Designing Migraine Applications
- A Qualitative Interview Study on Migraine Patients’ Motivation of using Mhealth Applications

Mobila migränapplikationer: en kvalitativ intervjustudie på migränpatienters motivation att använda mobila hälsapplikationer

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Abstract

Migraine is ranked as the third most widespread disease in the world by Global burden of Disease and study 2010. To reduce pressure on health care and also help patients understand their condition, mobile health applications have become increasingly popular and accessible. These applications help by providing disease information, to document symptoms and analyze attack patterns. However, there is both a lack of patient centered perspective and scientific based knowledge behind the design of these applications.

Therefore, the aim of this study is to explore what might affect the patients’ motivation to use a mobile application to explore their condition. This by looking into how these applications can be designed so that patients’ find them helpful and easy to use. This was done by doing a qualitative interview study with ten patients with severe migraine and analyzing the transcribed data through a reflexive thematic analysis. The thematic analysis resulted in three overarching themes personal motivations of exploring migraine, health care related motivations of exploring migraine, and technical support for motivation of exploring migraine.

Each overarching theme contained themes and sub-themes that are backed up by quotes in the data from the interviews. Also a proposal on how to visualize the three overarching themes in relation to each other is presented.

In conclusion, designing applications that help with acceptance of condition, adaptive content and functionality, and deciding on a specific target patient group, are central findings of this study. Directives from health care was found to be the largest motivational drive in this study and could further be explored to work better with migraine applications.
Acknowledgments

I want to thank my supervisor from the university Ulrika Müssener for helping me with the theory and the scientific methodology. I also want to thank my external supervisor Pascal Fahrni for a lot of helpful comments and for giving me the opportunity to work with such an important and interesting subject.

Finally, a huge thanks to every person that participated in this study, the pilot-study participant, the health care specialist, and all the migraine patients in the interview study.
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Introduction

Migraine is a common condition that affects about 6% of males and 20% of women [34]. It is often characterized as a headache pain, that comes in recurring attacks, with symptoms such as nausea, numbness, sensitivity to light and sounds [12]. It was ranked by the Global burden of Disease study (GBD2010) as the third most widespread disease in the world and the third most common cause of disability for all sexes under 50 [38]. A systematic literature review presents 17 articles which shows that patients with migraine and severe nonmigraine headaches are more likely to behave suicidal compared to subjects without any history of severe headaches [37]. Migraine has also been connected to mood/anxiety disorder and risk of developing lifelong Major Depressive Disorder (MDD) [39, 2]. It also affects everyday life, such as sleep and productivity, resulting in both sick leaves from work and a lot of medication [49].

There is also a shortage of neurologists in Sweden, which affects the care waiting time for patients with chronic migraine, since patients with more severe neurological conditions are being prioritized higher [19]. At the same time, there is vast number of personal smartphones and tablets which provide personal aid to patients that needs to track their symptoms and progress [24]. These are called mHealth (mobile health) applications, a subject within the area of eHealth that specifies on health support through mobile devices [1]. For instance, mHealth applications can help with migraine therapy by making it less resource demanding and providing techniques of self-administer [47]. These applications also provide support at all hours and anywhere, requires little resources from health-care, are cheap, and gather important data points that can be used to enhance a treatment and better manage medications.

However, even though there are numerous mHealth applications for migraine patients, very few of them provide scientifically based research of their effect [30]. Just a few of the existing applications help with diary keeping, self-management of condition, and facilitating interaction with health-care. Another problem are usability issues that follows with the symptoms of migraine attacks and negative feelings associated with management of the condition [40]. Symptoms such as photophobia and headache makes it difficult to interact with a screen and is something patients do not want to be reminded of on symptom free days.
1.1 Aim

This study aims at investigating what may affect migraine patients’ motivation to explore their condition using mHealth application. More specifically this is done by looking into patients’ attitude towards certain aspects of a mHealth application and how these applications can be designed to better increase motivation. To focus on patients’ experiences, this study is a qualitative interview study, conducting a reflexive TA (thematic analysis) on transcribed interviews with ten migraine patients.

1.2 Research questions

- How can personal experiences of migraine patients condition help in understanding the designing of migraine applications?
- What design considerations does a mHealth application have to take into consideration to help migraine patients explore their condition?

1.3 Background

This study is carried in collaboration with Leviate, a Swedish based company that is developing a new mobile migraine platform.

1.3.1 Migraine

There is a huge amount of research on migraine and most of it is connected to the field of neurology. This section is dedicated to providing a brief background on the clinical research of migraine and will not cover the entirety of the field. The following text will mention definitions, symptoms, common types of migraine and psychological effects of migraine. The clinical definition of the symptoms from migraine attacks are head pain (sometimes severe), nausea, vomiting, sensitivity to light and sound, or movement [12]. The two most common types of migraine are Migraine with Aura (MWA) and Migraine Without Aura (MWOA).

MWA was previously referred to as classical migraine and which symptoms are described as minute lasting, recurring, and often gradually increasing central nervous symptoms that is followed by headaches [38]. Criteria include one or more of reversible aura symptoms involving vision, sensorial, verbal or lingual, motoric and others.

Migraine without aura (MWOA), previously referred to as common migraine or hemicrania simplex, is diagnosed based on at least five attacks with the criteria of symptoms lasting up to 72 hours [38]. These criteria include a minimum of two of the following characteristics: unilateral location, pulsating quality, moderate or severe pain intensity, being intensified by physical activity, often resulting in avoiding it. Patients experience at least one of following during attacks: nausea with or without vomiting, or photophobia (fear of light) and phonophobia (fear of sound). Other headache diagnoses should always be ruled out as a part of the diagnostic process. Other than experiencing these symptoms, attacks of MWOA also causes cognitive impairments to work and learning abilities [10]. However, it is difficult to tell whether these impairments derive specifically from the migraine or the experienced discomfort of the symptoms.

There is also the difference between chronic and episodic migraine. A person with more than 15 migraine days per month is considered to have chronic migraine while a person with between 0-15 migraine day has episodic migraine [20]. Episodic migraine will not be discussed that much in this paper since this thesis focuses on patients with chronic migraine. However, it is worth mentioning that episodic migraine slowly progress to chronic migraine, faster if left untreated or in cases of overmedication [25].
Besides the impairments related to attacks such as dizziness, photophobia, phonophobia and more, migraine also affects the patients' life on symptom-free days. Patients tend to plan their everyday life, set up strategies, living their life preparing themselves for the next attack, as per a paper on lived experiences of long-time migraine patients [43]. This paper also presents that understanding more about one's migraine can result in patients feeling more safe with their condition, and that accepting the condition is key to reducing frustration. Not only is accepting the condition good for reducing stress and frustration, but by focusing on the less negative parts of everyday life, can in turn reduce the impact of migraine attacks [23]. This is what mHealth applications and documentation is aiming to help with, which will be covered in the following sections.

1.3.2 Medical informatics

Medical informatics is a cross-sectional discipline historically associated with biomedicine, health sciences and computer science. But with a growing need for data processing and information presentation in health-care, this field has grown to include more information technologies (IT) [14]. Technological advances in this field contribute to wider gaps between the technological artifacts and the end-user, gaps that interdisciplinary fields with IT and behavior, such as cognitive science, could help to bridge [41]. This in form of both approaches with human-computer interaction (HCI) to promote usability of systems, but also with theories within the field of distributed and situated cognition to understand and support collaboration in medicine. This study will focus on the user experience perspective within the HCI approach and not on the field of distributed and situated cognition.

Migraine platforms

According to a systematic review on mHealth applications in general, migraine was the least researched condition [24]. However, ranking on number of applications, migraine was ranked third to highest, which implies that migraine is of high commercial interest but of low research interest. This review also shows that most migraine applications focus on tracking, assistance and diagnose information. There are a few mHealth platforms focused specifically on headache and/or migraine patients. In a systematic review on commercial mobile applications with headache diaries the results showed that out of 38 platforms, only three of them met five out of seven app criteria displayed in Table 1.1 defined by the authors [17]. Most of the applications are easily accessed and reach a lot of people, but according to the authors of the review, there is still a need for evidence-based and high-quality mobile applications. Some common advice are looking at evidence-based medical applications and partnering up with headache experts. Indeed, most of the migraine application contain headache diaries, but only around 18% of them were created with clinical expertise background [47]. A study carried out similarly, showed that 17 out of 55 applications rated four or higher on the 1-5 Mobile App Rating Scale (MARS), a quality evaluation form measuring engagement, functionality, aesthetics, information, and subjective quality [35]. However, this study looked specifically on how well the applications used behavior change theories (BCT), with other words, the quality of self-monitoring techniques provided by the application, often involving types of stress management.

The creator of an existing mHealth application have found that patients with migraine prefer the option of free text input when keeping a symptom diary, being able to monitor co-existing conditions related and unrelated to headaches, having personal records of behavior therapy, and receiving information about migraine trigger preventions [27]. It is also stated that one of the most important functions of such an application is that a patient can understand their diagnosis and symptoms. There is also the alternative on looking at the bond between patient and mHealth applications through the perspective of attachment theory. Exploring this concept, Li et al. conceptualized that autonomy satisfaction, controlling ones own...
1.3. Background

<table>
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<th>Apps Created With Headache Expertise</th>
<th>Include either, or both, research experts or expert patients in the app development.</th>
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<td>Formal Psychometric and Feasibility Testing</td>
<td>Whether the app has gone through user testing in regards of, for example, usability, learnability, acceptability, efficiency, and accuracy.</td>
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<td>7</td>
<td>Ability to Export Headache Data From App</td>
<td>Be able to print out a form or summary to save or use physical data sharing.</td>
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Table 1.1: The seven criteria to assess migraine application quality from Hundert et al. [17]

self-expression, relatedness satisfaction, and the need to interact and connect with others, are all concepts that promote the patient’s attachment to the mHealth application [21]. This in turn helped patients in post surgery to recover faster. A study that focused more on the experience of migraine patients using a mHealth application for medical treatment, found that enrollment should not be too complex and involve information about responsibilities and requirements for the treatment [28]. Another interesting discovery was that patients find it difficult to use an application and report in the right way during migraine attacks. And on days without attacks, participants tended to not report anything instead, not wanting to think about migraines. Recording information on days without migraine is valuable to be able to analyze triggers and understand symptoms [40]. Similar findings, but in a study about patients with tinnitus, showed that users had negative feelings towards treatment interventions because it reminded them of their negative experience with tinnitus [13]. A common theme in their interviews was whether the interventions should focus on ignoring symptoms rather than managing them. However, this can be different from migraine management since it can be difficult to ignore a severe headache.

It is also important to consider the limitations of the interaction complexity of a mobile platform. Another mHealth application for migraine behavior management that included an interactive diary, tracking tools for headaches, and a communication tool with health-care workers, found in a study that their mobile application should present and focus on one task at the time [50]. The idea of presenting all the functions of the application simultaneously is tempting but simply ineffective with the limitations of the screen size and interaction possibilities of a smartphone. Lack of functionality, glitches, too many notifications, have also been found to lead to user frustration [26]. These problems can be counteracted by allowing the user to customize functionality and to give feedback in the application.
1.3. Background

Biofeedback

There is a growing interest in measuring and presenting patients biological data, referred to as biofeedback (BFB), in mHealth [18]. The goal is to implement the complicated and costly processes of clinical measurements within present advanced technology in smartphones and make it more accessible to more people. From a behavior standpoint, one of the main goals of BFB is to provide information so that it can help patients learn to control their physical reactions [32]. Worth mentioning is that most of the current studies are carried out in lab equipment and not with smartphones. Equipment measuring heart rate or eye movement, among others.

However, although proven effective for especially relaxing and pain management techniques, one study found that biofeedback does not provide significantly higher therapeutic benefits than regular therapy, and should not be isolated from typical treatment programs [31].

1.3.3 Migraine documentation

This section presents some of the currently most common migraine documentation methods used by Swedish migraine patients.

mHealth diaries

The limited amount of applications presented is due to the lack of research articles published on the specifics of migraine applications. Most applications can only be used by purchasing them, making them difficult to look into.

Migraine Buddy is the most frequently used application for headache tracking and management [49]. It is a free application relying on self-reporting attacks, triggers, symptoms and details of attacks. The application does not require the user to have any medical decided migraine diagnosis, which can affect the validity of user migraine attack reports [11]. Migraine Buddy has also been criticized for the vast amount of steps required to report an attack, contributing to a too high cognitive load for the limited cognitive capacity that migraine symptoms cause [16]. It includes measurements of attack frequency, medicine use, and even tracking of sleep quality, which may not always be of relevance for the patient [36]. As shown in the Figure 1.1, the application provides the user with a wide amount of visual representations to make a more detailed attack report.

A positive aspect of the application is that it includes some features that meet migraine patients emotional needs, such as an instructive and supportive avatar, the "migraine buddy". Also, as Noutsios et.al. [36] underlines, the application provides a summative report that the patient can present during doctor appointments and is the application is overall considered most clinical detailed.

Other documentation types

Besides using a mobile application to document migraine symptoms, there is a well known patient portal on the Swedish web provided by Svenska neuroregister called Patientens Egen Registrering (PER), "patients own registration" in English [33]. However, PER is only for patients registered to neuroregister, those already diagnosed with migraine and deemed to have severe symptoms. This makes PER not available for the wide migraine population. A study on the patient portal "MyMigraine" that helps with migraine self management, showed positive results on users acceptance of the portal, but also mentions problems with interactions being too time demanding [44]. Indeed, using a patient portal for documentation purposes as well usually requires the patient to sit down at a computer and recollect memories of previous migraine attacks. While a mobile application can theoretically be used anywhere at any given time.
1.3. Background

Other than mobile- and web applications, traditional paper diaries have also been used for documenting migraine symptoms. These will not be covered in this paper since the focus of this study is digital aids.
2 Method

This is an inductive qualitative study, where data was gathered from in-depth semi-structured interviews [15]. Transcribed data of the interviews was analyzed using a reflexive thematic analysis [6].

2.1 Setting and Sample

This section presents the participant group, recruiting, and ethical considerations.

2.1.1 Participant recruitment

A questionnaire for interest of participation in an interview study was sent out to an e-mail list of migraine patients from previous interview studies with Leviate. This questionnaire was created with the tool Survey&Report by Artologik accessed through Linköping university Appendix A. Participants were asked if they were willing to be a part of an interview study about a mHealth application for migraine patients. They were asked to provide some personal information such as name, age, gender, contact information and whether they were clinically diagnosed with migraine. Besides being diagnosed with migraine, the inclusion criteria were that the participant had to be over 18 years old and able to communicate fluently in Swedish.

2.1.2 Ethical considerations

The questionnaire contained information about data rights, data storage and that they could at any point require to withdraw their participation or require their data to be removed. Each participant was informed about their rights once more in the beginning of each interview and that they were being recorded. All participants reported verbal consent that was recorded in the beginning of each interview. Data from the interviews and questionnaires were anonymized for the paper. Interview data was stored locally and the recordings were eventually removed.
2.1.3 Participants

A total of 21 persons reported interest, but only ten replied after being contacted a second time through telephone calls. Ten participants were recruited in the ages between 35-63, eight females and two males. Four participants had a combination of two or more headache or migraine related conditions. Amongst the participants, eight answered that they had chronical migraine, two hormonal migraines, two tension-type headache, one whiplash injury and two answered only migraine.

Out of all the participants eight answered that they were currently on two or more different types of medical migraine treatment. Amongst the participants nine were currently using some sort of a triptane treatment, eight were on some sort of a CGRP-inhibitory treatment, three were receiving Botox as a treatment, two were receiving epileptic medicine as a treatment, and one taking antidepressant medications as a treatment.

Only two out of the ten participants had no previous experience with any mobile migraine applications or digital diaries.

2.2 Study Procedure

This section presents how the interviews were carried out and later on transcribed.

2.2.1 Interviews

Both the interview with the health-care specialist and the interviews with migraine patients were carried out through Zoom [51]. Each interview was recorded to be transcribed at a later point. All participants were informed about the procedure of the interview and that their answers will be recorded and transcribed to be used for analysis at a later point. They were also informed that their participation would be anonymized in the paper and that they at any point can withdraw their participation and request their data to be deleted. After being briefed about their data gathering, data storage and their rights, all participants reported verbal consent.

Each interview was carried out based on the patient interview guide in a semi-structured matter. A semi-structured interview was chosen to allow additional questions, not defined in the interview guide, to be asked to clarify vague responses, or encourage further elaboration to interesting thoughts [42]. Questions that had been answered through prior questions were skipped or modified to include possible overlooked details.

2.2.2 Transcription

Initially, some of the interview audio recordings were uploaded to Microsoft Word-online where it was automatically transcribed using Words transcribe function. The quality of the transcriptions was ensured by proofreading the text while listening through the audio recording and correcting mistakes. During the proofreading potential sensitive information was censured, such as personal names, places, telephone numbers or explicit language. Names of the interviewees were exchanged with aliases.

2.3 Data Collection

There were two interview guides used to collect data in this study Appendix C. One interview guide for an interview with a health-care specialist, and the other interview guide for interviews with migraine patients. The interview guide used for the patients was somewhat based on already existing interview guides Appendix B [48, 49].
2.3. Data Collection

2.3.1 Interview guide for health-care specialist

The interview guide for the health-care specialist was used for an interview with a doctor in neurological emergency care of patients with stroke and brain bleeding, also working part-time in a headache and migraine clinic. This interview would provide insights to the preparations of the questions for the interview guide with migraine patients. For instance, some of the questions revolved around how a health-care worker interacts with migraine patients during appointments. There were also a couple of questions aimed at getting a better understanding of the patient group.

Since the field of mHealth applications for migraine patients previously has lacked the perspective of experts and health-care specialists, some questions about migraine applications were included into the interview guide. This was investigated by including questions about importance of certain mHealth application functionality, design, and support. These questions were structured to have the health-care specialist elaborate on aspects of migraine applications, important for both their work, and the patient’s experience with health-care.

The results from the interview with the health-care specialist will not be used for thematic analysis, but instead be used to motivate the patient interview guide and to discuss the results of the thematic analysis.

2.3.2 Interview guide patients

This paper’s interview guide further developed from three previous patient focused interview guides and one interview guide carried out with a health-care specialist for this study. Two of the patient interview guides had been created in earlier studies with Leviate. One of the interview guides included questions exploring general information about migraine patients, such as quality of everyday life, personal support, strategies for migraine, and strategies for migraine prevention. Most of these questions were deemed too general or not relevant enough for this study. Therefore, only some of the questions were kept and included in the interview guide for this study.

The other patient interview guide that had been created in a study with Leviate was more focused on a migraine diary and how a user documents information about their condition. Some of these questions were included and reworked with the help of the results from the interviews of that study. This resulted in questions that focused more on the documentation and usage of headache diaries in relation to migraine attacks and migraine prevention. Those questions encouraged the patient to describe difficulties with documentation related to migraine symptoms and finding motivation.

Lastly, a third patient interview guide was explored to formulate questions about mHealth usage [3]. Most of these questions were reworked to be more specific to migraine patients and usage of migraine applications. This third interview guide also inspired questions investigating the patient’s attitude towards mHealth applications and asking them to share personal opinions about advantages or disadvantages with mHealth applications.

Some additional questions were added to the interview guide of this study to get a better comprehension about patients’ general mobile usage. Questions about mobile usage focused on if patients use, or avoid using, specific functions and applications unrelated to mHealth applications. These questions were included to explore if the usage of migraine applications is independent or a direct consequence of a general aversion of using the mobile during migraine. In addition, some questions about the experience of interaction with health-care were included in the interview guide. Specifically, asking about how the usage of migraine applications affect the interaction with health-care and if there are any discrepancies between the usage of a migraine application and the interaction with health-care. Some of the questions importance for this interview guide were validated by the answers from the interview with the health-care specialist. Answers from the interview with the health-care specialist also led to some minor final adjustments. The interview guide was written in Swedish since most of
the interviewees have Swedish as their main language and will therefore be more comfortable and provide more thorough answers.

2.3.3 Pilot interview

A pilot interview was carried out to test the patient interview guide. The participant was a 25-years-old female and was recruited through a convenience sample. This participant had a clinical migraine diagnosis, with experience of using headache diaries and being in contact with the health-care for many years. One question was removed from the interview guide concerning “what can mHealth application contribute to that health-care can/can’t?” This question was perceived as too complicated to answer by the interviewee. The two questions “what medicine are you taking?” and “what do you document on headache free days?” were added to the interview guide to include some missed information from the pilot. Lastly, some minor changes were made and a couple of follow up questions or question probes were added to clarify more complex questions.

2.4 Data Analysis

Thematic analysis is a qualitative method used to organize and categorize data collected from interviews, focus groups, or texts [8]. Patterns and overarching connections can emerge from the data during the analysis, shedding light on structural themes throughout the interviews. The themes are identified by the researcher and should be strongly related to the investigated phenomena, rather than being the most frequent identified patterns. Braun and Clarke suggest a six-step guide of completing a thorough thematic analysis. The steps are: familiarizing with the data, generating initial codes, searching for themes, reviewing themes, defining, and naming themes, and producing the report. This section of the paper is going to present each step one by one, except for the sixth step “producing the report”.

This study conducts an inductive analysis, a bottom-up process, where themes are decided based on the collected data, rather than defining themes before conducting the analysis, also called a reflexive approach [6, 5].

2.4.1 Familiarization with the data

There were two instances of familiarization with the data. First during the transcription itself, where each interview was revisited both during the manual transcription and the quality reassurance of the automatic transcription. This left a somewhat shallow immersion of the data, focusing on getting the transcription correct and leaving out reflection. Thus, each interview was revisited in its written form and reflected upon with highlights and comments on parts that could be interesting to explore further, as seen in Figure 2.1. These comments and highlights would further result in codes. During this phase some initial thoughts and summaries of the data were written down separately as notes.

2.4.2 Coding the data

Codes were created based on the comments and highlights from the familiarization phase. Each code was written on a sticky note separately into a web-based collaboration board program called Miro [29]. The sticky notes were color coded based on a designated color assigned to each interviewee, to backtrack quotes in the transcriptions more easily during the analysis, as seen in Figure 2.2.

Overall codes were included rather than excluded to build a wide bank of codes. All the codes are of semantic nature, not reading into whether there was an underlying meaning behind a patient’s answer [3, 6]. Coding was done in an inductive fashion, being a data-driven process focusing on experiences and perspectives of the participants. There was no
2.4. Data Analysis

Figure 2.1: Initial notes of highlight of the transcribed data from the interviews

synthesis or split of codes during this step, so a lot of the codes were very similar if not the same, and one code could represent several data points. The codes were also not condensed, meaning that some of the codes were long and very specific to allow for more thorough comparison during the making of themes.

Figure 2.2: Codes gathered from the initial notes. Each note is a code and each color is a different participant

2.4.3 Generating initial themes

Generating themes was a more rigorous process. Each code was taken into a separate working board where it was put into a theme. Some of the themes were defined based on the notes from the familiarization phase. If a code did not belong under any of the existing themes, a new theme was created. However, if a code was put under an already existing theme but still somewhat different from the other codes in the same category, then two new themes were created so that the codes were separated within the same overarching theme. Next time a new code was categorized into the same overarching theme, it was first checked if it belonged to one of the existing themes, otherwise yet another theme would be created with the new code in it. And so forth, was each code either put into an existing overarching theme or theme or put into a new more fitting overarching theme or theme, as seen in Figure 2.3.

During this process the research question was also taken into consideration. The codes were evaluated regarding whether they related to the research question or not. As a result, some of the codes were deleted and some more ambiguous codes were put into a others category. This process was iterative, so themes and codes were constantly alternated and moved around (chap 4, [6]).
2.4. Data Analysis

Figure 2.3: Initial organized themes based on the codes from transcripts

2.4.4 Reviewing and developing themes

By this point most of the themes were quite large and contained many similar and very specific codes. To organize even further each overarching theme and theme was revisited. Within each theme codes were yet again categorized after similarity. These groupings of codes were labeled with their own sub-theme. It was during this process that identical or almost identical codes were synthesized and given a more consistent description. The codes were attached to the corresponding synthesized code to better backtrack the original quotes from the transcripts. Some sub-themes were rearranged or removed depending on if they were not deemed relevant to the narrative of the themes or the research question, as seen in Figure 2.4. This reorganization of codes, sub-themes and themes provides some validity and explores further development of themes (chap 4, [6]). Codes in the others category were also revisited to see if they belonged in any of the new sub-themes, otherwise they were deleted.

Figure 2.4: Further reorganization of themes. Reducing, combining, and changing previous codes
2.4.5 Refining, defining, and naming themes

All the overarching themes, themes, and sub-themes were given more proper names. Once again, the themes were repolished by removing unrelated codes and sub-themes or by moving them, as seen in Figure 2.5. A short description was created for each theme to be presented in the analysis.

Thematic analysis overview

Figure 2.5: Final structure of overarching themes, themes, and sub-themes
This section of the thesis presents the three major themes created during the thematic analysis. After presenting the results of the thematic analysis, there is a short subsection that presents a proposition for a visualization of the three overarching themes in relation to each other to understand motivational drivers.

3.1 Personal motivations of exploring migraine

This overarching theme revolves around the personal interests that a participant might have in exploring their migraine condition and developing an understanding of their migraine. These results highlight participants experiences and personal strategies of dealing with migraine.

3.1.1 Triggers and patterns

One of the most prominent motivations mentioned throughout the interviews is the exploration and experimentation with triggers and patterns. Explorations of triggers and attack patterns are for example investigating if there are any new triggers, as Vilma says: “it has been done for myself to be able to see… well just like you are saying, to see if there are any new triggers that I haven’t understood and so on”, or in Lotta’s case, exploring attack patterns: “is it some kind of pattern? Is there a trend here? That is what I was after”. The results indicate that once participants have understood their triggers and attack patterns more, they seem to resolve to adapt their everyday life. Accordingly, Vilma states: “and then maybe you don’t… yeah, maybe you don’t go to that… party, specifically that week (…) If you know that almost always, or 99.9% of the time [you] get an attack, then and there”. However for some participants as Rita no triggers or patterns can be found due to too multifaceted triggers: “maybe there is a trigger that me and my neurologist can’t find, because we can’t understand combinations [of triggers]” or the nature of the neurological condition Rita “I haven’t found anything, that can trigger them (…) well my neurologists just says that it is inherited from my parents”. 


3.1. Personal motivations of exploring migraine

3.1.2 Patients understanding of condition

The participants describe how with the investigation of triggers and patterns, the participants can begin to understand and process their condition. There are two aspects to understanding the condition, one being the emotional process of dealing with acceptance and frustration as Gudrun presents: “I thought first that acceptance was about giving up, like... to the pain (...) well I can... I can accept... it, but I’m never going to like it (...) but if I maybe could tell myself -okay this is the condition, what can I do based on this?” The other aspect participants present is more about the gap of understanding that can occur by neglecting documentation of migraine, something that Hilda gas experience of: “Yes it would be great if one could see such patterns, but that requires that one documents (...) but as I said though, I haven’t documented for example, what the attacks can depend on.” Participants understanding seem to vary depending on acceptance or interest to document.

3.1.3 General motivations

Results highlight that the understanding and the investigation of triggers and patterns depends on other higher-level motivators, for simplicity these are labeled general motivations. In general, according to the participants, they seem more motivated if documentation involves positive feedback, continuous reminders, and general overview as Gudrun shows: “What was... silly was... that for me as a patient, can not get an overview over how it looks haha” and “in my experience is all knowledge one can get about oneself and ones disease, if one can get it summarized, then one also becomes more motivated to document.” Participants state that opposite to this, the factors of low motivation for documentation, are negative feelings related to being reminded of the condition, overwhelmed with information and requirements, and the actual symptoms of migraine. This is evident through Rosa’s frustration in this statement: “if somebody asks me -well did you do it correctly? (follow migraine strategies) No I did nothing, I was just in pain!” as well as Hilda’s irritation speaking on the subject: “So I don’t want to think about migraine, well... you shouldn’t think about migraine but... well I don’t know, I don’t want to think about it, it... feels boring and difficult.”

But the participants express that they also have more personal factors that motivate documentation, among these are wanting to improve the condition or analyzing the effect of treatments as Siv says: “With this, I can see that botox has helped me this much, that injections have helped me this much (...) or after that I have started with this medicine I have felt worse.” Some participants described that they were motivated by external higher-level factors, such as improving societies understanding, to get access to certain treatments, or simply because the health-care required it (this will be discussed more later). This can be seen in an exchange with Rosa: “Interviewer: Is there anything that could motivate you to document more? Rosa: Ehm... no it is only if... the doctor asks me and... and if I could show that this is, this goes directly to the doctor.”

3.1.4 Differences within patient group

Besides the general motivation factors, participants indicated that there could be documentation differences depending on the type of migraine patient. These differences can depend on level of health-care that the patient receives. But also, as Lotta speculates, patients with a longer history of migraine have different motivations to document, often driven by just monitoring the status quo: “in the beginning it is... super important, when you want to get to know... your migraine. But when you have done that and think that you have found your triggers and know what works and what doesn’t... then it’s not as important anymore.” For this reason, the patient Gudrun explains that new migraine patients might have higher motivation to explore and should therefore have a progressing level of support in an application: “you should actually start... small, maybe think as a headache diary, make sure you actually
3.2 Health-care related motivations of exploring migraine

The second overarching theme created during the analysis focuses on the influence that health-care can have on participants’ motivation to explore their migraine condition. Central to this theme is the event that takes place during the, often physical, interaction between patient and a health-care worker.

3.2.1 Focus from health-care side

This theme presents, what participants expressed that health-care finds interesting and disinterested. For starters, both the details of the participant’s migraine attacks and the effect of the current treatment were something that health-care undoubtedly focused on according to Rita: “What my neurologist, usually wants to know, is the number of days... level, level of pain, you can call it, pain intensity level. And how... if I during that time took medicine. It is those three things, he doesn’t care if I slept well or not haha. It’s just -did you take your medicine or not?” Participants explain that Health-care is not always interested in subjective or experienced parameters of migraine but tend to focus on measurable data such as medicine amount and attack frequency. Indeed, Monica expressed that her neurologists are disinterested in certain documentation types, usually those with too specific data points: “My last neurologist thought that this was way too much information, he didn’t need all that information, he just wanted to know the number of attack days (days with a migraine attack).”

A few codes were mentioned by different participants as both an interest and a disinterest to health-care. For example, the attitude towards mHealth applications was both described as positive by participants such as Bertil: “Yes, he is very interested in it (the app). I look, I always look at my data. Sometimes I print it so we can look at it together.” and negative by participants such as Hilda: “I think that I have showed it sometime to my neurologist but... well, I don’t know, I feel like he’s not very interested in it.” Specifics of the participant’s medicinal treatment were also described by Siv as an interest to health-care: “I have written down the number of doses myself, to show there (neurologist) (...) That is what I write and... then she (neurologist) can skip having to count them herself.” and by Bertil as a disinterest: “Interviewer: And he is not interested in how many doses of medicine you’ve taken? Bertil: No usually not.”

3.2.2 Patient meeting with health-care

The previous theme revolved around concepts outside the actual meeting with a health-care provider. This theme dives deeper into participants experiences and notions of the actual meeting with health-care providers. For instance, some participants preferred digital meeting and some preferred physical meetings. Those who were neutral, for example Vilma, expressed that the importance is not whether the meeting is physical or digital but rather that the meeting actually takes place: “it has been on the telephone (the meetings), I think it works well, I don’t think it’s worse, oh my god no. One should be happy to even meet, to be able to talk to a doctor.” It rather seems that it is what the participant’s meetings entail that affects the experience. The results show that most negative interactions with health-care are when participants experience that health-care lacks knowledge about migraine and that bad interactions have led to worsening migraine.

Participants describe that during meetings they use their mHealth application or digital migraine diary as a tool to support the communication and interaction with the health-care
3.3. Technical support for motivation of exploring migraine

The third overarching theme focuses on the technical support that a mHealth application can contribute by providing participants with more motivation to explore their migraine. These applications work as a tool for more efficient and simplified exploration of migraine, given that the correct users criteria are met. This theme highlights the required specifics of external support, i.e., not personal, or medical support.

3.3.1 Mobile utilization and perception

This theme explores some of the usability difficulties that follow depending on personal traits or with having migraine. For instance, some participants described it as easy to quantify their symptoms, while participants such as Monika experienced problems with the subjectivity of tools such as pain intensity scales: “A four for me, who is very used to… be in pain, could maybe be a nine for somebody else. And maybe it could have been a nine for me as well… back then, when I didn’t have chronical migraine.” The same divide amongst participants response can be found in habits of mobile use during attacks. Although some participants used their cellphone indifferent regardless of migraine or not, most participants either found it difficult or unthinkable to use a cellphone during migraine, as Hilda describes: “Interviewer: not even using it (mobile) to relax in some kind of way? Hilda: No, no, god no, no, no, when with migraine, it should be completely quiet and… no how awful, no, no, no.” But in cases where the phone is being used, there are also some usability adaptations related to sensory sensitivity during migraine attacks. These are, visual sensitivity: low screen light intensity and having the correct color contrasts, auditory sensitivity: annoyance with sudden, high, or sharp sounds, general sensitivity: such as general cognitive impairment and general irritation.

3.3.2 Technicality of documentation

To narrow down and look deeper into specific technical components, these results present themes about documentation, a central part of a migraine application. Participants experienced problems with the questioning in applications, the questions were often vague, too many and often resulted in the patient skipping questions. Siiv explains her biggest issue with the questions: “I think a difficulty can be because there is too much to write.” Skipping questions is perceived to lead to skewed representation of the condition. However, questions that provide quantified measurements seems to be more well perceived by the participants. As long as they are standardized and objectively measured or show a combined mean score,
which was of great importance to Klas: “Then can all, you as a neurologist and have a hundred of patients... then you can get the same basis, same format. And then you can easily combine over greater populations.”

Looking into when the participants documentation should take place, there seems to be some different opinions. Documenting on migraine free days is either perceived to be carried out only retroactively or, as for example Rosa, perceived to have a very small purpose: “I feel like this -why should I document if I’m not in pain? And there, then I can feel that it would be really great if, if I don’t write anything and it understands that I didn’t feel pain that day.” On migraine days, some participants felt that the documentation should be carried out directly and many were positive to rigorous documentation since it gives better representation of the condition. One recurring proposal by participants was a two-parted documentation with a quick registration of the attack and a more rigorous documentation later on. Bertil explains the concept like this: “It is a balance between... having it easy and trying to get as much documentation as possible. As I do today, I just press a button and then it’s registered (…) one would need a… how do you call it… reminder later on, to specify data for the registered attack.”

### 3.3.3 Functionality in application

This theme shifts away focus from documentation to other common functionalities in a mHealth application. For instance, participants express a couple of preferred types of interaction that facilitate motivation to use an application. Among these are being able to skip but revisit steps, support fast and easy actions, and generally avoid written input, as Lotta exemplifies: “I wanted symbols, so that it like felt right and so I can relate fast and I can just like… click fast.” This also relates to the participants need of being able to tailor application functions and content, for example, predefined triggers, displayed information, and statistical representation of condition, which Lotta further explains: “If the app could be modified in the beginning, I don’t know how, so that it fits me (…) so that what I see was adapted for me and I could choose what I want to be displayed.” Adaptation is also discussed by participants with reminders and that the application should remind the user to documentation, taking medicine, and to not miss appointments.

Further, prescription renewal and, as mentioned previously, creating a summative report of migraine condition to present to health-care, were functions that participants such as Gudrun brought up: “To print from my telephone, directly to my printer. If I can do that before my doctor’s appointment and arrive to my doctor and say -this is my development since our last meeting. This would give me a really good basis for a conversation with my doctor.”

Other more general functions mentioned during interviews were inclusion of machine learning for automatic trigger and attack pattern recognition, compatibility with third-party smart devices and applications, and being able to look at data on different platforms and transfer it between different migraine applications.

### 3.3.4 Content in application

Functionality is limited to deciding how things work in the application, whilst content refers to the information being shown to the user. According to participants, personal information should be displayed so that the user can get a good overview, get involved with their own data, present objective statistics, and present information in a way that is tailored to the user. Gudrun explains how this helps motivation: “So I think that… my, my, in my experience is all knowledge one can get about oneself and one’s disease, of one can get it summarized, then one also becomes more motivated to document.” Participants also called for information about migraine, make it easily accessible, and being able to show it to relatives. Monika express that this is something previous applications has left out: “What I would like in an, what I haven’t seen before, is an application… also containing information. If... someone,
let’s think... all kinds of patients, from episodic to chronic migraine that’s going to use this, -do you know what it is? What are the risks of developing chronic migraine? What is the limit of medicine you can take? Without risking developing chronic migraine. Those things are very difficult to get information about on the correct level.” There is also a need in participants for supportive information, to show good development as positive feedback, or give good examples of symptoms and pain levels.

3.4 Contribution to the research field

Based on these created themes, this paper is going to present a proposal for how to visualize the three factors on the participants’ motivation to document: personal, health-care, and mHealth application, and how these relate to each other. The visualization is a triangle with each factor in one corner, this to represent their codependence. This triangle is placed within a graph, where the x-axis represents the amount of motivational drive to explore the condition that one factor facilitates, and the y-axis represent the amount authority that is prescribed to one factor, as presented in Figure 3.1. Authority represents the extent an individual is willing to listen to one of the factors.

Figure 3.1: Visualization of the relation between three motivational inter partes.

For example, the personal factor, the individual’s internal goals and thought, is placed high on the y-axis and low on the x-axis. Throughout the interviews, it has been shown that patients listen more to themselves than a health-care advisor or an application but find low drive to commit to explore their condition if they have no external support. Almost the complete opposite can be said about the migraine platform, which is placed low on y-axis and high on the x-axis. The participants expressed that mHealth applications are a tool to exploring migraine but are also of low authority. Lastly, we have the health-care factor, which is placed high on the x-axis and almost as high as the personal factor on the y-axis. This because health-care was both a frequently mentioned reason to why patients explored
their migraine and also was something that patients listened very carefully to. Of course, this is on the premise that the health-care provider tells the patient to document their condition in the first place, which is mostly the case.

Another purpose of the triangle is that it shows how two factors combined create specific aspects of the migraine documentation. For instance, one the line between the personal factor and the migraine platform factor is achieving goals. This because a migraine platform helps the patient take internal goals and define them externally. By being able to revisit these goals and see their progress, the patient can more easily follow their progress and ultimately achieve their goals. Looking at the relationship between the personal factor and the health-care factor, the most dominant use of this is receiving care. Between the health-care factor and the migraine platform factor we have analyzing treatment. By looking into information about the patient’s development in the application, health-care can simplify their investigations of treatments, something that was regularly mentioned throughout the interviews.
This section of the thesis discusses the results and the method of the TA. The results are put in context to the theoretical background and evaluated in comparison to similar studies. The method discussion treats the subject of validity and trustworthiness by relating it to common qualitative research criteria.

4.1 Results discussion

This qualitative study explores what affect patients motivation to explore symptoms in a migraine mHealth application. The main findings present three overarching categories, personal, health-care related, and technical support. These were created to highlight what participants tend to focus on and expect in relation to each category. There is also a visualization proposed to understand the relation between the three categories. Furthermore, the results revealed that the development of a mHealth intervention with regards to some of the themes could increase both usability and motivation to document. However, this requires that the design of the mHealth application reflects on some of the results and considers what to focus on.

For instance, the results present an interesting conflict of interests between the patients’ goals to explore migraine and the patients’ discomfort of having to think about migraine. Indeed, the interviews repeatedly show how patients are, or have been, eager to understand their condition. But as shown in the interviews with patients’ such as Rosa, just thinking about migraine or having to think about the tasks a migraine application requires, creates anxiety and frustration. The same thing has been shown in a study on how patients experienced participating in a study with mHealth applications [28]. Experiences with the intervention of an application was perceived as an interruption from the daily schedule or something frustrating during free time. This creates a paradox since the patient needs to engage in their disease to be able to explore it but fails in doing so by avoiding thinking about it. Even more fascinating is that the patient itself recognizes this contradiction, which in turn results in the patient directing further negativity inwards. The self-negative feelings could result in even more reluctance to investigate the migraine, which creates a downward spiral. This could partly be the reason why migraine sometimes is connected to MDD and anxiety disorders [39, 2].
There is one proposal to tackle the paradox with wanting to explore migraine but not wanting to think about migraine. In another study that looked at migraine prediction using electrostimulation it was proposed that giving the patient a feeling of more impact on their migraine could increase their motivation to use a mobile application [45]. This is something that was frequently mentioned during the interviews as well, as covered in the section about triggers and patterns. Patients find motivation in being able to understand everyday factors and being able to choose to avoid them or consciously go through them.

But the notion of “control”, is a sensitive subject on its own. For instance, a few of the more experienced migraine patients criticized the question “do you have any strategies to counteract your migraine…” These patients meant that a migraine patient cannot “beat” migraine, a patient can only seek to explore their condition and maybe understand the nature of their migraine. This is touched upon in the section patients understanding of condition, where Gudrun expresses that accepting the condition helped here with moving forward and focusing on specifics of her condition. To accept the condition, is something that other research has found helps patients reduce frustration and live with their migraine [43, 23, 48]. A patient should rather reconcile with the fact that it is a neurological condition and continue from there.

These two discussed topics may seem to contradict each other, one advocating giving the patient the idea of improving the condition, and the other advocating the patient to accept it as it is. However, there is a third topic that somewhat separates these two topics, and that is the difference between longtime patients and those diagnosed more recently. Several of the interviews displays that the motivation of documenting in the beginning of the diagnosis, should be to understand patterns and treatment effects, and actively preventing the development of chronic migraine. Some of the patients with chronic migraine explained that the concept of developing chronic migraine from episodic migraine, was something that they never were aware of in the beginning of their diagnosis. Therefore, is it in the beginning where there is a need for more rigorous documentation. This could help with risk factor modifications through therapeutical and pharmaceutical interventions that help with the proper course of action for patients with episodic migraine [20]. As expressed from the interview with the migraine specialist, factors such as training and overmedication become extremely important to monitor to prevent development of chronic migraine. Indeed, a study on the transition to chronic migraine proposes that overuse of medication could be the biggest factor to developing chronic migraine [25]. Even though these factors may not change the course of the condition, they could help patients decrease everyday disability [4]. So, individuals new to the condition should be motivated by wanting to prevent their migraine worsening, while experienced patients should be more focused on accepting their condition and find ways to manage it. Of course, this does not mean that longtime migraine patients should give up on trying to improve their disease.

Another curious aspect of the results is the expressed differences between personal interests and the expectations from health-care. Participants impression of health-care was that their most prominent interest was the patient’s reaction to treatment and the quantity of attacks. These factors were of interest to most of the patients as well, but some patients expressed the lack of focus of health-care concerning treatments outside the health-care and habitual factors such as sleep, nutrition, and stress. Similarly, a study on healthcare communication with migraine patients in the U.S. found that majority of the questions were short, focused on attack frequency, and rarely asked about quality of life [9].

At the same time, the interview with the migraine specialist showed that the health-care side experiences that patients often do not care about habitual factors, even though it has been recommended to them. What this contradiction depends on is difficult to say. One possibility could be that by participating in this study, the participant is most likely interested enough in their condition, that they are not the type of patient the migraine specialist refers to. Thus, presenting a skewed representation on the larger migraine patient population. Or it could be the other way around, that this migraine specialist is more interested than the typical
health-care professional and does not represent the larger neurologist population. Either way, focusing on the one thing both groups did have in common, both expressed benefit of using migraine diaries to create common ground. This is what makes exportable summative reports so important, which was one of seven criteria Hundert et al. [17] deemed necessary for good quality in a migraine application. Whether a specific patient or health-care professional sees no value in a mHealth application should not affect the evident prospects of a meeting in which both parties are aided by such a tool.

Yet another discrepancy is the attitude towards support from mHealth applications. MHealth applications seems to provide patients with tools and help with reminders to explore the condition but are on the other hand very fast disregarded as something being in charge. A study on patients’ emotional attachment to mHealth applications mentions that autonomy, competence, and relatedness, are three attributes affecting both patients’ well-being and motivation [21]. It could be the case that the participants of this study have never used an application which possess these attributes. Still, this explanation does not necessarily explain the remaining contradictions. For instance, some participants appreciate notifications that send positive reinforcement and reminders, while some participants express frustration with being reminded of their condition. Same thing can be detected about information density, where some participants like to read as much as possible about their condition, and other just want the absolute relevant information. A previous study found that overwhelming number of notifications and questions in a migraine application, was one of the causes for users to delete the application [26].

Arguably there are roughly two alternatives to approach this problem. One is deciding on which of the users an application should be designed after. Either designing after the user that appreciates application detail and information density or designing after the user that wants a more minimalistic application with easy interactions. The latter probably covers a wider user group, since most migraine patients are not long-time sufferers of chronic migraine, often settling for easier functionality. But an article on migraine applications proposes the former alternative, that applications should focus on adherence for current users and set higher entry user thresholds, instead of focusing on getting as many downloads as possible [47]. The second approach is to include dynamic functionality or the possibility for the user to tailor content, which was another of the seven criteria for good quality in a migraine application [17]. This was something that a lot of participants also deemed important, to be able to control the flow and content of the application.

Lastly, there is the triangle, the proposed visualization to represent the interplay of the key motivation categories in a migraine application. This triangle should not be viewed as a static representation, but rather the factors can have different positioning within the graph depending on type of patients, type of condition, type of mHealth application, and so on. A triangle representing the documentation of tinnitus or diabetes could look completely different. The triangle is not an objective representation since it is derived from a subjective thematic analysis. And this is not the point of the triangle either, instead it should be used to give a good overview of specific findings on motivations of documenting in mHealth application.

Putting the discussed results in context of the triangle, it is interesting to see that health-care is such a high driver for exploration. Health-care requiring the patient to use diaries was usually expressed as the highest motivation to document, even though the same patients heavily criticized the goal prioritization and the overall experience of health-care.

4.2 Method discussion

Discussing the trustworthiness of a qualitative research requires looking into the studies credibility, transferability, dependability, and confirmability [22]. Credibility was assured through researcher triangulation by involving this thesis supervisors in latter part of the analysis. Credibility was also assured by taking reflexive notes throughout the coding process.
4.2. Method discussion

The interviews were rich in data, including a variety of experiences, and included transcription notes for transparency, thus enhancing the credibility. Further, transferability was established by providing a rich description of the method and procedure. The results also present how these findings can be interesting for using mHealth applications in similar settings. This might however vary depending on how care is organized and financed in areas with patients with different conditions. Dependability is assured by using an interview guide and clarifying the data analyzing steps in accordance with a thematic analysis. Finally, confirmability is not necessarily central to this study since this study build results on the data, not finding objective results of the data.

A limitation of this study is that informants were recruited partly purposely, resulting in a more narrow sample, which might present a difference between the study sample and the general population. The sample size was based on data saturation and accordingly, data collection was finalized when the data reached satisfactory depth and complexity to answer the research questions with sufficient confidence.

The sample consists of data from participants with the most severe migraine conditions. Eight out of ten participants in this study were diagnosed with chronic migraine and four participants had a combination of two or more types of headaches or migraines. This might present a knowledge gap about those unsure or in the beginning of their diagnosis. As displayed in the theme patient difference within patient group, patients in the beginning often have different motivations and goals. These initial motivations and goals were only discussed retrospectively by experienced patients in this study. Even though the patients with more severe migraine also once were new to migraine, they still lack the explicit expression of experiences only newly diagnosed can have. Especially since most of the participants were old enough to not have access to digital headache diaries and mHealth applications when they first where diagnosed.

Also, since most of the participants had chronic migraine, some of the questions were not suited to them. For instance, questions regarding triggers were often not applicable to these participants, since they had sometimes been unsuccessful in finding triggers and could experience migraine regardless of their actions.

Participants in this study can therefore not be assumed to represent the bigger migraine and headache population. Besides the majority having more severe migraine symptoms, the majority was also female and middle-aged. For example, interviewing especially younger patients, could have given insight into a user group with more expertise of using mobile applications. Regarding if ten participants were enough to get a sufficient variety of data is much more difficult to answer. The concept of data saturation is not very applicable to reflexive TAs and should be viewed critically [7].

Some questions were also difficult for the participants to answer, regardless of the severity of the patient’s condition. The problem with these questions was that they were too specific or involved too complicated design concepts. For instance, the question “what support do you want to see in a mHealth application?” was often met with a counterquestion asking for a clarification of the question. Similar confusion occurred during questions about what contents participants would want to see in a mHealth application. This was often resolved by reformulating the question or providing examples but may still have resulted in overall participant insecurity or building on general confusion.

Lastly, there is the discussion about the TA. It is always difficult to know when to consider a TA complete, since it can be modified, changed, and reorganized without having a specific ending point [6]. But since the results present a compelling narrative of the data, the TA should not be considered incomplete. However, there could have been a further reduction of themes since some of them are more central to the research question than others. But saying that some themes are more “central” than others, could also be influenced by a selection bias that could occur from early literature reading, resulting in exploring patterns and themes that
are already existing in the research [8]. Since this study was a deductive analysis, this should have prevented this bias, since there was not any grounded theory shaping the process prior to the analysis.

It is also worth mentioning that the three overarching themes do not contain three distinct separated themes and codes, but rather highlights three different perspectives from which themes and codes can be put into context in terms of motivation of exploring migraine.
This study aimed to explore patients’ motivations to document in a migraine application. This by presenting the present state of the research field of both mHealth applications and behavioristics of migraine patients. One doctor specialising in migraine was interviewed, and ten migraine patients were recruited and interviewed. All the interviews were transcribed and processed with a reflexive TA. The TA resulted in three overarching themes, personal motivations of exploring migraine, health-care related motivations of exploring migraine, and technical support for motivation of exploring migraine. Each overarching theme was presented with their containing themes and sub-themes. A few of the themes are discussed and contextualized to each other, presenting some contradictions of the results, which are also discussed.

Regarding the research questions, the results presented in this study gives further insight into what to think about when designing mHealth applications for patients with migraine. The shared personal experience of the ten migraine patients has provided strong themes which gives further insight into designing a migraine application. Some of the design considerations that help migraine patients further explore their condition are focusing on the patient accepting the condition, preventing development of chronic migraine in early stages. Also, adaptive content and functionality, are extremely important for patients to make the interaction fast and effective which can be crucial for patients experiencing migraine. A mHealth application designer does also need to decide a target user group by either designing more advanced functionality for longtime patients, or more introductory and exploratory content for patients new to migraine.

Besides the design perspective, there also seems to be a need for some structural changes in health-care, further integrating migraine applications and pivoting focus to habitual parts of a patients everyday life. This is very important, since mHealth was found to be the biggest motivation for a patient to explore their condition. Further research could explore more of the health care side and its use of mHealth application in relation to migraine patients.

Additionally, a triangular graph, visualizing the interplay of the overarching themes is presented, and proposed as a representation of motivation for patients using mHealth applications. Further research should focus on exploring this visualization on other types of migraine patients or other patient groups.
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2. Jag tillhör följande åldersspann:
   - 0-19
   - 20-29
   - 30-39
   - 40-49
   - 50-59
   - 60-69
   - 70+

3. Jag är kliniskt diagnostiserad med migrän:
   - Ja
   - Nej

5. Mailadress att bli kontaktad på:

6. Telefonnummer (trivilligt - för smidig tidsbokning):

7. Jag samtycker till att min emailadress sparas och används för att kontakta mig vid ett senare tillfälle. Jag är medveten om att mina svar kommer att sparas och behandlas i riktlinjer med GDPR och att jag kan när som helst kan ta bort min intresseanmälning och begära att mina uppgifter raderas.
   - Ja
   - Nej
Old interview guides

B.0.1 First interview guide

Supplementary file: 2

1. **In-depth Interview guides**

1. Icebreaker
   a. How are you doing?
   b. What kinds of work are you doing these days?

2. Could you please share your experience of using mobile phone? *Probe: How, when, for what purpose etc*

3. What do you know about use of mobile health in management of high blood pressure?

4. Could you please share your opinion on using mobile phone for management of high blood pressure? *Probe: what, how*

5. Have you heard, or have you been told that you can get health messages through mobile phone?

6. What is your opinion about it? What is your perspective on potential of mobile health service in management of hypertension in Nepal? *Probe: what, how, example*

7. What could the potential advantages of using mobile health in Nepal?

8. What could be the challenges in using mHealth in Nepal for the management of hypertension?

9. What can be done to overcome the challenges for successful outcome?

10. What kinds of mobile health services you would like to get/use?

11. What should be the contents, timing, and frequency of such mHealth services?

12. Do you want to share anything which I missed to discuss?
III. FGD guides

Let’s start by going around the circle and having each person introduce her/himself. *(Members of the research team should also introduce themselves and describe each of their roles.)*

1. Icebreaker
   a. How are you doing?
   b. What kinds of work are you doing these days?
2. Could you please share your experience of using mobile phone? *Probe: How, when, for what purpose etc*
3. What do you know about use of mobile health in management of high blood pressure?
4. Could you please share your opinion on using mobile phone for management of high blood pressure? *Probe: what, how*
5. Have you heard, or have you been told that you can get health messages through mobile phone?
6. What is your opinion about it? What is your perspective on potential of mobile health service in management of hypertension in Nepal? *Probe: what, how, example*
7. What could the potential advantages of using mobile health in Nepal?
8. What could be the challenges in using mHealth in Nepal for the management of hypertension?
9. What can be done to overcome the challenges for successful outcome?
10. What kinds of mobile health services you would like to get/use?
11. What should be the contents, timing, and frequency of such mHealth services?
12. Do you want to share anything which I missed to discuss?

B.0.2 Second interview guide

Interview guide from a previous study carried out with Leviate [48].
Old interview guide 2:

Social situation
• Hur ser din sociala situation ut? (make/maka, änklings, hemmavarande barn + ålder, barn som flyttat hemifrån, bor själv)
• Upplever du att de personer som är i din omgivning har förståelse för din situation? skala 1-5
• Upplever du att de personer som du har i din omgivning kan stötta dig gällande din sjukdom? skala 1-5
• Tycker du att det är viktigt att personer i din omgivning förstår din sjukdom? skala 1-5. inte viktigt alls - väldigt viktigt.


Hur väl stämmer dessa påstående in på ditt liv:
• Jag är medveten om vad som tigger min migrän
• Jag är medveten om vad som minskar risken att jag få migrän
• Jag upplever att jag behöver anpassa mitt liv på grund av min migrän
• Jag upplever att jag har strategier till min migrän som fungerar för mig generellt i livet
• Jag är nöjd med de strategier jag har för att hantera min migrän.

Skriva om dessa till mer öppna frågor.

Hur väl stämmer dessa påstående in när du inte har migrän
• Jag upplever att jag har strategier till min migrän som fungerar för mig när jag inte har migrän
• Jag upplever att jag har strategier till migränhantering som fungerar för mig när jag är på jobbet/skolan/annan sysselsättning
• Jag upplever att jag har strategier till migränhantering som fungerar för mig i hemmet
• Jag upplever att jag har strategier till migränhantering som fungerar för mig när jag är med vänner
• Jag upplever att jag har strategier till migränhantering som fungerar för mig på min fritid

Sömn
• Jag sover vanligtvis jättebra 1-5
• Vanligtvis sover jag 1-4/4-5/5-6/6-7/7-8/8-10 eller mer h/natt
• Jag upplever att min sömnkvalitet påverkar hur ofta jag får migrän 1-5
• Jag använder någon form av applikation relaterat till sömn

Hälsa och livskvalitet (dessa frågor kan vara ihop med när frågor om det ämnet tas upp)
• Hur skulle du skatta din hälsa mellan 0-10? 0 ingen hälsa/10 maximal hälsa
• Är du nöjd med din hälsa? 1-5 från inte nöjd till jättenöjd
• Är du nöjd med din sociala situation? 1-5
• Är du nöjd med din sysselsättning? 1-5
• Är du nöjd med din självkänsla? 1-5
• Är du nöjd med din självkänslomedom? 1-5
• Är du nöjd med din livssituation? 1-5

B.0.3 Third interview guide

Interview guide from a previous study carried out with Leviate [16].
Old interview guide 3:

- Använder du dig för tillfället av en migrändagbok?
  o Har du tidigare använt dig av en migrändagbok?
    ▪ Vad fick dig att sluta använda en migrändagbok?
  o Vad fick dig att börja dokumentera din migrän?

- Hur dokumenterar/dokumenterade du din migrän?
  o Vad har du upplevt funktat väl med det systemet?
    ▪ Varför känner du så?
  o Vad har du upplevt funktat mindre bra med det systemet?
    ▪ Varför känner du så?
  o Har du använt andra alternativ förut för att dokumentera din migrän?
    ▪ Vilka då / varför inte?

- Vad dokumenterar du i din migrändagbok?
  o Dokumenterar du olika mycket beroende på om du har haft ett migränanfall eller inte?
  o Dokumenterar du något de dagar då du inte haft migrän?
    ▪ Varför/varför inte?

- Känner du att dokumentationen har hjälpt dig?
  o På vilka sätt?
  o Varför/varför inte?
  o Känner du att dokumentationen har hjälpt din läkare?

- Hur använder du din migrändagbok?

- Vad tror du skulle motivera dig att fylla i din migrändagbok oftare?
  o Om vi vänder på frågan, vad tror du skulle få dig att fylla i din migrändagbok mer sällan?

- Hände det att man glömmer att fylla i sin migrändagbok?
  o Varför händer det?
  o Varför inte?
C.1 Health care interview guide

• Beskriv kort vad du sysslar med i ditt arbete?
• Hur skulle du beskriva patientgruppen generellt?
  o Vad är de mest typiska egenskaperna hos migränpatienter?
  o Hur påverkar migrän deras liv?
  o Vad har migränpatienter gemensamt sinsemellan?
• Hur hanterar patienterna deras migrän generellt?
  o Vad för strategier i att hantera migrän har patienten innan, under och efter en attack?
  o Vilka strategier har patienterna för att förhindra migränanfall?
• Av din erfarenhet, från vilka typer av källor får patienterna support?
  o Följd: sjukvård, läkemedel, vanor och beteendetips, terapi eller liknande, familj och bekanta, patientorganisationer, självhjälp (till exempel träning eller mindfullness), applikationer, online-forum, självhjälpsgrupper

• Vad är viktigt att tänka på innan och under ett möte med en migränpatient?
  o Följd: varför, hur förbereder du dig, vad är målet med ett möte
• Vad för förväntningar har du av migränpatienter inför ett möte?
  o Följd: varför, vad för information från patient, möter de förväntningarna, finns det återkommande svårigheter

• Vad är din erfarenhet med Mhealth applikationer?
  o Följd: speciellt migränapplikationer, har du använt en
• Vad är något som du anser att migränapplikationer måste ha i åtanke?
  o Följd: funktion, visuellt, timing
• Vad kan bli implementerad i en migränapplikation för att underlätta ditt arbete?
  o Följd: funktion, timing
• Vad tycker du om mhealth applikationer?
  o Följd: bra, dåliga, varför, funkar i vården eller inte, eventuell motvilja i branschen

• Är det någon annan person som du skulle säga är viktig för mig att kontakta utöver patienter?
• Är det något som du skulle vilja tillägga?

Tack så mycket!
C.2 Patient interview guide

Generellt om patient:
- Hur gammal är du?
- Har du en klinisk migrändiagnos som du fått via sjukvården?
  o Följd: av läkare, står i din journal

Migrän:
- Vet du vilken typ av migrän du har?
  o Följd: med aura, utan aura, kopplad till hormoner
  o Skulle du kunna beskriva symptomen under ett av dina typiska migränanfall?
- Hur ofta upplever du migränanfall eller huvudvärk?
- Hur allvarliga är migränanfallen vanligtvis?
  o Följd: hur länge, intensitet
- Tar du någon medicin mot din migrän?
  o Följd: tabletter, ordinerad, vilken, hur ofta
- Vad tror du triggar, eller kan trigga, dina migränanfall?
- Har du några strategier för att hantera din migrän under ett anfall?
  o Följd: vilka, varför inte, hur effektiva
- Har du några strategier för att motverka din migrän långt innan eller precis innan ett anfall?
  o Följd: vilka, varför inte, hur effektiva

MHealth:
- Har du tidigare använt en mHealth applikation som du kan berätta om?
  o Följd: vad, när, hur, varför
- Kan du snälla beskriva din upplevelse av att använda en mobil applikation för att hantera migrän?
  o Följd: vad använde du den till, varför använde du den
- Vad är din uppfattning om potentialen av mHealth applikationer för att hjälpa till med hanteringen av migrän?
  o Följd: vad, hur, exempel
- Vad skulle kunna vara fördelarna av att använda en mHealth applikation?
  o Följd: specifikt för dig, för andra
- Vad skulle kunna vara utmaningarna med att använda en mHealth applikation för att hantera eller motverka migränanfall?
  o Följd: specifikt för dig, för andra
  o Vad skulle kunna göras för att lösa dessa utmaningar?
    • Följd: specifika funktioner, design, exempel
- Vad för stöd skulle du vilja se i en mHealth applikation?
  o Följd: vad för information, vad för typ av hjälp
- Vad borde vara innehållet för en mHealth applikation?
  o Följd: timing, utseende, funktion, något som kan hjälpa dig med strategier i det vardagliga livet

Dagbok:
- När du får ett migränanfall, hur svårt eller lätt är det att beskryva eller dokumentera dina symptom?
C.2. Patient interview guide

- Vad skulle du säga är det viktigaste att förmedla, lägga på minnet eller dokumentera från ett migränanfall?
  - Följd: varför, vad är svårt, vad är lätt
  - Hur skulle du helst vilja dokumentera i en migrändagbok?
    - Följd: hur ofta, triggers, anfall, text eller symboler
  - Vad dokumenterar du på huvudvärkslösa dagar?
    - Följd: varför, varför inte
    - Vad skulle hjälpa dig att dokumentera oftare eller mer noggrant på huvudvärkslösa dagar?
      - Följd: påminnelser, funktioner
  - När du upplever ett migränanfall eller en huvudvärk, hur påverkar det din användning av din mobil jämfört med när du inte har migrän/huvudvärk?
    - Följd: varför
    - Är det något speciellt på din telefon som du använder mer?
      - Följd: underhållning, musik, avslappning
    - Är det något speciellt på din telefon som du försöker att undvika?
      - Följd: skärmintensitet, ljud, specifika applikationer
  - Hur är din inställning till att dokumentera information om din migrän?
    - Följd: positivt eller negativt, hjälper det, är det krävande

Sjukvården:

- Har du någonsin varit i kontakt med vården på grund av din migrän/huvudvärk?
  - Följd: hur, varför, när
  - Skedde det mötet och nuvarande möten i person eller online?
  - Hur var din upplevelse med vården?
    - Följd: positiv, negativ
  - Använde du dig av en huvudvärksdagbok och hur använde du den under mötet med sjukvården?
    - Följd: visade du den, var den relevant, vad sa sjukvårspersonalen
- Vilka aspekter av interaktionen med sjukvården skulle du vilja säga är viktigt att ha med i en mHealth applikation?
  - Följd: stödja mötet med sjukvårspersonalen, göra mötet enklare, receptförnyelse
- Vad kan mHealth applikationen bidra med som sjukvården kan/inte kan?
  - Följd: vad, hur

Sammanfattning:

- Är det något ytterligare du skulle vilja tillägga som vi inte tagit upp?

Tack så mycket!