

Juvenile language disorders and their interaction with dentistry: a bibliometric analysis

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ABSTRACT

Language disorders may interfere with social integration and affect personal development. Because the balance of the stomatognathic system can interfere with language, it is important for speech therapy and dentistry to work together, providing multidisciplinary healthcare. **Aim:** To analyze the 100 most frequently cited articles on language disorders in children and adolescents and assess the interplay with dentistry by means of a bibliometric analysis. **Materials and Method:** A search of the 100 most frequently cited articles up to December 2021 on language disorders was performed in the Web of Science Core Collection database. Four researchers extracted the data on number of citations, title, authors, country, year of publication, journals, study design, prevalent clinical conditions, and area of expertise. The analyses were performed using VOSviewer and Excel. **Results:** The total number of citations ranged from 251 to 1,431. Four articles were cited more than 1,000 times. Bishop DVM (10 articles; 3,653 citations) and Tomblin JD (10 articles; 4,261 citations) were the most frequently cited authors. The institutions with the largest number of publications were the University of Oxford/England (11%) and the University of Kansas/USA (8%). Observational study design was the most frequent (77%). Autism spectrum disorder (18%) and dyslexia (14%) were the most broadly investigated clinical conditions. Speech-language pathology (32%) was the area of expertise with the largest number of articles, and none of the top 100 studies showed interplay with dentistry. **Conclusion:** The 100 most widely cited articles on language disorders are mostly observational, mainly address autism spectrum disorder, and are in the field of speech-language pathology. No study reported interplay with dentistry.

Keywords: bibliometrics - communication disorders - language disorders - interdisciplinary research - dentistry

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Transtornos da linguagem juvenil e sua interação com a odontologia: uma análise bibliométrica

RESUMO

Os distúrbios de linguagem podem interferir na integração social e afetar o desenvolvimento dos indivíduos. O trabalho multidisciplinar entre fonoaudiologia e odontologia é muito importante para a promoção da saúde. O equilíbrio do sistema estomatognático interfere na linguagem. **Objetivo:** Analisar os 100 artigos mais citados sobre distúrbios de linguagem em crianças e adolescentes e verificar a interação com a odontologia por meio de análise bibliométrica. **Material e Método:** Foi realizada uma busca pelos 100 artigos mais citados sobre distúrbios de linguagem na base de dados Web of Science Core Collection até dezembro de 2021. Quatro pesquisadores extraíram os dados referentes a número de citações, título, autores, país, ano de publicação, periódicos, desenho de estudo, condições clínicas prevalentes e área de especialização. As análises foram realizadas utilizando VOSviewer e Excel. **Resultados:** O número total de citações variou de 251 a 1.431. Quatro artigos foram citados mais de 1.000 vezes. Bishop DVM (10 artigos; 3.653 citações) e Tomblin JD (10 artigos; 4.261 citações) foram os autores mais frequentemente citados. As instituições com maior número de publicações foram a Universidade de Oxford/Inglaterra (11%) e a Universidade de Kansas/EUA (8%). O desenho de estudo observacional foi o mais frequente (77%). O transtorno do espectro autista (18%) e a dislexia (14%) foram as condições clínicas mais amplamente investigadas. A Fonoaudiologia (32%) foi a área de atuação com maior número de artigos e nenhum estudo, entre os top 100, mostrou interação com a Odontologia. **Conclusão:** Os 100 artigos mais citados sobre distúrbios de linguagem são em sua maioria observacionais, abordam principalmente transtornos do espectro do autismo e estão na área de fonoaudiologia. Nenhum estudo apresentou interação com a odontologia.

Palavras-chave: bibliometria - distúrbios de comunicação - distúrbios de linguagem - pesquisa interdisciplinar - odontologia.

INTRODUCTION

Language involves exchanging information effectively. Language disorders may interfere with social integration and affect personal development in several domains¹. Chronologically, language acquisition in normotypical children follows an unwavering order, though its pace varies considerably². According to the American Speech, Language, and Hearing Association³, alterations of speech, language and hearing are regarded as language disorders, and they cause negative impact on children's lives and may be considered a public health problem⁴.

The different health professionals who monitor child development should be properly trained to identify the landmarks expected at each age. In addition to speech-language pathologists, who can diagnose and treat language disorders, other health professionals such as pediatricians, pediatric dentists, psychologists and education professionals are part of the supporting network for children's language development⁵. These professionals should pay special attention to children's global development and resort to a multidisciplinary approach when any speech delay or disorder is suspected.

Some studies report that language disorders are the most prevalent conditions among children^{4,6}. Dentistry plays a crucial role in identifying children with speech disorders, and its integration with speech therapy is of the utmost importance. Disharmonies in dental arches, malpositioned teeth, or missing teeth can cause articulatory speech disorders, because the balance of the stomatognathic system, which involves the teeth, lips, and tongue, plays an important role in the articulation of consonants through obstruction and modification of airflow⁷.

Language development disorders may interfere in health promotion as a whole. A multidisciplinary approach can help improve quality of life, especially of children and adolescents, and contribute to providing more precise guidelines and public health promotion⁸.

The use of bibliometric studies has been suggested to help the academic community identify the history and tendencies in a given area or topic, by analyzing the quantitative aspects of the science and scientific production that provides critical input to research on the subject⁹⁻¹¹. The number of times a publication is cited in other articles is a potential marker that represents its influence¹². Widely cited articles

are expected to have high quality and data that significantly contribute to knowledge¹³. Although numerous bibliometric studies have been conducted in areas or topics related to dentistry^{10,14,15}, analyses of children's speech have not been performed to date.

The aim of this study was to assess the 100 most frequently cited articles on language disorders in children and adolescents by means of a bibliometric analysis. Given that a multidisciplinary approach is crucial for a comprehensive and effective treatment, the present study also aimed to ascertain which of these articles reported some interaction with dentistry during their production. Based on the analysis, this report intends to provide an overview of existing research on this topic, identifying areas of interest as well as poorly researched areas, and encouraging future research in the field.

MATERIALS AND METHOD

Search strategy

A literature search was conducted on 17 December 2021. No data or language restrictions were imposed. The search was conducted in the Web of Science Core Collection (WoS-CC) database. The search strategy began with the evaluation of the most widely investigated topics in the field of speech-language pathology. Language was found to be a recurrent topic in the databases. A search using relevant MeSH terms, synonyms, and free terms associated with language disorders in children and adolescents was performed. Boolean operators (AND, OR, and NOT) were used for combinations of terms. The search key is described in Table 1.

Table 1. Search key for the Web of Science Core Collection (WoS-CC) database.

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TS=(speech OR language* OR linguistic OR communicat*)
AND TS=(disorder* OR impair* OR problem* OR
dysfunction* OR difficult* OR therap* OR train* OR
rehabilitat* OR treat* OR remediat* OR intervention* OR
pathol*) AND TS=(child* OR infant* OR toddler* OR
adolescen* OR teen* OR young* OR newborn* OR
offspring* OR kid OR kids OR pediatric* OR paediatric* OR
neonat* OR juvenile*) NOT TS=(adult* OR elder*)
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Eligibility criteria and study selection

Articles that addressed language disorders in different fields of health and education and dealt

with the pediatric population were included. Articles that included adults or older people, clinical trial protocols, books or book chapters, and conference/symposium proceedings were excluded.

All the articles retrieved from the database were organized according to the number of citations in decreasing order. Four researchers selected the articles by applying the eligibility criteria, and any disagreements were resolved through consensus. The selection was concluded when the hundredth most frequently cited article was retrieved.

Data extraction

All included studies were transferred to Microsoft Excel® 2010 (Microsoft, Redmond, WA, USA) for classification. The following data were obtained from each article: ranking, number of citations, title, year of publication, country (based on the corresponding author's affiliation), authors, journal, study design (observational, intervention, review, and case report/case series), area of expertise (dentistry, speech-language pathology, psychology, medicine, education, and combinations of these areas), and clinical conditions addressed (autism spectrum disorder, dyslexia, specific language impairment, hearing loss, attention deficit/hyperactivity disorder, auditory processing disorder, dyscalculia, and cerebral palsy).

Bibliometric analysis

The VOS viewer (version 1.6.11, Center for Science and Technology, Leiden University, the Netherlands) was used to create density plots for network maps of authorship and co-authorship¹⁶. On the maps, the items were linked by considering the number of co-authored articles. Each point on the density plot has a color that indicates the density of the items at that point. The colors range from blue to yellow to red. The larger the number of items in the vicinity of a point and the higher the weight of the neighboring items, the closer the point is to red. Conversely, the smaller the number of items in the vicinity of a point and the lower the weights of the neighboring items, the closer the point is to blue¹⁶.

The clinical conditions assessed by the articles were organized into a word cloud, where the larger the size of the word, the higher the frequency of research into that condition¹⁷⁻²⁰.

RESULTS

The searches on the WoS-CC retrieved 88,804 articles. The 100 most frequently cited articles were organized in decreasing order according to the number of citations and are listed in Table 2.

Altogether, the articles were cited 41,108 times (mean of 411.09 citations per article), and only 224 (0.54%) were self-citations. The most widely cited article (1,431 citations) was "Specific reading disability (dyslexia): What have we learned in the past four decades?" by Frank R. Vellutino, published in 2004²¹. The articles were published between 1986 and 2017 and most of them were published in the first decade of the 21st century.

Global publication

Most of the 100 most frequently cited articles were published by North American countries (61 articles; 27,101 citations), followed by European countries (37 articles; 13,695 citations). Of these continents, 58 articles, with 24,171 citations, and 31 articles, with 11,253 citations, were published by the USA and England, respectively. No article was published by South American, Middle Eastern, or African countries.

Authorship metrics

Bishop DVN and Tomblin JB were the authors with the largest number of publications. The co-authorship map shows four major clusters, highlighting authors such as Bishop DVN, Tomblin JB, Catts HW, Zhang XY, and Tall P. Collaborations among authors occurred at national and international levels (Fig. 1).

Journal metrics

The most frequently cited articles were published mainly in the *Journal of Speech Language and Hearing Research* (24%), followed by the *Journal of Child Psychology and Psychiatry* (13%), which, after 2004, was the journal in which the largest number of the most frequently cited articles was published.

Study type analysis

Most studies had an observational design (77%), while 40% were cross-sectional, 25% longitudinal, 8% cohort studies, and 4% case-controls, followed by review articles (11%) and meta-analyses (4%).

Table 2. The 100 most frequently cited articles on language disorders among children and adolescents, in decreasing order.

Rank	Article	Number of citations
1	VELLUTINO, Frank R. et al. Specific reading disability (dyslexia): What have we learned in the past four decades?. <i>Journal of child psychology and psychiatry</i> , v. 45, n. 1, p. 2-40, 2004.	1431
2	TOMBLIN, J. B. et al. E., & O'Brien, M.(1997). Prevalence of specific language impairment in kindergarten children. <i>Journal of Speech, Language & Hearing Research</i> , v. 40, n. 6, p. 1245.	1194
3	YOSHINAGA-ITANO, Christine et al. Language of early-and later-identified children with hearing loss. <i>Pediatrics</i> , v. 102, n. 5, p. 1161-1171, 1998.	1100
4	GATHERCOLE, S. E.; BADDELEY, A. D. The role of phonological memory in vocabulary acquisition. Is there a causal connection. <i>Journal of Memory and Language</i> , v. 29, p. 336-360, 1990.	1021
5	TALLAL, Paula et al. Language comprehension in language-learning impaired children improved with acoustically modified speech. <i>Science</i> , v. 271, n. 5245, p. 81-84, 1996.	821
6	MARTINUSSEN, R. M., Hayden, J., & Tannock, R.(2005). A Meta-Analysis of Working Memory Impairments in Children With Attention-Deficit/Hyperactivity Disorder. <i>J. Am. Acad. Child Adolesc. Psychiatry</i> , v. 8.	801
7	STAVONICH, K. E.; SIEGEL, L. S. The phenotypic performance profile of reading-disabled children: A regression-based test of the phonological-core variable-difference model. <i>Journal of Educational Psychology</i> , v. 86, p. 24-53, 1994.	795
8	CATTS, H. W. et al. Dyslexia and specific language impairment: Same or different developmental disorder. <i>Journal of Speech, Language, and Hearing Research</i> , v. 48, p. 1378-1396, 2005.	730
9	MERZENICH, M. Jenkins W, Johnston P, Schreiner C, Miller S, Tallal P. Temporal processing deficits of language-learning impaired children ameliorated by training. <i>Science</i> , v. 271, p. 77-81, 1996.	687
10	MOELLER, Mary Pat. Early intervention and language development in children who are deaf and hard of hearing. <i>Pediatrics</i> , v. 106, n. 3, p. e43-e43, 2000.	682
11	ZATORRE, Robert J.; BELIN, Pascal. Spectral and temporal processing in human auditory cortex. <i>Cerebral cortex</i> , v. 11, n. 10, p. 946-953, 2001.	638
12	DOLLAGHAN, Chris; CAMPBELL, Thomas F. Nonword repetition and child language impairment. <i>Journal of Speech, Language, and Hearing Research</i> , v. 41, n. 5, p. 1136-1146, 1998.	631
13	CATTS, Hugh W. et al. A longitudinal investigation of reading outcomes in children with language impairments. 2002.	577
14	TAGER-FLUSBERG, Margaret M. Kjelgaard Helen; KJELGAARD, M. M. An investigation of language impairment in autism: Implications for genetic subgroups. <i>Language and Cognitive Processes</i> , v. 16, n. 2-3, p. 287-308, 2001.	561
15	NICOLSON, Roderick I.; FAWCETT, Angela J.; DEAN, Paul. Developmental dyslexia: the cerebellar deficit hypothesis. <i>Trends in neurosciences</i> , v. 24, n. 9, p. 508-511, 2001.	533
16	BOTTING, Nicola; CONTI-RAMSDEN, Gina. Non-word repetition and language development in children with specific language impairment (SLI). <i>International Journal of Language & Communication Disorders</i> , v. 36, n. 4, p. 421-432, 2001.	522
17	LEFEVRE, Jo-Anne et al. What counts as knowing? The development of conceptual and procedural knowledge of counting from kindergarten through Grade 2. <i>Journal of experimental child psychology</i> , v. 93, n. 4, p. 285-303, 2006.	516
18	CATTS, Hugh W.; ADLOF, Suzanne M.; WEISMER, Susan Ellis. Language deficits in poor comprehenders: A case for the simple view of reading. 2006.	496
19	RICE, Mabel L.; WEXLER, Kenneth; HERSHBERGER, Scott. Tense over time: The longitudinal course of tense acquisition in children with specific language impairment. <i>Journal of Speech, Language, and Hearing Research</i> , v. 41, n. 6, p. 1412-1431, 1998.	487
20	BELLINI, Scott; AKULLIAN, Jennifer. A meta-analysis of video modeling and video self-modeling interventions for children and adolescents with autism spectrum disorders. <i>Exceptional children</i> , v. 73, n. 3, p. 264-287, 2007.	483
21	BISHOP, Dorothy VM; NORTH, Tony; DONLAN, CHRIS. Nonword repetition as a behavioural marker for inherited language impairment: Evidence from a twin study. <i>Journal of child Psychology and Psychiatry</i> , v. 37, n. 4, p. 391-403, 1996.	470
22	BESS, Fred H.; DODD-MURPHY, Jeanne; PARKER, Robert A. Children with minimal sensorineural hearing loss: prevalence, educational performance, and functional status. <i>Ear and hearing</i> , v. 19, n. 5, p. 339-354, 1998.	462
23	KASARI, Connie; FREEMAN, Stephanny FN; PAPARELLA, Tanya. Early intervention in autism: Joint attention and symbolic play. In: <i>International review of research in mental retardation</i> . Academic Press, 2000. p. 207-237.	458
24	GEURTS, Hilde M. et al. How specific are executive functioning deficits in attention deficit hyperactivity disorder and autism?. <i>Journal of child psychology and psychiatry</i> , v. 45, n. 4, p. 836-854, 2004.	446
25	HERBERT, M. R. et al. Dissociations of cerebral cortex, subcortical and cerebral white matter volumes in autistic boys. <i>Brain</i> , v. 126, n. 5, p. 1182-1192, 2003.	434
26	HUDRY, Kristelle et al. Preschoolers with autism show greater impairment in receptive compared with expressive language abilities. <i>International journal of language & communication disorders</i> , v. 45, n. 6, p. 681-690, 2010.	412
27	LANDA, Rebecca; GARRETT-MAYER, Elizabeth. Development in infants with autism spectrum disorders: a prospective study. <i>Journal of child psychology and psychiatry</i> , v. 47, n. 6, p. 629-638, 2006.	412
28	BISHOP, D. V. et al. 2017, Phase 2 of CATALISE: A multinational and multidisciplinary Delphi consensus study of problems with language development: Terminology. <i>Journal of Child Psychology and Psychiatry</i> , v. 58, n. 10, p. 1068-1080.	404
29	STEIN, John. The magnocellular theory of developmental dyslexia. <i>Dyslexia</i> , v. 7, n. 1, p. 12-36, 2001.	403
30	CHAVARRIGA, Javier et al. Local analytic integrability for nilpotent centers. <i>Ergodic Theory and Dynamical Systems</i> , v. 23, n. 2, p. 417-428, 2003.	402

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Table 2. The 100 most frequently cited articles on language disorders among children and adolescents, in decreasing order.

Rank	Article	Number of citations
31	WILLCUTT, Erik G. et al. Neuropsychological analyses of comorbidity between reading disability and attention deficit hyperactivity disorder: In search of the common deficit. <i>Developmental neuropsychology</i> , v. 27, n. 1, p. 35-78, 2005.	399
32	WING, Leekam. Leekam S. R. Libby S. J., Gould J. and Larcombe M, p. 307-325, 2002.	396
33	MCCLELLAND, Megan M.; MORRISON, Frederick J.; HOLMES, Deborah L. Children at risk for early academic problems: The role of learning-related social skills. <i>Early childhood research quarterly</i> , v. 15, n. 3, p. 307-329, 2000.	395
34	HIRST, Jessica C. Hodgson Rebecca J.; HUDSON, John M. Hemispheric speech lateralisation in the developing. <i>Language</i> , v. 89, p. 362-369, 2016.	393
35	MODY, Maria; STUDDERT-KENNEDY, Michael; BRADY, Susan. Speech perception deficits in poor readers: Auditory processing or phonological coding?. <i>Journal of experimental child psychology</i> , v. 64, n. 2, p. 199-231, 1997.	389
36	CATTS, Hugh W. The relationship between speech-language impairments and reading disabilities. <i>Journal of Speech, Language, and Hearing Research</i> , v. 36, n. 5, p. 948-958, 1993.	388
37	RIQUE, Luciana Degrande et al. Leitura após formação de classes de equivalência em crianças com implante coclear: Precisão e fluência em palavras e textos. <i>Acta Comportamental: Revista Latina de Análisis de Comportamiento</i> , v. 25, n. 3, p. 307-327, 2017.	387
38	LANDERL, Karin; WIMMER, Heinz; FRITH, Uta. The impact of orthographic consistency on dyslexia: A German-English comparison. <i>Cognition</i> , v. 63, n. 3, p. 315-334, 1997.	386
39	TIMLER, Geralyn R. Use of the Children's Communication Checklist—2 for classification of language impairment risk in young school-age children with attention-deficit/hyperactivity disorder. 2014.	383
40	WRIGHT, Beverly A. et al. Deficits in auditory temporal and spectral resolution in language-impaired children. <i>Nature</i> , v. 387, n. 6629, p. 176-178, 1997.	381
41	KRAUS, Nina et al. Auditory neurophysiologic responses and discrimination deficits in children with learning problems. <i>Science</i> , v. 273, n. 5277, p. 971-973, 1996.	379
42	HAPPÉ, Francesca et al. Executive function deficits in autism spectrum disorders and attention-deficit/hyperactivity disorder: examining profiles across domains and ages. <i>Brain and cognition</i> , v. 61, n. 1, p. 25-39, 2006.	377
43	BIRBAUMER, Niels. Breaking the silence: brain-computer interfaces (BCI) for communication and motor control. <i>Psychophysiology</i> , v. 43, n. 6, p. 517-532, 2006.	376
44	EHRI, Linnea C. et al. Phonemic awareness instruction helps children learn to read: Evidence from the National Reading Panel's meta-analysis. <i>Reading research quarterly</i> , v. 36, n. 3, p. 250-287, 2001.	375
45	LAW, James et al. Prevalence and natural history of primary speech and language delay: findings from a systematic review of the literature. <i>International journal of language and communication disorders</i> , v. 35, p. 165-188, 2000.	370
46	SUSAN, Gathercole; SUSAN, Pickering. Working memory deficits in children with low achievements in the national curriculum at seven years of age. <i>British Journal of Educational Psychology</i> , v. 70, n. 2, p. 177-194, 2000.	368
47	CATTS, Hugh W. et al. Are specific language impairment and dyslexia distinct disorders?. 2005.	361
48	RICE, Mabel L.; WEXLER, Kenneth; HERSHBERGER, Scott. Tense over time: The longitudinal course of tense acquisition in children with specific language impairment. <i>Journal of Speech, Language, and Hearing Research</i> , v. 41, n. 6, p. 1412-1431, 1998.	361
49	BURCHINAL, Margaret et al. Threshold analysis of association between child care quality and child outcomes for low-income children in pre-kindergarten programs. <i>Early childhood research quarterly</i> , v. 25, n. 2, p. 166-176, 2010.	358
50	GOSWAMI, U. et al. Proceedings of the National Academy of Sciences. 2002.	344
51	O'BRIEN, Louise M. et al. Neurobehavioral implications of habitual snoring in children. <i>Pediatrics</i> , v. 114, n. 1, p. 44-49, 2004.	343
52	TROUTON, Alexandra; SPINATH, Frank M.; PLOMIN, Robert. Twins early development study (TEDS): a multivariate, longitudinal genetic investigation of language, cognition and behavior problems in childhood. <i>Twin Research and Human Genetics</i> , v. 5, n. 5, p. 444-448, 2002.	343
53	FUCHS, L. S.; FUCHS, D. Compton, DL, Powell, SR, Seethaler, PM, Capizzi, AM,... Fletcher, JM (2006). The cognitive correlates of third-grade skill in arithmetic, algorithmic, computation, and arithmetic word problems. <i>Journal of Educational Psychology</i> , v. 98, p. 29-43.	341
54	WEISMER, Susan Ellis et al. Nonword repetition performance in school-age children with and without language impairment. <i>Journal of Speech, Language, and Hearing Research</i> , v. 43, n. 4, p. 865-878, 2000.	334
55	REICHOW, Brian; VOLKMAR, Fred R. Social skills interventions for individuals with autism: Evaluation for evidence-based practices within a best evidence synthesis framework. <i>Journal of autism and developmental disorders</i> , v. 40, n. 2, p. 149-166, 2010.	330
56	HILL, Elisabeth L. GOLDSMITHS Research Online. <i>Brain and Cognition</i> , v. 71, p. 99-107, 2009.	325
57	SHRIBERG, Lawrence D.; TOMBLIN, J. Bruce; MCSWEENEY, Jane L. Prevalence of speech delay in 6-year-old children and comorbidity with language impairment. <i>Journal of speech, language, and hearing research</i> , v. 42, n. 6, p. 1461-1481, 1999.	323
58	GEERS, Ann Elizabeth et al. <i>Ear and Hearing</i> . Lippincott Williams & Wilkins, 2003.	318
59	SNOWLING, Margaret J.; GALLAGHER, Alison; FRITH, Uta. Family risk of dyslexia is continuous: Individual differences in the precursors of reading skill. <i>Child development</i> , v. 74, n. 2, p. 358-373, 2003.	317

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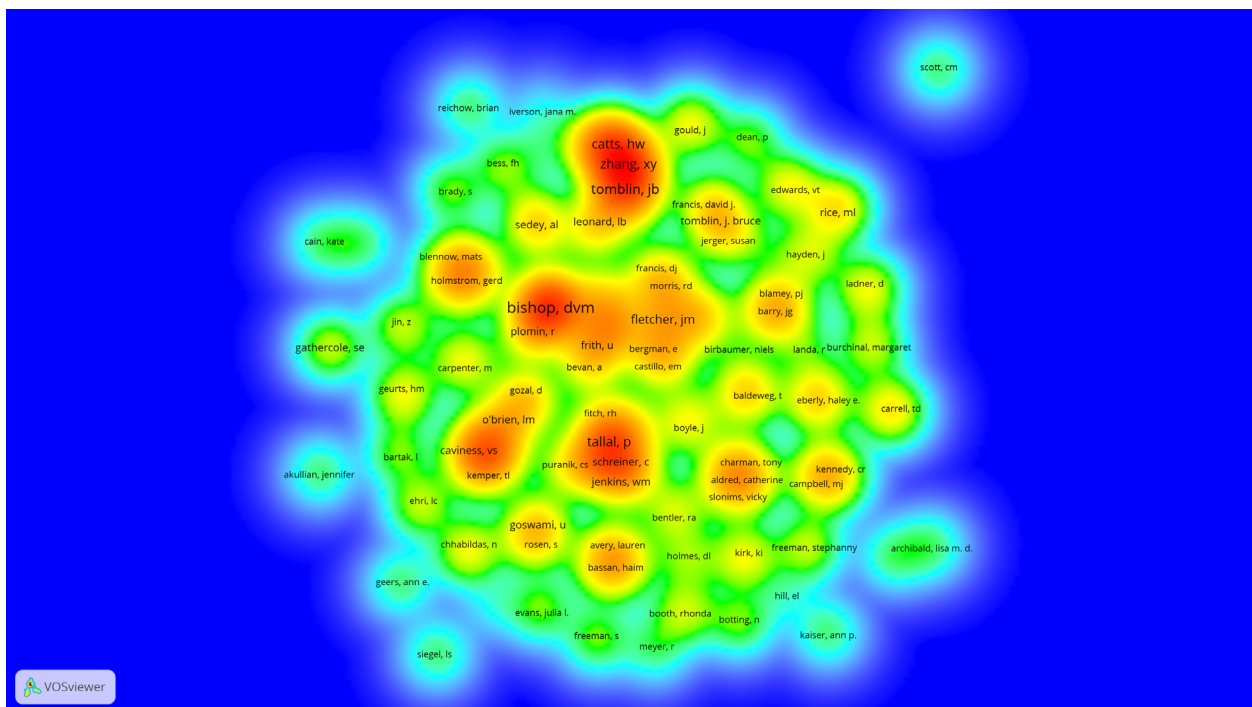
Table 2. The 100 most frequently cited articles on language disorders among children and adolescents, in decreasing order.

Rank	Article	Number of citations
60	LIMPEROPOULOS, Catherine et al. Does cerebellar injury in premature infants contribute to the high prevalence of long-term cognitive, learning, and behavioral disability in survivors?. <i>Pediatrics</i> , v. 120, n. 3, p. 584-593, 2007.	315
61	LEONARD, Laurence B. et al. Speed of processing, working memory, and language impairment in children. 2007.	315
62	NATION, K. és Snowling, MJ (1998): Semantic Processing and the Development of Word-Recognition Skills: Evidence from Children with Reading Comprehension Difficulties. <i>Journal of Memory and Language</i> , v. 39, n. 1, p. 85-101.	314
63	WOLKE, Dieter; MEYER, Renate. Cognitive status, language attainment, and prereading skills of 6-year-old very preterm children and their peers: the Bavarian Longitudinal Study. <i>Developmental medicine and child neurology</i> , v. 41, n. 2, p. 94-109, 1999.	313
64	SCOTT, Cheryl M.; WINDSOR, Jennifer. General language performance measures in spoken and written narrative and expository discourse of school-age children with language learning disabilities. <i>Journal of Speech, Language, and Hearing Research</i> , v. 43, n. 2, p. 324-339, 2000.	311
65	SERENIUS, F. Kållén K, Blennow M, Ewald U, Fellman V, Holmström G, et al. Neurodevelopmental outcome in extremely preterm infants at 2.5 years after active perinatal care in Sweden. <i>Jama</i> , v. 309, n. 17, p. 1810-1820, 2013.	310
66	SIOK, Wai Ting et al. Biological abnormality of impaired reading is constrained by culture. <i>Nature</i> , v. 431, n. 7004, p. 71-76, 2004.	308
67	KENNEDY, Colin R. et al. Language ability after early detection of permanent childhood hearing impairment. <i>New England Journal of Medicine</i> , v. 354, n. 20, p. 2131-2141, 2006.	306
68	GABRIELI, John DE. pufferfish Offline. <i>Science</i> , v. 325, n. 5938, p. 280-283, 2009.	303
69	ARCHIBALD, L. Gathercole S.(2006a). Short-term and working memory in specific language impairment. <i>Int. J. Lang. Commun. Disord</i> , v. 41, p. 675-693.	301
70	MCARTHUR, Genevieve M. et al. On the "specifics" of specific reading disability and specific language impairment. <i>The Journal of Child Psychology and Psychiatry and Allied Disciplines</i> , v. 41, n. 7, p. 869-874, 2000.	299
71	MORRIS, R. et al. Subtypes of reading disability: A phonological core with cognitive variability. <i>Journal of Educational Psychology</i> , v. 90, p. 1-27, 1998.	299
72	MILLER, Carol A. et al. Speed of processing in children with specific language impairment. 2001.	298
73	CATTS, Hugh W. et al. Estimating the risk of future reading difficulties in kindergarten children. 2001.	297
74	BISHOP, Dorothy V. The underlying nature of specific language impairment. <i>Child Psychology & Psychiatry & Allied Disciplines</i> , 1992.	294
75	WEISMER, Susan Ellis; EVANS, Julia; HESKETH, Linda J. An examination of verbal working memory capacity in children with specific language impairment. <i>Journal of Speech, Language, and Hearing Research</i> , v. 42, n. 5, p. 1249-1260, 1999.	289
76	BISHOP, Dorothy VM; NORBURY, Courtenay Frazier. Exploring the borderlands of autistic disorder and specific language impairment: a study using standardised diagnostic instruments. <i>Journal of child Psychology and Psychiatry</i> , v. 43, n. 7, p. 917-929, 2002.	286
77	ROBERTS, Megan Y.; KAISER, Ann P. The effectiveness of parent-implemented language interventions: A meta-analysis. 2011.	285
78	DALE, Philip S. et al. Outcomes of early language delay. 2003.	280
79	BENASICH, April A.; TALLAL, Paula. Infant discrimination of rapid auditory cues predicts later language impairment. <i>Behavioural brain research</i> , v. 136, n. 1, p. 31-49, 2002.	278
80	HERBERT, Martha R. et al. Brain asymmetries in autism and developmental language disorder: a nested whole-brain analysis. <i>Brain</i> , v. 128, n. 1, p. 213-226, 2005.	276
81	SIMOS, Panaqiotis G. et al. Dyslexia-specific brain activation profile becomes normal following successful remedial training. <i>Neurology</i> , v. 58, n. 8, p. 1203-1213, 2002.	276
82	EVANS, Julia L.; SAFFRAN, Jenny R.; ROBE-TORRES, Kathryn. Statistical learning in children with specific language impairment. 2009.	271
83	NICHOLAS, Johanna Grant; GEERS, Ann E. Will they catch up? The role of age at cochlear implantation in the spoken language development of children with severe to profound hearing loss. 2007.	271
84	BISHOP, Dorothy VM; NORTH, Tony; DONLAN, Chris. Genetic basis of specific language impairment: Evidence from a twin study. <i>Developmental Medicine & Child Neurology</i> , v. 37, n. 1, p. 56-71, 1995.	271
85	NATION, Kate et al. Hidden language impairments in children. 2004.	270
86	BIRD, Judith; BISHOP, Dorothy VM; FREEMAN, N. H. Phonological awareness and literacy development in children with expressive phonological impairments. <i>Journal of speech, language, and hearing research</i> , v. 38, n. 2, p. 446-462, 1995.	270
87	DAVIS, Julia M. et al. Effects of mild and moderate hearing impairments on language, educational, and psychosocial behavior of children. <i>Journal of speech and hearing disorders</i> , v. 51, n. 1, p. 53-62, 1986.	269
88	ZIEGLER, Johannes C. et al. Developmental dyslexia in different languages: Language-specific or universal?. <i>Journal of experimental child psychology</i> , v. 86, n. 3, p. 169-193, 2003.	268
89	NORBURY, Courtenay Frazier; BISHOP, Dorothy VM. Narrative skills of children with communication impairments. <i>International journal of language & communication disorders</i> , v. 38, n. 3, p. 287-313, 2003.	268

continues on the next page

Table 2. The 100 most frequently cited articles on language disorders among children and adolescents, in decreasing order.

Rank	Article	Number of citations
90	KASARI, Connie et al. Language outcome in autism: randomized comparison of joint attention and play interventions. <i>Journal of consulting and clinical psychology</i> , v. 76, n. 1, p. 125, 2008.	267
91	LE, Charlop-Christy M. Carpenter M. L LeBlanc LA Kellet K Using the picture exchange communication system (PECS) with children with autism assessment of PECS acquisition, speech, social-communicative behavior, and problem behavior <i>Appl. Behav. Anal.</i> , v. 35, n. 3, p. 213, 2002.	267
92	BLAMEY, Peter J. et al. Relationships among speech perception, production, language, hearing loss, and age in children with impaired hearing. 2001.	267
93	TOMBLIN, J. Bruce; RECORDS, Nancy L.; ZHANG, Xuyang. A system for the diagnosis of specific language impairment in kindergarten children. <i>Journal of Speech, Language, and Hearing Research</i> , v. 39, n. 6, p. 1284-1294, 1996.	261
94	MOELLER, Mary Pat et al. Current state of knowledge: Language and literacy of children with hearing impairment. <i>Ear and hearing</i> , v. 28, n. 6, p. 740-753, 2007.	258
95	SWAN, Denise; GOSWAMI, Usha. Phonological awareness deficits in developmental dyslexia and the phonological representations hypothesis. <i>Journal of experimental child psychology</i> , v. 66, n. 1, p. 18-41, 1997.	258
96	STEVENSON, Ryan A. et al. Multisensory temporal integration in autism spectrum disorders. <i>Journal of Neuroscience</i> , v. 34, n. 3, p. 691-697, 2014.	257
97	TEMPLE, Elise et al. Disrupted neural responses to phonological and orthographic processing in dyslexic children: an fMRI study. <i>Neuroreport</i> , v. 12, n. 2, p. 299-307, 2001.	256
98	CAIN, Kate; OAKHILL, Jane; BRYANT, Peter. Investigating the causes of reading comprehension failure: The comprehension-age match design. <i>Reading and Writing</i> , v. 12, n. 1, p. 31-40, 2000.	254
99	LEONARD, Laurence B. et al. Three accounts of the grammatical morpheme difficulties of English-speaking children with specific language impairment. <i>Journal of Speech, Language, and Hearing Research</i> , v. 40, n. 4, p. 741-753, 1997.	252
100	LIÉGEOIS, Frederique et al. Language reorganization in children with early-onset lesions of the left hemisphere: an fMRI study. <i>Brain</i> , v. 127, n. 6, p. 1229-1236, 2004.	251

*Fig. 1: Co-authorship map.*

There was an editorial (1) among experimental studies (1%). No case reports or case series were retrieved.

Clinical conditions

The most frequent clinical conditions were autism spectrum disorder (ASD) (18%), followed by dyslexia (14%), specific language impairment (9%), hearing loss (9%), and attention-deficit/hyperactivity disorder (3%).

Area of expertise

Speech-language pathology was the most frequent area of expertise (32%), followed by psychology (27%) and neurosciences (9%). Some articles covered two or more areas, such as neuropsychology and linguistics (3%). No article on dentistry was found (Fig. 2).

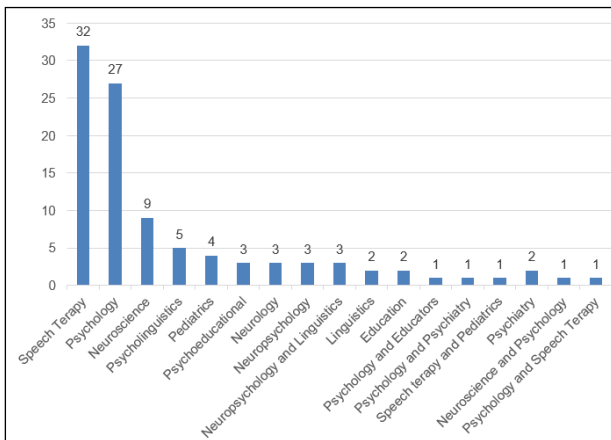


Fig. 2: Area of expertise.

DISCUSSION

Both speech-language pathologists and dentists deal with the functions of the stomatognathic system, so their interdisciplinary work is of the utmost importance to providing successful treatment¹⁷. Interaction between them has increased substantially. The number of citations of scientific articles depends on the year in which the study was submitted for publication, given the profusion of articles over time. Scientific papers are not usually cited until 1–2 years after publication, generally reaching a peak after 3–10 years, after which they continue to be cited at a lower rate. In general, a widely cited article is regarded as a milestone and may therefore have considerable influence on research and practice¹⁸. To become a classic, an article must be cited at least 400 times¹⁹. In the present bibliometric study, 30 articles were cited 400 or more times and four were cited more than 1,000 times.

Self-citations, albeit in a low number, were observed in this study. They can affect bibliometric data because they may be considered inappropriate²⁰. Nevertheless, they are sometimes necessary, as most authors have been researching a topic for a very long time and can provide deeper insights into it. In such cases, self-citations are useful and contribute to the body of knowledge^{10,20}.

The most frequently cited article had 1,431 citations. Its main goal was to provide an updated review of the previous four decades, drawing upon historically influential and contemporary concepts regarding the etiologies of “specific reading disorder” or “dyslexia”²¹. This large number of citations over the years shows that this article has had considerable impact on the understanding of dyslexia, a language disorder that mainly affects the ability to read and write. The fact that it was so often cited was probably because of the influence it can have on people, especially during the literacy development phase²¹.

Europe and North America were the continents with the largest number of articles in the list of the top 100 citations. The United States had the largest number of articles. Some of the world’s leading research centers are in the USA, where large-scale funding is made available to the scientific community²². No publications were retrieved from South America, Africa, or the Middle East. Other bibliometric studies have shown that these continents have linguistic and financial barriers, as well as few partnerships with other institutions and researchers^{23,24}. This scenario shows the need for and importance of collaborative networks among authors from different countries for scientific construction in developing countries, as well as in those with striking differences in culture, history, capacity, and productivity.

The *Journal of Speech Language and Hearing Research* and the *Journal of Child Psychology and Psychiatry* were the journals with the largest number of published articles. The former was founded in 1936 and addresses normal and disordered speech, language, and hearing processes and related areas such as cognition, oral motor function, and swallowing, with significant contributions to the advancement of knowledge (<https://pubs.asha.org/journal/jslhr>). The latter was founded in 1960, with the main objective of selecting research articles on children in different areas of expertise such as psychiatry, psychology, pediatrics, psychoanalysis, social case work, and sociology. It is concerned with developmental psychopathology and child development and has gained additional importance for research and clinical practice, having made numerous contributions, especially to emotional factors with an impact on language disorders (<https://acamh.onlinelibrary.wiley.com/journal/14697610>). Bishop DVN and Tomblin JB were the authors with

the largest number of publications in the field. The studies by Dorothy Bishop, a psychologist from the University of Oxford in the UK, have had an extremely relevant impact on neuropsychology, speech-language pathology, and developmental psychology. Around 1990, she presented numerous findings on topics such as autism spectrum disorder, dyslexia, and specific language impairment, which had been poorly investigated until then. She devised many methods for evaluating children's language, including the test for reception of grammar and the children's communication checklist. Psychology has increasingly contributed to scientific breakthroughs, providing broader understanding of human relationships, and enabling us to rethink and analyze some issues^{25,26}. The second most frequently cited author, James Bruce Tomblin, a psychologist from the University of Iowa, USA, has made remarkable contributions to the epidemiology, etiology, assessment, and treatment of childhood language disorders. He and his colleagues developed a valid and reliable system for diagnosing specific language impairment.

In the bibliometric analysis, the prevalence of observational studies was higher than that of intervention studies. Observational studies are less expensive, more convenient, and easier to perform, especially on children and adolescents²⁷. Most observational studies dealt with etiology and risk or prevalence and incidence, which is expected, given that the investigator in these studies does not interact with the participants, but examines the natural relationships between factors and outcomes²⁸. Etiology and prevalence are still highly investigated, considering that the etiopathogenesis of language disorders is not yet fully understood and that it may involve organic, intellectual/cognitive, and emotional factors (family context), and in most cases, all possible factors are related²⁹.

Autism spectrum disorder (ASD) was the most frequently addressed clinical condition. It is characterized by various alterations in language development (alterations of speech, echolalia, and mutism, among others)^{1,30}. The fact that this was the most frequently addressed topic in this bibliometric study shows how concerned global research is with its elucidation. Studies have reported high worldwide prevalence of ASD, which affects 62 out of every 10,000 individuals, with higher prevalence among male children³¹. Autism is still heatedly

debated worldwide and has come under the spotlight because of its different clinical manifestations, high incidence, and the concern regarding its impact on child development¹. The multidisciplinary approach is of the utmost importance in cases of ASD¹.

Speech-language pathology (32%) and psychology (27%) were the areas under which most studies were published. Both fields seek to understand the behavior of language. Human behavior, emotional factors, stress, anxiety, and depression interfere with language development, and here, the role of both psychologists and speech-language pathologists is important^{25,31}. Clinical manifestations of behavior and human development in different age groups were the target of these two main fields in this bibliometric analysis. Psychology seeks to understand human behavior and its complexities, whereas speech-language pathology seeks to prevent and treat disorders that affect human communication skills^{25,31,32}.

The current bibliometric study did not retrieve any publications in the field of dentistry. A child's first contact with healthcare professionals often involves pediatricians and pediatric dentists³³. Pediatric dentists address different clinical conditions and should endeavor to understand the patients' language development in addition to their initial complaint.

The need for a multidisciplinary approach to healthcare means that the roles of all professionals are crucial to providing comprehensive, humane care³⁴. This is especially true regarding children and adolescents with language disorders, because they do not easily understand instructions, which could compromise their general health. Although language disorders have been widely studied in the past few decades, and despite the large number of pediatric dentistry articles published on oral health comorbidities^{33,35,36}, the paucity of studies on language disorders shows the need for further research.

The present bibliometric study has some limitations such as the fact that it included only research papers, case reports, case series, and review articles, leaving out a sizable number of important books or book chapters and conference proceedings. As this was a bibliometric analysis rather than a systematic review, it did not evaluate the methodology, quality, or risk of bias of the studies. The fact that the 100 most frequently cited articles on language disorders did not address dental problems does not indicate

a lack of integration between the areas, but only that they were not among the most frequently cited articles. Nevertheless, it is essential to encourage dental researchers to investigate language disorders.

CONCLUSION

To conclude, the analysis of the 100 most widely cited articles on language disorders provides better understanding of children's language development and shows the major characteristics of important articles published in this field. Most of the studies were performed in North America. Bishop DVN (UK) and Tomblin JB (USA) were the most

frequently cited authors, and the *Journal of Speech Language and Hearing Research* presented the highest number of publications. Most studies on ASD had an observational design. Speech-language pathology was the most prevalent area of expertise, and there was no collaboration with the dental field that involved children and adolescents. Therefore, our findings demonstrate that dental researchers should be encouraged to investigate language disorders, and the interplay between speech-language pathology and dentistry should be strengthened and worked on further.

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