Comprehensibility of written and verbal nutrition recommendations for individuals with hearing impairment in Germany

Johanna Köllen, Silvia Wiegel, Tina Bartelmeß

Abstract

Hearing disability encompasses all levels of hearing loss, from mild impairment to deafness. Verbal communication can pose challenges for those affected, particularly in cases of deafness. Written communication may also create barriers, as it often serves as a prerequisite for engaging with predominantly written health and nutrition education materials. This article explores the issues surrounding the comprehensibility of nutrition recommendations and consultation for individuals with hearing impairments in Germany and offers suggestions for improving their presentation and communication. A survey conducted with hard of hearing and deaf individuals (n = 218) revealed that the comprehensibility of these recommendations is closely linked to health literacy and proficiency in German spoken and written language. To enhance communication, respondents expressed a preference for visualisations to reduce barriers to accessing health and nutrition information.

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Introduction

From a medical perspective, hearing impairment is a physical condition that encompasses various forms of hearing loss, ranging from partial hearing reduction to complete deafness [1]. Currently, 302.510 individuals in Germany are affected by hearing impairment (deaf: 50,160; hard of hearing: 252,350)[2]. Hearing impairments result in significant communication challenges, as the perception and understanding of information, such as a nutrition recommendation by the recipient, is crucial for effective communication [3], not merely the sender's intention to communicate [4]. For individuals with hearing impairments, the perception of messages itself poses a challenge. While spoken language communication remains possible through the auditory channel for individuals with hearing loss, depending on their degree of impairment, deafness necessitates visual forms of communication, such as German Sign Language (*Deutsche Gebärdensprache*, DGS), since speech sounds cannot be adequately perceived [5]. This reliance on DGS also affects the acquisition of written language, as DGS is not a signed version of German spoken or written language but a distinct language in its own right [6–8].

The preferred modes of communication among hearing-impaired individuals also vary depending on their socio-cultural identification with the sign language community. Deaf individuals predominantly use DGS, while those who are hard of hearing or have lost their hearing later in life often use sign-supported spoken German or rely solely on spoken German [5].[1] Consequently, for these groups, perceiving written messages – and thus understanding them – often involves barriers similar to those encountered with spoken messages [8, 9].

These barriers hinder hearing-impaired individuals' access to written nutrition and health education materials, exacerbating health inequalities

[1] In this study, the term 'deaf' is used for sign language orientated individuals and the term 'hard of hearing' is used for spoken language orientated individuals. The term 'hearing impaired' refers to both groups.

and increasing the risk of low health literacy, as studies from the United States demonstrate [10, 11]. Health literacy is defined as the purposeful management of health information and comprises four dimensions that represent steps in information processing across the domains of *disease management/health care*, *prevention*, and *health promotion* [12]: (1) seeking and *finding* health information, *understanding* it, (3) *evaluating* it, and (4) *applying* it to maintain one's health. To date, no studies have been conducted on the health literacy of hearing-impaired individuals in Germany, partly since data collection based on the European Health Literacy Questionnaire (HLS-EU-Q) is conducted exclusively in spoken German. However, studies from the United States reveal that while hearing-impaired individuals use written information – for instance, via visual online resources – more frequently than hearing individuals, they report difficulties accessing such materials due to a lack of subtitles or the use of overly complex language [13]. Additionally, hearing-impaired individuals often struggle to identify unreliable or low-quality sources [14].

Verbal communication between hearing and hearing-impaired individuals is also frequently prone to misunderstandings [5], as spoken information is often either not perceived or only partially understood by hearing-impaired individuals [10]. This could hinder their access to verbal nutritional counselling; however, there is a lack of scientific studies on this issue in Germany.

Removing communication barriers could improve the health literacy of hearing-impaired individuals whose communication preferences and needs are diverse, as suggested by studies from the United States. According to these studies, individuals with strong written language skills, i.e., high literacy in the national language, benefit from texts and subtitles [15]. Meanwhile, visually-oriented information recipients, who process information predominantly through hand movements, facial expressions, and body posture, benefit from translations into sign language. Other research also indicates that deaf individuals derive significant benefits from simplified written language and translations into plain language [16, 17]. Visual aids are also recommended for verbal nutritional counselling [18], which could particularly benefit deaf individuals [10], as well as other groups with language barriers [16, 18, 19].

This study examines the factors contributing to comprehension difficulties with written recommendations and verbal nutritional advice for a healthy diet among hearing-impaired individuals in Germany. It also explores their attitudes towards proposed improvements identified in the literature, with the aim of developing recommendations for more targeted nutritional information and communication. Based on the hearing status and health literacy, this study presents findings on the utilisation, comprehensibility, and experiences of written nutrition communication, as well as suggestions for its improvement. Additionally, the use of and experiences with verbal nutritional counselling within this group will be investigated to identify potential avenues for enhancement in this area.

Methods

Design

In 2023, a fully structured written cross-sectional survey was conducted among hearing-impaired adults in Germany. The survey utilised an online questionnaire implemented with LimeSurvey, which was approved by the ethics committee of the University of Bayreuth (application no. 23-010).

Development of the questionnaire

The questionnaire[2] was developed based on current research on health literacy and approaches to improving communication with individuals with hearing impairments. To identify sociological and physiological causes and consequences of challenges in understanding nutrition recommendations and counselling, socio-demographic characteristics, eating styles, and BMI were also recorded. The questionnaire predominantly consisted of closed questions with predefined single-choice answer options. Open-response fields were included for participants to provide additional *input or comments* on verbal communication of nutrition recommendations and to offer feedback on the survey.

The questionnaire comprised five thematic sections:

I. Socio-demographic data: Age, gender, education level, language skills and utilisation
II. Hearing status: Details regarding the type and severity of hearing loss, as well as the use of hearing aids
III. Health literacy: Assessment of health literacy
IV. Food behaviour: Dietary style and status, BMI parameters and experiences with written nutrition recommendations, along with an evaluation of proposed solutions
V. Experiences with verbal nutrition recommendations: Descriptions and evaluation of participants' experiences

Health literacy was measured using the widely applied short version of the European Health Literacy Questionnaire (HLS-EU-Q), which assesses four dimensions: *finding*, *understanding*, *assessing*, and *applying* health information [20, 21] The short version, adapted from Schaeffer (2021) and Sørensen (2013) [22, 23], was modified to align with the word-

[2] Questionnaire, survey structure for Limesurvey and SPSS dataset for download on the Open Science Framework platform (www.osf.io/xvcwd).

ing of the study on 'Health Literacy of the Population in Germany before and during the Corona Pandemic' (HLS-GER 2). It was implemented as a matrix question containing 16 sub-questions with four response options: *very easy*, *easy*, *difficult*, and *very difficult*. Question 18 (*understanding what a doctor says to me*) included the clarification: "*Here, 'understanding' refers only to the content of what is said and not how you understand the doctor due to your hearing impairment – it is about understanding the content, not the acoustics.*"

To improve accessibility, videos[3] of individual questions and completion instructions (without answers) were created in German Sign Language (*Deutsche Gebärdensprache*, DGS) and linked to the questions on YouTube as an alternative translation.

Sampling

Participants were recruited using a snowball sampling method. The survey link was distributed via email to associations across Germany related to hearing impairment, with a request to share it through websites, newsletters, and other networks. The link was also published on platforms like Taubenschlag, a website primarily targeted at people with hearing impairments, and promoted on a dedicated Instagram profile with 241 followers.[4] The survey phase lasted four weeks (2–29 May 2023). Out of 343 participants, 224 completed the survey in full. Most dropouts occurred after the welcome page or after completing section III. Six participants were excluded because they were underage, did not have a hearing impairment (according to their selected response option, 'no impairment up to 20 dB'), or admitted to providing false information.

Statistical processing and evaluation

Data analysis was performed using SPSS (version 6). Only complete cases were included in the final analysis. The raw data was cleaned and categorised: as in HLS-GER 2, age groups were consolidated into four categories, and educational attainment was classified into three levels. To calculate health literacy scores, responses were dichotomised as in HLS-GER 2: '*very difficult*' and '*difficult*' were assigned a code of 0, while '*very easy*' and '*easy*' were assigned a code of 1. The 16-question health literacy scores were totalled and scaled to 100. Based on the resulting scores, participants were categorised into one of four levels used in HLS-GER 2: *excellent*, *sufficient*, *problematic*, or *inadequate*. The remaining questions were analysed individually. Subgroup analyses were conducted based on participants' self-identification as either 'deaf' or 'hard of hearing'. Cross-tabulations and Spearman correlations were used to evaluate the data.

Results

Description of the sample, language preferences, skills and utilisation

The sample included 218 participants: 26.6% male, 70.6% female, and 2.8% diverse. Most participants (41.3%) were aged 30–45 (◆ Table 1). Overall, 77.6% identified as deaf, while 22.9% identified as hard of hearing. Among the deaf participants (n = 168), 89.9% reported being borderline deaf.[5] Among the hard-of-hearing participants (n = 50), 40.0% described themselves as borderline deaf. Nearly all participants were hearing impaired on both sides (deaf: 98.8%, hard of hearing: 92.0%).[6]

DGS was the native language for 82.7% of deaf participants, while 62.0% of hard-of-hearing participants reported German (spoken and written) as their primary language. At the time of the survey, 90.5% of deaf participants preferred DGS over spoken (3.6%) or written language (0.0%). Among the hard of hearing, DGS (38.0%) and spoken language (40.0%) were nearly equally preferred, while written language was favoured by only 4.0%. A total of 97.6% of deaf participants reported a strong proficiency in DGS, compared with approximately half of the hard-of-hearing participants (52.0%). DGS was used regularly by 94.6% of deaf participants and 48.0% of hard-of-hearing participants. In contrast, hard-of-hearing participants primarily utilised German spoken and written language (spoken: 92.0%, written: 98.0%). ◆ Table 1 provides a detailed breakdown of the socio-demographics of the sample.

Dietary style and health status

Half (49.1%) of all participants followed a flexitarian diet, while 26.6% were omnivorous, 16.5% vegetarian, 4.6% vegan, and 3.2% adhered to other diets. The dietary styles of deaf and hard-of-hearing participants were similar in percentage terms. On average, both groups were overweight (deaf: 52.1%; hard of hearing: 54.0%), although the hard-of-hearing participants had a slightly lower BMI

[3] Video links in the questionnaire for download on the Open Science Framework platform (www.osf.io/xvcwd).

[4] Status: 14.05.2024

[5] The groups were categorised according to self-identification. The degree of hearing loss among participants in both groups is described here from a medical perspective.

[6] Percentages in the following always refer to the number of cases as shown in ◆ Table 1.

(deaf: 26.2 kg/m²; hard of hearing: 25.6 kg/m²). A total of 59.5% of deaf participants and 58.0% of hard-of-hearing participants rated their nutritional and health status as at least fairly good. It was observed that this status was rated more favourably when BMI was lower.

Health literacy

The relative majority of the total sample (36.7%) and deaf participants exhibited *inadequate* health literacy, while hard-of-hearing participants often demonstrated *excellent* health literacy (◆ Figure 1).

According to the current state of research on hearing impairment and health communication, proficiency in written German was identified as a relevant factor in the development of health literacy. In this sample, a medium, highly significant correlation was observed, supporting the current state of research (overall: r = -0.402**; deaf: r = -0.327**; hard of hearing: r = -0.422**)[7].

Utilisation and comprehensibility of written nutrition communication

A total of 154 participants, 67.3% of whom were deaf (n = 113) and 82.0% of whom were hard-of-hearing (n = 41), reported that they had read nutrition recommendations. Among this group, deaf participants most frequently read nutrition recommendations once or twice a month (41.6%), whereas hard-of-hearing participants predominantly read them only a few times a year or never (36.6%). Of the total sample, 32.7% of deaf participants and 18.0% of hard-of-hearing participants had never read nutrition recommendations. Among the deaf, problems with comprehension were the more common reason for not reading (16 out of 55), whereas disinterest was the primary reason for the hard of hearing (5 out of 9).

Most deaf participants indicated that they were able to understand the majority of nutrition recommendations after reading them several times, while nearly half of the hard-of-hearing participants (46.3%) reported understanding them immediately (◆ Figure 2). Most deaf participants stated that they *understood most of the nutrition recommendations after reading them several times at the latest*, while almost half of the hard-of-hearing participants (46.3%) stated that they *understood them immediately* (◆ Figure 2).

Characteristic	Total (%) (n = 218)	Deaf (%) (n = 168)	Hard of hearing (%) (n = 50)
Gender			
male	58 (26.6)	45 (26.8)	13 (26.0)
female	154 (70.6)	117 (69.3)	37 (74.0)
diverse	6 (2.8)	6 (3.6)	0 (0)
Age			
Mean (standard deviation)	*40.9 (13.7)*	*38.7 (11.7)*	*48.3 (17.3)*
18–29 years	54 (24.8)	44 (26.2)	10 (20.0)
30–45 years	90 (41.3)	79 (47.0)	11 (22.0)
46–64 years	63 (28.9)	44 (26.2)	19 (38.0)
from 65 years	11 (5.0)	1 (0.6)	10 (20.0)
Education level			
Low	51 (23.4)	39 (23.2)	12 (24.0)
Medium	130 (59.6)	104 (61.9)	26 (52.0)
High	37 (17.0)	25 (14.9)	12 (24.0)
Monthly net income			
Up to € 2,000	130 (59.6)	102 (60.7)	28 (56.0)
From € 2,000	88 (40.4)	66 (39.3)	22 (44.0)
Hearing loss			
Bordering on deafness (above 90 dB)	171 (78.4)	151 (89.9)	20 (40.0)
Mild to severe (20–90 dB)	47 (21.6)	17 (10.1)	30 (60.0)
Language skills			
DGS			
Good	190 (87.2)	164 (97.6)	26 (52.0)
Poor	28 (12.8)	4 (2.4)	24 (48.0)
German spoken language			
Good	145 (66.5)	98 (58.3)	47 (94.0)
Poor	73 (33.5)	70 (41.7)	3 (6.0)
German written language			
Good	181 (83.0)	132 (78.6)	49 (98.0)
Poor	37 (17.0)	36 (21.4)	1 (2.0)
Sprachverwendung			
DGS			
min. 2x/week	183 (83.9)	159 (94.6)	24 (48.0)
max. 1x/week	35 (16.1)	9 (5.4)	26 (52.0)
German spoken language			
min. 2x/week	153 (70.2)	104 (61.9)	49 (98.0)
max. 1x/week	65 (29.8)	64 (38.1)	1 (2.0)
German written language			
min. 2x/week	189 (86.7)	143 (85.1)	46 (92.0)
max. 1x/week	29 (13.3)	25 (14.9)	4 (8.0)

Tab. 1: **Socio-demographics, hearing loss, language skills and utilisation of the sample in absolute frequencies (and column percentages)** (total and split by self-identification as 'deaf' and 'hard of hearing') (n = 218)

The subjectively perceived comprehensibility of the nutrition recommendations correlates significantly with the self-assessed language and health literacy of the participants. In the overall sample, there is a moderate correlation between comprehensibility and the utilisation of both written German (r = 0.315**) and health literacy (r = -0.476**). These correlations are similarly pronounced in the group of deaf participants (r = 0.310** and

[7] Correlation strength according to Diaz-Bone [24]: * p < 0.05 (2-sided); ** p < 0.01 (2-sided); **p < 0.01 (2-sided). The negative correlations are attributable to the reverse direction of the scale for the *'health literacy'* variable. Unlike the scales for 'comprehensibility' and 'ability to use German written language', this scale begins with a value interpreted as negative (1 = *'inadequate'*) and ends with a value interpreted as positive (4 = *'high'*).

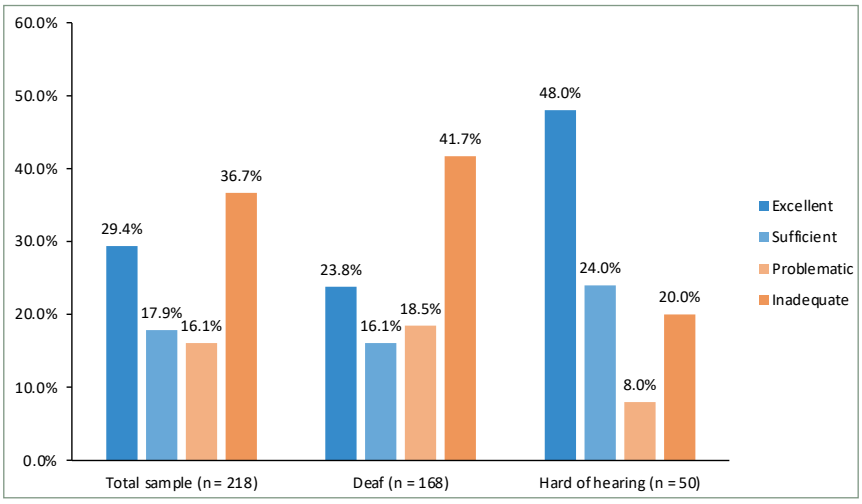

Fig. 1: **Health literacy of the self-identification groups**

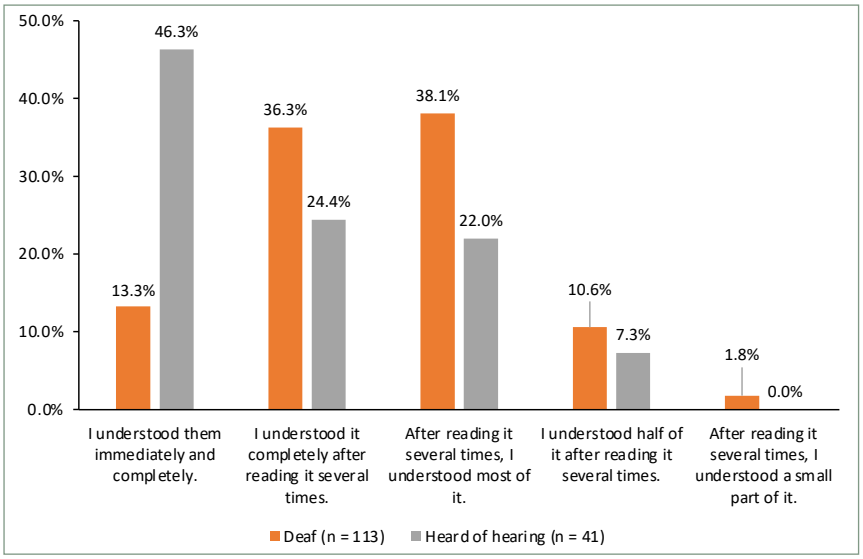

Fig. 2: **Comprehensibility of nutrition recommendations**[8]

r = -0.426**, respectively). For hard-of-hearing participants, there is a moderate correlation between comprehensibility and health literacy (r = -0.473**). However, for the hard of hearing, comprehensibility does not correlate with the utilisation of German written language but rather with the ability to speak German (r = 0.410**). Insufficient health literacy is also associated with greater comprehension difficulties.

In summary, the comprehensibility of the nutrition recommendations was subjectively assessed as better when German Sign Language was used less frequently, and German spoken and written language was used more frequently. Additionally, better proficiency in German spoken and written language, along with higher health literacy, contributed to improved comprehensibility.

Suggestions for improving written nutrition communication from the perspective of individuals with hearing-impairments

To improve comprehensibility, deaf participants (n = 168) preferred visualisations (59.5%) over German Sign Language (DGS) (48.8%) and plain language (33.3%). Hard-of-hearing participants (n = 50) showed an even stronger preference for visualisations (62.0%) compared to DGS and plain language (18.0% each). When choosing a proposed solution, deaf participants were more likely to opt for DGS, whereas hard-of-hearing participants were more inclined to favour visualisations.

Some participants highlighted the utility of combining DGS and visualisations with text (without plain language) for complex content: "*I understand a text straight away, but I can't visualise quantities by weight, i.e. by a number. Visualisations help a lot here. But when it comes to explaining why you should eat something, why not, I have no problems. I think many Hearing [sic!] people have these problems too.*" Individual preferences for support were also noted. Participants suggested basic subtitling for videos containing spoken text and called for a 'lexicon for every diet [sic!] in DGS'.[9]

Experience with verbal nutritional counselling

A total of 41 participants had attended a face-to-face nutritional counselling session (25 deaf; 16 hard of hearing). Communication with the hearing dietitian usually worked well for the majority of deaf participants (64.0%) and *always* worked well for most hard-of-hearing participants (56.3%). However, the aids used varied between the two groups: deaf participants primarily relied on *sign language interpreters* (52.0%), followed equally by *written* communication and unaided communication (20.0% each). In contrast, hard-of-hearing participants mostly communicated *without any aids* (75.0%). Only three participants used *technical aids* and two used *sign language interpreters*.

According to the participants' own statements, comprehension problems during nutritional counselling led to increased cognitive stress and psychological discomfort, as there was a fear

[8] The answer option *I still didn't understand it after reading it several times* was not included in the diagram as no participant selected it.

of causing 'psychological' harm to the counsellor due to repeated questioning. Other participants explained that the use of DGS by dietitians could reduce waiting times required to apply for cost coverage and minimise the time-consuming appointment arrangements associated with using sign language interpreters.

"It would be great [to have] nutrition counselling with DGS and easy to speak German, [making ot] more visual. And [an] internet page about health with [a] DGS overlay. Gladly, counsellor hearing [sic] write difficult German sentence[s]. Give up. Or please phone. I am deaf. Hearing [people] think [I can use the] phone. [They] do not understand. Many barriers." [sic!]

In summary, the results highlight the need to adapt health and nutrition communication for the hearing impaired through appropriate measures such as DGS, plain language, and, above all, visualisations.

Discussion

The survey aimed to identify factors contributing to difficulties in understanding written and verbal nutrition recommendations for the hearing impaired in Germany, as well as their attitudes towards improvement measures proposed in the literature.

Influencing factors

A key factor influencing difficulties in understanding written nutrition recommendations is a **lack of health literacy** stemming from insufficient spoken and written language skills. All participants in the survey identified themselves as hearing impaired, with most categorising themselves as deaf and a smaller proportion as hard-of-hearing. A high BMI was prevalent in the sample, indicating a high rate of obesity. Despite these objective health indicators, most participants rated their nutritional and health status as rather good, suggesting a distorted perception of health, as obesity is a well-established health risk factor [25, 26]. This discrepancy aligns with the findings of the HLS-GER 2 study [22] and could be attributed to various factors, including the desire for positive self-presentation, a non-medical perception of ideal health, or the lower education levels of the sample. The younger demographic of the sample, which was recruited online, may also contribute to this phenomenon [27].

The survey showed that a **lack of written language skills in both identification groups, and additionally in German spoken language for hard-of-hearing individuals**, contributed to difficulties in understanding health and nutritional information. Hard-of-hearing participants who were proficient in spoken and written German understood nutrition recommendations faster and more completely. Deaf individuals reported that their comprehension improved due to the more frequent use of written German. However, it is unclear whether this is reflected in the actual reading of nutrition recommendations, as this was a retrospective survey. Another influencing factor is the **routine in reading nutrition recommendations**. Comprehension seems to improve through regular practice in everyday life. Participants who did not read nutrition recommendations due to comprehension problems generally had lower health literacy. However, some participants with excellent health literacy stated that they did not read nutrition recommendations because they felt sufficiently informed. It is not yet clear which specific nutrition recommendations they had read, as this was not asked.

Possibilities for improving written food communication

The survey results suggest that the presentation of written nutrition recommendations for the hearing impaired can be improved through visualisation. Although the survey only measured participants' attitudes towards the suggested improvements and not whether these measures actually facilitate understanding, there is a clear preference for visualisation. This preference confirms previous studies indicating a preference for visual learning and visual information among the hearing impaired [10, 17].

The study also revealed differences in language skills and needs between deaf and hard-of-hearing individuals. Some participants expressed a desire for a variety of assistive communication methods, highlighting the need for flexible and customisable communication strategies. The first author, herself deaf and familiar with the barriers and needs of deaf and hard-of-hearing individuals, addressed this need through DGS translation, which serves as an example of a community-engaged research approach [28, 29].

Possibilities for improving verbal food communication

The survey also provides initial indications for improving verbal food communication or nutritional counselling with hearing-impaired individuals in Germany, although only a few participants had experience with nutritional counselling, meaning the results cannot be generalised. Deaf individuals appear to make less use of nutritional counselling than hard-of-hearing individuals, which could be due to known communication difficulties with healthcare services, including doctors, as shown in a study from the USA [30]. Like

[9] A 'lexicon in DGS' refers to a reference resource, presented in German Sign Language, which explains various forms of nutrition or components of diets.

this and other studies [10, 18] the present study also shows that visualisation has the potential to improve the comprehensibility of nutritional advice for the hearing impaired. Participants in this survey also suggested combining different communication media to enhance comprehensibility, such as the integration of pictures, videos in sign language, and simple questions in nutritional counselling, which has already been successfully used in studies on high blood pressure and diabetes among individuals with hearing impairments [31]. The improvement in comprehensibility shown in other studies through translation into simple language is also confirmed by the present study, though it is ranked lower in priority than visualisation and sign language [16, 17].

Conclusion

The online survey of individuals with hearing impairments identified several factors that hinder this group's access to health and nutrition information. A key finding of this survey is the significant correlation between the comprehensibility of nutrition recommendations, health literacy, and language skills in spoken and written German among individuals with hearing impairments. The respondents also saw visualisations as useful and desirable additions to conventional written and verbal nutrition communication that nutrition communicators could adopt.

However, the responsibility for improving nutrition communication for the hearing impaired does not lie solely with those affected or the nutrition communicators. Promoting reading and writing skills through support from relatives, additional school courses, integration and inclusion offices, and the social environment is equally important. Healthcare providers can also adapt their verbal and written services to the needs of the hearing impaired by integrating interpreting services and visualisations. Developing such materials in collaboration with hearing-impaired individuals [32] and/or following best practice examples [29] is crucial.

Researchers can analyse the search for health and nutrition information and the handling of communication barriers for individuals with hearing impairments, developing corresponding recommendations for action. The form of communication for this information and differentiation according to the type of sender should be taken into account, for instance, to consider established organisations in nutrition communication as well as the ongoing expansion of both analogue and virtual nutrition communication by laypersons.

These measures are not only necessary to improve short-term access to health information for individuals with hearing impairments, but also to reduce health inequalities between hearing and hearing-impaired population groups in the long term.

Declaration of Conflict of Interest and the Use of AI
The authors declare that there is no conflict of interest.
AI was used for language optimisation and translation.

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