

Language deprivation syndrome: a possible neurodevelopmental disorder with sociocultural origins

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Abstract

Purpose There is a need to better understand the epidemiological relationship between language development and psychiatric symptomatology. Language development can be particularly impacted by social factors—as seen in the developmental choices made for deaf children, which can create language deprivation. A possible mental health syndrome may be present in deaf patients with severe language deprivation.

Methods Electronic databases were searched to identify publications focusing on language development and mental health in the deaf population. Screening of relevant publications narrowed the search results to 35 publications.

Results Although there is very limited empirical evidence, there appears to be suggestions of a mental health syndrome by clinicians working with deaf patients. Possible features include language dysfluency, fund of knowledge deficits, and disruptions in thinking, mood, and/or behavior.

Conclusion The clinical specialty of deaf mental health appears to be struggling with a clinically observed phenomenon that has yet to be empirically investigated and defined within the DSM. Descriptions of patients within the clinical setting suggest a language deprivation syndrome.

Language development experiences have an epidemiological relationship with psychiatric outcomes in deaf people. This requires more empirical attention and has implications for other populations with behavioral health disparities as well.

Keywords Behavioral health · Language deprivation · Sign language · Hearing loss · Social psychiatry

Introduction

Psychiatric health is often epidemiologically affected by social factors, such as poverty, social distress, and prejudice [1–5]. In this review, we argue that language development, or the disruption of language development, is another social factor that contributes to the epidemiology of mental illness—as observed in the deaf population.

In general, people experience hearing loss in different ways. The majority of hearing loss is age-related sensory impairment in people who have achieved language development milestones—namely, post-lingual hearing loss [6]. Those who lose their hearing at birth or during the critical period of language development, pre-lingual hearing loss, are the focus of this discussion. Approximately two to three out of 1000 children experience pre-lingual hearing loss at birth [7]; in a sample of 37,828 deaf students with known hearing loss onset, at least 55.1% reported hearing problems before the age of 2 years [8], impacting the first language development.

Language deprivation

Language deprivation occurs due to a chronic lack of full access to a natural language during the critical period of

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language acquisition (when there is an elevated neurological sensitivity for language development), approximately the first 5 years of a child's life [9, 10]. Language deprivation during the critical period appears to have permanent consequences for long-term neurological development [11]. Neurological development can be altered to the extent that a deaf child “may be unable to develop language skills sufficient to support fluent communication or serve as a basis for further learning” [12].

Exposure to a fully accessible language has an independent influence on brain development separate from the auditory experience of hearing loss. Indeed, recent neuroimaging studies indicate the presence of adult neurostructural differences in deaf people based on timing and quality of language access in the early childhood [13–15].

Access to spoken language

Medical professionals are not able to assure that hearing aids and cochlear implants will result in positive language outcomes [16]. Many deaf children are significantly delayed in language skills despite their use of cochlear implants. Large-scale longitudinal studies indicate significant variability in cochlear implant-related outcomes when sign language is not used, and there is minimal predictive knowledge of who might and who might not succeed in developing a language foundation using just cochlear implants [17].

For example, a study of 27 French-speaking implanted children found that only half of these children displayed language skills comparable to their hearing peers at the word level and less than half at the sentence level [18]. Long-term language trajectories of 188 implanted children were described as “slower and more variable” than their 97 hearing peers and even those who were implanted earlier than 18 months of age continued to exhibit language delays of more than a year behind their peers [19]. Studies of long-term speech production and perception in 110 implanted children found extreme variability as some demonstrated zero ability to express or perceive spoken English clearly, while others performed nearly as high as 100% accuracy from elementary school to high school [20, 21]. Finally, a meta-analysis of 12 studies focusing on spoken language vocabulary found that implanted children had significantly less expressive and receptive vocabulary knowledge than their hearing peers [22].

Access to visual language

In contrast to depending solely on spoken language, another communication option for deaf children is sign language—a fully accessible, visual language for deaf children. Contrary to popular—but uninformed—opinion, sign languages

have their own grammars and linguistic rules equivalent to spoken languages [23]. Yet, less than 8% of deaf children receive regular access to sign language in the home (i.e., fluent, bidirectional conversations) [8]. Although using sign language is encouraged for hearing babies to develop language skills before they can begin to speak, sign language is not routinely offered as a primary or complementary intervention for deaf children; rather, if offered at all, it is often proposed as a last-resort option to deaf children who have not developed speech abilities as expected [24].

This pattern occurs—because many advocates, professionals, and educators believe that sign language acquisition will interfere with deaf children's development of speech skills [25, 26]—despite research that has shown signing implanted children actually demonstrate better speech development, language development, and intelligence scores than non-signing implanted children [20, 27, 28]. This resistance has recently been described as a prejudice against both sign languages and the state of being deaf [29]. As a result, delayed exposure to sign language is a “common educational occurrence arising from the priority frequently given to speech over sign by rehabilitation professionals and hearing parents” [9]. The end result is that most deaf children do not develop native fluency in sign language.

Based on the current literature, results suggest that technological interventions (e.g., hearing aids, cochlear implants) are insufficient as a stand-alone approach for language acquisition in deaf children. Paired with delayed or absent exposure to sign language during the critical period of language acquisition, a deaf child can be at risk for experiencing long-term language deprivation—which leads to a spectrum of neurological, educational, and developmental consequences across the lifespan. Therefore, many deaf children are likely experiencing some level of language deprivation that might contribute to greater health disparities relative to the general population, such as the increased prevalence of mental illness seen in the deaf population.

Behavioral health

Deaf individuals experience a higher prevalence of behavioral health concerns than the general population. For example, a study conducted with a community sample of 236 deaf individuals found significantly poorer quality of life and higher levels of emotional distress compared to the general population [30]. Deaf female undergraduates are two times as likely to experience interpersonal trauma [31]. In addition, a community sample of 308 deaf individuals found elevated reports of lifetime emotional abuse (27.5%), physical abuse (21.0%), and sexual violence (20.8%) [32]. Deaf adolescents can experience emotional and behavioral mental health problems

associated with low self-esteem and peer rejection [33], and a range of developmental adversities unique to being deaf in a hearing world, such as lack of accessible communication with parents and peers [34].

While overall increased rates of mental health problems and extreme barriers to behavioral health care are reported in the deaf population, the early access to family and peer communication are protective factors against these disparities [35]. Indeed, some claim that the higher prevalence of trauma and psychiatric symptoms in the deaf population are partially caused by inappropriate and/or incomplete medical and educational language interventions early in life [24, 36–39], which create risk for subsequent language deprivation and behavioral health problems. These associations warrant further research to guide interventions to target these mental health challenges in the deaf population.

The hypothetical existence of a unique mental health syndrome that has a relationship with language deprivation deserves investigation as language difficulties complicate diagnosis and treatment of many deaf patients [38, 40–43]. There is a need to help clinicians to differentiate primary and secondary contributors to deaf patients' mental health issues. The current structured literature review attempts to clarify potential psychiatric symptoms resulting from language deprivation and to investigate whether such suggestions of a mental health syndrome exist.

Method

Search strategy

Five indexed databases were used for the literature search to identify articles that discuss the impact of language on mental health in the deaf population: MEDLINE (PubMed interface), PsycINFO (OVID interface), EMBASE (Scopus search engine), CINAHL, and ERIC (EBSCO interface). Searches were iteratively constructed to identify the most effective search terms and syntax. As a major goal was to document the literature over time, the authors looked back as far as possible within each database. No restrictions were placed on types of material to ensure that relevant literature would be included from English-only journals, books, and theses/dissertations. Figure 1 shows the search strategy applied to each database.

The initial searches for the identification stage were conducted in January 2015. Results were imported into the RefWorks citation management database. Using RefWorks' de-duplication feature, duplicate publications were eliminated. These publications were then exported into Excel.

Inclusion criteria

Publications needed to meet the following criteria for inclusion in the structured literature review: (a) focus on the deaf population; (b) focus on at least one aspect of language

Fig. 1 Search strings by database

PubMed Search String:

("Persons With Hearing Impairments"[Mesh] OR "Deafness"[Mesh:noexp]) AND ("Language Development"[Mesh] OR "Language Development Disorders"[Mesh] OR "Language"[Mesh] OR "Cognition"[Mesh] OR "Communication Barriers"[Mesh] OR "Speech"[Mesh]) AND "Mental Disorders"[Mesh]

PsycINFO Search String:

exp Hearing Disorders AND (exp Speech Development OR exp Language Development)
Scopus (including EMBASE) Search String: (Hearing Impairment) AND (Language Acquisition OR Interpersonal Communication) AND (Mental Disease OR Mental Health OR Posttraumatic Stress Disorder OR Dissociation)

ERIC Search String:

(descriptor:deafness OR descriptor:hearing impairment) AND (descriptor:language impairments OR descriptor:language acquisition OR descriptor:language aptitude) AND (descriptor:mental disorders OR descriptor:mental health)

CINAHL Search String:

(MH "Deafness" OR MH "Hearing Impairment") AND (MH "Language Impairments" OR MH "Language Acquisition" OR MH "Language Aptitude") AND (MH "Mental Disorders" OR MH "Mental Health")

development; and, (c) focus on behavioral health (i.e., mental health or substance use disorder). Due to the complex nature of language development and mental health outcomes, certain publications were accepted without meeting all the criteria if they provided important context.

Abstraction form

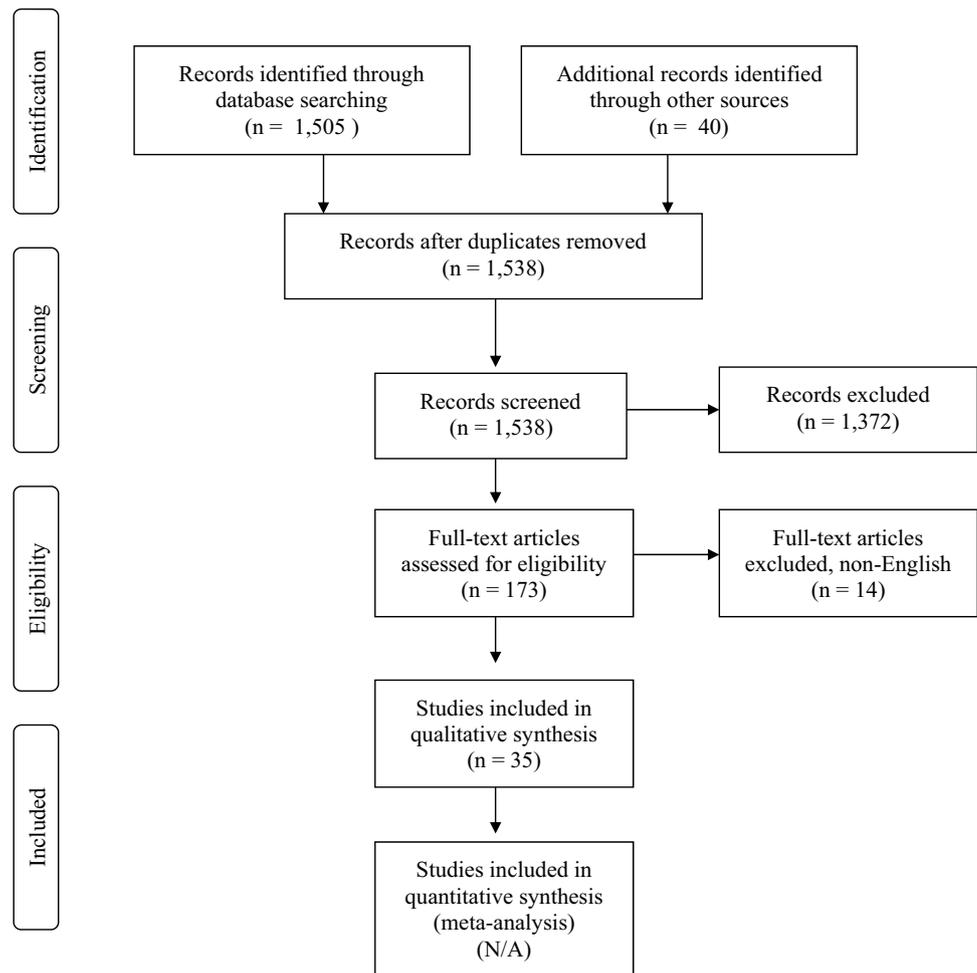
An abstraction form is a standard method of systematically collecting data from literature reviews based on inclusion criteria. Our form elicited the following information about each included study: (1) description of the deaf individuals in the study sample; (2) type of language exposure; (3) type of intervention (where applicable; e.g., cochlear implant, social skills training, cognitive behavioral therapy), and (4) reported mental health/behavioral outcomes.

Search results

Figure 2 utilizes the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram [44], demonstrating the structured literature review steps up to the full-text review. During the identification stage, 1505 publications were identified through database searching and 40 additional publications were found through other sources (e.g., Google Scholar, bibliography hand-searching). The screening process eliminated 1372 publications, the remaining 173 were given full-text reviews. Fourteen non-English publications were immediately excluded. Upon full-text review, further 49 publications were excluded. Abstraction forms were used for the remaining 110 full-text publications.

Seventy-five full-text publications were excluded during abstraction form review. The remaining 35 full-text

Fig. 2 PRISMA flow diagram



publications were included in this paper, forming the basis of the structured literature review. The [Appendix](#) details the abstraction form results of the 35 structured literature review publications.

Results

Historical attempts of developing diagnostic concepts and terms

Discussions of a potentially unique clinical disorder in the deaf mental health field appear to have begun in the 1960s [45–48]. Psychiatric diagnosis of deaf patients was described as extremely complex and time-consuming [49]. Unfortunately, there has been a general lack of awareness in the psychiatry field towards these unique deaf clinical presentations and features. This led one clinician to describe consistent misdiagnoses and clinical confusion associated with deaf patients as “catastrophic mistakes [leading to] unnecessary and prolonged hospitalizations, placing patients on [unnecessary] powerful psychotropic medications, and the failure to develop appropriate treatment programs or provide needed services” [38].

Various categorical terms were proposed, including surdophrenia and primitive personality. The term surdophrenia stems from Basilier’s “Psychic Consequences of Congenital or Early Acquired Deafness” [46] and primitive personality was coined by Altshuler in several early 1960s publications [45] which compared some deaf patients to feral children abandoned in the wild (i.e., *The Wild Boy of Aveyron* [50]). The general theory behind these terms was that a unique cluster of mental health symptoms (e.g., behavioral issues, cognitive delays, and lack of social skills) resulted from unavoidable communication difficulties of deafness (i.e., inadequate exposure to spoken or signed language).

Vernon and Raifman [51] explain their diagnosis of “primitive personality: surdophrenia” as applying to a subpopulation of approximately 5–15% of deaf individuals who have a linguistic disability that creates severe cognitive deprivation, as well as psychological naiveté and immaturity. Their suggested criteria include: (1) minimal or total absence of language knowledge (including sign language, English, or other language); (2) functional illiteracy as measured by a standardized educational achievement test; (3) a history of little or no formal education; (4) cognitive deprivation involving little or no knowledge of basics, including paying taxes, or following recipes, etc., and, (5) a performance IQ score of 70 or less.

Clinical descriptions of patients often referred to “problem behaviors of deafness,” invariably including some reference to immaturity, impulsiveness, explosiveness, and

general lack of skills (e.g., “soft skills”) that promote success in society [49, 52]. Since that time, criticism of this sentiment in the literature—in which there appeared to be an underlying belief that these behaviors were actually characteristic of deaf people themselves—has redirected these “problem behaviors of deafness” as a consequence of language deprivation or other adverse developmental experiences [37]. Glickman [41] attempted to address the weaknesses and bias of the previous diagnostic attempts by developing his own label and criteria (Fig. 3), with the goal of further solidifying a potential diagnostic concept.

Language dysfluency

Language dysfluency occurs when a person’s best language is considered not fluent [38]. Ironically, although language dysfluency may be more common in deaf people, literature discussing language dysfluency in deaf individuals is extremely limited. Dysfluency may be caused by either language deprivation and/or neurological deficits unrelated to language deprivation, including life events (such as traumatic brain injuries and prenatal illness) and mental illness [53].

It can be more difficult to assess deaf individual’s psychiatric symptoms due to extremely wide variability in developmental language experiences that lead to variable degrees of language dysfluency in many deaf patients [54]. An inpatient unit serving deaf patients documented a high prevalence of language dysfluency using subjective communication assessments [38, 55]. Approximately, 75% of patients were found to be language dysfluent, yet only 28% to have a psychotic disorder (compared to 88.9% of hearing inpatients) [55], but the generalizability of these findings is unknown. As a result, many deaf patients appear to be hospitalized not for mental illness, but for the various sequelae related to language deprivation—including language dysfluency—that social and medical systems failed to adequately address.

Languages in either modality (auditory or visual) have rules and structures that make them languages; some suggest that language dysfluency may cause disruption in these rules and structures. Descriptions of psychosis-related sign language dysfluency suggest that it follows “classic” symptoms seen in hearing patients including neologisms, clang associations, and content poverty, among others [54, 56].

One clinician’s case study of a deaf inpatient with suggested non-psychotic language dysfluency highlights limited vocabulary, lack of time referents, disturbed spatial organization, and lack of syntax as possible key features of language deprivation-related dysfluency in sign language [for a review, see 38]. A language-dysfluent patient’s vocabulary may be limited to “concrete objects, actions, and descriptions [a person] has experienced

Fig. 3 Glickman’s proposed criteria of “language deprivation with deficiencies in behavioral, emotional, and social adjustment”

- a. The person is born with a hearing loss severe enough so as to preclude the ability to comprehend oral language or the child loses that ability before the acquisition of oral language.
- b. The hearing loss can not be remediated, or is not remediated, sufficiently for the person to be able to acquire and comprehend oral language effectively.
- c. The child is not exposed to American Sign Language (or other sign languages) sufficiently so as to acquire it as a native user.
- d. The person is severely dysfluent in his or her best language or communication modality, either receptively, expressively, or both, as measured by objective tests or determined by expert evaluators of that language. The person is functionally illiterate in the spoken/written language of the larger community. If the primary communication modality is sign language, one sees deficits such as these:
 - i. Severely impoverished vocabulary as well as signs used with the incorrect meaning
 - ii. Absence or minimal use of grammatical features and vocabulary for tense and time resulting in the inability to give an historical, linear account of events.
 - iii. The person communicates mostly in signs or phrases rather than full sentences. Sentence structure, where it exists, is simple.
 - iv. The person frequently omits subjects and/or objects, or conveys these haphazardly, so as to convey poorly *who* did what to *whom* or *what* happened.
 - v. In sign language, spatial location and movement are used haphazardly resulting in a visual message that is disorganized and unclear.
- e. From childhood, the child displays a global pattern of behavioral, social, and emotional disturbances such as aggression, self-harm, a gross lack of social skills, and poor school performance. These problems occur at home, school, and all other settings.
- f. The person demonstrates an enormous deficit in fund of information about the world (e.g., social norms, knowledge of history, government, current events, rights and responsibilities of being a citizen).
- g. As an adult, the person experiences great difficulties developing work skills, in particular in the interpersonal and attitudinal aspects of work, and learning to live independently.
- h. The person is at least 14 years of age.
- i. The person does not have mental retardation, schizophrenia, or another psychotic disorder. If adolescent, they do not have a conduct disorder; and if adult, they do not have antisocial personality disorder.

directly...” [38]. While telling a narrative, typical time markers (i.e., day, week, month, year) may be missing. Temporal organization may be extremely disturbed to the point where patients may struggle with general awareness of time.

As a three-dimensional visual language, ASL relies heavily on spatial organization and locations (the three-dimensional space in front of a person) as part of its grammar structure to hold and communicate information. However, the language-dysfluent patient established a town in one spatial location then did not refer to it again and subsequently reused that same spatial location for a different town in the same conversation (a violation of ASL grammar), causing confusion to the conversational partner.

Overall, language dysfluency is described as resembling a “series of pictures in the present tense, organized loosely as a kind of collage... almost a stream of consciousness” with an emphasis that these features are

not a part of psychosis phenomena [38]. While limited to one case study, disturbance of these features likely would make a language-dysfluent person struggle with understanding other people and the world around them, and to be understood.

Fund of knowledge deficits

Fund of knowledge deficits (also known as fund of information deficits) are best described as gaps in knowledge due to an “accumulated lack of [environmental] information” [57]. Normal acquisition of passive information is made through media, such as radio, newspapers, television, and word of mouth—avenues not always accessible to deaf individuals. Deaf people’s increased risk of deficits in accumulative general knowledge has been noted in the literature for some time [36, 49, 54, 57–61]. For example, a 1970s deaf inpatient unit described their patients as poorly educated “with limited general knowledge” [49]. As such,

primary treatment for these patients often consists of “the social skill education that they should have received at home and in school” [38].

Deaf epistemology notes a dinner table syndrome in which deaf children and adults are frequently left out of conversations with hearing family members and friends in many everyday settings, including at home and in school [61]. This consistent lack of exposure to everyday opportunities likely results in an overall loss of understanding of how many aspects of society function, such as school interactions, government functions, healthy personal behaviors, and many others. The dinner table syndrome phenomenon, coupled with the chronic effects of language deprivation and dysfluency, is likely to also exert a significant lifelong impact on deaf individual’s physical, mental, and social health—partially mediated through a chronic lack of health literacy and knowledge [62, 63].

Disruptions in thinking, mood, and/or behavior

Deaf patients have been described in the historical psychiatric literature as having more negative personality traits than the general population, such as denial, lack of insight, immaturity, impulsivity, lack of insight, as well as increased rage and aggression [37, 48, 52, 64]. This is echoed by Cooper [59] who proposed that the most common disorders in the deaf psychiatric literature at the time were “problems of behavior and maladjustment apparently related to deafness.”

The view of deafness has historically been heavily negative, seemingly attributing various psychiatric symptoms to the experience of being deaf itself. Instead, it is possible that these various observed symptoms are more accurately attributed to language delays. The case study of a patient with language dysfluency [38] specifically mentioned the “inference” of unstructured language implying unstructured thinking, suggesting that gaps in language access create similar gaps in thinking processes. Deaf individuals do generally appear to be at heightened risk for various psychiatric issues compared to the general population [35]. This risk is likely partially magnified due to language deprivation, which is a rarity in the hearing population.

The underlying implication is that deafness—in and of itself—does not create psychiatric symptoms; rather, the influence of language (or lack thereof) on cognition results in such symptoms. This aligns with research suggesting a relationship between psychiatric disorders and speech/language issues in hearing children [65], including a study of adolescent hearing inpatients where most had some type of language impairment [66]. In addition, a study of deaf individuals with schizophrenia found better linguistic ability

(via earlier ages of sign language exposure) to be associated with greater functional outcomes [67].

While there appears to be general agreement on a higher prevalence of psychopathology in deaf patients, this has commonly focused only upon behavior and adjustment issues [36]. Several literature reviews highlight a strong link between language and behavior issues, especially among deaf children [68, 69]. A study of 120 oral (speech-only) deaf children suggested that those children with the least developed language abilities had significantly more behavior problems than their hearing peers [68]. Elevated rates of emotional problems and disorders [33] and interpersonal trauma exposure [31, 32, 34, 57] are present, and may have a relationship with language ability [70].

A relationship between language and behavioral health psychopathology appears evident in the deaf population. For a small subset of the population, this psychopathology may be serious enough to require long-lasting care in both outpatient and inpatient settings.

Discussion

The etiology of this possible language deprivation syndrome appears to have sociocultural origins. The language deprivation that deaf people frequently experience is a social occurrence centered around the developmental choices made for them as children [24, 36, 38, 40, 71, 72]. These developmental choices drastically increase the risk of a “snowball” effect of cognitive and social skills consequences that, in turn, increase the likelihood of mental illness.

Policy implications

Language deprivation occurs in the deaf population primarily as a function of medical and education policies. These policies are generally created without the inclusion of deaf people and are ones in which sign language has been—and is—excluded as a primary and/or complementary language intervention option for deaf children [12, 24, 39, 47, 52, 58, 72–76]. In sum, “a change in [medical and] education policy provides the most powerful opportunity in preventive psychiatry for deaf people” [37].

The early assessment of language access is crucial; this would increase the likelihood of deaf children reaching appropriate language milestones to maintain a healthy developmental path. Subsequently, immersing deaf children in a rich signing environment would likely reduce the risk of harm associated with language deprivation [24]. Current

early childhood education should shift to prioritizing language and cognitive development—not solely speech or spoken language outcomes, especially at the expense of general education and human development [74].

Diagnostic implications

In theory, the arrays of symptoms caused by language deprivation are not unique to only the deaf population. A hearing person who experiences similar deprivation in their early childhood (such as the famous case of “Genie” [77]) may present with similar symptoms. In contrast to the everyday occurrence for deaf children, for hearing children to experience similar consequences of language deprivation requires extreme situations of neglect and/or abuse. In essence, “there is no such thing as a typical deaf personality” [36]; rather, there is likely a typical presentation of extreme language deprivation in a subset of the deaf population that requires extensive psychiatric care.

The clinical specialty of deaf mental health is struggling with the inadequacy of existing Diagnostic and Statistical Manual of Mental Disorders 5 diagnoses (DSM-5) to capture an observed clinical phenomenon, and to not only define it but also obtain legitimate psychiatric recognition. The DSM-5 group of neurodevelopmental disorders [78] contains diagnoses that may describe specific observed symptoms (e.g., intellectual disability, language disorder, social communication disorder, and specific learning disorder), but using multiple diagnoses to explain one condition is both inefficient and inappropriate.

Proposed diagnostic concept

Although an agreed-upon diagnostic label continues to escape the field, deaf people and professionals frequently encounter the consequences associated with developmental experiences of language deprivation [40]. Glickman [79] describes the most commonly used term as “low functioning deaf.” The vocational rehabilitation field offers its own description, a “traditionally underserved person who is deaf,”—a subset of deaf people who exhibit limited communication abilities, difficulty maintaining employment without assistance or support, poor social/emotional skills, including problem-solving, impulsivity, low frustration tolerance, inappropriately aggressive, and inability to live independently [60].

We recommend the term “language deprivation syndrome” [40, 42, 43] to highlight the possible cluster of symptoms that results from language deprivation. There is not enough empirical evidence to currently formulate

formal diagnostic criteria, but there appears to be a need to begin empirically developing these criteria. Potential diagnostic concept areas needing empirical attention include language dysfluency, fund of knowledge deficits, and disruptions in thinking, mood, and behavior.

Empirically supported recognition would also help deaf individuals interacting with mental health and legal systems, and identify areas to intervene for systematic prevention (e.g., medical and education systems) [38]. Research focused on the deaf population is severely lacking and needs to be prioritized, especially on the topic of language deprivation and its associated mental health issues. Future research directions should especially consider how to measure sign language dysfluency, the role of behavioral problems in diagnosis, and the potential existence of other clinical comorbidities (e.g., conduct disorder and antisocial personality disorder).

Limitations

Although the results of our review suggest a possible language deprivation syndrome, there are some limitations to our findings. The reviewed literature included only those articles that were written or translated into English, due to the authors’ lack of fluency in other languages. This means that potentially relevant publications in other languages are not captured here. In addition, the literature is lacking empirical evidence—this is likely due to the clinical priorities of many of the authors, and the lack of existing deaf research methodology to quantify their observations (a problem that still exists today), among other possible reasons. Finally, there is a historically prevalent negative, biased view of deafness that may have influenced psychiatric descriptions of character traits attributed to deaf people.

Conclusion

Results from the current structured literature review suggest that there is critical need for further empirical and clinical attention on a possible language deprivation syndrome. This attention may eventually lead to formal diagnostic criteria in the Diagnostic and Statistical Manual of Mental Disorders. What appears to be a recognized everyday occurrence in the deaf mental health field and the Deaf community (i.e., “low functioning deaf” [79]) has not garnered a significant attention in the general community.

Language exposure has an inextricable impact on one’s development across the lifespan. The early suggestions of a language deprivation syndrome indicate that it may be a

natural consequence of chronic lack of full access to language. This has implications for language development as a social factor influencing the epidemiology of mental health. Although this phenomenon is perhaps most obvious in the deaf population, understanding the linkage between language exposure and mental health outcomes also contributes to our broader understanding of behavioral health epidemiology. As such, experiences of language exposure and mental health outcomes in other populations should be given more empirical attention (e.g., low socioeconomic status and immigrants moving to different countries).

The socioemotional development of deaf children has historically been described as “delayed” or “developmental retardation” [58, 59, 80]. These negative descriptions might more accurately describe the development of the language-deprived child, rather than a deaf child. This descriptive shift is powerful in allowing for a change in the general philosophical approach to deaf child development. Language deprivation in deaf children is preventable. Proactive prevention of language deprivation appears to be a much-needed approach, rather than continued attempts to avoid

“auditory deprivation” and the subsequent need to provide long-term behavioral health treatment for the most extreme consequences of chronic language deprivation.

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Compliance with ethical standards

Conflict of interest On behalf of all the authors, the corresponding author states there is no conflict of interest.

Appendix

See Table 1.

Table 1 Structured summaries and commentaries

First author	Type of publication	Deaf individuals	Language exposure	Intervention (if applicable)	Mental health/behavioral outcomes
Altschuler 1971 USA	Clinical observations (16 years total)	1000 New York State inpatients and outpatients	General lack of language exposure during the early development		Schizophrenia prevalence comparable to general population, impulsive/aggressive behaviors, less depressive symptoms
Altschuler 1986 USA	Literature review	Literature review	General lack of language exposure during early development		Schizophrenic presentation different in deaf individuals, impulsive/aggressive behaviors common
Anderson 2011 USA	Quantitative study of trauma prevalence	100 deaf female college students	75 ASL, 21 English, 4 other		Deaf females approximately two times as likely to experience interpersonal victimization and trauma as hearing females
Anderson 2016 USA	Qualitative study of deaf-unique trauma experiences	17 deaf trauma survivors	ASL		Some trauma experiences overlap with general population, others are unique to deaf people (i.e., lack of communication with family)
Barker 2009 USA	Analysis of language and behavior problems	188 families with implanted, deaf children compared to 97 families with hearing children	Spoken English	Cochlear implant	Implanted children evidenced more behavior problems, oral language deficits, and parent-child communication than hearing children
Barnett 2011 USA	Literature review and commentary	Literature review and commentary	Limited access to environmental information		Low health literacy and health disparities exist in Deaf sign language populations
Basilier 1964 Norway	Theoretical review	Theoretical review	General lack of language exposure during early development		Associates general experience of deafness with a "deaf personality structure" and stresses a need for specialized psychiatric services
Black 2006 USA	Archival analysis of clinical records	64 discharged deaf inpatients	75% of deaf inpatients classified as "language deprived" or "dysfluent due to language deprivation"		Deaf inpatients more likely to present associated behavior issues with language deprivation than a psychotic disorder diagnosis
Cooper 1976 England	Literature review	Literature review	Differences in psychiatric presentation depending on hearing loss onset and severity		Highlights "problems of behavior and maladjustment related to deafness" as most common disorders in psychiatric literature as well as general knowledge deficits especially with early onset

Table 1 (continued)

First author	Type of publication	Deaf individuals	Language exposure	Intervention (if applicable)	Mental health/behavioral outcomes
Denmark 1971 England	Literature review	Literature review	Highlights relationship between deafness and psychiatry relating to impoverished language exposure		Personality development of deaf child described as "developmental retardation," risk of general knowledge deficits
Denmark 1972 England	Describes process and barriers in establishing psychiatric unit for deaf people	109 deaf inpatients at time of publication	Inpatients generally had poor language exposure, and "educational retardation"	Staff communication in sign language beneficial for treatment, hired teacher for social skills training	Highlights psychiatric diagnosis as complex and time-consuming, describes patients as impulsive and lacking skills
Fellinger 2012 Austria	Literature review	Literature review	Connects poor language abilities with behavioral and psychosocial problems		Generally suggests prevalence of mental and behavioral health issues in deaf people to be elevated compared to general population, highlights lack of access to treatment
Gaines 2009 USA	Analysis of language and learning challenges in hearing adolescent inpatients	34 adolescent hearing inpatients	Generally had native language exposure but poor language skills	Concrete skills development, rather than traditional talk therapies	Poor language skills associated with psychiatric disorders and inpatient hospitalization in hearing adolescents
Giddan 1996 USA	Study of speech and language deficits prevalence in preadolescent hearing inpatients	55 preadolescent hearing inpatients	Native language exposure but clear speech and language deficits		60% of admitted inpatients had speech and language deficits, most prevalent in those with anxiety and aggressive conduct disorder
Glickman 2007 USA	Case study of deaf inpatient with language dysfluency	Deaf inpatient ("Juanita")	Little to no education or sign language exposure		In-depth description of language dysfluency features connected to language deprivation
Glickman 2009a USA	Literature review and commentary	Literature review and commentary	Offers diagnostic criteria for "language deprivation with deficiencies in behavioral, emotional, and social adjustment"		Highlights social causes of language deprivation, potential co-morbidity of language deprivation with various behavioral diagnoses
Hauser 2010 USA	Literature review and commentary	Literature review and commentary	Highlights dinner table syndrome and general worldly knowledge deficits		Deaf individuals at risk for physical and mental health issues, less health literacy and knowledge
Horton 2010 USA	Study of sign language ability, cognition and functional status in deaf outpatients with schizophrenia	34 deaf outpatients with schizophrenia	Earlier sign language exposure associated with greater functional outcomes		Better language ability appears to improve functional outcomes of deaf individuals with schizophrenia

Table 1 (continued)

First author	Type of publication	Deaf individuals	Language exposure	Intervention (if applicable)	Mental health/behavioral outcomes
Huber 2011 USA	Quantitative study of mental health status	32 deaf adolescents with cochlear implant, 212 hearing adolescents	Spoken language	Cochlear implant	Implanted children more likely to experience peer problems, signing ability may have a relationship with emotional problems
Kitson 1990 England	Literature review and commentary	Literature review and commentary	General lack of language exposure during early development		Suggests that increased prevalence of mental health issues in deaf people is related to spoken-language policy in their education
Lane 1976 USA	Literature review and commentary	A hearing feral child, the Wild Boy of Aveyron	Raised by animals, delayed exposure to language		Described as “feral” and not being able to behave appropriately according to social norms
Long 1993 USA	Literature review and commentary	Literature review and commentary	Delayed language exposure creates “traditionally underserved” deaf individuals		Limited communication skills, difficulty maintaining employment without support, poor socio-emotional skills, inability to live independently
McKee 2015 USA	Quantitative study of health literacy assessment	166 deaf individuals and 239 hearing individuals	Health literacy was correlated with reading literacy		48% of deaf participants had inadequate health literacy, 6.9 times more likely than hearing individuals
Pollard 2014 USA	Quantitative study of intimate partner violence	308 deaf individuals from Rochester, 162 deaf individuals from national sample, 1,906 hearing individuals from Monroe County, NY	Ranging language experiences		Deaf individuals more likely to experience emotional abuse and forced sex from their partner than hearing individuals
Pollard 1998 USA	Literature review and commentary	Literature review and commentary	Generally highlights delayed language exposure in deaf mental health population		Describes language dysfluency as separate from psychotic symptoms
Rainer 1966 USA	Report of comprehensive mental health services for the deaf in New York State	Literature review and commentary	Generally highlights delayed language exposure in deaf mental health population		Highlights deaf patients not fitting existing diagnostic criteria, discusses “Primitive Personality Disorder” existing in the deaf mental health population
Schenkel 2014 USA	Study of maltreatment and trauma prevalence	147 deaf college students, 317 hearing college students	Ranging language experiences		Deaf participants more at risk for maltreatment and trauma experiences, general knowledge deficits as well

Table 1 (continued)

First author	Type of publication	Deaf individuals	Language exposure	Intervention (if applicable)	Mental health/behavioral outcomes
Sinkkonen 1994 Finland	Dissertation study	379 deaf students, 234 hearing students	The early exposure for deaf children with signing hearing parents		Found no difference in mental health prevalence between signing deaf and hearing children
Stevenson 2010 USA	Quantitative study of language development and behavior problems	120 children with hearing loss, 63 hearing children	Spoken English (signing children excluded from analyses)	Cochlear implant in some participants	Children with hearing loss had higher behavior problems, level of problems were highest among those children with least developed language
Thacker 1994 England	Quantitative study of sign language use in schizophrenic patients	30 schizophrenic and 7 manic deaf adults	British Sign Language as primary means of communication		Formal communication disorder can occur in sign language
van Gent 2011 USA	Quantitative study of psychosocial risk factors	68 deaf adolescents	Spoken Dutch		Deaf adolescents at risk for self-esteem issues, emotional problems, and hearing peer rejection
Vernon 1969 USA	Book chapter focusing on hearing loss sociological and psychological factors	Literature review and commentary	Discusses delayed language exposure in deaf population		Generally suggests intelligence of deaf people to be comparable to hearing people, highlights social causes of deaf people's lagging achievement in multiple developmental and educational areas from delayed language exposure
Vernon 1997 USA	Literature review and commentary	Literature review and commentary	Severely delayed language exposure		Suggests "Primitive Personality: Surdophrenia" and potential diagnostic criteria for especially deaf individuals with language deprivation who are placed in the legal system
Vernon 1968 USA	Literature review and commentary	Literature review and commentary	Discusses the deaf population as generally language-delayed		Delayed language exposure leads to defensive mechanisms, lack of insight, psychological immaturity, impulsiveness, higher incidence of certain psychiatric disorders
Weiler 2013 USA	Case study	Deaf inpatient ("D.S.")	Complex history with incomplete language records and potential brain-based issues from pre-natal rubella	Risperidone, divalproex sodium	Physical aggression, paranoia, thought disorganization, learning difficulties, minimal language skills

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