



Research article

Why do many children who are hard of hearing not use remote microphones to compensate for their hearing loss?

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ABSTRACT

Objectives: The aim of the study is to explore parents' reasons for not acquiring remote microphones that would compensate for their child's hearing loss and why some children do not use these devices even after they are purchased.

Background: The benefit of remote microphones for better understanding speech has been proven by multiple studies. Consistent with the research, there is an official recommendation that all children who are hard of hearing should be considered as potential candidates for remote microphone systems in classrooms in Western countries, but in the Czech Republic, only a relatively small number of children use them. Therefore, it is important to focus on the reasons why parents do not buy such devices for their child and why some children do not use an already acquired device.

Methods: Data from 41 semi-structured interviews were collected and analysed using the DIPEX methodology (personal experiences of health and illness), which involves rigorous analysis of narrative interviews of people with particular conditions chosen to represent the widest practicable range of experiences.

Results: Parents report multiple barriers to buying remote microphones: insecurity about the right moment, financial reasons, a lack of information and the child's refusal to use them. The reasons why children do not use such devices despite their being purchased are the reluctance of children and teachers and the low perceived benefit of remote microphones.

Conclusions: These barriers have to be taken into consideration by audiologists, policymakers and other stakeholders when addressing medical, educational and social systems supporting children who are hard of hearing as well as their families. Socio-political measures, improved systems of support for children who are hard of hearing and direct work with families can reduce these barriers.

1. Introduction

Despite the use of primary compensatory devices (hearing aids/cochlear implants), children who are hard of hearing (HoH) are disadvantaged compared to their peers. These disadvantages include speech recognition under noisy conditions or understanding speech at a greater distance [1, 2, 3]. This does not necessarily mean that the child cannot hear or understand, but they usually find listening more difficult and have to exert more effort than their classmates with normal hearing [4]. A lack of or limited access to spoken language, especially at a young age, negatively affects language and communication skills and has implications for educational success [5].

Remote microphones (RM) are wireless technologies used as assistive devices for children who are hard of hearing (HoH). They were originally

developed to limit the negative effects of noise on understanding speech for hearing-aid users in challenging listening environments, and they are now also compatible with cochlear implants [6].

Prior research has proven the multiple benefits of RM, such as better understanding speech in noisy environments or at greater distances [7], improved academic achievement, speech and language development, behaviour and attention in the classroom [8]. Benefits have been shown not only in improving speech understanding and skills related to communication and listening, but also in the child's overall well-being, improved attention, or reduced effort and thus less fatigue while listening [5, 9]. In Western countries, the use of RM is included in official procedures for the rehabilitation of hearing loss, and they are recommended for all children who are HoH at school and at home from their early childhood [10, 11, 12, 13].

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The Czech health care system is based on compulsory insurance providing universal coverage and a broad range of benefits. The social security system is comprised of social insurance and social assistance. The purchase price of hearing assistive technologies is fully (cochlear implants) or partially (hearing aids, RM) covered by the health insurance. If there is an official “need” (e. g. low income, severe disability), a family can also apply for an allowance from the social system to ensure full coverage of expenses [14]. The Czech Republic is among those countries with an education system offering dual education [15]; children who are HoH are in schools for the Deaf and HoH or (most of them) in mainstream classes in the form of inclusive education [16]. In the Czech school system, inclusive education has been promoted since 2004, and truly inclusive school practices have become consistently required following further legislative changes since 2016. Teachers are supported by school counselling centres, which are available to all Czech schools [17]. Supporting measures for children who are HoH include the establishment of the assistant teacher position, a reduction in class sizes, the creation of individual education plans, teaching materials, the use of special methods, procedures and forms of teaching, and the provision of special equipment [15]. RM are not purchased by schools, because they are considered to be individual assistive devices and must be owned by parents. The topic of RM is marginal in the Czech environment, but some experts do acknowledge their advantages. For example, Doležalová, Horáková [18] pointed to better comprehension results and faster responses to teacher instructions in mainstream schools when students used RM. However, only a relatively small number of children who are HoH actually use RM and, inconsistent with research, audiologists do not prescribe them for all children who are HoH [19]. The decision on whether a family buys RM, and thus the main responsibility for their use, is held by parents. In addition, parents’ experience is important to keep in mind, as their attitudes and beliefs are crucial for both the purchase of the microphone and its proper use by the child [20].

It is therefore important to focus on the reasons why the number of children who are HoH who actually use such devices remains low. Hence, the purpose of this article is to explore parents’ reasons for not acquiring RM to compensate for their child’s hearing loss, and why some children do not use these devices despite their having been purchased.

2. Methods

The data presented in this article are drawn from a broader study focusing on parents’ experiences of having a child who is HoH conducted through the project “Promoting more effective use of wireless technologies by children with hearing impairment” (TJ02000150), which was funded by the Technology Agency of the Czech Republic. This article describes in detail findings on barriers to the use of RM. Approval of the Ethics Committee was obtained from the Olomouc University Social Health Institute 2019/04.

2.1. Design

From July 2019–November 2020, 41 in-depth semi-structured interviews were conducted with 42 parents/carers for a child (children) who are HoH. The methodological approach used was the DIPEX methodology, an applied science method focused on patients’ experiences and aiming to further support patients and professionals [21]. This methodology involves rigorous analysis of narrative interviews of people with particular conditions, chosen to represent the widest range of experiences [22]. The research explored parents’ experiences with their child’s/children’s hearing loss. The aim of the present study is to explore barriers to RM use.

2.2. Data collection

A total of 25 parents were interviewed face-to-face and another 16 interviews were conducted online; one interview was conducted by telephone. Most of the face-to-face interviews were conducted with

participants in their own homes, and seven were conducted elsewhere (office, rectory) at the participant’s request.

The parents’ interviews lasted between 52 min and 2 h 12 min (average 81 min). The interviews were guided using an interview scenario. The interview was conducted in two parts – a narrative section and a semi-structured section.

The researcher started by asking a general question intended to elicit the story in the person’s own words. Then semi-structured questions were asked to complete the following topics: first symptoms, professional care, compensatory devices, symptoms, communication, daily life, social aspects, education, messages. They also aimed to seek clarification of areas the respondents themselves raised. In order to include as many different experiences as possible, this study used maximum variation sampling (with regard to type and severity of hearing loss of their child, their age, the age at diagnosis, sociodemographic factors) [23].

Participants were recruited through the application guarantor (society REJA, Czech distributor of wireless devices), audiologists, organisations working with the target group (early care centres, special education centres), and an advisory panel (professionals and members of target group supervising all phases of the research) and support groups, including virtual communities on social networks.

2.3. Data analysis

All interviews were video or audio-recorded and transcribed verbatim, then checked, anonymised and returned to the participant for approval. All participants provided informed consent to use the data for research. Inductive and deductive methods were applied. The data were then coded systematically in the NVivo 12 software using inductive thematic analysis [24]. The following basic codes were established based on a study of the literature and consultation with the experts on the advisory panel: pathway to diagnosis, compensatory aids, manifestations of hearing loss, daily life, medical care, specialist care, parenting, education, messages and recommendations. As new themes were identified during the analysis of the interviews, new codes emerged. When a new code was generated, it was necessary to go back through the interviews thus far conducted and check whether the new code was also present in them. This procedure ensured that all the topics that appeared in the interviews were covered. Multiple researchers were involved in the coding. Each coded interview was cross-checked. Codes related to RM were then organised into categories and examined across the whole dataset, as well as in the context of each person’s interview. In addition to codes directly about RM, other codes or categories of codes were used in the analyses for this dissertation to provide deeper context (diagnosis, information, daily life, hearing aids, cochlear implant, insurance, communication, medical care, specialist care, manifestations of hearing loss, parenting, education, messages and referrals). The “one sheet of paper” OSOP technique was used [22]. The OSOP method involved the following steps: the researcher went through the codes that fall under the theme of RM and put together parts of the utterances that were similar or related in nature and recorded the number of the conversation in which they appeared. The researcher then analysed all the pieces of text that fell under a particular category, sorting the information obtained and looking for commonalities or differences. The OSOP method allows a large amount of qualitative data to be processed clearly, capturing interactions between codes, identifying prevalent experiences and not omitting less common ones [22]. The analysis was conducted partly manually and partly in a freeware web application for creating structured mind maps, Coggle. it.

3. Results

3.1. Sample description

The sample consisted of 31 mothers and 11 fathers from across the Czech Republic (Table 1). All of them were their child’s (children’s) biological parents, except one foster mother. Two of the mothers had two

Table 1. Sociodemographic factors.

Participants	n	%
men	11	26.2 %
women	31	73.8 %
Age		
26–30	7	16.7 %
31–40	22	52.4 %
41–50	11	26.2 %
51–60	2	4.8 %
Number of children in the family		
1	16	38.0 %
2	21	50.0 %
3	4	9.5 %
4	1	2.4 %
Number of children who are Deaf and hard of hearing in the family		
1	40	95.2 %
2	2	4.8 %
Education		
basic and secondary	19	45.2 %
higher	23	54.8 %
Economic activity		
employed	30	71.4 %
unemployed	11	26.2 %
n/a	1	2.4 %
Residence according to the level of care provided		
city*	13	31.0 %
town**	17	40.5 %
village***	12	28.6 %

Note: N = 42; mean age of the parent 38.17; SD = 7.37.

* Specialised care available in hospital or audiology clinic and cochlear implant centre.

** Audiologist/phoniatrist available.

*** No or basic medical care available.

children who are HoH. Two interviews were conducted with the parents of the same child and one interview was attended by both parents together, so the information concerned a total of 42 children (Table 2).

These children had mild to profound hearing loss and were aged from 1 to 19. In the case of 12 children (28.6%), hearing loss was compensated for by cochlear implants (10x bilaterally, 2x unilaterally); 29 children (69%) were fitted with hearing aids (two of whom did not wear hearing aids regularly), and one child did not have a compensatory device due to the type of hearing deficiency. Seven children (16.7%) had other issues besides hearing difficulties – additional cognitive impairments, learning disorders, ADHD.

Sixteen parents (14.6%) had no experience with RM; 13 families (31.7%) had longer experience with RM (the child actually had it or used it in the past); 13 families (31.7%) had borrowed RM for the purpose of the project (for two months) in order to verify its benefit. The aim of this trial was to increase the number of people with the experience of using RM, as one of the goals of our projects was to evaluate the benefit of wireless technologies in the Czech Republic. Another objective was also to verify if the opportunity to try the device for two months was sufficient to evaluate its benefit for the child. The borrowed devices were selected and fitted under the supervision of an audiologist, and families were trained in their use. The two-month trial was not conditional on participation in the study; parents could freely decide whether or not to participate.

3.2. Findings

A large proportion of parents did not encounter any barriers to their child's use of RM. We present the results of a qualitative analysis on the topics perceived by those who spoke about the reasons why they had not

purchased RM and those who identified some barrier or disadvantage. Families usually reported more than one concern within a specific barrier category.

3.2.1. Why don't children have a remote microphone?

Interviews included parents of 29 children, who had not purchased an RM. The reasons why families did not purchase an RM can be divided in four categories – hesitation (n = 17; 58.6%) finances (n = 8; 27.6%), lack of information (n = 7; 24.1%) and child's advance refusal (n = 2; 6.9%). Some parents reported multiple reasons, as described in Table 3. One father did not report any specific barrier and was planning to purchase an RM in the near future.

3.2.1.1. Uncertainty and “bad timing”. In 17 cases (28.6% of those, who had not purchased an RM), parents postponed the decision to buy an RM, perhaps in the future. Seven of them doubted that it was a right time to buy an RM from objective reasons. This happened in two cases, when the child was newly diagnosed or already had a new compensatory device (hearing-aids, cochlear implants); in three other cases there was a probability of cochlear implantation in the future; in two cases, parents were waiting for a new type of hearing aid.

We wanted to wait until it turned out to be 100% needed. So, the financial side was the most important (barrier) and then the fact that an engineer who dealt with us about other things with hearing aids told us that there will be hearing aids that should have the receiver built in, without attaching an external receiver. So we considered whether it would not be better to wait until the more modern hearing aids would be available, and that we would buy it then. Anyway, he (our son) will have to buy new hearing aids after 5 years (mother 32y, son 2y, moderately severe hearing loss, fitted with hearing aids).

On the other hand, five other parents also did not buy an RM because they perceived compensation by hearing aids or cochlear implants to be sufficient. This statement was sometimes contradictory with other narrations, as the following citations show:

Do you plan to buy wireless technologies?

No. I think she can handle it with the hearing aids alone; she's happy (mother 40y, daughter 5y, moderate hearing loss, fitted with hearing aids).

Another part of the same interview:

When she was four, she went to a public kindergarten, and when I picked her up, I often saw that there were a bunch of children and my daughter was standing in the back, the teacher was saying something, and my daughter was looking around and understanding nothing. So I asked the teacher if she could take her closer. And maybe when reading fairy tales to let her sit next to her just to have a chance to understand something. Because in all the noise it's really no fun (the same mother).

Five other parents reported that it was too early to buy a device. Either the child was considered still too young to use an RM or three parents were waiting for “the right moment”, i.e. school age, the transition to the second level of primary school, or irrefutable proof that the child needs it.

We haven't had the need yet, because we still have a child within earshot (father 46y, daughter 5y, profound hearing loss, fitted with cochlear implants).

Let's try again. Let's wait until he goes to school and see whether he'll understand the teacher (mother 40y, son 6y, moderate hearing loss, fitted with hearing aids).

3.2.1.2. Finances. For eight parents (27.6% of those, who had not purchased an RM), the main reasons why they did not buy an RM was the

Table 2. Demography of children.

	Total	%	Without a RM experience	Longer experience with RM	Two-month trial of RM
boy	22	52.4 %	7	7	8
girl	20	47.6 %	9	6	5
Age at interview					
0–2	6	14.3 %	5	0	1
3–5	12	28.6 %	8	2	2
6–9	11	26.2 %	2	4	5
10–15	11	26.2 %	1	5	5
16–19	2	4.8 %	0	2	0
Age at diagnosis					
less than 1 year	16	38.1 %	6	5	5
1–3 years	20	47.6 %	10	5	5
4–6 years	4	9.5 %	0	1	3
7–10 years	2	4.8 %	0	2	0
Level of hearing loss					
mild (26–40 dB)	2	4.8 %	2	0	0
moderate (41–55 dB)	5	11.9 %	3	2	0
moderately severe (56–70 dB)	3	7.1 %	1	0	2
severe (71–90 dB)	20	47.6 %	7	7	6
profound (up to 90 dB)	11	26.2 %	6	4	1
other diagnosis	1	2.4 %	0	0	1
Other special needs besides hearing loss (combined disabilities, learning disorders)					
yes	10	23.8 %	6	2	2
no	32	76.2 %	10	11	11
Primary assistive device					
hearing aids	29	69.0 %	9	9	11
cochlear implant(s)	12	28.6 %	7	4	1
without hearing aids or cochlear implant(s)	1	2.4 %	0	0	1
Education					
mainstream school	26	61.9 %	7	10	9
school for the Deaf and hard of hearing	10	23.8 %	6	2	2
at home (with mother)	5	11.9 %	3	0	2
completed school attendance	1	2.4 %	0	1	0

Note: N = 42; mean age of the child 7.71; SD = 4,95.

high price. Even though many parents (especially from families who could not afford it) did not have to cover the entire price by themselves and had opportunities for other funding (foundations, charities, social benefits), there were parents who lacked information about such possibilities or did not apply for them.

To complete the picture, of the total number of parents involved (n = 41), thirteen parents (31.7%) applied for the Special Assistance Allowance, a state subvention to fund compensatory devices. Five of them encountered no major difficulties in making their application until it was granted. Six children were denied the allowance, despite having, according to their parents, similar hearing loss to other children who received it. Two parents were awaiting the decision at the time of interview. Three parents complained of long decision times and lack of information from staff or social workers. Seven parents considered the state support insufficient. Finally, eight parents had successfully used other funding options, such as foundations, organising a benefit concert, obtaining sponsorship donations, carrying out crowdfunding via the Internet, etc. Two parents said they felt ashamed asking for money.

When they denied it (a social benefit) to me, I considered buying the device with my own money or trying to contact foundations, or thought about how we would deal with it. But at the time I first talked with the teacher, she said that she didn't think they'd take advantage of it yet, that they didn't need it. So, I put the decision off; I'll leave it until when we'll be buying new hearing aids. Then it will be easier to contact foundations to contribute to both the hearing aids and the

remote microphone (mother 34y, son 8y, severe hearing loss, fitted with hearing aids).

3.2.1.3. Lack of information. Seven parents (24.1% of those, who had not purchased an RM) claimed that they didn't have enough information needed to decide to buy an RM.

She needed new hearing aids and some special teaching system. And I *didn't* know how to buy it, what to buy so that it would suit her in that regular elementary school, so that I *wouldn't* buy something that she would more or less not be able to use, because it wouldn't be suitable for those conditions (mother 33y, daughter 13y, severe hearing loss, fitted with hearing aids).

Nine parents (21.4% of the total number of parents involved) had learned about RM from the hearing aids/cochlear implants distributor, either when they were purchasing new hearing aids or during a service visit. Seven parents (16.7%) learned of the existence of RM from the Internet (the distributor's website, information websites, other parents on social media). Four families (9.5%) were informed by their audiologist. Five parents (11.9%) first heard about RM at a lecture organised by a non-profit organisation. Six parents (14.3%) were given information by a social worker. One mother (2.4%) was familiar with RM, because she had one as a child. Six parents (14.3%) did not specify the primary source of information or did not remember it accurately. One mother had never heard about RM before.

Table 3. Parents who had not purchased an RM and their reasons.

interview number	gender of the child	age of the child	age at diagnosis	level of hearing loss	assistive device	reasons			
						uncertainty/bad timing	finances	lack of information	child's refusal
01	F	5	2	severe	HA	X			
05	M	15	3	severe	HI				X
08	F	1	0	profound	CI			X	
09	F	2	0	moderately severe	HA	X			
10	F	11	5	severe	HA	X	X		
12	F	5	1	profound	CI			X	
13	M	4	0	severe	CI			X	
14	M	6	1	severe	HA	X			
15*	M	8	1	profound	CI	X			
15**	M	2	0	profound	CI	X			
16	M	8	4	severe	HA	X			
17	F	14	10	other diagnosis	none		X		X
18	M	2	0	moderately severe	HA	X	X	X	
21	F	3	0	mild	HA		X		
22	F	3	1	moderately severe	HA	X	X		
23	F	2	0	moderate	HA	X			
25	M	12	1	severe	HA	X			
26	M	15	2	severe	HA		X		
27	F	9	0	moderately severe	HA		X		
28	M	5	3	severe	HA	X			
29	M	6	6	severe	HA	X			
30	F	3	2	severe	HA	X			
31	M	6	0	profound	CI	X			
32	M	6	1	profound	CI	X			
33	M	5	0	severe	HA	X		X	
34	F	3	0	mild	HA			X	
37	M	1	0	profound	CI			X	
40	F	15	2	severe	HA		X		
41***	F	3	2	moderately severe	HA	n/a	n/a	n/a	n/a
Total						17 (58.6 %)	8 (27.6 %)	7 (24.1 %)	2 (6.9 %)

Note: N = 29, mean age of the child 6.2; SD = 4.4.

* first son

** second son

*** no barrier reported.

I'm angry that no one told me before. Information that I could have just known a year earlier and my daughter could have had it, even if it was only for the fairy tales. Kids have "a sponge period" and develop every moment. So every fairy tale she didn't hear, that she didn't understand ... she was just impoverished (mother 33y, daughter 6y, severe hearing loss, fitted with hearing aids)

3.2.1.4. Child's acceptance before acquisition. Two parents (4.8% of the total, 6.9% of those, who had not purchased an RM) decided not to purchase an RM, because they took into consideration the opinion of the child, who did not want to use it.

To illustrate, children responded differently to the opportunity to use the RM. Eight children (19% of the total) welcomed the new device with curiosity and enthusiasm. On the other hand, six children (14.3%) had reservations, especially with use at school (the shame of explaining to the teacher how to use it, fear of peer reactions). The remaining children ranged between these two extremes. Usually, the child finally accepted the device in the first days of use. Parents had different approaches to help their child accommodate to the RM. Some of them appreciated when there was an opportunity to try the device before they decided to buy it. This motivated their child to accept the RM and explained the benefit of its use, or they tried the device at home using games. They found it important to explain to the teachers beforehand how the device works.

Two parents of younger children delegated one teacher (or teaching assistant) to take care of the device and to pass it on to other teachers, so the children didn't have to worry about it. In one case, the teacher involved the whole class in a discussion about sound transfer and about RM and the whole class participated in a game trying out the functions of the device (a "spy" game about sound transfer through the wall).

My daughter said she wouldn't wear it, so we didn't deal with it anymore, and I just watched my daughter and subtly tried to persuade her. Because children, if they don't accept it, even if you have it at home 10 times, they won't use it, so it's useless. ... It's the same as they told us about braces: "If a child doesn't want to wear braces, it won't help them that much and they will be terribly unfortunate. It will break out; ruin their teeth, because they won't take care of them." And that's exactly the same with this device, when the child is already a teenager. I think that if we had found out earlier, even at preschool age, then we would have been able to convince our daughter somehow. But now she is a teenager (mother 44y, daughter 14y, unclear diagnosis).

3.2.2. Why don't children use a remote microphone despite having one?

For this section, the barriers reported by parents who had longer experience with the RM (n = 13) or had at least tried it (n = 13) were

analysed. Child acceptance, teacher reluctance and low benefit were identified as the most crucial ones and may have led to the child stopping using the RM. Parents also mentioned other minor disadvantages (e.g. the cost of batteries, incompatibility with some electrical devices, more listening fatigue until the child got used to it, difficulty in locating the sound source, etc.), but these were not essential for the frequency of use and the child did not stop using the RM because of them.

3.2.2.1. Child's acceptance to use a remote microphone. One of the most critical barriers to using RM was the negative attitude of the child, which occurred in four families (15.4% of parents who had experience with an RM): one boy with cochlear implant (profound hearing loss), two boys with HA (severe level of hearing loss) and one girl (unclear diagnosis, probably auditory neuropathy spectrum disorder, no compensatory aid) from 13 to 15 years old. In three cases, the problem persisted, and in one case parents found the way to overcome the barrier. Parents stressed the need to motivate the child in using the RM regularly. In these four cases the children during pubescence stopped using the RM over time or claimed that they did not want to use it anymore even though the RM was used regularly and considered beneficial. Parents listed multiple reasons why, in their minds, the children stopped using the device: changes in the classroom (e.g. a new teacher) or changes in self-perception related to an effort to not differentiate oneself from one's peers, shyness and unwillingness to speak with teachers (e.g. in teenagers) or listening discomfort (e.g. teacher talking too loudly) or low benefit (e.g. in group activities). Two of these parents thought that the problem would not have appeared if the child had been accustomed to the device at an earlier age.

Participant: When we had borrowed the (device), it happened in the first days that he (our son) didn't tell the teacher that she should put it on, so then we had to deal with it. He was ashamed to give it to her; he was ashamed to have something new. So, we explained him that it was important and that it didn't matter if others saw it. He had a bit of that block, so to speak.

Researcher: And did you manage to overcome it?

P: We borrowed it for two months. So, then it was no longer a problem.

R: So, it helped that you explained it to him?

P: Yes, even the teachers already knew it; they just said, "give it to me". So, then they asked for the device themselves (mother 46y, son 15y, severe hearing loss, fitted with hearing aids).

3.2.2.2. Unwillingness of teachers. Three parents (11.5% of parents who had experience with an RM) reported that teachers did not want to use the RM or progressively stopped using them. The experience or concern that teachers had a negative attitude towards the use of the RM was mentioned by more parents. The explanations of parents included the incompetence of some teachers or schools, reservations about modern technology, a reluctance to learn new skills and the discomfort of wearing an RM. Other parents' explanations were that teachers were convinced that they can handle the needs of the child well enough, so they did not want to change their approach. Among the total number of parents, in four cases (9.5%) it appeared that teachers were afraid of losing, damaging or destroying the device.

At school, they didn't want to use the remote microphone – a terrible problem. They didn't take it out of the bag and stuff. And I said why you don't use it, then you yell at the boy or the boy just doesn't understand. Everyone in the school club was doing something, and he wasn't doing it and I said, "Why didn't you do it?", "I didn't understand what to do there"...

R: And why do you think the teachers didn't want to use it?

P: Maybe they were afraid of the technology. It was an expensive device, so that it wouldn't break. Maybe the fact that there are a lot of children, so it takes the teachers time, that it somehow limits them, that they have to think about when to turn it on, when to turn it off. Perhaps for those reasons they didn't use it much, they didn't want to use it (mother 45y, son 8y, moderately severe hearing loss, fitted with hearing aids).

3.2.2.3. Low benefit. Nine parents (34.6% of parents who had experience with an RM) reported, that in some circumstances, the benefit of RM was low, for example in situations such as an extremely noisy environment or with multiple speakers. On the other hand, the benefit was also perceived negligible in calm environments, like at home or in small classes where many children could operate without it (hearing aids or cochlear implants were considered sufficient). Children with hearing loss were (in the parents' opinion) used to their listening limitations; therefore, they might not perceive the necessity for further compensation. Some of these parents also assumed that family members and teachers were able to adapt speech sufficiently to the child's specific needs. However, some misunderstanding of the child's needs related to the hearing difficulties was evident from the interviews. In some cases, it was also unclear whether parents understood how the technology worked or whether the device was not set up correctly, as shown in the following example:

(The remote microphone) did not meet the expectation. It is primarily intended to hear the teachers well, to better understand what the teacher is saying, that the sound goes straight into the ear and not through the noise of the classroom. But that's not exactly what it's like at primary school. It's only good when lecturing, but when the lesson takes place in the group form, when the teacher keeps asking something and the class keeps reporting and answering, then (my son) just can't hear his classmates properly (father 40y, son 13y, severe hearing loss, fitted with hearing aids).

The nine participants who observed low benefit were mothers and fathers of children of varying ages and severity of hearing loss, as shown in [Table 4](#). The perception of low benefit was mainly for children with more severe hearing loss using hearing aids.

The motivation to use an RM in situations when the benefit is considered negligible is then low. In two cases (7.7% of parents who had experience with an RM), the RM was put aside because no benefit was perceived (in one case, the cochlear implantation was quite recent and the child did not understand speech; in other case there was a speech deficiency linked to a cognitive impairment).

It occurred to us that our use (at home) did not matter. We tried to use it in the day nursery; there were six children, and there was a lot of peace and quiet, so it didn't help much there either. I think maybe now it would be different when she hears better and understands better. Because she didn't understand what was going on, because suddenly my voice appeared somehow different than she was used to, she was completely confused. My impression of this was that it didn't help much at her age or at her stage of development. But at the same time, I think that in the future it may be helpful, but I don't know, I don't know (father 28y, daughter 3y, severe hearing loss, fitted with hearing aids).

4. Discussion

Our study explored parents' reasons for not acquiring RM that compensate for the hearing loss of their children and why some children do not use these devices, even if they do have it. We found multiple barriers to buying these devices: hesitancy choosing the right moment to buy one, financial reasons, a lack of information and the child's refusal to use them. This last reason mentioned was also the main reason why they

Table 4. Characteristics of the children of parents who reported low benefit of RM.

interview number	gender of the child	age of the child	age at diagnosis	level of hearing loss	assistive device	longer experience/trial
11	M	13	3	severe	HA	longer
18	M	2	0	moderately severe	HA	trial
25	M	12	1	severe	HA	trial
27	F	9	0	moderately severe	HA	trial
28	M	5	3	severe	HA	trial
30	F	3	2	severe	HA	trial
32	M	6	1	profound	CI	trial
39	M	19	2	profound	CI	longer
40	F	15	2	severe	HA	trial

Note: N = 9; mean age of the child 9.3; SD = 5.8.

do not use the device despite its being purchased. The others are the reluctance of teachers and the low benefit of RM.

This study contributes to research on assistive listening devices. A recent study of Gustafson, Ricketts [25] explained the limited use of RM by psychosocial factors, a shortage of educational audiologists, financial resource limitations, the use of other assistive listening technologies and the low benefit gained with these devices in realistic classroom environments, which is consistent with our research, aside from the use of another assistive listening technology (none of our participants had such an experience, other assistive listening technologies are not common in the Czech Republic).

4.1. Hesitancy

Reasons why parents hesitated or delayed the decision were mentioned 17 times in the interviews. Some reasons were related to changes in the child's life (anticipated cochlear implantation), to the conviction that the primary compensatory device is sufficient to compensate for their child's hearing difficulties, or that (s)he was considered too young.

It is unclear what developmental point is most appropriate to introduce RM [26]. Prior studies have shown that RM are beneficial from early childhood [8] and are beneficial on vocabulary and language skills in most of situations [10, 12]. Recent research has even demonstrated that younger children enjoyed the benefit from RM more than older children [25], and families of children as young as 15 months were able to include these technologies in their daily routines [26]. Notwithstanding, the use of RM by young children remains low according to many authors [12, 27], and the use of RM in the Czech Republic is commonly limited to school use, and even then, it is not standard [19]. In a study of Moodie, Rall [27] audiologists expressed concern about the knowledge parents had about the concepts of difficult listening, loudness and reverberation and their effect on a prelingual deaf child [27]; it is therefore probable that parents are not able to evaluate the benefit of RM.

The experience of parents in contrast to the common knowledge of professionals has also emerged in prior research [12]. One reason may also be that parents are not informed enough about the use and benefits of RM, and it is possible that parents may not understand the challenges their child faces with hearing aids and cannot properly assess situations in which RM would be beneficial.

4.2. Finances

The funding of RM can differ according to the socio-political approach of the country. In our setting, the state allowance was considered low and more parents claimed that they could not afford RM, which is consistent with results from other countries [25, 27]. But the parents in our study often had not tried all the funding options available. It may be that people in the Czech Republic are used to relying on state benefits and it is unusual for them to turn to the non-state sector for financial

assistance. It is also possible that the denial of social benefits gave the impression that RM are unnecessary and inappropriate for that particular child.

To reduce funding barriers, Moodie, Rall [27] proposed the wider dissemination of evidence related to the benefits and advantages of RM to policymakers and other organisation leaders [27]. Our findings also stress the need to better inform parents about funding possibilities and to reduce the perceived stigma related to asking for financial help. It would be important to study how funding opportunities and stigma may affect the decision to acquire RM.

4.3. Lack of information

Insufficient information about RM was frequently mentioned by parents. Some of them had never heard about the existence of these devices. Professionals agree that audiologists should be the key stakeholders for providing information about compensatory devices [28]. In a study of Moodie, Rall [27], audiologists indicated that their provision of RM is dependent on the age of the child, the listening environments, the needs, degree and configuration of hearing loss, cognitive status, and other medical conditions. Results from 66 respondents showed that for non-educational settings (mobiles, music players, TV) RM were often recommended for children older than 10 years of age, but they were never or rarely recommended for younger children. By the time children reached school age, audiologists in their study reported that they "often" (only 32%) or "always" (only 23%) provide information to the family about RM for home or school use [27]. The qualitative design of our study can't confirm these alarmingly low results; thus, more research is needed to explore audiologists' involvement.

4.4. Child's acceptance

Our finding that the child's acceptance of an RM is essential both before and after buying the device is consistent with previous research and is a key factor for RM use.

Children with hearing loss could choose not to use RM because they did not perceive any significant benefit from such devices, as in the study of Gustafson, Ricketts [25]. Other studies suggested that children who are HoH often are not aware of what they are missing and have developed coping strategies to overcome their hearing loss [29, 30]. However, in many cases, especially for teenagers, as previous studies have shown, despite the perceptual benefit of the device, a higher role in the device uptake as well as acceptance and usage is played by personal and environmental factors (stigma, low self-esteem, cosmetic appearance, self-perception of normality). One of the most significant barriers is the social factor, specifically, not wanting to appear different from their peers [2, 9, 29]. Taking these factors into consideration may contribute to motivating children to use RM regularly. Rekkedal [31] also suggests examining classmates' attitudes, because of the importance of their

acceptance. School-parent-child cooperation is needed to overcome these barriers and to motivate the child to use RM.

4.5. Unwillingness of teachers

One of the explanations for non-use of RM experienced by parents was the reluctance of teachers. In several cases, teachers openly refused such technology; in several cases they progressively stopped using it in the classroom.

Our findings are consistent with prior research showing that teachers who use RM are in general satisfied [32], but in some activities it can interfere with the classroom learning objectives, and some teachers consider RM to be inappropriate for their teaching styles [8]. Positive attitudes of teachers to RM and their knowledge about hearing loss are important. According to Rekkedal [31] the central dimensions to the teachers' attitudes towards RM was the teachers' knowledge, the parents' involvement and the type of interventions.

The unwillingness of teachers may also be related to the acceptance of education of children with special needs in general. The level of teachers' insight into the problems of hearing loss is sometimes limited. Prior research has concluded that the quality of life of children who are HoH is often affected by insufficient knowledge of teachers [33]. Eriks-Brophy and Whittingham [34] suggest that in inclusive classrooms in particular, teacher attitudes are crucial to the successful schooling of students with special needs. The key skills are an openness and receptiveness to acquiring new information, the ability to reflect on and criticise one's own teaching practices, along with an associated willingness to implement change. They also put forward that teachers' educational and professional development programmes are often insufficient in preparing to teach students with hearing loss. Inclusive education in the Czech Republic is quite recent. Slowik, Safrankova [17] explained that quality in inclusive education is not just a question of the professional readiness of teachers, but above all, their human maturity and their attitude towards diversity. There is a constant need for more teacher support in Czech schools. In fact, the capacity of counselling centres is very limited, and therefore the support offered to teachers in mainstream schools is usually insufficient.

4.6. Low benefit

Last but not least, the perception of low benefit can be an obvious reason not to use RM. This is intertwined with the previously presented reasons. On the one hand, a low benefit was observed in extremely noisy and in situations with multiple-speakers. On the other hand, the benefit was also considered negligible when children's hearing loss was well compensated for by hearing aids or cochlear implants alone.

It was mainly parents of children with higher level of hearing loss using hearing aids who reported low benefits. We can infer from this that low microphone contribution may be very closely related to audibility with the primary compensatory aid. Quality fitting of hearing aids or cochlear implants before using the RM itself appears to be essential. Further research on audibility could provide important insights into the relationship between RM efficiency and the primary compensatory aid.

It is also important to emphasise that the presented results are based on an analysis of parents' experiences and do not reflect the objectively measured benefits of RM. The perceived benefits may differ from the real ones. In addition, most of the families involved had only borrowed RM on a trial basis; their perceptions may have been influenced by the short period of use.

Prior research has shown that, on average, the use of RM improves children's speech perception in complex listening environments, and the insufficient benefit for some children has not been explored in-depth in many studies. Wolfe, Duke [1] explored modern RM with adaptive functions for solving the ineffectiveness of earlier technologies for small-group listening and interactive lessons [1]. Modern types of devices, through different functions and modes, focus on the special needs

of children in different listening situations. However, in a quiet environment with minimal distance between the speaker and the listener, the use of the device does not likely enhance the audibility of the speaker any further [12]. The distance and situations in which the child may profit from the device are individual.

It is not easy to evaluate the benefit for each child individually, especially in their early years. Recent research by Gustafson, Ricketts [25] suggests that the main predictors of benefits are the child's age (younger children benefit more than older ones) and performance with the use of primary compensatory devices (children well compensated with hearing aids alone are less likely to have speech recognition benefit than those who struggle to communicate in complex environments with omnidirectional hearing aids) [25]. However, Anderson and Goldstein [4] found that even if children performed reasonably well in the domain of speech perception with hearing aids alone, they performed even better with RM.

A parent's perception of the benefit, whether objective or not, directly influences the purchase of RM as well as the extent of its use. Ambrose, Appenzeller [20] observed that the rate of hearing aid use is triggered by parents' beliefs. We can assume that their beliefs equally influence their use of RM. Previous studies have pointed out positive benefits, such as: incidental learning, overhearing, improved listening skills [5], enhanced clarity of speech, general well-being of the child [26], improved attention and receptive language, and reduced listening effort and fatigue. These positive effects are mostly long-term and are not easily perceptible. Therefore, the evaluation of use often cannot be based merely on the perception of parents or the children themselves. Moreover, some of the parents' statements suggest that many problems could have been avoided if the device had been used properly (i.e. function switching) and parents had been better instructed. It is essential that audiologists are trained in the appropriate fitting of RM and troubleshooting so that children benefit as much as possible in their actual home and school environment.

5. Limitations

Our study has several limitations that need to be considered when interpreting the results. The sample included two parents who are HoH, but we did not succeed in recruiting parents who are Deaf and communicate only by sign language to explore their experience, which may be different from that of hearing parents (i.e. access to information, assessment of benefits). The sample is ethnically homogeneous, which is due to the characteristics of the Czech population.

Moreover, the research was carried out with parents, so their opinions regarding why their child or the teacher is not willing to use the device are only their interpretations. Additional research focused on barriers perceived by children and teachers themselves is needed.

The disadvantage of our research is that we did not measure the audibility with the primary compensatory device, so we cannot prove an association between low RM benefit and hearing aid or cochlear implant efficiency.

Another limitation is that the original data collection also included interviews with 13 parents who had borrowed a device for the purpose of the project. Novelty bias could influence their satisfaction with the device; moreover, there is also a risk of acquiescence bias – some of them seemed to be grateful about the possibility to try the device for free, so that it's possible they answered in a way meant to please the researcher (an effort to find at least one barrier or to show satisfaction). To reduce this bias, the researcher explained in advance the purpose of the research and stressed that no answer is wrong. However, the possibility to try the device helped to recruit parents who otherwise would not have participated and to motivate them to examine the function of the device in detail.

Qualitative interviews are widely recognised as the most appropriate research method for identifying patients' experiences [22]. Hence, this study did not include any quantitative data; therefore, the findings are limited to research conducted in a qualitative paradigm and reduce the possibility of generalising the findings.

6. Conclusions

Despite their benefits having been proven many times, in the Czech Republic RM are not commonly used by children who are HoH. Our study focused on why parents do not buy these devices and why children do not use them. Multiple barriers were found, including financial, systemic (lack of information) and personal (children's or teachers' refusal, hesitancy of parents). These barriers can be reduced by socio-political measures (funding for compensatory devices), by improving the system supporting children who are HoH (accurate information provided by audiologists, better education of teachers) and by direct work with families (motivation of children, instruction of parents and teachers). Regarding the low benefit, the last reason reported by parents, this should be evaluated individually and subjected to further research concerning development in the field of sound amplification systems and assistive listening devices. Audiologists should inform families about RM and their use in different situations, but also remind them that even though the child responds well without the device, RM could still benefit them. Families should also be instructed about the needs of children who are HoH and about the effects of hearing loss that may not be apparent at first glance (e.g., listening fatigue, the effect of listening on early childhood development).

These barriers have to be taken into consideration by audiologists, policy-makers and other stakeholders when addressing medical, educational and social systems that support children who are HoH and their families.

Declarations

Author contribution statement

Kristyna Gabova: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Zdenek Meier: Analyzed and interpreted the data; Wrote the paper.

Peter Tavel: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data will be made available on request.

Declaration of interest's statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

Sources

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