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Perceptions of Music Listening for Pain Management: A Mixed-Methods Study

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ABSTRACT

Objectives: Music listening for pain relief is well studied in diverse healthcare settings, but its implementation remains challenging. While healthcare providers generally have a positive attitude, there is a lack of knowledge about healthcare recipients' perceptions and attitudes. Therefore, the aim of this study is to explore healthy volunteers' perceptions of using music for pain management, focusing on their general attitudes, implementation strategies, and subjective experiences of how music helps (or does not help).

Design: A mixed-method study compromising a quantitative survey and qualitative interviews. It is a follow-up 6 months after a randomized experimental study, which assessed the influence of different music genres on pain tolerance. At the end of the original experiment, participants received advice on music listening in painful situations.

Setting: Rotterdam, The Netherlands.

Participants: The survey involved 169 participants (age mean 30.6, SD 9.8; 61.9% female), who conducted the initial trial. Following this, 20 in-depth interviews were conducted.

Outcome measures: Perceptions of music for pain management were investigated, revealing general trends in the quantitative survey data. Data-led thematic analysis of the qualitative interviews focused on individual perceptions.

Results: Participants showed a high willingness to use music for pain relief, particularly for so-called emotional pain. Individual attitudes varied regarding different situations, types of music and types of pain. Barriers such as not considering the option and social sensitivity within healthcare contexts were discussed. A proactive approach by healthcare professionals and autonomy of healthcare recipients were suggested to overcome these barriers. Interestingly, the "wrong" type of music or the "wrong" situation were mentioned as nonbeneficial or even harmful.

Conclusions: Awareness of individual needs and potential negative effects is crucial for the use of music for pain relief. A proactive and personalized approach is needed to effectively implement music in healthcare.

ARTICLE SUMMARY

Strengths and limitations of this study

- The mixed-method approach investigates both general and individual perceptions on music for pain management, offering a nuanced overview.
- Despite the homogeneity in the study population, individual differences regarding different situations, types of music and types of pain were observed.
- This study is of exploratory nature and provides valuable insights for implementation strategies and optimalization of music in healthcare, which need to be tested in patient populations.

KEYWORDS

Implementation

Music

Pain

Mixed-methods study

1. INTRODUCTION

Throughout the history of medicine, music has been recognized for its therapeutic potential (1). Integrating music into pain management strategies represents a promising, nonpharmacological approach to improve patient outcomes (2). Consequently, music is increasingly being integrated into clinical practices. For instance, a national guideline on the use of music in the perioperative process was published in the Netherlands in 2023 (3). Numerous studies have highlighted the benefits of music in alleviating pain, reducing anxiety, and enhancing overall well-being (4-8). There are several theories on how music alleviates pain, including distraction, hormone release, and emotional regulation (9). While medical research objectively demonstrates the impact of music on the human body (10-12), the subjective experience of music listening in the context of pain has not been adequately studied.

Additionally, music in healthcare is often studied on a larger scale using objective outcomes and is viewed as an intervention with no discernible side effects (4, 13). Many (clinical) studies have focused solely on positive outcomes, potentially overlooking situations where music might be counterproductive. Given that the experience of listening to music (in healthcare-related situations) is highly subjective, it is crucial to capture these perceptions in an exploratory manner (14, 15). This approach could give more insights into the effects of music in healthcare, both positive and potentially negative.

Despite this growing body of evidence, its implementation in clinical practice remains challenging due to various barriers such as funding, time to prepare playlists and staff turnover (16, 17). Other commonly documented barriers when implementing guidelines in clinical practice include poor communication, inadequate knowledge, and lack of motivation. (18). While healthcare professionals are generally supportive and research on this topic is extensive (19, 20), there remains a significant gap in understanding how healthcare recipients themselves perceive the use of music as a therapeutic tool. Currently, individuals' thoughts about music for pain relief, their willingness to incorporate it into their pain management routines, and their perspective on the most effective and accepted strategies for its implementation are not well documented.

This study aims to explore healthy volunteers' perceptions of using music for pain management, focusing on their general attitudes, implementation strategies, and subjective experiences of how music helps (or does not help). Through a mixed-methods approach, we hope to provide comprehensive insight into public attitudes toward this topic and contribute to the development of effective, patient-centred strategies for integrating music into pain management practices.

2. METHODS

The present study is a follow-up conducted six months after a randomized experimental trial on the influence of music genres on pain tolerance (21). The protocol of the follow-up study (ETH2324-0398) was approved by the ESHCC Research Ethics Review Committee of Erasmus University Rotterdam (Rotterdam, The Netherlands). Only participants who completed the original trial were invited to participate, with in- and exclusion criteria matching those of the original trial (21). There patients or public

Directly after participation in the original trial, participants received a music listening advice. This advice included both written information and a personal conversation with one of the researchers. In the advice, participants were recommended to listen to music during procedures or situations in healthcare where pain, anxiety and/or stress could arise in the next six months. The participants were told that an invitation for a follow-up study would be sent by e-mail after six months if they provided specific informed consent.

2.1 SURVEY (QUANTITATIVE DATA)

The follow-up survey was developed iteratively by the research team with input from pain researchers and sociologists, following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for reporting observational cohort studies (**Supplementary Table 2**). The survey included multiple choice and open questions on demographics, music listening behaviour, health status, pain experiences, and attitudes toward music listening in healthcare. The survey was sent via Qualtrics software (Version 2020©, Qualtrics, Provo, UT). Data were collected between February and April 2024. Several reminders were sent for up to two months, and a raffle for gift vouchers was sent to encourage participation. It took approximately 10 minutes to complete the survey.

2.2 INTERVIEWS (QUALITATIVE DATA)

In-depth semistructured interviews were conducted via an interview guide developed by the research team. The guide included open-ended questions to explore participants' perspectives on music for pain management. Interviews were performed between March and May 2024, either online or in person, and lasted 30–45 minutes. All interviews were audio-recorded with consent, and notes were taken to capture nonverbal cues. Participants received a €25 gift voucher. To ensure that the group was as heterogeneous as possible, individuals of various ages and educational backgrounds were invited to participate. Data saturation was reached after 20 interviews.

2.3 ANALYSIS

For the quantitative (survey) data, descriptive analyses were performed using means and standard deviations for continuous data. For categorical data, frequencies and percentages were utilized. All data were analysed with SPSS (IBM Corp., Chicago, USA) version 28.0. For the qualitative (interview) data, data-led thematic analysis was conducted. First, author RC (female researcher with expertise in conducting qualitative interviews and no personal relationship with any of the participants) performed all interviews. Next, the anonymized interview transcripts were individually coded by authors AB, EVB, and RC and assigned to different subthemes, following the guidelines of thematic analysis and the Standards for Reporting Qualitative Research (SRQR) (**Supplementary Table 3**) (22-24). In the results section, survey and interview data are presented together per theme, ensuring a comprehensive view of the different findings. Moreover, quotes from the interviews are used to provide context and depth to the quantitative results.

2.4 PATIENT AND PUBLIC INVOLVEMENT

Patients and the public were not involved in developing the research questions, study design, or analysis.

3. RESULTS

In total, 169 participants conducted the follow-up survey, and 20 participated in the interviews (**Figure 1**). An overview of the survey demographics (**Table 1**) revealed that the participants were predominantly female (61.9%), higher educated (88.8%) and of different ages, with the majority being younger adults (mean 30.6, SD 9.8). Accordingly, in the interviews, the participants were primarily female (60%) and higher educated (90%), with a mean age of 34.7 years (**Supplementary Table 1**). In the survey, the average rating of music importance was 8.9 in general and 8.3 for well-being (10-point Likert scale). In the interviews, almost all participants found music important for their life, functioning and well-being. There was a fair distribution in terms of music listening behaviour and pain experienced in the last six months in both survey and interviews.

Table 1 Baseline characteristics of survey participants

Characteristic	N	Value
Age (mean ± SD)	169	30.6 ± 9.8
Gender (%)	168	
Female	104	61.9
Male	62	36.9
Other	2	1.2
Level of education (%)*	169	
Lower	5	3.0
Medium	14	8.3
Higher	150	88.8
Language of survey (%)	169	
Dutch	163	96.4
English	6	3.6
Music importance – general§ (mean ± SD)	168	8.9 ± 1.1
Music importance – well-being§ (mean ± SD)	169	8.3 ± 1.5
Daily music listening hours – passive (%)	169	
< 0.5 h	7	4.1
0.5 to 1 h	16	9.5
1 to 2 h	47	27.8
2 to 4 h	54	32.0
4 to 6 h	30	17.7
> 6 h	15	8.9
Pain in last 6 months (%)	166	
Daily	11	6.6
Several times per week	24	14.5
One time per week	27	10.2
Several times per month	30	18.1
One time per month	30	18.1
Less than one time per month	35	21.1
Other	5	3.0
Not at all	14	8.4

*The level of education is based on the International Standard Classification of Education (ISCED). §10-point Likert scale.

3.1 ATTITUDE TOWARDS MUSIC FOR PAIN MANAGEMENT

In both survey and interviews, most participants wanted to listen to music when experiencing pain (**Figure 2**). Notably, both survey and interview data highlighted that participants were more inclined to listen to music for so-called 'emotional pain' and for overall (mental) well-being than for physical pain. For survey participants who had experienced pain, anxiety and/or stress and had listened to music in the past six months (85.0%), the perceived effect of music (10-point Likert scale) was higher for stress (7.8 ± 1.6) and anxiety (7.0 ± 2.2) than its perceived effect on pain alone (5.2 ± 2.2). In the interviews, all participants believed that music helped with pain relief, primarily by serving as a distraction and influencing emotions, which was mentioned by everyone at least once. Other working mechanisms of music discussed were positive associations, memories, placebo effects and motivation to persevere. All survey participants discussed their (different and sometimes highly specific) beliefs and expectations about which music would (not) work for them.

The survey results revealed several trends, such as a lower willingness to listen to music when experiencing headaches (3.1 ± 2.5 on a 10-point Likert scale) than in other situations, such as during surgery (8.1 ± 1.6) or in the waiting room (6.6 ± 2.6). For painful medical procedures, most survey participants preferred to listen to music either during the procedure (79.9%) or for a longer period before (64.5%), with a preference for using their own equipment (67.5%). The interviews revealed that the willingness to listen to music and the choice of music were influenced by diverse factors that strongly varied among individuals. For example, participant 12 (M, 35) explained:

For me, it depends on the season. Last year, I had a root canal treatment. When I went outside, everything actually hurt quite a bit. However, the sun was shining, and because of that, I chose to play some chill house music, which helped me.

Most interview participants indicated a preference for music that aligns with their personal tastes. However, they generally chose harder/upbeat music in situations associated with acute pain, whereas more classical/relaxing music was preferred when they were admitted to the hospital and experienced pain. For example, participant 14 (M, 36) stated, *"I think that being able to endure pain for as long as possible, hardstyle music would work better."*

3.2 IMPLEMENTATION OF MUSIC IN HEALTHCARE

An overview of the perceived barriers and optimal situation of music implementation in healthcare is shown in **Figure 3**. The primary reason survey participants did not listen to music in a healthcare situation was that they had not considered it/not remembered the advice given (91.7%). Other reasons

were mostly personal and social factors, such as feeling that there was no time (29.2%) and considering it impolite or awkward to ask (20.8%). A minority of survey and interview participants mentioned practical factors, which were limited to technical issues, such as uncertainty about equipment availability. In the interviews, a frequently perceived barrier to listening to (their own) music was the perceived social sensitivity to this topic. Both survey and interview participants indicated that a more proactive approach by healthcare professionals in suggesting or advising music listening would be highly beneficial. For example, participant 2 (F, 21) explained, *"If they suggested listening to music, it would be easier. I don't think I would quickly ask myself, 'Can I put on my techno music?' because it's not very socially accepted and you might also bother others."*

Nearly all interview participants emphasized the importance of having control and autonomy in selecting the type of music, the equipment and the context in which to listen to it. Preferences for listening to music varied significantly based on the situation and personal preferences. Another crucial factor was the need for information about the possibility of listening to music before a planned (surgical) procedure. Finally, nearly all participants mentioned the importance of healthcare providers offering options and taking personal (music) preferences into account. For example, participant 13 (F, 35) explained:

The optimal situation for me would be to have options. Do you want it in the room, headphones, or earphones? And also what kind of music do you want to listen to? And whether you want music at all. That all choices are left to you.

3.3 POTENTIAL NEGATIVE EFFECTS OF MUSIC IN HEALTHCARE

During the interviews, many participants mentioned situations dependent on factors such as the type of pain and mood, where music might not be beneficial or even disadvantageous to them. Those factors were highly individual, for example, while participant 4 (F, 25) mentioned that "*With a headache, I would truly like to listen to music."* Participant 9 (M, 31), in contrast, stated, *"Therefore, it [the music] would work very counterproductively there [with headaches] because the stimuli are part of the cause of the pain."*

Other interview participants mentioned potential negative effects of music in certain situations. For example, participant 4 (F, 25) discussed the fear of developing negative associations with a piece of music after listening to it in a painful context:

I don't know if I would want to hear music immediately after surgery. You always wake up so confused from anaesthesia. I'm not sure if listening to music right away would later make you associate the music with the anaesthesia.

Overall, the type of music emerged as a crucial factor. Interview participants mentioned that music linked to certain memories could work averse. For example, participant 13 (F, 35) noted, "*If you happen to play the wrong song with specific memories, I don't think it necessarily helps at that moment.*"

Almost all interview participants mentioned that disliked music would not help them and could even have the opposite effect. For example, participant 15 (F, 36) states: *"As long as I find the music enjoyable. I don't need classical music. That won't help me, on the contrary. I also find jazz very annoying. It won't help me."*

Some participants mentioned that the wrong type of music could discourage them from listening to music in healthcare. For example, participant 11 (F, 36) explained: *"Earlier this year, I had an MRI scan. You could get headphones, but they only have two Dutch radio stations. I don't want that. I'd rather listen to the noise of the scan."*

4. DISCUSSION

This mixed-methods study explored the perceptions of healthy volunteers regarding the utilization of music in healthcare. In general, participants wanted to use music for pain management. Although participants were relatively homogenous in terms of music importance, their attitudes toward the type of music and specific situations varied. In healthcare-related situations, participants encounter certain barriers when listening to music. Our results show that several personal, social and practical aspects need to be considered when implementing music in healthcare. In particular, the role of autonomy and control for patients has emerged as an important factor, making it crucial to consider personal preferences. In other words, music is not a one-size-fits-all intervention but should be tailored to the individual, the setting, and the type of pain. Moreover, healthcare professionals should adopt a more proactive approach in facilitating music in healthcare, offering options and demonstrating social sensitivity. Finally, it is important to recognize that the "wrong" type of music or the "wrong" situation could have a nonbeneficial or even harmful effect.

4.1 ATTITUDE TOWARDS MUSIC FOR PAIN MANAGEMENT

To our knowledge, this mixed-methods study is among the first to explore perceptions of music for pain management from the perspective of healthcare recipients. Previous research has highlighted the positive attitudes of healthcare professionals toward music as a therapeutic intervention (2, 19). Similarly, our results revealed a positive attitude of participants toward the use of music for pain relief in healthcare-related settings. Our data indicate that listening to music for so-called emotional pain was more intuitive for participants than listening to music for physical pain. Extensive research has documented positive effects of music on both emotional pain (e.g., anxiety, stress, and psychiatric disorders) and physical pain (e.g., surgery, dental procedures, and experimental nociceptive pain). Although pain is defined as a sensory and emotional experience, it is traditionally researched and treated separately from emotions (25). However, physical pain and emotions share overlapping conceptual and neuroanatomical spaces and can influence each other. While the complete mechanisms of music's effect on pain are not fully understood, music-induced emotions may play a key role in pain alleviation (9, 26, 27). Therefore, although participants intuitively separated the effects of music on emotional and physical pain, these aspects influence each other and should not be considered separately when evaluating the impact of music on pain. In addition, participants mostly believed that music worked for pain relief as a distraction. Central pain processing can be modulated by several factors, such as pain context, mood and cognitive set, with attention and distraction as important dimensions (28). Previous studies on the pain-relieving effects of music have predominantly measured these factors quantitatively (12, 26, 29, 30). In our study, we focused on the subjective experience, revealing that distraction and emotions are commonly experienced factors in pain modulation by

music. Additionally, some participants mentioned contextual factors such as the placebo effect and their beliefs or expectations about which music would (not) help them.

4.2 IMPLEMENTATION OF MUSIC IN HEALTHCARE

Previous research has shown that patients are generally willing to listen to music, which aligns with our findings (31). However, certain barriers significantly impact the successful implementation of music in healthcare (16, 19). From the healthcare providers' perspective, these barriers include knowledge about the intervention, decision-making processes, and patient turnover timing. From the patients' perspective, a lack of knowledge and awareness prevents them from using music for pain relief. While qualitative research has explored healthcare providers' views on music in healthcare (19), our study focuses on recipients' perspectives, combining qualitative and quantitative methods for more nuanced conclusions. One common barrier was that participants simply did not consider/remember listening to music, and healthcare providers did not suggest it. Social acceptability was also a concern, such as the feeling that it is impolite or awkward to ask for music, which could be addressed by healthcare providers taking a more proactive role in offering information and guidance. Our results highlight that autonomy and control are crucial. Participants expressed that choices regarding music for pain management (e.g., type of music, equipment, timing) should be left to them. This finding is in line with previous studies that showed that listening to the preferred type of music is most efficient for pain relief (21, 32, 33). A study by Howlin et al. described the link between perceived control and the analgesic benefits of music in an experimental setting, but this link has not been thoroughly investigated in clinical settings (34, 35). Willingness to listen to music varied among individuals depending on the situation and type of pain. Our study population highly valued music, but the general population might have a higher percentage of individuals not wanting to engage with music in healthcare. Overall, our results emphasize the need to tailor music interventions to individual needs and preferences. Providing options in terms of the type of music and listening situations, along with a proactive approach from healthcare providers, could facilitate the implementation of music in healthcare.

4.3 POTENTIAL NEGATIVE EFFECTS OF MUSIC IN HEALTHCARE

Many studies have highlighted the positive effects of music in healthcare settings, such as reducing anxiety, stress, and pain and improving overall well-being (4, 5, 7, 36). Assuming that music has no side effects, one might conclude that it is always a suitable option since it 'does no harm'. However, our study revealed that participants identified specific situations, moods, and types of pain where they did not want to listen to music. Listening to music under those circumstances was described as nonbeneficial or even harmful. Our results also revealed that music in the wrong situation, such as directly after surgery, could create negative associations. Moreover, music of a type that is considered

"wrong" or "not preferred" by the individual could lead to nonbeneficial or even negative effects. Offering a single type of music (such as classical music, which is often used in clinical trials) may not optimal for everyone, indicating a need for more personalized approaches (4). To our knowledge, these possible negative effects have not been described before. Our findings suggest that being sensitive to individual preferences and contexts is crucial when using music in healthcare, as the wrong music in the wrong situation can actually do harm**.**

4.4 LIMITATIONS AND FUTURE RESEARCH

One limitation of this mixed-method study is the relatively young and highly educated study population. This population is not representative of the general population, particularly not of hospitalized patients who tend to be older. Additionally, while the study population was quite homogeneous in terms of high music importance, there were still many individual differences. Moreover, the participants in this study experienced barriers to use music in healthcare, which might be even more challenging for individuals with a lower value for music. Nevertheless, more research is needed to investigate the perceptions of patients with diverse backgrounds regarding music in healthcare. Another limitation lies in the nature of this study, which assessed the subjective attitudes and experiences of overall healthy participants. These perceptions are important for understanding the perspective of healthcare recipients and improving implementation strategies. However, further research applying objective measurements in clinical settings under suitable (placebo) control conditions is needed to validate these findings.

5. CONCLUSION

In conclusion, this mixed-methods study reveals that healthcare recipients want to use music for pain relief. However, they encounter barriers to actually listen to music, which can be divided into personal, social and practical factors. A proactive approach by healthcare providers and giving autonomy and control to patients are crucial. Participants expressed highly individual attitudes and beliefs about which music would (not) help them. The wrong type of music in the wrong situation was experienced as nonbeneficial and sometimes even harmful. In summary, tailoring music to individual needs and preferences is essential for implementing music for pain relief in healthcare.

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AUTHOR CONTRIBUTION STATEMENT

This study was designed by EVB, AB, JS, RC, MB and MK. Interviews were conducted by RC. The data were analyzed by EVB, AB and RC, and the results were critically examined by all authors. EVB and AB had a primary role in preparing the manuscript, which was edited by JS, MB, RC and MK. All authors have approved the final version of the manuscript and agree to be accountable for all aspects of the work.

DATA AVAILABILITY STATEMENT

The data underlying this article cannot be shared due to privacy reasons. Data are available on reasonable request to the corresponding author.

CONFLICT OF INTEREST

None to declare.

FIGURE LEGENDS

Figure 1 Flow diagram of study participants

Flow diagram of participants included in the survey (n=169) and interviews (n=20), with reasons for exclusion per recruitment phase, starting with the original trial (21).

Figure 2 Summary of general attitudes toward music in healthcare

The figure shows the key findings on the general attitudes toward music in healthcare from survey (left) and interview (right) data.

*Participants who experienced pain, anxiety and/or stress in a healthcare-related situation within the last six months.

**Participants who experienced pain, anxiety and/or stress and listened to music in the past six months.

Figure 3 Perceived barriers and optimal situation for music implementation in healthcare

Summary of the perceived barriers (upper section) and optimal situation (lower section) for music implementation in healthcare. The overview is based on both survey and interview data.

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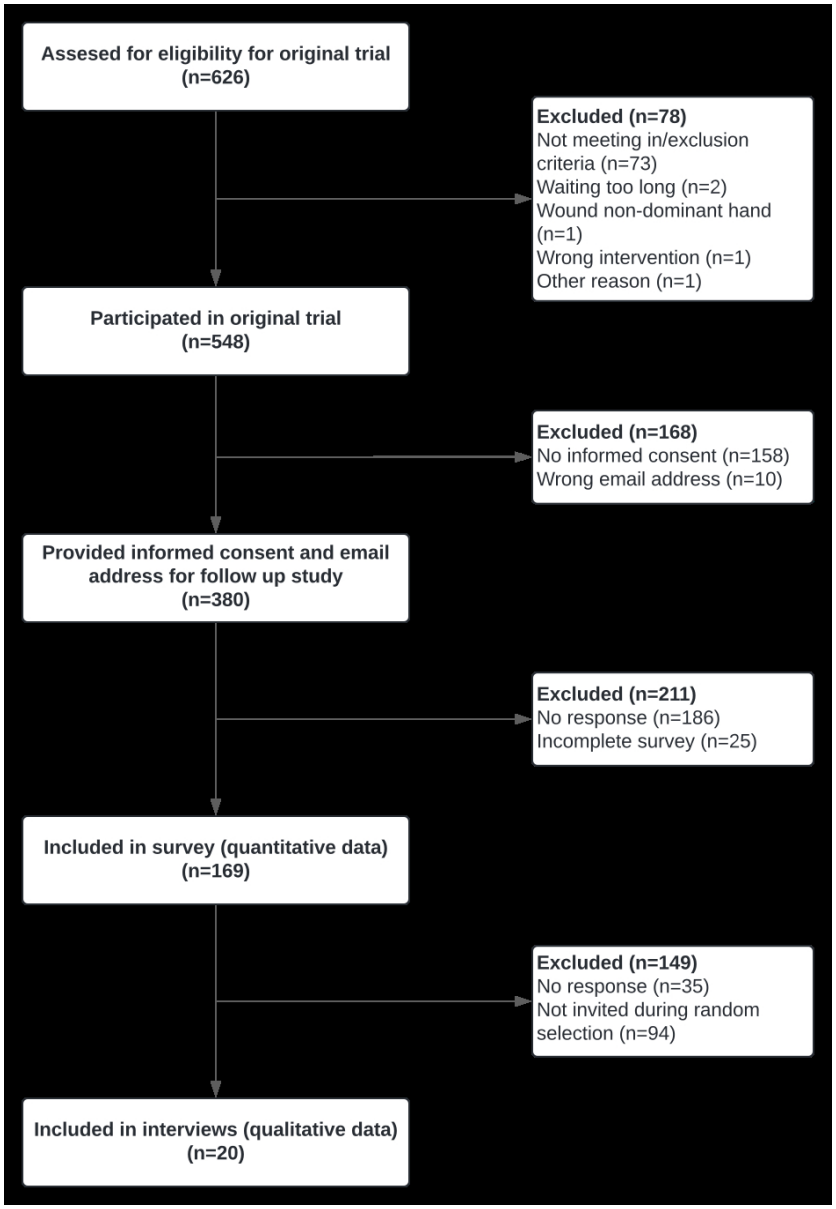

Figure 1 Flow diagram of study participants
Flow diagram of participants included in the survey (n=169) and interviews (n=20), with reasons for exclusion per recruitment phase, starting with the original trial (21).

332x480mm (72 x 72 DPI)

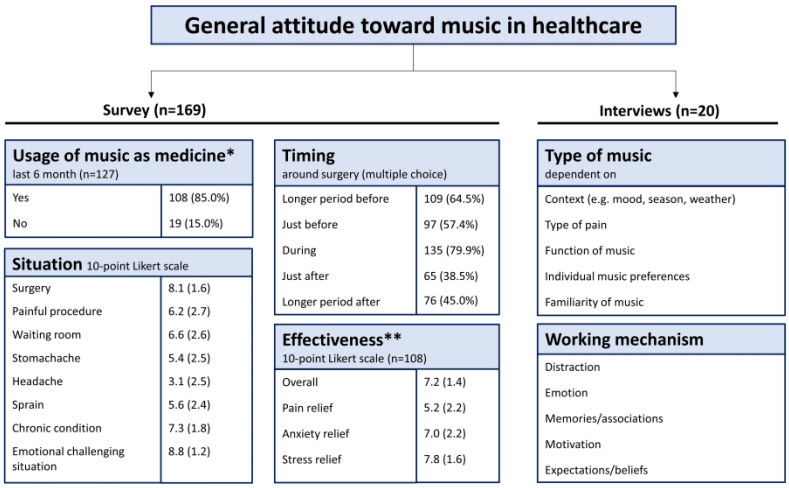

Figure 2 Summary of general attitudes toward music in healthcare
The figure shows the key findings on the general attitudes toward music in healthcare from survey (left) and interview (right) data.
*Participants who experienced pain, anxiety and/or stress in a healthcare-related situation within the last six months.
**Participants who experienced pain, anxiety and/or stress and listened to music in the past six months.

861x484mm (236 x 236 DPI)

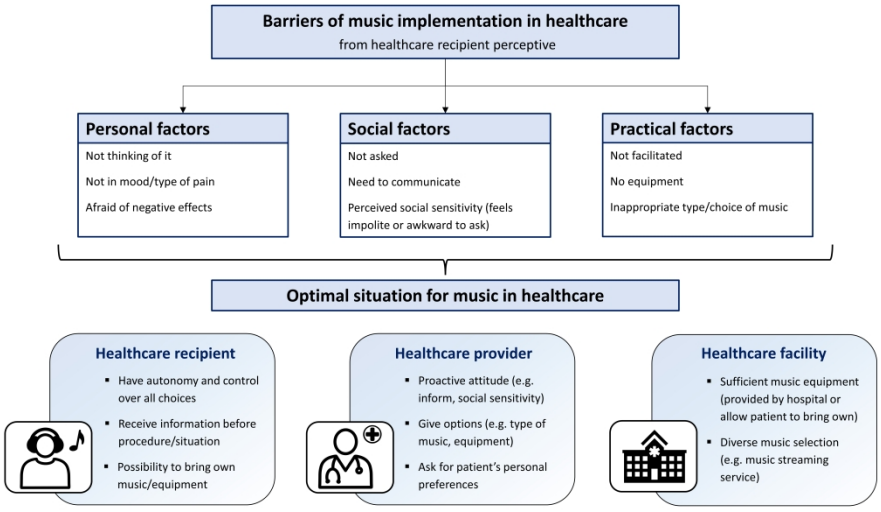

Figure 3 Perceived barriers and optimal situation for music implementation in healthcare
Summary of the perceived barriers (upper section) and optimal situation (lower section) for music implementation in healthcare. The overview is based on both survey and interview data.

861x484mm (236 x 236 DPI)

Supplementary Table 1 Characteristics of interview participants

Participant Number	Gender	Age (years)	Level of Education*	Music importance – general§	Music importance - wellbeing§	Daily music listening hours	Pain in last six months
1	Female	21	HBO	10	10	3-4 h	Several times per month
2	Female	21	WO	10	10	3-4 h	Less than one time per month
3	Female	23	WO	9	8	2-3 h	Several times per week
4	Female	25	HBO	10	8	1.5-2 h	Daily
5	Female	25	WO	9	9	2-3 h	One time per month
6	Male	27	HBO	7	7	3-4 h	One time per week
7	Male	27	WO	7	5	1-1.5 h	Several times per week
8	Female	29	WO	10	10	3-4 h	One time per month
9	Male	31	WO	10	9	4-5 h	Other
10	Female	31	WO	7	6	2-3 h	Less than one time per month
11	Female	34	MBO	10	10	>6 h	Several times per week
12	Male	35	HBO	9	9	1.5-2 h	Other
13	Female	35	HBO	10	10	>6 h	Less than one time per month

14	Male	36	HBO	7	7	>6 h	Several times per month
15	Female	36	WO	9	9	1.5-2 h	Less than one time per month
16	Male	41	MBO	10	10	>6 h	Other
17	Female	43	WO	10	8	1-1.5 h	One time per month
18	Female	52	HBO	8	7	3-4 h	Not at all
19	Male	53	WO	10	8	1-1.5 h	Not at all
20	Male	69	HBO	9	8	1-1.5 h	Several times per week

Characteristics of all interview participants, including gender, age, level of education, and answers to survey questions on music importance, daily music listening hours and pain experienced in the last six months.

*HBO = Higher vocational secondary education (in Dutch: Hoger Beroepsonderwijs), MBO = Intermediate vocational secondary education (in Dutch: Middelbaar Beroepsonderwijs), WO = Research-oriented higher education (in Dutch: Wetenschappelijk Onderwijs).

§10-point Likert scale.

Supplementary Table 2 STROBE 2007 (v4) Statement - *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1, 2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	2, 5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5, 6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, explain how loss to follow-up was addressed	N/A
		(*e*) Describe any sensitivity analyses	N/A

Results			
Participants	13	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	6
		(c) Consider use of a flow diagram	6
Descriptive data	14	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	6
		(c) Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15	Report numbers of outcome events or summary measures over time	8, 9, 10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8
		(*b*) Report category boundaries when continuous variables were categorized	N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	11, 13
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11, 12, 13
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

Supplementary Table 3 Standards for Reporting Qualitative Research (SRQR)

Section/Topic	Reported on page #
Title and abstract	
Title - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	1
Abstract - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	2
Introduction	
Problem formulation - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	4
Purpose or research question - Purpose of the study and specific objectives or questions	4
Methods	
Qualitative approach and research paradigm - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale**	5, 6
Researcher characteristics and reflexivity - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability	6
Context - Setting/site and salient contextual factors; rationale**	5
Sampling strategy - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**	5
Ethical issues pertaining to human subjects - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	5
Data collection methods - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale**	5

Data collection instruments and technologies - Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	5
Units of study - Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	6
Data processing - Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/de-identification of excerpts	6
Data analysis - Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale**	6
Techniques to enhance trustworthiness - Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale**	6
Results/findings	
Synthesis and interpretation - Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	6, 8, 9, 10
Links to empirical data - Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	8, 9, 10
Discussion	
Integration with prior work, implications, transferability, and contribution(s) to the field - Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	11, 12, 13
Limitations - Trustworthiness and limitations of findings	13
Other	
Conflicts of interest - Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	14
Funding - Sources of funding and other support; role of funders in data collection, interpretation, and reporting	14

Reference:

O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. **Standards for reporting qualitative research: a synthesis of recommendations.** *Academic Medicine*, Vol. 89, No. 9 / Sept 2014
DOI: 10.1097/ACM.0000000000000388

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Perceptions of Music Listening for Pain Management: A Multi-Method Study

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ABSTRACT

Objectives: Music listening for pain relief is well studied in diverse healthcare settings, but its implementation remains challenging. While healthcare providers generally have a positive attitude, there is a lack of knowledge about healthcare recipients' perceptions and attitudes. Therefore, the aim of this study is to explore healthcare recipients' perceptions of listening to music for pain management, focusing on their general attitudes, implementation strategies, and subjective experiences of how music helps (or does not help).

Design: A multi-method study compromising a quantitative survey and qualitative interviews. It is a follow-up 6 months after a randomized experimental study, which assessed the influence of different music genres on pain tolerance. At the end of the original experiment, participants received advice on music listening in painful situations.

Setting: Rotterdam, The Netherlands.

Participants: The survey involved 169 participants (age mean 30.6, SD 9.8; 61.9% female), who participated in the initial trial. Following this, 20 in-depth interviews were conducted.

Outcome measures: Perceptions of music for pain management were investigated, revealing general trends in the quantitative survey data. Data-led thematic analysis of the qualitative interviews focused on individual perceptions.

Results: Participants showed a high willingness to use music for pain relief, particularly for so-called emotional pain (e.g., anxiety, stress, heartbreak). Individual attitudes varied regarding different situations, types of music and types of pain. Barriers such as not considering the option and social sensitivity within healthcare contexts were discussed. A proactive approach by healthcare professionals and autonomy of healthcare recipients were suggested to overcome these barriers. Interestingly, the "wrong" type of music or the "wrong" situation were mentioned as nonbeneficial or even harmful.

Conclusions: Awareness of individual needs and potential negative effects is crucial for the use of music for pain relief. A proactive and personalized approach is needed to effectively implement music in healthcare.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- The multi-method approach investigates both general and individual perceptions on music listening for pain management, offering a nuanced overview.
- The relatively young and highly educated study population is not representative of the general population, which is a limitation of this study.
- This study is of exploratory nature and provides valuable insights for implementation strategies and optimalization of music listening in healthcare, which need to be tested in actual patient populations.

KEYWORDS

Implementation

Music

Pain

Multi-method study

1. INTRODUCTION

Throughout the history of medicine, music has been recognized for its therapeutic potential [1]. Integrating music into pain management strategies represents a promising, nonpharmacological approach to improve patient outcomes [2]. Consequently, music is increasingly being integrated into clinical practices. For instance, a national guideline on the use of music in the perioperative process was published in the Netherlands in 2023 [3]. Numerous studies have highlighted the benefits of music in alleviating pain, reducing anxiety, and enhancing overall well-being [4-8]. There are several theories on how music alleviates pain, including distraction, hormone release, and emotional regulation [9]. While medical research objectively demonstrates the impact of music on the human body [10-12], the subjective experience of music listening in the context of pain has not been adequately studied.

Different forms of music engagement, such as music therapy, active music making, and listening to recorded music, have been shown to be effective in various healthcare settings [7, 13, 14]. Listening to recorded music is often studied on a larger scale using objective outcomes and is viewed as an intervention with no discernible side effects [4, 15]. Many (clinical) studies looking at the effect of music listening have focused solely on positive outcomes, potentially overlooking situations where music might be counterproductive. Given that the experience of listening to music (in healthcare-related situations) is highly subjective, it is crucial to capture these perceptions in an exploratory manner [16, 17]. This approach could give more insights into the effects of music in healthcare, both positive and potentially negative.

Despite this growing body of evidence, its implementation in clinical practice remains challenging due to various barriers such as funding, time to prepare playlists and staff turnover [18, 19]. Other commonly documented barriers when implementing guidelines in clinical practice include poor communication between healthcare providers, inadequate knowledge, and lack of motivation [20]. While healthcare professionals are generally supportive and research on this topic is extensive [21, 22], there remains a significant gap in understanding how healthcare recipients themselves perceive the use of music as a therapeutic tool. Currently, individuals' thoughts about music for pain relief, their willingness to incorporate it into their pain management routines, and their perspective on the most effective and accepted strategies for its implementation are not well documented.

This study aims to explore healthcare recipients' perceptions of listening to music for pain management, focusing on their general attitudes, implementation strategies, and subjective experiences of how music helps (or does not help). Through a multi-method approach, we hope to provide comprehensive insight into public attitudes toward this topic and contribute to the

development of effective, patient-centred strategies for integrating music into pain management practices.

2. METHODS

The present study is a follow-up conducted six months after a randomized experimental trial on the influence of music genres on pain tolerance [23]. In this trial, healthy volunteers underwent a cold pressor test as a pain stimulus while listening to different music genres. Participants in the original trial were healthy volunteers aged 18 years and older, with specific exclusion criteria to ensure valid results and participant safety. These criteria included factors such as recent alcohol or drug use, chronic or acute pain conditions, cardiovascular diseases, and hearing problems. The protocol of the follow-up study (ETH2324-0398) was approved by the ESHCC Research Ethics Review Committee of Erasmus University Rotterdam (Rotterdam, The Netherlands). Only participants who completed the original trial were invited to participate, with inclusion criteria matching those of the original trial [23]. The eligibility criteria of this follow-up study are provided in **Table 1**.

Directly after participation in the original trial, participants received a music listening advice. This advice included both written information and a personal conversation with one of the researchers. In the advice, participants were recommended to listen to music during procedures or situations in healthcare where pain, anxiety and/or stress could arise in the next six months. Other than the post-trial advice, the original trial did not promote music listening. The participants were told that an invitation for a follow-up study would be sent by email after six months if they provided specific informed consent. Six months after the original trial, participants were recruited for this follow-up study via email, with invitations to join the survey (online) and/or participate in an interview (either online or in person at Erasmus Medical Centre). This follow-up study follows a multi-method approach, where both qualitative and quantitative data were collected in parallel and analysed separately. After these analyses, the findings from both data sources were compared and merged to draw comprehensive conclusions.

Table 1 – Overview of the in- and exclusion criteria

Inclusion criteria	Exclusion criteria
Adults ≥18 years	Significant hearing impairment
Sufficient knowledge of Dutch or English language	Presence of acute or chronic pain during original trial
Provision of written informed consent	Medical history of cardiovascular diseases during original trial
	Use of antidepressants or other psychiatric medication during original trial
	Use of pain medication (within 12h), recreational drugs (within 24h) or alcohol level >0.5‰ before original trial

2.1 SURVEY (QUANTITATIVE DATA)

The follow-up survey was developed iteratively by the research team with input from pain researchers and sociologists, following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for reporting observational cohort studies (**Supplementary Table 1**). The survey included multiple choice and open questions on demographics, music listening behaviour, health status, pain experiences, and attitudes toward music listening in healthcare. An overview of the survey questions is provided in **Supplementary Table 2**. The survey was sent via Qualtrics software (Version 2020©, Qualtrics, Provo, UT). Data were collected between February and April 2024. Several reminders were sent for up to two months, and a raffle for gift vouchers was sent to encourage participation. It took approximately 10 minutes to complete the survey.

2.2 INTERVIEWS (QUALITATIVE DATA)

In-depth semistructured interviews were conducted via an interview guide developed by the research team (**Supplementary Table 3**). The guide included open-ended questions to inductively explore participants' perspectives on music for pain management. Interviews were performed between March and May 2024, either online or in person, and lasted 30–45 minutes. All interviews were audio-recorded with consent, and notes were taken to capture nonverbal cues. Participants received a €25 gift voucher. To ensure that the group was as heterogeneous as possible, individuals of various ages and educational backgrounds were invited to participate. Data saturation was reached after 20 interviews.

2.3 ANALYSIS

The quantitative (survey) data were analysed with SPSS (IBM Corp., Chicago, USA) version 28.0. Descriptive analyses were performed using means and standard deviations for continuous data. For categorical data, frequencies and percentages were utilized. To investigate the relationship of certain baseline characteristics (such as age, gender, music importance) on the willingness to listen to music in the different situations and the overall effectiveness rating, linear multivariable regression analyses were conducted. For the qualitative (interview) data, data-led thematic analysis informed by grounded theory was conducted [24]. First, author RC (female researcher with expertise in conducting qualitative interviews and no personal relationship with any of the participants) performed all interviews. Next, the anonymized interview transcripts were individually coded by authors AB, EVB, and RC and assigned to different subthemes, following the guidelines of thematic analysis and the Standards for Reporting Qualitative Research (SRQR) (**Supplementary Table 4**) [25-27]. This coding was conducted independently by the three individual authors, and the results were compared and discussed in the axial coding phase to ensure consistency. Finally, the found themes were compared with the themes from the survey results in the selective coding phase, to ensure reliability. This resulted in the three overarching dimensions that structure the results section. Additionally, notes regarding nonverbal cues (e.g., facial expressions, vocal nuances, gestures) were written down during the interviews and considered during the coding process to provide a more comprehensive understanding of the participants' responses. In the results section, survey and interview data are presented together per theme, ensuring a comprehensive view of the different findings. Moreover, quotes from the interviews are used to provide context and depth to the quantitative results.

2.4 PATIENT AND PUBLIC INVOLVEMENT

Patients and the public were not involved in developing the research questions, study design, or analysis.

3. RESULTS

In total, 169 participants conducted the follow-up survey, and 20 participated in the interviews (**Figure 1**). An overview of the survey demographics (**Table 2**) revealed that the participants were predominantly female (61.9%), higher educated (88.8%) and of different ages, with the majority being younger adults (mean 30.6, SD 9.8). Accordingly, in the interviews, the participants were primarily female (60%) and higher educated (90%), with a mean age of 34.7 years (**Supplementary Table 5**). In the survey, the average rating of music importance was 8.9 in general and 8.3 for well-being (10-point Likert scale). In the interviews, almost all participants found music important for their life, functioning and well-being. There was a fair distribution in terms of music listening behaviour and pain experienced in the last six months in both survey and interviews. Although some participants experienced daily pain at the time of their study participation (e.g., broken leg, post-surgery), there were no participants with chronic pain.

3.1 ATTITUDE TOWARDS MUSIC FOR PAIN MANAGEMENT

In both survey and interviews, most participants wanted to listen to music when experiencing pain (**Figure 2**). Notably, both survey and interview data highlighted that participants were more inclined to listen to music for so-called 'emotional pain' (such as anxiety, stress, and heartbreak) and for overall (mental) well-being than for physical pain. For survey participants who had experienced pain, anxiety and/or stress and had listened to music in the past six months (85.0%), the perceived effect of music (10-point Likert scale) was higher for stress (7.8 ± 1.6) and anxiety (7.0 ± 2.2) than its perceived effect on pain alone (5.2 ± 2.2). In the interviews, all participants believed that music helped with pain relief, primarily by serving as a distraction and influencing emotions, which was mentioned by everyone at least once. Other working mechanisms of music discussed were positive associations, memories, placebo effects and motivation to persevere. All survey participants discussed their (different and sometimes highly specific) beliefs and expectations about which music would (not) work for them.

Table 2 Baseline characteristics of survey participants

Characteristic	N	Value
Age (mean ± SD)	169	30.6 ± 9.8
Gender (%)	168	
Female	104	61.9
Male	62	36.9
Other	2	1.2
Level of education (%)*	169	
Lower	5	3.0
Medium	14	8.3
Higher	150	88.8
Language of survey (%)	169	
Dutch	163	96.4
English	6	3.6
Music importance – general§ (mean ± SD)	168	8.9 ± 1.1
Music importance – well-being§ (mean ± SD)	169	8.3 ± 1.5
Daily music listening hours (%)	169	
< 0.5 h	7	4.1
0.5 to 1 h	16	9.5
1 to 2 h	47	27.8
2 to 4 h	54	32.0
4 to 6 h	30	17.7
> 6 h	15	8.9
Pain in last 6 months (%)	166	
Daily	11	6.6
Several times per week	24	14.5
One time per week	17	10.2
Several times per month	30	18.1
One time per month	30	18.1
Less than one time per month	35	21.1
Other	5	3.0
Not at all	14	8.4
Chronic pain	0	0.0

*The level of education is based on the International Standard Classification of Education (ISCED).

§10-point Likert scale.

Abbreviations: SD= standard deviation.

The survey results revealed several trends, such as a lower willingness to listen to music when experiencing headaches (3.1 ± 2.5 on a 10-point Likert scale) than in other situations, such as during surgery (8.1 ± 1.6) or in the waiting room (6.6 ± 2.6). For painful medical procedures, most survey participants preferred to listen to music either during the procedure (79.9%) or for a longer period before (64.5%), with a preference for using their own equipment (67.5%). Looking at the influence of participants' baseline characteristics, some trends emerged regarding their willingness to listen to music in the different situations and the overall effectiveness rating (**Supplementary Table 6**). For instance, participants who attributed higher importance to music for their well-being were more likely to want to listen to music during surgery (β 0.34, 95% CI 0.12 - 0.57, p=0.003), and in emotionally challenging situations (β 0.36, 95% CI 0.18 - 0.53, p<0.001). Additionally, female participants (β 1.47, 95% CI 0.64 - 2.30, p<0.001) and those who listened to music more frequently in their daily lives (β 0.26, 95% CI 0.08 - 0.45, p=0.006) tended to prefer listening to music in the waiting room. The interviews revealed that the willingness to listen to music and the choice of music were influenced by diverse factors that strongly varied among individuals. For example, participant 12 (male, 31 – 40 years) explained:

For me, it depends on the season. Last year, I had a root canal treatment. When I went outside, everything actually hurt quite a bit. However, the sun was shining, and because of that, I chose to play some chill house music, which helped me.

Most interview participants indicated a preference for music that aligns with their personal tastes. However, they generally chose harder/upbeat music in situations associated with acute pain, whereas more classical/relaxing music was preferred when they were admitted to the hospital and experienced pain. For example, participant 14 (male, 31 – 40 years) stated, *"I think that being able to endure pain for as long as possible, hardstyle [up-tempo electronic dance music subgenre] music would work better."*

3.2 IMPLEMENTATION OF MUSIC IN HEALTHCARE

An overview of the perceived barriers and optimal situation of music implementation in healthcare is shown in **Figure 3**. The primary reason survey participants did not listen to music in a healthcare situation was that they had not considered it/not remembered the advice given (91.7%). Other reasons were mostly personal and social factors, such as feeling that there was no time (29.2%) and considering it impolite or awkward to ask (20.8%). A minority of survey and interview participants mentioned practical factors, which were limited to technical issues, such as uncertainty about equipment availability. In the interviews, a frequently perceived barrier to listening to (their own) music was the perceived social sensitivity to this topic. Both survey and interview participants

indicated that a more proactive approach by healthcare professionals in suggesting or advising music listening would be highly beneficial. For example, participant 2 (female, 21 to 30 years) explained, *"If they suggested listening to music, it would be easier. I don't think I would quickly ask myself, 'Can I put on my techno music?' because it's not very socially accepted and you might also bother others."*

Nearly all interview participants emphasized the importance of having control and autonomy in selecting the type of music, the equipment and the context in which to listen to it. Preferences for listening to music varied significantly based on the situation and personal preferences. Another crucial factor was the need for information about the possibility of listening to music before a planned (surgical) procedure. Finally, nearly all participants mentioned the importance of healthcare providers offering options and taking personal (music) preferences into account. For example, participant 13 (female, 31 to 40 years) explained:

The optimal situation for me would be to have options. Do you want it in the room, headphones, or earphones? And also what kind of music do you want to listen to? And whether you want music at all. That all choices are left to you.

3.3 POTENTIAL NEGATIVE EFFECTS OF MUSIC IN HEALTHCARE

During the interviews, many participants mentioned situations dependent on factors such as the type of pain and mood, where music might not be beneficial or even disadvantageous to them. Those factors were highly individual, for example, while participant 4 (female, 21 to 30 years) mentioned that "*With a headache, I would truly like to listen to music."* Participant 9 (male, 31 to 40 years), in contrast, stated, *"Therefore, it [the music] would work very counterproductively there [with headaches] because the stimuli are part of the cause of the pain."*

Other interview participants mentioned potential negative effects of music in certain situations. For example, participant 4 (female, 21 to 30 years) discussed the fear of developing negative associations with a piece of music after listening to it in a painful context:

I don't know if I would want to hear music immediately after surgery. You always wake up so confused from anaesthesia. I'm not sure if listening to music right away would later make you associate the music with the anaesthesia.

Overall, the type of music emerged as a crucial factor. Interview participants mentioned that music linked to certain memories could work averse. For example, participant 13 (female, 31 to 40 years) noted, "*If you happen to play the wrong song with specific memories, I don't think it necessarily helps at that moment."*

Almost all interview participants mentioned that disliked music would not help them and could even have the opposite effect. For example, participant 15 (female, 31 to 40 years) states: *"As long as I find the music enjoyable. I don't need classical music. That won't help me, on the contrary. I also find jazz very annoying. It won't help me."*

Some participants mentioned that the wrong type of music could discourage them from listening to music in healthcare. For example, participant 11 (female, 31 to 40 years) explained: *"Earlier this year, I had an MRI scan. You could get headphones, but they only have two Dutch radio stations. I don't want that. I'd rather listen to the noise of the scan."*

4. DISCUSSION

This multi-method study explored the perceptions of healthcare recipients regarding listening to music in healthcare. In general, participants wanted to use music for pain management. Although participants were relatively homogenous in terms of music importance, their attitudes toward the type of music and specific situations varied. In healthcare-related situations, participants encounter certain barriers when listening to music. Our results show that several personal, social and practical aspects need to be considered when implementing music in healthcare. In particular, the role of autonomy and control for patients has emerged as an important factor, making it crucial to consider personal preferences. In other words, music is not a one-size-fits-all intervention but should be tailored to the individual, the setting, and the type of pain. Moreover, healthcare professionals should adopt a more proactive approach in facilitating music in healthcare, offering options and demonstrating social sensitivity. Finally, it is important to recognize that the "wrong" type of music or the "wrong" situation could have a nonbeneficial or even harmful effect.

4.1 ATTITUDE TOWARDS MUSIC FOR PAIN MANAGEMENT

To our knowledge, this multi-method study is among the first to explore perceptions of music for pain management from the perspective of healthcare recipients. Our study focuses on listening to recorded music, which differs from music therapy and live-music interventions that include for example interaction with a therapist or performing musician. Previous research has highlighted the positive attitudes of healthcare professionals toward music as a therapeutic intervention [2, 21]. Similarly, our results revealed a positive attitude of participants toward the use of music for pain relief in healthcare-related settings. Our data indicate that listening to music for so-called emotional pain (such as anxiety, stress and heartbreak) was more intuitive for participants than listening to music for physical pain. Extensive research has documented positive effects of music on both emotional pain (e.g., anxiety, stress, and psychiatric disorders) and physical pain (e.g., surgery, dental procedures, and experimental nociceptive pain) in different healthcare setting [4, 28-30]. Although pain is defined as a sensory and emotional experience, it is traditionally researched and treated separately from emotions [31]. However, physical pain and emotions share overlapping conceptual and neuroanatomical spaces and can influence each other. While the complete mechanisms of music's effect on pain are not fully understood, music-induced emotions may play a key role in pain alleviation [9, 32, 33]. Therefore, although participants intuitively separated the effects of music on emotional and physical pain, these aspects influence each other and should not be considered separately when evaluating the impact of music on pain. In addition, participants mostly believed that music worked for pain relief as a distraction. Central pain processing can be modulated by several factors, such as pain context, mood and cognitive set, with attention and distraction as important dimensions [34]. Previous studies on the

pain-relieving effects of music have predominantly measured these factors quantitatively [12, 32, 35, 36]. In our study, we focused on the subjective experience, revealing that distraction and emotions are commonly experienced factors in pain modulation by music. Additionally, some participants mentioned contextual factors such as the placebo effect and their beliefs or expectations about which music would (not) help them.

4.2 IMPLEMENTATION OF MUSIC IN HEALTHCARE

Previous research has shown that patients are generally willing to listen to music, which aligns with our findings [37]. However, certain barriers significantly impact the successful implementation of music in healthcare [18, 21]. From the healthcare providers' perspective, these barriers include knowledge about the intervention, decision-making processes, and patient turnover timing. From the patients' perspective, a lack of knowledge and awareness prevents them from using music for pain relief. While qualitative research has explored healthcare providers' views on music in healthcare [21], our study focuses on recipients' perspectives, combining qualitative and quantitative methods for more nuanced conclusions. One common barrier was that participants simply did not consider/remember listening to music, and healthcare providers did not suggest it. Social acceptability was also a concern, such as the feeling that it is impolite or awkward to ask for music, which could be addressed by healthcare providers taking a more proactive role in offering information and guidance. Our results highlight that autonomy and control are crucial. Participants expressed that choices regarding music for pain management (e.g., type of music, equipment, timing) should be left to them. This finding is in line with previous studies that showed that listening to the preferred type of music is most efficient for pain relief [23, 38, 39]. A study by Howlin et al. described the link between perceived control and the analgesic benefits of music in an experimental setting, but this link has not been thoroughly investigated in clinical settings [40, 41]. Willingness to listen to music varied among individuals depending on the situation and type of pain. The quantitative analysis indicated that individual characteristics such as gender, music listening behaviour, and importance attributed to music for well-being can influence these decisions, while the qualitative interviews further emphasized the individuality of music listening in healthcare. Our study population highly valued music, but the general population might have a higher percentage of individuals not wanting to engage with music in healthcare. Overall, our results emphasize the need to tailor music interventions to individual needs and preferences. Providing options in terms of the type of music and listening situations, along with a proactive approach from healthcare providers, could facilitate the implementation of music in healthcare.

4.3 POTENTIAL NEGATIVE EFFECTS OF MUSIC IN HEALTHCARE

Many studies have highlighted the positive effects of music in healthcare settings, such as reducing anxiety, stress, and pain and improving overall well-being [4, 5, 7, 42]. Assuming that music has no side effects, one might conclude that it is always a suitable option since it 'does no harm'. However, our study revealed that participants identified specific situations, moods, and types of pain where they did not want to listen to music. Listening to music under those circumstances was described as nonbeneficial or even harmful. Our results also revealed that music in the wrong situation, such as directly after surgery, could create negative associations. Moreover, music of a type that is considered "wrong" or "not preferred" by the individual could lead to nonbeneficial or even negative effects. This aligns with the results of the original trial, which indicated that music preference, irrespective of the genre, predicted higher pain tolerance [23]. The results of this follow-up study suggest that while more preferred music had a positive effect on pain relief, less preferred music could also have a negative effect, potentially lowering pain tolerance in the original trial. Offering a single type of music (such as classical music, which is often used in clinical trials) may not be optimal for everyone, indicating a need for more personalized approaches [4]. To our knowledge, these possible negative effects have not been described before. Our findings suggest that being sensitive to individual preferences and contexts is crucial when using music in healthcare, as the wrong music in the wrong situation can actually do harm**.**

4.4 LIMITATIONS AND FUTURE RESEARCH

One limitation of this multi-method study is the relatively young and highly educated study population, which attributes slightly more importance to (listening to) music than the average population [43]. This population is not representative of the general population, particularly not of hospitalized patients who tend to be older. Additionally, while the study population was quite homogeneous in terms of high music importance, there were still many individual differences. Moreover, the participants in this study experienced barriers to use music in healthcare, which might be even more challenging for individuals with a lower value for music. Nevertheless, more research is needed to investigate the perceptions of patients with diverse backgrounds regarding music in healthcare. Next, enrolling participants who had volunteered in the original trial assessing music for pain relief had the strength that 85% used music as medicine and therefore provided an adequate sample for the study – but may also limit generalizability to the general population. Another limitation lies in the nature of this study, which assessed the subjective attitudes and experiences of overall healthy participants. These perceptions are important for understanding the perspective of healthcare recipients and improving implementation strategies. However, further research applying objective measurements in clinical settings under suitable (placebo) control conditions is needed to validate these findings. A final limitation is that the qualitative data analysis of this study was not based on a deductive conceptual framework. Given the multi-method approach and considering that this was the

first study on this topic from a healthcare recipient perspective, we opted for an inductive, theme-led analysis based on the survey themes to remain open to novel findings. However, future research looking at music listening for pain relief from a healthcare recipient perspective should consider established implementation science frameworks, such as the Consolidated Framework for Implementation Research [18, 44].

5. CONCLUSION

In conclusion, this multi-method study reveals that healthcare recipients want to listen to music for pain relief. However, they encounter barriers to actually listen to music, which can be divided into personal, social and practical factors. A proactive approach by healthcare providers and giving autonomy and control to patients are crucial. Participants expressed highly individual attitudes and beliefs about which music would (not) help them. The wrong type of music in the wrong situation was experienced as nonbeneficial and sometimes even harmful. In summary, tailoring music to individual needs and preferences is essential for implementing music for pain relief in healthcare.

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AUTHOR CONTRIBUTION STATEMENT

This study was designed by EVB, AB, JS, RC, MB and MK. Interviews were conducted by RC. The data were analysed by EVB, AB and RC, and the results were critically examined by all authors. EVB and AB had a primary role in preparing the manuscript, which was edited by JS, MB, RC and MK. All authors have approved the final version of the manuscript and agree to be accountable for all aspects of the work. AB acted as guarantor.

DATA AVAILABILITY STATEMENT

The data underlying this article cannot be shared due to privacy reasons. Data are available on reasonable request to the corresponding author.

CONFLICT OF INTEREST

None to declare.

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FIGURE LEGENDS

Figure 1 Flow diagram of study participants

Flow diagram of participants included in the survey (n=169) and interviews (n=20), with reasons for exclusion per recruitment phase, starting with the original trial [23].

Figure 2 Summary of general attitudes toward music in healthcare

The figure shows the key findings on the general attitudes toward music in healthcare from survey (left) and interview (right) data.

*Participants who experienced pain, anxiety and/or stress in a healthcare-related situation within the last six months.

**Participants who experienced pain, anxiety and/or stress and listened to music in the past six months.

Abbreviations: SD= standard deviation.

Figure 3 Perceived barriers and optimal situation for music implementation in healthcare

The figure illustrates the perceived barriers (upper section) and optimal situation (lower section) for music implementation in healthcare from the perspective of healthcare recipients. Thematic analysis of both survey and interview data identified personal, social, and practical factors that pose barriers to music listening in healthcare settings. Based on these factors, participants described the optimal situation for music in healthcare, addressing healthcare recipients, healthcare providers, and healthcare facilities.

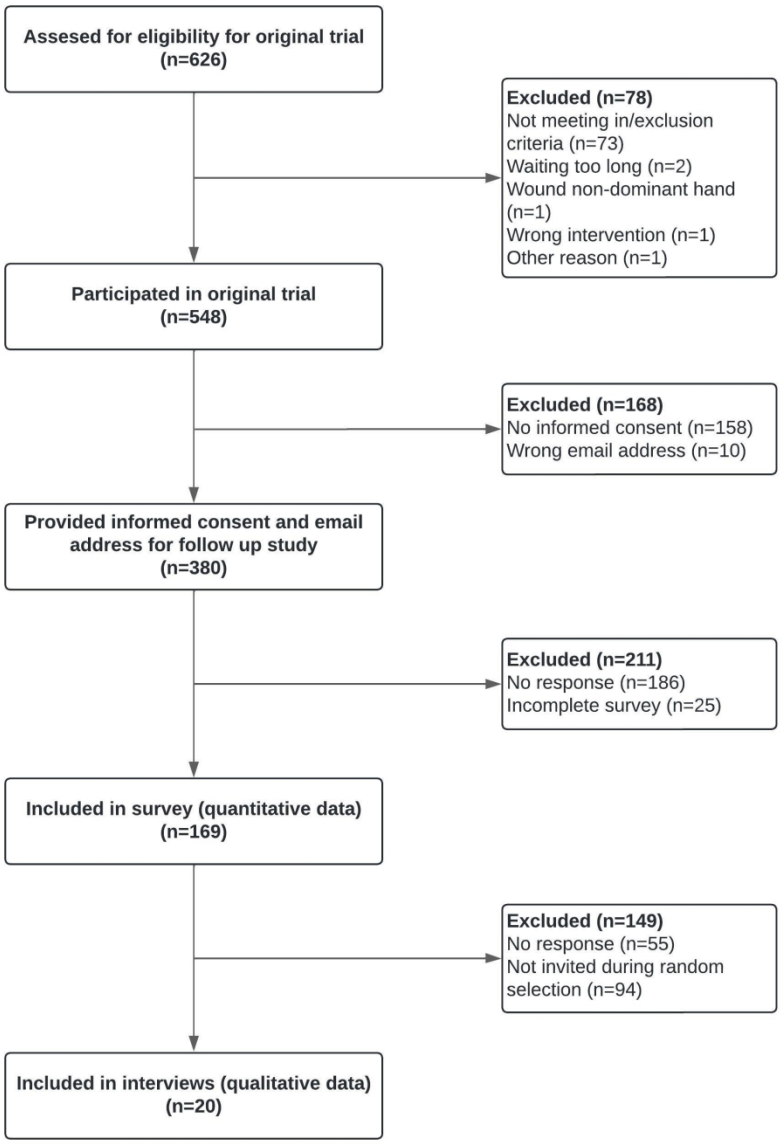

Figure 1 Flow diagram of study participants
Flow diagram of participants included in the survey (n=169) and interviews (n=20), with reasons for exclusion per recruitment phase, starting with the original trial [23].

155x222mm (300 x 300 DPI)

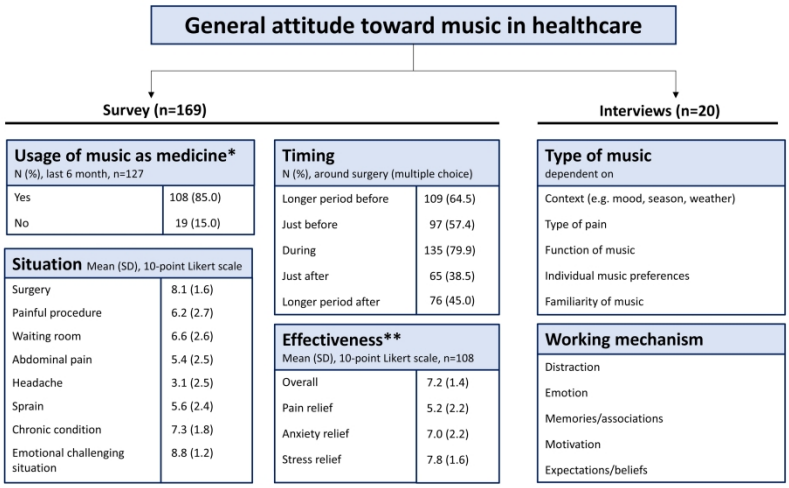

Figure 2 Summary of general attitudes toward music in healthcare
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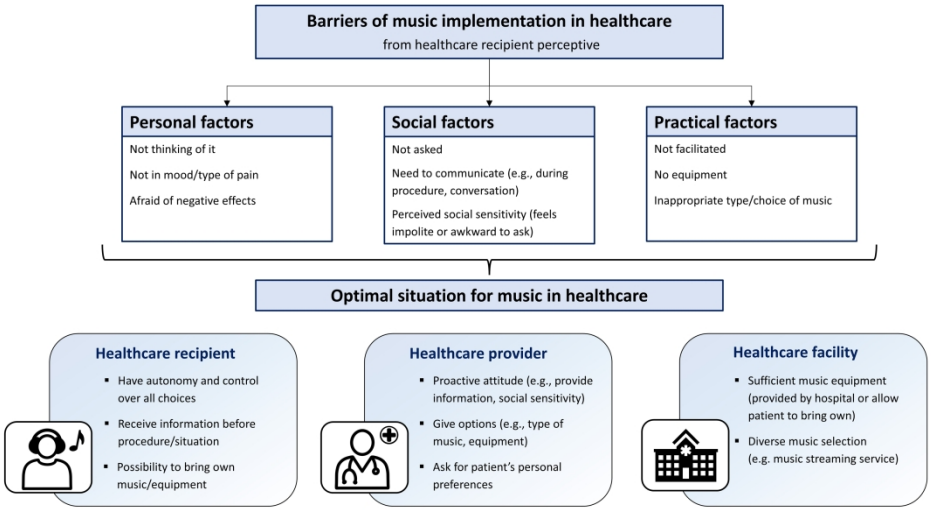
**Participants who experienced pain, anxiety and/or stress and listened to music in the past six months.
Abbreviations: SD= standard deviation.

338x190mm (300 x 300 DPI)



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338x190mm (300 x 300 DPI)

Supplementary Table 1 STROBE 2007 (v4) Statement - *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1, 2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	2, 5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5, 6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, explain how loss to follow-up was addressed	N/A
		(*e*) Describe any sensitivity analyses	N/A

Results			
Participants	13	(a) Report numbers of individuals at each stage of study—e.g. numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	6
		(c) Consider use of a flow diagram	6
Descriptive data	14	(a) Give characteristics of study participants (e.g. demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	6
		(c) Summarise follow-up time (e.g. average and total amount)	N/A
Outcome data	15	Report numbers of outcome events or summary measures over time	8, 9, 10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8
		(*b*) Report category boundaries when continuous variables were categorized	N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—e.g. analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	11, 13
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11, 12, 13
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14

Supplementary Table 2 Overview of survey questions with answer options

#	Question/statement	Answer options
Music listening behaviour		
1	I consider myself a music lover	Likert scale 0-10
2	I find music important for my (mental and/or physical) well-being.	Likert scale 0-10
3	On average, how much time per day do you spend listening to music?	< 0.5h; 0.5 to 1h; 1 to 2h; 2 to 4h; 4 to 6h; > 6h
Demographics and health situation		
6	How old are you?	Number [years]
7	As which gender do you identify?	Female; Male; Other; Do rather not say
8	What is the highest level of education you have taken?	Primary and junior vocational education; Junior general secondary education; Senior general secondary and intermediate vocational education; Pre-university education; Vocational colleges; University
9	Are you currently as healthy as you were during the original research trial, or has your health situation changed (e.g., temporary hospitalization, new diagnosis(s), new medication)?	Yes, I am just as healthy; No, my health situation has changed. My changed health situation now is ... [open text field]
Pain and pain perception		
10	In the past 6 months, how often have you experienced pain? If you don't know, make an estimate.	Daily; Several times per week; One time per week; Several times per month; One time per month; Less than one time per month; Other; Not at all
11	If Daily pain – Has this daily pain existed for more than 3 months?	Yes; No
12	How severe was the pain you experienced in the past 6 months if you express the pain as an average number, when you experienced pain?	Likert scale 0-10
13	How severe was the pain you experienced in the past 6 months when the pain was at its worst?	Likert scale 0-10
Perceptions on music when experiencing pain		
14	To what extent would you want to listen to music in the following situations?	Likert scale 0-10 (per situation)

	– Surrounding a surgical procedure – Surrounding a short painful procedure (such as at dentist, general practitioner) – In waiting room – For abdominal pain – For headaches – For a sprain or contusion – In long term or chronic (continuous) pain or illness – When in an emotional challenging situation (such as anxiety, sadness or stress)	
15	If you were to listen to music around a painful healthcare procedure or surgery, when would you most like to listen to music? (multiple choice)	Longer period before; Before; During procedure; Just after; Longer period after
Music listening advice		
16	In the past 6 months, have you experienced a situation where you felt pain, anxiety and/or stress?	Yes; No
17	Have you listened to music in such a situation?	Yes; No
18	If No – What is the biggest reason you did not listen to music in this situation(s)? (multiple choice)	Technical reasons (e.g., no equipment); Not allowed by health care provider; Not thought of; Not feeling like it; I didn't know if it could listen to music; It felt like it was awkward; I didn't know it had a positive effect; I don't like music; It didn't feel like there was time for it; Other, ... [open text field]
19	If No – What would have caused you to listen to music in this situation(s)? (multiple choice)	Caregiver who had asked if I wanted to listen to music; Facilities to listen to music from caregiver (e.g., headphones, earbuds, tablet); Number of playlists to choose from; Option to bring your own music equipment specifically named; Option to be allowed to select your own music; Advice by health care provider to listen to music due to positive effects; Situation in which I felt it was possible; Nothing because I don't want to listen to music; Other, ... [open text field]

20	If Yes – In what situation(s) have you listened to music? (multiple choice)	Surrounding a surgical procedure; Surrounding a short painful procedure (such as at dentist, general practitioner); In waiting room; For abdominal pain; For headaches; For a sprain or contusion; In long term or chronic (continuous) pain or illness; In an emotional challenging situation (such as anxiety, sadness or stress)
21	Did you listen to music before, during and/or after the procedure (such as surgery or short procedure)? (multiple choice)	Longer period before; Before; During procedure; Just after; Longer period after
22	To what extent did you feel that listening to music had an effect in this situation(s) in general?	Likert scale 0-10
22	To what extent did you feel that listening to music …? – Had an effect for pain relief? – Had an effect for anxiety relief? – Had an effect for stress relief?	Likert scale 0-10 (per question)

Supplementary Table 3 Interview topic guide

Section/Topic	Content
Introduction	– Introduction to the study – Explanation informed consent form and checking whether it has been understood and signed – Ask if respondent has questions
General music question	– Can you tell me how important music is to you in your life? – Did you grow up with music/got experiences from home?
General pain question	– Can you tell me what role pain plays in your life? – Did you experience this in last six months?
Biography	– Do you think music works against pain for you? Why or why not? – If yes, what music could help you with pain? – What does music do for you in this painful situation? – Do you think different music would help you with different types of pain? If yes, what? Or no music at all for certain types of pain? – What do you pay the most attention to in music? E.g. lyrics, melody, volume? – In what context/situation does that work or not work? – Do you consciously reach for it or is it more coincidental? – Is there a difference before/after the original trial/the music listening advice? – Would you use music against pain again? Why? – Can you give an example of a moment when music worked well? – Can you give an example of a moment when music did not work? – Do you share these experiences with people around you?
Thoughts and actions	– What do you think about listening to music as medicine? – Have your thoughts changed about music as medicine since Lowlands? – Has your behaviour changed since Lowlands regarding music as medicine? – Would you recommend others to use music against pain? Why? – What does the use of music look like in your social environment? – Have you ever discussed music as medicine with your social environment? If yes, what? – How has this influenced you?

	– Are there things that could make it easier for you to listen to music in healthcare settings? (e.g. earplugs, headphones, Spotify subscription) – What would be the optimal situation for listening to music in healthcare? (context, but also what music, how to listen, how long to listen, and active/passive?)
Pain and music	– Why do you think music works or does not work for pain relief? – Do you think there is a difference in which music would work best for short- or long-term pain? Why? – What do you think would be the optimal timeframe for you to listen to music to, when experiencing pain? – What do you think of music played in waiting rooms or treatment rooms?
Background factors	– Age – Educational level – Ethnicity – Daily activities/work – Religion – Relationship status/family situation

Interviews were conducted in Dutch and the topic guide was accordingly translated.

Supplementary Table 4 Standards for Reporting Qualitative Research (SRQR)

Section/Topic	Reported on page #
Title and abstract	
Title - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	1
Abstract - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	2
Introduction	
Problem formulation - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	4
Purpose or research question - Purpose of the study and specific objectives or questions	4
Methods	
Qualitative approach and research paradigm - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale**	5, 6
Researcher characteristics and reflexivity - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability	6
Context - Setting/site and salient contextual factors; rationale**	5
Sampling strategy - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**	5
Ethical issues pertaining to human subjects - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	5
Data collection methods - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale**	5

Data collection instruments and technologies - Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	5
Units of study - Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	6
Data processing - Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/de-identification of excerpts	6
Data analysis - Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale**	6
Techniques to enhance trustworthiness - Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale**	6
Results/findings	
Synthesis and interpretation - Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	6, 8, 9, 10
Links to empirical data - Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	8, 9, 10
Discussion	
Integration with prior work, implications, transferability, and contribution(s) to the field - Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	11, 12, 13
Limitations - Trustworthiness and limitations of findings	13
Other	
Conflicts of interest - Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	14
Funding - Sources of funding and other support; role of funders in data collection, interpretation, and reporting	14

Reference:
O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. **Standards for reporting qualitative research: a synthesis of recommendations.** *Academic Medicine*, Vol. 89, No. 9 / Sept 2014
DOI: 10.1097/ACM.0000000000000388

Supplementary Table 5 Characteristics of interview participants

Participant Number	Gender	Age group (years)	Level of Education*	Music importance – general§	Music importance - wellbeing§	Daily music listening hours	Pain in last six months
1	Female	21 - 30	HBO	10	10	3-4 h	Several times per month
2	Female	21 - 30	WO	10	10	3-4 h	Less than one time per month
3	Female	21 - 30	WO	9	8	2-3 h	Several times per week
4	Female	21 - 30	HBO	10	8	1.5-2 h	Daily
5	Female	21 - 30	WO	9	9	2-3 h	One time per month
6	Male	21 - 30	HBO	7	7	3-4 h	One time per week
7	Male	21 - 30	WO	7	5	1-1.5 h	Several times per week
8	Female	21 - 30	WO	10	10	3-4 h	One time per month
9	Male	31 - 40	WO	10	9	4-5 h	Other
10	Female	31 - 40	WO	7	6	2-3 h	Less than one time per month
11	Female	31 - 40	MBO	10	10	>6 h	Several times per week
12	Male	31 - 40	HBO	9	9	1.5-2 h	Other
13	Female	31 - 40	HBO	10	10	>6 h	Less than one time per month

14	Male	31 - 40	HBO	7	7	>6 h	Several times per month
15	Female	31 - 40	WO	9	9	1.5-2 h	Less than one time per month
16	Male	41 - 50	MBO	10	10	>6 h	Other
17	Female	41 - 50	WO	10	8	1-1.5 h	One time per month
18	Female	51 - 60	HBO	8	7	3-4 h	Not at all
19	Male	51 - 60	WO	10	8	1-1.5 h	Not at all
20	Male	61 - 70	HBO	9	8	1-1.5 h	Several times per week

Characteristics of all interview participants, including gender, age, level of education, and answers to survey questions on music importance, daily music listening hours and pain experienced in the last six months.

*HBO = Higher vocational secondary education (in Dutch: Hoger Beroepsonderwijs), MBO = Intermediate vocational secondary education (in Dutch: Middelbaar Beroepsonderwijs), WO = Research-oriented higher education (in Dutch: Wetenschappelijk Onderwijs).

§10-point Likert scale.

Supplementary Table 6 Influence of baseline characteristics on situation and effectiveness in healthcare

	Value	Age (years)	Gender (0=male, 1=female)	Music importance – general§	Music importance - well-being§	Daily music listening hours#
Situation in healthcare						
Surgery	β (95% CI)	0.02 (-0.01; 0.04)	0.03 (-0.48; 0.54)	0.05 (-0.24; 0.33)	0.34 (0.12; 0.57)	0.04 (-0.07; 0.16)
	P-value	0.178	0.900	0.753	0.003**	0.476
Painful procedure	β (95% CI)	0.04 (0.00; 0.08)	0.85 (-0.04; 1.75)	0.02 (-0.48; 0.53)	0.18 (-0.20; 0.56)	0.13 (-0.08; 0.34)
	P-value	0.071	0.062	0.925	0.358	0.209
Waiting room	β (95% CI)	-0.01 (-0.05; 0.04)	1.47 (0.64; 2.30)	-0.24 (-0.70; 0.23)	-0.07 (-0.43; 0.30)	0.26 (0.08; 0.45)
	P-value	0.788	<0.001***	0.315	0.725	0.006**
Abdominal pain	β (95% CI)	0.00 (-0.04; 0.04)	0.84 (0.00; 1.67)	-0.34 (-0.82; 0.14)	0.39 (0.03; 0.75)	-0.01 (-0.20; 0.18)
	P-value	0.966	0.050*	0.167	0.033*	0.931
Headache	β (95% CI)	-0.01 (-0.05; 0.04)	-0.41 (-1.27; 0.44)	0.00 (-0.47; 0.47)	0.08 (-0.28; 0.44)	0.16 (-0.03; 0.35)
	P-value	0.805	0.344	0.996	0.657	0.104
Sprain	β (95% CI)	0.01 (-0.03; 0.05)	0.36 (-0.38; 1.10)	-0.08 (-0.56; 0.41)	0.25 (-0.12; 0.63)	0.07 (-0.13; 0.26)
	P-value	0.642	0.339	0.748	0.185	0.484
Chronic condition	β (95% CI)	0.04 (0.01; 0.07)	-0.36 (-0.94; 0.22)	-0.22 (-0.57; 0.12)	0.59 (0.30; 0.88)	0.04 (-0.10; 0.18)
	P-value	0.014*	0.224	0.201	<0.001***	0.544
Emotional challenging situation	β (95% CI)	-0.02 (-0.03; 0.00)	-0.08 (-0.45; 0.30)	-0.02 (-0.23; 0.19)	0.36 (0.18; 0.53)	0.00 (-0.09; 0.09)
	P-value	0.092	0.690	0.862	<0.001***	0.978
Effectiveness in healthcare						
Overall	β (95% CI)	0.02 (-0.01; 0.05)	-0.05 (-0.62; 0.53)	-0.25 (-0.60; 0.09)	0.26 (-0.03; 0.54)	0.00 (-0.14; 0.14)
	P-value	0.211	0.874	0.147	0.077	0.990

All dependent variables were assessed using 10-point Likert scales. Linear multivariable regression analyses were conducted to investigate the influence of these baseline characteristics (age, gender, music importance in general/regarding well-being and daily music listening) on the willingness to listen to music in healthcare and the overall effectiveness rating.

§10-point Likert-scale.

#10-point Likert scale, ranging from "Never" to "More than 6 hours".