lower functioning hearing loss group was characterized as language-impaired. Poorer performance of lower-functioning hearing loss group did not seem to reflect a more general cognitive deficit. There might be a group of children with hearing loss who have concomitant learning disabilities. One out of every two children with a hearing loss might be language-impaired.

*PTA = pure tone average; dB = decibel; SRT = speech reception threshold; HTL = hearing threshold level; TONI = Test of Nonverbal Intelligence; PPVT-R = Peabody Picture Vocabulary Test-Revised; EOWPVT = Expressive One-Word Picture Vocabulary; SPELT-II = Structured Photographic Expressive Language Test II; GU-TOLD = Grammatical Understanding subtest of Test of Language Development-2

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Halliday LF, Bishop DV: Frequency discrimination and literacy skills in children with mild to moderate sensorineural hearing loss. J Speech Lang Hear Res. 2005; 48: 1187–1203.	Two groups of children were given psychometric and auditory assessments (a) to investigate whether children with mild-to-moderate sensorineural hearing loss were impaired in their ability to discriminate tones of different frequencies, (b) to determine whether any impairment might be attributable to a deficit in phase locking, and (c) to consider whether frequency discrimination abilities might predict literacy and phonological skills.	SNH*: 12 of the 22 children were approached following their participation in an earlier project. The other 10 were recruited via Peripatetic Services for children with hearing loss in 5 regions in South East England. Invitations were given to teachers to pass on to parents of children who met criteria. CA*: Children with no known educational difficulties or history of speech and language problems were matched with children in the SNH group on chronological age and sex. 14 of the CA group were randomly selected from the classrooms of the SNH group. The other 8 were recruited from local primary and middle schools.	Children 6–13 years of age. SNH group divided into 2 categories of hearing loss: Mild: PTA* (.25, .5, 2, 4 kHz*) threshold of 20–40 dB* HL*; Moderate: PTA threshold of 41–70 dB. CA group: Efforts taken to match CA children with children in the SNH group on basis of SES*. All of CA group had PTA thresholds less than 20 dB.	SNH group: 10 boys, 12 girls with mean age of 10.47 years. CA group: 10 boys and 12 girls with mean age of 10.33 years.	Auditory assessment: Frequency discrimination was assessed at 1 kHz and at 6 kHz. Psychometric measures: Nonverbal ability: Matrices Reasoning subtest of the Wechsler Abbreviated Scales of Intelligence. Grammatical abilities: computerized version of the Test for the Reception of Grammar. Expressive and receptive language: Expressive subtest of the One Word Picture Vocabulary and the receptive subtest of the One Word Picture Vocabulary. Reading accuracy and fluency: Version A of the Test of Word Reading Efficiency. Phonological processing and phonological memory: Repetition of Nonsense Words subtest from the Developmental Neuropsychological Assessment.	Overall the SNH group performed worse than the CA group. The SNH group performed worse than the CA controls across all syllable levels. Both SNH and CA groups performed at approximately age-appropriate levels for all measures except the test of non-word repetition in which both groups performed below the mean. The SNH group scored significantly higher than the CA group on test of nonverbal cognitive ability. Scores on the repetition of non-words showed a strongly bimodal distribution in the CA group.	Children with mild-to-moderate sensorineural hearing loss might also have considerable difficulty with tasks that require them to discriminate sounds of different frequency; these deficits are not confined to low-frequency stimuli. The study indicated the importance of analyzing within-group correlations when considering associations between language and psychophysical tests, especially when investigating children with auditory difficulties. The results suggest that rather than poor frequency discrimination skills predicting poor language abilities, good performance on measures of frequency discrimination predicts good phonological processing and literacy.

*SNH = sensorineural hearing loss group; CA = chronological age-matched control group; PTA = pure tone average; kHz = kilohertz; dB = decibels; HL = hearing level; SES = socioeconomic status.

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Hansson K, Sahlén B, Mäki-Torkko M. Can a "single hit" cause limitations in language development? A comparative study of Swedish children with hearing impairment and children with specific language impairment. <i>Int J Lang Comm Disord.</i> 2007;42(3): 307–323.	The purpose of the study was to compare language skills among children with hearing loss with children with SLI* in relation to hearing levels, age, nonverbal IQ*, and PSTM*. PSTM, output phonology, lexical ability, receptive grammar, and verb morphology were assessed among two groups of children.	Parents received written and oral information about the project and signed an informed consent form. Study was approved by the research ethics committee of the Medical Faculty, Lund University. Testing sessions took place at the Department of Logopedics, Phoniatrics and Audiology, Lund University, Sweden.	Two groups: Children with bilateral mild–moderate hearing loss who were educated in an oral setting and who had hearing parents. Children with SLI who had no hearing loss (<20 dB* HL*) and nonverbal cognitive skills within normal limits, but identified as having grammar difficulties.	Total of 23 children aged 5.6–9.0 years. 11 children who had bilateral sensorineural mild–moderate hearing loss (30–71 dB HL). 12 children with SLI who had no hearing loss.	Swedish language versions of the tests administered by a SLP* and an audiologist. Sessions were audio-taped and videotaped. IQ tested with RSPM*. Nonword repetition test to assess PSTM. Output phonology measured with picture-naming test. Receptive vocabulary assessed with PPVT*. Lexical organization and retrieval assessed with auditory associations subtest of ITPA*. Lexical access measured with RAN*. Receptive grammar assessed with TROG*. Finite verb morphology assessed with tasks eliciting past tense forms of new and novel verbs.	The children with hearing loss scored higher than the children with SLI on all tests except the TROG. The children with hearing loss did not differ significantly from 5–6 year-old norms, but were significantly below norms for children aged 6.4 to 7.4 years. The SLI group performed significantly below the 5–6 year-old norms. Their nonword repetition correlated significantly with expressive phonology. The children with hearing loss performed close to ceiling on expressive phonology, whereas the SLI group had a significantly lower mean and a lot of variation. Comparison with norms for Swedish indicated that the children with hearing loss scored significantly lower than expected for their age on nonword repetition, PPVT, auditory associations, TROG, and inflection of novel verbs.	What most distinguished the children with hearing loss from the children with SLI were phonological skills, lexical access, and inflection of known verbs. The two groups were more similar in PSTM, vocabulary, and receptive grammar. Language problems were more severe among younger children with hearing loss but were not as visible in verb morphology as they were among children with SLI. Nonword repetition showed some relation to hearing level for the children with hearing loss, suggesting their perceptual deficit might have influenced their PSTM.

*SLI = specific language impairment; IQ = intelligence quotient; PSTM = phonological short-term memory; dB = decibel; HL = hearing level; SLP = speech-language pathologist; RSPM = Raven's Standardized Progressive Matrices; PPVT = Peabody Picture Vocabulary Test; ITPA = Illinois Test of Psycholinguistic Abilities; RAN = Rapid Automatized Naming; TROG = Test for Reception of Grammar.

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Most T. Assessment of school functioning among Israeli Arab children with hearing loss in the primary grades. Am Ann Deaf. 2006;151(3): 327–335.	Purpose was to assess the performance of Israeli Arab children with hearing loss who were included in the regular classroom, relative to the performance of their classmates with no hearing loss. The effect of degree of hearing loss and grade level on classroom performance was also examined. Graduate students distributed questionnaires to teachers and requested an evaluation of the children's achievement levels in Arabic and mathematics.	Participants were recruited through Shema, a nonprofit association that serves school-aged children with hearing loss. Participants were recruited from a list of children enrolled in general elementary schools. Teachers were asked to complete questionnaires and provide Arabic and math achievement levels for two children with no hearing loss from the same class as the child with hearing loss in their classroom. The children with no hearing loss were selected randomly from the class roster (the name listed above and the name listed below the name of the child with hearing loss).	Israeli Arab children in grades 1–6 with hearing loss who attended regular elementary schools in northern Israel. All study children (cases and control children) used spoken Arabic to communicate. Minimal hearing loss = 16–25dB* Mild hearing loss = 26–30dB Moderate hearing loss 31–50dB Moderate–severe hearing loss = 31–70dB Severe hearing loss = 71–90dB	33 children with hearing loss: 7 with minimal hearing loss, 2 with mild hearing loss 14 with moderate hearing loss, 7 with moderate–severe hearing loss, 3 with severe hearing loss. To evaluate the effect of severity on SIFTER * scores and math achievement, children with hearing loss were divided into 2 groups: 13 with mild or unilateral hearing loss and 20 with moderate–severe hearing loss. There were 60 control children with no hearing loss from the same classrooms.	SIFTER used to screen children's functioning in the classroom and to identify students educationally at risk. The SIFTER has 5 domains: academics, attention, communication, class participation, and school behavior. Teachers reported on each child's achievement in Arabic and mathematics based on homework, papers, examinations, and other schoolwork. Background information was provided in the Shema files regarding each child's hearing loss, use of sensory aids, mode of communication, and additional difficulties.	Children with normal hearing scored significantly better than children with hearing loss in all SIFTER and achievement results. Higher SIFTER scores correlated with higher achievement scores. Communication and class participation: children with mild or unilateral hearing loss scored lower than children with moderate–severe hearing loss. No significant differences between the hearing subgroups in the other domains. Among children with hearing loss, the youngest subgroup (1 st –2 nd grade) had better scores in all SIFTER domains except school behavior than children in 3 rd –4 th and 5 th –6 th grade subgroups. No significant differences between 3 rd –4 th grade subgroup and 5 th –6 th grade subgroup.	Professionals and educators should increase sensitivity to the adverse effects of a minimal or unilateral hearing loss on children's functioning within the educational system and should provide the necessary services. The discrepancy in functioning between the 2 hearing subgroups (minimal–mild versus moderate–severe) was greater in the higher grades than in the lower grades.

*dB = decibel, SIFTER = Screening Instrument for Targeting Education Risk.

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Norbury CF, Bishop DV, Briscoe J. Production of English finite verb morphology: a comparison of SLI and mild-moderate hearing impairment. <i>J Speech Lang Hear Res.</i> 2001;44(1): 165-78.	Case-matched control. Purpose is to compare two theoretical accounts of SLI:* (1) <i>EOI*</i> = SLI caused by syntactic disability and (2) <i>SH*</i> = SLI caused by general processing capacity and problems in perceiving and producing non-salient morphemes. SH predicts even mild hearing loss might result in morphemes of low perceptual salience being missed, delaying grammatical development, but no reason to believe children with SNHL* have processing limitations.	<i>SLI Children:</i> Recruited from special classes and schools in southeast England. <i>Mild-Moderate SNHL Children:</i> Recruited via Local Education Authorities in south-east England. <i>Controls:</i> 2 groups recruited from primary schools in Oxfordshire.	PTA* = .5, 1, 2, 4 kHz* <i>Mild:</i> 20-40dB* (N = 13). <i>Moderate:</i> 41-70dB (N = 3). <i>High Frequency:</i> >25 dB at 2 frequencies >2 kHz (N = 3).	Total: N = 68 <i>SLI:</i> N = 14; ages 7.2-10.9 years. <i>Mild-Moderate SNHL:</i> N = 19; ages 5.9-10.7 years All attended mainstream classes full-time and were learning spoken English only. <i>Controls:</i> Chronologically age-matched (CA); N = 20 Language-age matched (LA); N = 15. All subjects matched on Raven's Progressive Matrices.	<i>Core Measures:</i> BPVS;* TROG;* Recalling Sentences subtest of CELF-UK;* CNR-rep.* <i>Related Language Measures:</i> Phonological discrimination task. The verb subsection of the Test of Word Finding. <i>Finite Verb Morphology Tasks:</i> Third Person Singular task. Past Tense Elicitation.	<i>Core Language Measures:</i> SNHL group within norm on BPVS (vocabulary); below CA controls, but better than SLI. TROG (receptive grammar): SLI worse than CA controls and SNHL group. Recalling sentences: SNHL and SLI below CA controls; SLI lower than SNHL group. <i>Related Language Measures:</i> Phonological discrimination: SLI and SNHL groups below CA controls. <i>Verb Morphology Tasks:</i> 3 rd person singular: Significant differences between SLI and control groups. <i>Regular Past Tense(ed):</i> SLI lower than all other groups; no differences between SNHL group and controls. Divided SNHL group into language impaired and non-impaired groups. Impaired group younger; significant differences between groups on all language measures, but not CNR-rep because both groups did poorly.	Overall, SH theory not confirmed, but does not mean that degraded auditory input does not affect learning of morphosyntax because SNHL children showed a higher rate of language impairment than expected in normal population (22% versus 7%). Although mild-moderate hearing loss is a risk factor for delayed language development, it has less marked effect on morphosyntax than on phonological discrimination.

*SLI = specific language impaired; EOI = extended optional infinitive; SH = surface hypothesis; SNHL = sensorineural hearing loss; PTA = pure tone average; kHz = kilohertz; dB = decibel; BPVS = British Picture Vocabulary Scales; TROG = Test for Reception of Grammar; CELF-UK = Clinical Evaluation of Language Fundamentals-UK version; CNR-rep = Children's Non-word Repetition Test.

REFERENCE	DESIGN	RECRUIT- MENT	CASE DEFINITION	SUBJECTS	ASSESSMENT TOOLS	RESULTS	AUTHORS' CONCLUSIONS
Teasdale TW, Sorensen, MH: Hearing loss in relation to educational attainment and cognitive abilities; A population study. Int J Audiology. 2007; 46:172–175.	<p>Population-based study of all Danish young men accepted for military draft.</p> <p>To assess the relationship between hearing loss and educational level and IQ*, the men were divided into 3 groups according to level of hearing: normal, mild loss, and severe loss.</p> <p>Results from IQ scores and education level were compared with those for each hearing loss group.</p>	<p>All young Danish men were required to appear before a draft board at age 18 years to be assessed for suitability for military. 10%–15% were exempted from service.</p>	<p>All men not exempted from military between August 2003–June 2004.</p> <p>Divided into three groups: -Normal hearing -Mild hearing loss: not worse than 25 dB* HL* in both ears for all tones less than 3,000 Hz*, and not worse than an average of 45 dB in both ears for all tones >200 Hz. -Severe hearing loss: greater than category 2.</p>	<p>22,162 young Danish men eligible for the draft.</p> <p>Two educational groups -Those who left after grade school (usually at age 16 years) -Those who transferred at age 15 years to 3-year senior college (approximately equal to American senior high school).</p>	<p>Audiological examination: Tone bursts at 500–8,000 Hz for left and right ear. Initially presented at 20dB.</p> <p>Cognitive tests: Borge Prien's Prove is a battery of 4 tests: -Progressive Matrices -Verbal Analogies -Number Series test -Geometric Figures test</p>	<p>75% of all men had normal hearing. 20% had mild hearing loss 5% had more severe hearing loss.</p> <p>The relationship between hearing loss and educational level was significant, $p < 0.001$.</p> <p>The odds of men with mild hearing loss not attending senior college was 1.4 times greater than men with no hearing loss.</p> <p>The odds of men with severe hearing loss not attending senior college was greater than 2 times that of the men with normal hearing.</p> <p>Education level was strongly and equally related to performance on all cognitive tests within each of the three groups.</p> <p>IQ and educational level were highly significantly related to hearing loss.</p>	<p>Results indicated a negative association between hearing loss and both educational attainment and cognitive abilities. This association was stronger for more severe hearing loss than for mild hearing loss.</p>

*IQ = intelligence quotient; dB = decibel; Hz = hertz

REFERENCE	DESIGN	RECRUIT- MENT	CASE DEFINITION	SUBJECTS	ASSESSMENT TOOLS	RESULTS	AUTHORS' CONCLUSIONS
Wake M, Tobin S, Cone-Wesson B, Dahl, HH, Gillam L, McCormick L, Poulakis Z, Richards FW, Saunders K, Ukoumunne OC, Williams, J: Slight/Mild sensorineural hearing loss in children. Pediatrics. 2006; (118):1842–1851.	<p>Population-based.</p> <p>Purpose: To determine the prevalence and effects of slight–mild bilateral sensorineural hearing loss among elementary school children.</p> <p>Phase 1: Cross-sectional, cluster-sample survey of children in 1st and 5th grades.</p> <p>Phase 2: Each child with slight–mild hearing loss was matched to 2 normally hearing children for more in-depth assessment of outcomes.</p>	<p>Phase 1: Stratified random sample of all schools in the region. Identified 7,784 grade 1 and 5 children in 89 schools.</p> <p>Parents were contacted via an information package sent home from school, and returned a completed questionnaire with their written consent.</p> <p>Phase 2: All children who met study criteria were invited to participate in additional assessments.</p>	<p>Low-frequency, pure-tone average across 0.5, 1, and 2 kHz* and/or high-frequency, pure-tone average across 3, 4, and 6 kHz of 16–40 dB hearing level in the better ear, with air-bone conduction gaps of <10 dB.</p>	<p>55 children were identified with slight–mild bilateral sensorineural hearing loss.</p> <p>48 children with slight–mild hearing loss participated in Phase 2.</p> <p>33 had slight loss (16–25 dB* HL*); 15 had mild loss (26–40 dB HL).</p> <p>Each of the 33 was matched with 2 children with no hearing loss</p>	<p>Phase 1: HRQoL* (parent report) SDQ*</p> <p>Phase 2: HRQoL*; CELF-4*, CNRep*, WIATT-II*, Marie Clay*, AIM*, HHIA*, PA*, PD* WASI*</p> <p>Audiometry: Children who failed the screen proceeded to full audiometric evaluation including pure-tone air-conduction and bone-conduction threshold tests and tympanometry.</p>	<p>Prevalence of slight–mild SNHL* was .88%</p> <p>Mean values were similar for the 2 groups on measures of literacy, language, reading and academic achievement, child self-reported HRQoL, self-perceived effect of hearing, parent-reported HRQoL, and child behavior. Although, on the basis of the lower limits of the CIs*, clinically small differences remain possible.</p> <p>The hearing loss group performed substantially less well in non-word repetition.</p>	<p>Slight–mild SNHL led to a reduction in phonologic processing abilities, but this did not translate into poorer functioning in a range of child developmental, behavioral and academic domains.</p>

*HRQoL = Health Related Quality of life; SNHL = Sensorineural Hearing Loss; kHz = kilohertz; dB = decibel; HL =hearing level; SDQ = Strengths and Difficulties Questionnaire; CELF-4 = Clinical Evaluation of Language Fundamentals; CNRep = Children’s Test of Non-word Repetition; WIAT-II = Wechsler Individual Achievement Test; Marie Clay = Marie Clay observational survey of early literacy achievement; AIM = Achievement Improvement Monitor; HHIA = Hearing Handicap Inventory for Adults; PA = Matching spoken words on the basis of thyme or onset; PD = Determining within spoken pairs, whether words/non-words are the same or different; WASI = Wechsler Abbreviated Scale of Intelligence; CI = confidence interval