CHALMERS
UNIVERSITY OF TECHNOLOGY

UNIVERSITY OF GOTHENBURG

ADHD, Mental Health and Smart Devices

Exploring Preferences and Perceptions of Smart Watches and Devices and their Potential Role in Supporting Adults with ADHD

Master's thesis in Computer Science and Engineering

EVELINA SALOMONSSON STRIDSBERG

Department of Computer Science and Engineering
CHALMERS UNIVERSITY OF TECHNOLOGY
UNIVERSITY OF GOTHENBURG
Gothenburg, Sweden 2024

Master's thesis 2024

ADHD, Mental Health and Smart Devices

Exploring Preferences and Perceptions of Smart Watches and Devices and their Potential Role in Supporting Adults with ADHD

EVELINA SALOMONSSON STRIDSBERG

UNIVERSITY OF
GOTHENBURG

CHALMERS
UNIVERSITY OF TECHNOLOGY

Department of Computer Science and Engineering
Chalmers University of Technology
University of Gothenburg
Gothenburg, Sweden 2024

ADHD, Mental Health and Smart Devices
Exploring Preferences and Perceptions of Smart Watches and Devices and their Potential Role in Supporting Adults with ADHD
EVELINA SALOMONSSON STRIDSBERG

Supervisor: Vasiliki Mylonopoulou, Human-Computer Interaction in the Applied IT department
Examiner: Morten Fjeld, Interaction Design and Software Engineering, Computer Science and Engineering

Master's Thesis 2024
Department of Computer Science and Engineering
Chalmers University of Technology and University of Gothenburg
SE-412 96 Gothenburg
Telephone +46 31 772 1000

Typeset in LaTeX
Gothenburg, Sweden 2024

ADHD, Mental Health and Smart Devices
Exploring Preferences and Perceptions of Smart Watches and Devices and their Potential Role in Supporting Adults with ADHD
EVELINA SALOMONSSON STRIDSBERG
Department of Computer Science and Engineering
Chalmers University of Technology and University of Gothenburg

Abstract

This thesis explores the potential of wearable technology, specifically smartwatches, to assist individuals with Attention-Deficit/Hyperactivity Disorder (ADHD) in managing daily challenges. ADHD is characterised by inattention, hyperactivity and impulsivity, which can significantly affect executive functioning and overall well-being. The study investigated how individuals with ADHD currently use wearables and other technologies, their preferences, challenges and perceived benefits. It also explored how smartwatches can be tailored to provide support and how these devices can integrate the strategies that individuals with ADHD use to address their everyday challenges. It concludes that smartwatches can be tailored to address these challenges through features like customisable notifications, alarms, timers and reminders that align with the individuals routines, as well as quick note-taking through voice recording. Additionally, it emphasises the importance of providing education, trial opportunities and personalised setup assistance to enhance the adaption and effective use of wearable technology. The findings highlight the need for further research and integration of these tools within healthcare systems or educational institutions to provide additional support for people with ADHD in their daily lives.

Keywords: ADHD, HCI, Mental Health, Smart Devices, Smartphone, Smartwatch, Features, Recommendations.

Acknowledgements

I would like to extend my deepest gratitude to my supervisor, Vasiliki Mylonopoulou, whose guidance and support have been invaluable throughout this journey. Her willingness to read my thesis more times than required, her help in crafting specific deadlines, and her understanding of the challenges I faced when I couldn't always perform at my best have been crucial to my progress. Her unwavering faith in my ability to complete this work gave me the confidence to persevere, and for that, I am sincerely grateful.

My participants felt more comfortable speaking Swedish, so I want to include a special thanks to them directly:

Tack för att ni tog er tid att delta i denna studie och för att ni delade era erfarenheter och tankar med mig. Er öppenhet och vilja att prata om era vardagsliv och utmaningar har varit ovärderlig för den här forskningen. Jag är oerhört tacksam för er medverkan och förtroendet ni visade mig. Jag hade inte kunnat slutföra detta arbetet utan er, jag är er evigt tacksam!

Tack så hemskt mycket ännu en gång! Thank you all so much!

Evelina Salomonsson Stridsberg, Gothenburg, 2024-09-30

Contents

List of Figures

List of Tables

List of Acronyms

Below is the list of acronyms that have been used throughout this thesis listed in alphabetical order:

ADHD	Attention-Deficit/Hyperactivity Disorder
AT	Assistive Technology
CBT	Cognitive Behavioural Therapy
EDA	Electro-Dermal Activity
ECG	Electrocardiogram
EEG	Electroencephalogram
GAD	Generalized Anxiety Disorder
GDPR	General Data Protection Regulation
GT	Grounded Theory
iCBT	Internet-based Cognitive Behavioural Therapy
MDD	Major Depressive Disorder
PBS	Positive Behaviour Support
TA	Thematic Analysis
BT	Behaviour Therapy
CT	Cognitive Therapy
GSR	Galvanic Skin Response
NICE	National Institute for Health and Care Excellence

1

Introduction

People with the neurodevelopmental condition Attention-Deficit/Hyperactivity Disorder (ADHD) [1] may struggle with inattention, hyperactivity and impulsivity [1]. These struggles often manifest in everyday scenarios, leading to instances like misplacing keys due to inattentiveness and engaging in excessive talking prompted by hyperactivity and impulsivity. Individuals with ADHD may encounter difficulties with executive functions, which represent the cognitive abilities needed for adapting and achieving goals [2]. These functions involve the brains ability to organise, remember and execute tasks. ADHD manifest differently in individuals, there are studies suggesting gender variations, where men often present with hyperactivity and impulsivity, while women predominantly present with inattentive symptoms [3], [4]. Women with ADHD, compared to men, experience higher rates of anxiety and depression [3]. As more research is conducted on ADHD amongst individuals, Katzman et al.[5] and Ogrodnik et al. [6] acknowledge that 80 % of adults with ADHD experience mental health issues such as depression, anxiety and substance abuse at least once in their life [5], [6]. Adults with ADHD are also 2.7 times more prone to have depression than an adult without ADHD [7].

This research aims to explore the needs of adults with ADHD and how technology can aid in everyday life. In contemporary society, the majority of individuals own a smartphone, with a global ownership rate of 78 %, reaching an even higher rate of 93 % within Europe [8]. Additionally, wearable ownership made up 46 % in Sweden [9]. Given the widespread use of these technologies, they present both challenges and opportunities [10].

The expansion of smartphones and wearables has the potential to transform existing societal norms into more advanced, high-tech structures, prompting the need for extensive research to fully harness this potential [10]. Wearable devices, particularly smartwatches, offer individuals valuable insights into their health by tracking personal data such as heart rate, sleep and step count [11], [12].

Building upon the widespread use of smartphones and wearables, this research explored their potential beyond conventional usage. Given that individuals with ADHD are more prone to anxiety and depression, it is crucial to investigate the challenges they encounter and the strategies they employ to manage them. This study aimed to explore the possibility of integrating wearable technology as a supportive tool and utilising these tools and strategies in daily life.

1.1 Research questions

To gain a deeper understanding of how wearable technology could support individuals with ADHD in their daily lives, this research explored several key areas. The aim was to identify the current usage patterns of wearables and other technologies, along with the challenges and benefits experienced by individuals with ADHD. Additionally, the study investigated the potential of wearables to provide meaningful support in managing perceived struggles such as time management, focus, and overall well-being. Finally, it examined the strategies that individuals with ADHD employed to overcome their everyday challenges. These considerations shaped the following research questions:

1. How do individuals with ADHD currently utilise wearables and other technologies, what are their preferences, challenges and perceived benefits?
2. How can wearable technology provide support for people with ADHD?
3. What strategies do people with ADHD employ to overcome their everyday challenges?

2

Background

The rapid expansion of digital mental health innovations, including numerous mobile applications targeted for individuals with ADHD, is outpacing scientific evaluation [13], [14]. This expansion highlights the need for healthcare professionals and researchers to be actively involved in the technical evolution, ensuring technology development is not only created by the industry but also fully meets the needs and aligns with healthcare professionals recommendations. Hence, this background chapter aims to comprehensively review existing literature to explore available technologies and solutions.

The following subsections will provide a thorough insight and examination of existing technology aimed at supporting and addressing the various challenges experienced by individuals with ADHD. However, it is important to note that not all technology discussed in this chapter may be endorsed or supported by healthcare professionals.

2.1 ADHD

ADHD is a condition characterised by interference with the brain's development and functioning, manifesting in noticeable patterns of inattention, hyperactivity and impulsivity [1].

Adults diagnosed with ADHD constituted in 2021 of approximately 6.8 % (366.3 million) of the global population, regardless of onset age [15]. In Sweden, the estimated percentage of adults with ADHD was 3 % [16]. While the male-to-female ratio of ADHD in children is 3:1, it converges to 1:1 ratio in adults. Many women are diagnosed later in life, in adulthood, despite struggles that have been present since they were children [17]. This is due to the fact that there has not been extensive research conducted on women. As a result, the diagnostic criteria, primarily based on male samples, may not accurately reflect how ADHD manifests in females. Girls tend to mask their symptoms to a greater extent, which further contributes to the lack of recognition for women with ADHD [18], [19]. For those undiagnosed women, profound negative impacts on their mental health, relationships, self-esteem and overall well-being become evident [20]. Furthermore, women with ADHD, compared to men, experience higher rates of anxiety and depression [3].

According to the 'Nationella riktlinjer 2024: ADHD och autism' (National Guidelines 2024: ADHD and Autism) [21] provided by Socialstyrelsen [22], various sup-

ports and interventions are recommended for individuals with ADHD. While these guidelines serve as a foundational reference for this thesis, it is important to acknowledge that many of the concepts and treatments discussed are influenced by previous research and guidelines. The National Institute for Health and Care Excellence (NICE) [23] has issued a guideline [24] that is frequently referenced in the field of ADHD. ADHD and autism are related conditions, which is why the Socialstyrelsens guidelines cover both [21]. Socialstyrelsen emphasises the importance of coordinated and continuous healthcare, ensuring individuals receive support from early suspicion to diagnosis and follow-up. Multidisciplinary teams including psychologists, doctors and other specialists work together to provide integrated care, reducing the burden on individuals and their families.

Behavioural and psychological treatments such as Cognitive Behavioural Therapy (CBT), psychoeducation and Positive Behaviour Support (PBS) are key components in managing ADHD [24]. Socialstyrelsen recognises the importance of physical activity. Guidelines for physical activity in disease prevention and treatment include specific recommendations for children and adolescents with ADHD, highlighting the need for support around physical activity and sedentary behaviour.

When appropriate, ADHD medications can complement other treatments by improving focus, reducing hyperactivity and minimising impulsivity [24]. However, medication is not the first-line treatment and is always part of a broader care plan that is regularly reviewed for efficacy.

As for the suggestion on non-pharmacological treatment, Nimmo-Smith et al. [25] conducted a meta-analysis and determined that the most common psychotherapy was CBT [26]. CBT is a form of psychotherapy treatment that combines elements of Cognitive Therapy (CT) and Behaviour Therapy (BT) techniques [27]. CBT aims to help individuals gain insight into their thinking patterns and behaviours, which can be effectively addressed to improve the overall well-being [1]. For individuals with ADHD these insights have highlighted the work on which needs to be focused on, such as improving coping skills, communication, organisational skills and time management [28].

Considering that Socialstyrelsen guidelines emphasise the integration of healthcare with physical activity recommendations, studies by Chimiklis et al. [29] and Bigelow et al. [30] explore the benefits of mindfulness meditation for individuals with ADHD. Research indicates that exercise can enhance executive functions and alleviate symptoms [31], while also improving mood and confidence in individuals with ADHD [28]. The findings from Chimiklis et al. also support existing literature suggesting that yoga and mindfulness positively influence hyperactivity and inattention [29].

2.2 Assistive Technology

Support for individuals with ADHD is vital to their well-being and daily functioning. Technology can be integrated into these support systems, functioning as Assistive Technology (AT) designed to assist individuals with impairments in their daily lives [32]. AT products can address physical impairments, such as hearing, mobility and

vision, as well as mental impairments related to cognition and mental load [33]. These AT tools aim to enhance the freedom and overall well-being of individuals. While physical disabilities often receive more attention, individuals with psychosocial disabilities, such as ADHD, can also significantly benefit from AT [34].

AT has different focus points in various fields, of the Assistive Technology Act of 2004, AT is described as:

> "...any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customised, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities" (H.R. Rep. No. 100-819, 1988) [35], [36]

Another explanation of what AT is from the Kings Fund Consultation are:

> "Assistive Technology is any product or service designed to enable independence for disabled and older people." [37]

AT is often broadly defined, with variations in description across different fields, each adapting the definition to fit its specific context.

In this thesis, a broader perspective on AT was adopted. While the traditional understanding of AT may not primarily focus on psychosocial disabilities such as ADHD, this thesis will. Specifically, aids designed to enhance functioning for individuals with ADHD, such as digital calendars and reminders, will be recognised and considered as forms of AT.

This approach aligns with highlighting diverse applications of AT, such as digital designs and wearables, in enhancing accessibility, adaptability and inclusivity for individuals with ADHD. This expanded view of AT aims to maximise its potential to improve the freedom and overall well-being of individuals with ADHD.

AT can range from constructions with mechanics to digital designs [38] and are made to make things more accessible, adaptable and inclusive. Lindstedt and Umb-Carlsson [39] highlighted in their research that AT can be used to improve productivity through weekly schedules both paper and digital, mental load through object finders and sleep quality with the help of a weighted blanket [39]. Various combinations of mechanics and digital tools have been developed, among which is the format of wearables [40].

Wearable technology, technology worn by a user, offers a versatile range of devices that can be attached directly to the body or integrated into clothes or accessories [41]. Examples of wearable devices include smartwatches [42], wristbands, glasses, rings, headbands, helmets, body sensors [43], patches [44] and implants [45]. These devices can play a role in assisting individuals with ADHD in managing their symptoms and improving their daily functioning. Additionally, wearable technology can track various personal data, such as heart rate, blood pressure, sleep pattern, step count, water levels and physical movement [11], [12] to name a few, and they can provide valuable insight into an individuals' well-being.

2.3 Technology and ADHD

Technology has the potential to significantly support individuals with ADHD in managing their symptoms and enhancing their daily functioning. For instance, Moëll et al. [46] conducted a study aimed at assessing the potential of utilising existing smartphone features to enhance the daily functioning of adults with ADHD. The study evaluated the effectiveness of an internet-based course known as *Living Smart*, which incorporated strategies such as utilising calendars, notes, to-do lists and minimising distractions [46]. The utilisation of vibrations from smartphones and smartwatches, along with strategies for planning and organisation, can assist individuals with ADHD in staying on task and mitigating struggles with impulsivity and forgetfulness [38], [47]. While the course demonstrated improvement in addressing symptoms of inattention and organisational difficulties, participants reported that their overall perceived stress levels remained unchanged. Despite these improvements of inattention and organisation, the implementation of these strategies provided greater structure in their daily lives [46].

In their research, Desrochers et al. [48] echo the findings of Moëll et al. [46], emphasising that individuals with ADHD often rely on various tools such as calendars, lists, planners and timers to manage their time effectively. Where timers are a great tool for time blindness and hyperfocus. The authors suggest that existing technology could be better tailored to meet the needs of people with ADHD and propose for future work the integration of multiple time management strategies into a single digital tool for greater efficacy [48].

While calendars, lists, planners and timers are often developed with the general population in mind, they can be adapted and utilised effectively to meet the specific needs of individuals with ADHD. Even though timers are used to remind, the perception of time might still be lost. Eriksson et al. [49] have developed an AT device for time perception, which aids individuals with ADHD to visualise new tasks or reminder of time. The wearable is a small disc that can fit in your pocket or be worn on your wrist. The disc incorporates lights and vibration patterns to give time perception feedback and acts as an reminder of remaining time for a tasks, thus not functioning as a traditional clock [49].

In addition to managing time effectively through planning and organisation, technology offers further support for individuals with ADHD. Productivity can be enhanced by minimising distractions, which strengthens concentration. Söderlund et al. [50] expresses that white noise has shown promise in helping individuals with ADHD improve their concentration [50], [51] through the use of sound machines, playlists and headphones. Furthermore, noise-cancelling headphones can effectively mitigate distracting sounds [52].

There are multiple online tools available for people with ADHD and mental health conditions, ranging from psychotherapy formats to mobile applications and gaming platforms [53]. Converting these tools to a digital format allows for a broader audience to access assistance. However, despite their cost-effectiveness and accessibility, digital options present challenges such as limited internet access and consistent de-

vice usage [54]. For example, with the use of mobile applications on smartphones there is potential of enhancing self-awareness through educational content that focus on psychological insight, which in turn can help individuals cultivate more effective self-management techniques [55]. To address the challenges faced by individuals with ADHD, CBT has proven to be a valuable psychotherapy. Combining psychotherapy with technology will enhance accessibility for individuals with ADHD. Pettersson et al. [56], highlight the use of technology, specifically internet-based Cognitive Behavioural Therapy (iCBT), to address behaviours and serve as a learning mechanism for managing stress and other challenges experienced by individuals with ADHD. However, the limited sample size suggests that further investigation is necessary [56].

In the context of ADHD, wearable technology offers innovative solutions to address specific challenges faced by individuals with the condition. Vibration patterns were used to assist users in maintaining focus, as noted by Legge et al. [57] they integrated a wearable, that is pager shaped, that prompted students to document whereas they are paying attention in class or not. Smit and Bakker [58] used instead a beltworn wearable that could help students manage their impulsivity by receiving vibrations before interrupting in class through speaking [58]. Both of these wearables use vibrations to convey a message to the user to maintain focus or not interrupt in class.

Dibia [59] presented a design named *Foqus*, a smartwatch application designed to aid adult individuals with ADHD in maintaining focus and reducing anxiety and stress. The application incorporates features such as an adaptable integration of a study technique, aimed at promoting focus through structured work sessions, as well as a guided meditation feature to reduce anxiety. Through these functionalities, Dibia aimed to provide an application to support individuals with ADHD in managing their symptoms and improving their overall well-being [59].

To address Chimiklis et al.'s [29] findings that yoga and mindfulness have a positive impact on hyperactivity and inattention, Kim et al. [60] adds on the influence of meditation, particularly focusing on breathing, on cognitive and neurological patterns. Kim et al. suggest that verbal cues might be distracting for individuals with ADHD, thus proposing haptic feedback in the form of vibrations instead, to aid awareness of breathing without distracting concentration through voice cues. However, they do not recommend excluding verbal cues entirely. Instead, they suggest that a combination of both methods can be more effective in guiding the meditators breathing without causing distractions. Additionally, Kressbach [61] has examined the potential of wearable devices in delivering interventions to improve mental health. These interventions include mindfulness exercises that use guided breathing techniques from smartphone applications. Additionally, they involve monitoring breathing and heart rate through wearables, such as smartwatches or devices that can be clipped on or attached to a belt or waistband [61].

In conclusion, technology offers promising solutions to aid individuals with ADHD in managing their challenges, including task management, organisation, mindfulness and therapy. However, despite the potential benefits there remains a notable gap

in understanding how these technologies are actually utilised by individuals with ADHD in their everyday lives.

2.4 ADHD Comorbidity with Mental Health Conditions

Mental health conditions encompass a range of conditions which interfere individuals' psychological, emotional and social well-being [62]. These conditions can manifest in various forms, some of these are anxiety, depression and neurodevelopmental disorders [63]. Among neurodevelopmental disorders, ADHD is a notable subtype. Individuals with ADHD combined with other mental health conditions are called comorbidity. In addition, Katzman et al. [5] and Sherman et al. [7] express that individuals with ADHD are more prone to be affected by depression. Furthermore, women with ADHD experience higher rates of anxiety and depression compared to men [3], [4].

ADHD comorbid with anxiety is experienced by up to 50% of adults [64]. With individuals having both ADHD and anxiety there are different courses of actions in treatments. However, CBT is also recommended for comorbid anxiety [64]. Feeling anxious and occasionally worrying are not inherently bad, but with recurring symptoms of anxiety and dread, multiple aspects of one's everyday life can be affected such as work, school or even social relationships. The symptoms of the different kinds of anxiety vary, with discomfort, dread, fear and a sense of losing control [65].

In adults with ADHD, 30 % also experience depression [66]. With individuals having both ADHD and depression, there are multiple treatment options available. However, CBT is recommended and mindfulness meditation has been addressed to be helpful as well [66]. Depression impacts various aspects of an individual's life, from inner emotions to social interactions and behaviours [67]. Symptoms of depression include persistent sadness, feelings of emptiness or anxiety and diminished interest or pleasure in activities previously enjoyed. Depression is not only physiological but can also manifest physically, resulting in decreased energy and feelings of fatigue [67]. Knouse et al. [68] conducted a study concluding that depression may develop in individuals with ADHD due to executive dysfunction and avoidance behaviours. Their research revealed that negative thought processes and avoidance behaviours contribute to depression in adults with ADHD. Additionally, they elaborate that depression is not because of individuals with ADHD having more stressful events in their lives, but rather avoidance behaviour plays a significant role in their mental health [68].

2.5 Technology and Mental Health Conditions

Mental health conditions, with ADHD being comorbid with anxiety and depression impact individuals' psychological, emotional and social well-being. Treatment approaches, such as CBT [64], [66] and mindfulness meditation [66] have both been

addressed to be helpful in managing these conditions. This section explores the potential of wearable monitoring systems and digital platforms to assist individuals with ADHD and comorbid anxiety or depression in managing their emotional states, tracking physiological responses and ultimately enhancing their overall well-being.

In 2015, Lanata et al. [69] conducted a study on the *PSYCHE* system, a personalised wearable monitoring system designed for patients with mental disorders, particularly bipolar disorder. This system integrates various sensors into a t-shirt and incorporates a mobile application for mood management by patients, facilitating interaction between healthcare professionals and users [69]. Even though bipolar disorder is not covered in this thesis, the study might be applicable to ADHD with comorbid anxiety or depression. This due to the fact that emotional dysregulation and anxiety might be able to be monitored with this sort of wearable. And because individuals with ADHD experience difficulty with inattention and impulsivity [1], insights from their study offer useful considerations when developing technology for individuals with ADHD.

Instead of a wearable t-shirt, Tsirmpas et al. [70] conducted a study on the Feel Digital Precision Medicine Platform named *Feel*, focusing on individuals who display symptoms characteristic of ADHD, in addition to those experiencing symptoms of Major Depressive Disorder (MDD) or Generalized Anxiety Disorder (GAD). The platform integrates a wristband called *the Feel Emotion Sensor*. The study utilised a combination of the application, device, individual sessions and homework assignments. Through the application, users could log their emotions, while the wristband monitors alterations in the autonomic nervous system [70]. This innovative technology can provide individuals with comorbid ADHD with an accessible tool for tracking their emotional states and monitoring their physiological responses, ultimately aiding in emotional regulation and stress management.

Richards et al. [71] conducted a study on an iCBT program known as *Space from Depression*. This program consisted of seven modules, each containing information, quizzes, activities, homework assignments and summaries. Participants engaged in weekly sessions with supporters aimed at helping them manage their depression and anxiety. Through the structured modules and support from the trained volunteers, participants learned coping skills, practiced on restructuring their cognitive thinking patterns and change behaviours, which led to reducing in their depressive symptoms over time [71]. With iCBT, individuals have significant opportunities for improvement. However, this type of assistance often requires regular interaction with supporters and therapists, making it resource-intensive and time-consuming.

In the realm of mental health, wearable technology suggests promising solutions to address various challenges faced by individuals dealing with mental health conditions. Can et al. [72] conducted a literature review on stress detection methods, focusing on the utilisation of wearable devices. The review highlights the importance of unintrusive methods, particularly heart rate and Electro-Dermal Activity (EDA), in detecting stress. The study emphasised the potential of smartphones and wearable devices, including wrist-worn and chest-based heart rate sensors, as well as wrist-worn and finger-based Galvanic Skin Response (GSR) for EDA. The de-

vices should be unintrusive and integrated into a system that is capable of detecting stress in natural settings. Furthermore, the review stressed the importance of not only detecting stress but also providing individuals with tools and activities to help them relax [72].

Gonzalez et al. [73] conducted a comprehensive review of wearables for stress management, aligning with Can et al.'s [72] findings regarding the physiological signals to detect stress through heart rate and EDA. Gonzalez et al. elaborated on the methods for measuring these signals, noting that respiratory rate could be effectively measured using respiratory belts and that brain activity could be monitored through placing electrodes on the scalp. They also mentioned the use of infrared technology for measuring temperature. Additionally, they highlighted that other indicators for identifying stress are noticing changes in behaviour patterns such as walking, arousal, outburst, sleep and posture. These changes could be captured using accelerometers and gyroscopes commonly integrated into smartwatches and activity trackers [73]. Both Can et al. and Gonzales et al. emphasise the different methodologies available for monitoring physiological signals associated with stress, suggesting that wearables technology can be used for stress management strategies.

Hickey et al. [74] conducted a systematic review of different wearable devices and how these were used to detect and monitor stress, anxiety and depression. However, they noted in their review that current wearable technology has not fully succeeded in detecting depression. They highlighted the studies by Cao et al. [75], who utilised wearable forehead Electroencephalogram (EEG) to detect depression, and Narziev et al. [76], who employed accelerometers and heart rate monitors integrated into a smartwatch to identify reduced activity associated as a consequence of depression. Hickey et al. suggested that integrating these two methods into a single wearable device could be promising for being able to detect depression [74]. Additionally, Hickey et al. [74] and Elgendi and Menon [77] reported controversial results regarding the use of electrocardiogram (ECG) for detecting anxiety. Both articles suggest that wearable ECG could be a promising measure for the future. Elgendi and Menon propose that integrating other biosignals might enhance the accuracy of anxiety detection.

Wearables can provide valuable insights into an individual's psychological well-being making it possible for them to track and identify fluctations and triggers [74]. These technologies allow users to track their mood fluctuations, identify stress triggers and monitor their overall mental well-being in real-time. With individuals being able to track their mood variations and triggers, they can better understand behaviours and act accordingly.

In conclusion, while technology provides promising solutions to aid individuals with ADHD comorbid with anxiety and depression in managing their challenges, there remains a significant gap in understanding how effectively these technologies are utilised in their everyday lives. Many wearable devices that aim to capture and manage stress, anxiety and depression may require user engagement, and thus may not seamlessly fit into the existing routines of individuals with ADHD. Moreover, while wearables offer valuable insights into the overall mental well-being, there are

still limitations in their accuracy and effectiveness, especially in detecting and managing complex mental health conditions such as anxiety and depression.

2.6 The Potential of Technology to Support Individuals with ADHD

In conclusion, there are numerous technical and digital support systems available to assist individuals with ADHD in managing their everyday challenges. These solutions encompass physical aids, digital tools and innovative wearables tailored to address specific needs. Although wearable devices designed to monitor and manage stress, anxiety, and depression are available, their incorporation into daily life poses significant challenges for individuals with ADHD [74]. These devices often require a high degree of active user involvement, which can make them difficult to integrate seamlessly into existing routines. Additionally, while wearables can offer valuable insights into general mental well-being, their accuracy and effectiveness remain limited, particularly when it comes to detecting and managing more complex mental health conditions like depression and anxiety.

There is also wearable technology available to assist individuals with ADHD with their challenges and struggles. This through task management and organisation through calendars, to-do lists, timers, reminders and schedules. Additionally, the integration of vibrational patterns into various wearables is used to alert time, upcoming abruptions and remind of inattention. Wearables and applications are also utilised for mindfulness and meditation, as well as iCBT.

Smartphones and wearables show promise in supporting individuals with ADHD, yet their effective use remains a challenge [10]. With the prevalence of smartphones and wearables in contemporary society, these wearables present both challenges and opportunities and they have the potential in assisting individuals with ADHD in their everyday lives.

However, the crucial question is whether individuals with ADHD are actually utilising these systems and products to facilitate their daily routines. Therefore, this thesis aimed to explore the perception of individuals with ADHD regarding wearables. It examined how they currently use them, their preferences, challenges encountered and perceived benefits. Thus, this research seeked to address the research questions established in Section 1.1.

3

Theory

This chapter presents a comprehensive overview of the methodologies and methods relevant to this research endeavour. Structured to provide insight into various theoretical frameworks guiding data collection, evaluation and analysis, it culminates in an explanation for the selection of specific methods. Through this exploration, this section aims to clarify the reasoning behind methodological choices in the next chapter, establishing a solid foundation for understanding the subsequent analyses.

3.1 Methodology

The methodology section outlines the systematic approach used to gather and analyse data. In this section, three distinct methods are described:

- Quantitative
- Qualitative
- Mixed-methods

Each methodology serves a unique purpose in addressing research questions and enhancing the accuracy, relevance and practicality for the results.

Quantitative data: Quantitative data refers to numerical information that can be represented or converted into numeric format. This methodology is employed to obtain objective data that can be measured and explained using numbers [78]. It is often utilised when there is a need to numerically compare different variables, making structured data gathering particularly useful [79].

Qualitative data: On the other hand, qualitative data gathering involves non-numerical or descriptive information, such as behaviours, experiences and opinions. This methodology is employed to capture detailed insights and the context in which the descriptive information occurs [80]. It is often utilised when there is a need to explore meaning, perspective and relation, making qualitative research particularly useful for understanding the nuances of the experiences [79].

Mixed-method: In a mixed-method study a combination of quantitative and qualitative methods are employed. This methodology allows researchers to gather and analyse both numerical and descriptive information, thus providing a more comprehensive understanding. It is often utilised when addressing complex problems that

require multiple perspectives or for enhancing the validity and relativity of results [81], [82].

3.2 Methods for Data Gathering

The section provides insight into the systematic procedures employed to collect and evaluate data. It explores various methods, each serving distinct purposes and offering unique advantages in research. Quantitative methods involve collecting numerical data, facilitating objective analysis and comparison of variables. On the other hand, the qualitative methods focus on gathering non-numerical descriptive information thus providing detailed insights into behaviours, experiences and opinions of participants. Depending on the research objectives and the types of structure and questions included in the methods, they can be used to gather both quantitative and qualitative data. Understanding the differences between these methods are crucial for selecting the most appropriate approach to address the research question and meet the goal.

3.2.1 Questionnaires

A questionnaire is a research technique used to gather data from predetermined questions [83]. Such questions can be in either closed or open format and are commonly used in surveys and research studies. These inquiries can be created in various formats, with online distribution being the most common, facilitating widespread use. This method allows for the integration of both quantitative and qualitative data, making it adaptable to different research objectives. Questionnaires are flexible tools that can be tailored to suit the specific research problem at hand and can be used before, during and after various studies to gather data in the desired format [79].

When using questionnaires, there is a risk that users may rush through the task if insufficient time is allocated, leading to potentially inaccurate or incomplete responses. An alternative approach is to conduct face-to-face interviews with a structured format. This allows the interviewer to ensure that the participants do not rush through the questions and it provides the opportunities for clarification if needed. However, it consumes considerable time and resources. Additionally, with the possibility of explaining the questions more thoroughly, it may enhance the quality and depth of the responses [79].

3.2.2 Interviews

There are different forms of interviews, an interview can be structured, semi-structured or unstructured. There are also instances where interviews can be made in larger groups [79]. The format of the interview depends on the different outcomes required or desired by the researchers. However, collecting qualitative data with this format is more practical [84]. Data collected from interviews can range from observations to both qualitative and quantitative data [85].

Structured interviews are interviews that can be correlated to questions being asked in a questionnaire. This means that every participant in a study gets asked the same questions, in the same order [84]. This sort of interview can be more adaptable than a questionnaire in the way the interviewee is able to ask questions if they do not understand the question, however, it consumes considerable time and resources [79].

On the other hand, unstructured interviews can be described as conversations between two people where the interviewer guides the direction of the discussion. If the interviewer is inexperienced, this method may be influenced by the interviewers biases [79]. Additionally, to effectively measure the information gathered from different users, this method of conducting interviews may reveal shortcomings in terms of comparison or require additional resources [84].

Semi-structured interviews are a combination of how structured and unstructured interviews work. The interviewer has a general plan of which questions to ask, but there is room to diverge or expand more on a topic if the participants are more forthcoming with a specific area [79]. When conducting a semi-structured interview, the usage of predetermined questions is the foundation. In this interview format, probe questions are employed to thoroughly evaluate or explore the research problem [84].

Ultimately, the choice between interview formats depends on the research context and the depth of insights required into the participants' experiences and perspectives.

3.2.3 Why-why-why?

The method of evaluation with Why-why-why can be used to have a broad perspective of why the participants have their specific opinion to more thoroughly find the possible problems and solutions of wearables. This is to understand the perspectives beyond how it is right now and perceive the technology differently. By asking multiple why-questions, in a positive manner can explain why and why not the user have their opinion and may explain the original formulation provided. Aside from obtaining a deeper understanding of the user's answers, the method of asking 'why' also serves as a means of probing questions [86].

3.3 Methods for Data Analysis

Various methods and methodologies are available for data analysis and selecting the appropriate one depends on the nature of the data and the research objectives. Different analysis methods are applicable depending on how the data is gathered and formulated, with some being more suitable for quantitative data and others for qualitative data. In the following sections, the two methods and methodologies for analysing gathered data will be briefly explained.

3.3.1 Thematic Analysis

Thematic Analysis (TA) is a method for analysing qualitative data, focusing on identifying recurring themes within the dataset [87]. The theme emerges from identifying and analysing patterns within the data. These extracted themes reflect the dataset. Providing a detailed explanation of the information gathered. Unlike some analytical approaches, TA is not bound by a specific theoretical framework, allowing researchers to highlight the diverse experiences and perceptions of the participants [88]. However, in TA, there are typically two main paths or approaches that researchers can take:

- Inductive
- Deductive

These two paths offer flexibility to the researcher and allow them to adapt the methods to fit the research problem and goal.

Inductive (data-driven) Thematic Analysis: By adopting this approach, themes emerge directly from the data set, reflecting patterns observed within the dataset itself. Researchers approach the analysis with an open mind, allowing themes to surface organically from the data without preconceived notions or biases. This approach enables the exploration of new perspectives and insights for the specific dataset, to gather a deeper understanding and perspectives of the research area [88].

Deductive (theory-driven) Thematic Analysis: In this approach, researchers initiate the analysis with predetermined themes, theories, concepts or research questions, rather than deriving themes directly from the dataset. Utilising pre-existing theoretical frameworks, researchers derive themes from the dataset, aiming to confirm or extend already established theoretical understandings. This approach is suitable for studies with specific hypotheses and theories, providing a framework for analysis within established theoretical contexts [88].

3.3.2 Grounded Theory

The Grounded Theory (GT) methodology allows for the study of both qualitative and quantitative data [89]. Over the years, multiple strands of GT have emerged [90]. In contrast to other analysis methods, GT emphasises collecting and analysing data as the initial step. Subsequently, the theory will be derived from the analysed data. Notably, this theory integrates data collection and analysis in an intertwined and iterative process [89]. Although GT is theoretically bound, its similarities to TA lies in their shared objective of identifying patterns within the data [88]. However, utilising this method requires caution, as this method can easily be misunderstood [90].

3.4 Sampling Methods

There are multiple different techniques when it comes to qualitative sampling. Deciding on which method to utilise will affect the findings and knowing how these methods affect the outcomes of the study is crucial to understand the possible limitations and possibilities [91]. In this section, purposeful and convenience sampling methods will be described.

3.4.1 Convenience Sampling

The utilisation of convenience sampling is when the participants for a study is selected due to their availability, demographic position, accessibility in time and voluntary of participation [91]. By using convenience sampling gathering potential participants can be done relatively fast. One possible limitation of using convenience sampling is the risk of disproportionate inclusion of certain groups, leading to an imbalanced inclusion of the population. When employing a convenience sampling technique it is important to understand the limitation of not being able to generalise the gathered data to represent the whole population of the intended target group [92].

3.4.2 Purposeful Sampling

With purposeful sampling, the participants are selected through criteras that are relevant to a research question [91]. There is different branches of purposeful sampling. Some exemplars include maximum variation sampling, homogeneous sampling and criterion sampling. These methods enable researchers to gather the most insightful data by using sampling strategies that best fit their research question [93]. Homogeneous sampling are employed to limit the sample size to concentrate on shared traits while the maximum variation sample are employed to do the opposite and broaden the diversity or distinctions. Criterion sampling is employed when the sample size must adhere to predetermined criteria. Participants that have the desired information or experiences are selected based on predefined criteria to accurately represent the research questions intended target group.

4

Methods

This chapter outlines the methodology used to address the three research questions established in Section 1.1. The study utilised semi-structured interviews aimed at gathering comprehensive insights from adults with ADHD. Convenience and purposeful sampling methods were employed for participant recruitment. The interviews were conducted digitally to provide flexibility and were conducted in Swedish to accommodate participants' language preferences. Prior to the main study, a pilot study was conducted, leading to the refinement of the interview guide for optimal data collection.

4.1 Data Collection

To answer the research questions and problem description mentioned above, semi-structured interviews were conducted. The attributes of being able to diverge or expand on topics that semi-structured interviews [79] allow for were utilised for gathering qualitative data from the participants. Semi-structured interviews served as the core method for gathering information. This choice was made because of its ability to incorporate probing questions, allowing for a deeper understanding of participants' thinking patterns and perceptions [84]. Unlike structured interviews or questionnaires, which lack the flexibility for follow-up inquiries, semi-structured interviews enable exploration into the reason behind the participants' opinions and perceptions. While an unstructured interview format may seem appealing for its flexibility, it requires more resources and time to extract coherent arguments or information, potentially being limited to just one individuals perception. Therefore, the semi-structured interview format strikes a balance by providing a consistent framework while allowing for probing questions to delve into participants' responses [79].

A semi-structured interview framework was deliberately chosen to ensure consistency while allowing flexibility. This format provided a structured guideline to return to, but also facilitated divergence from the main topics, enabling the interviewer to follow relevant discussions as they emerged. The balance between structure and flexibility was essential for this research, as it allowed for the exploration of participants' experiences in a more nuanced way. By having a clear framework in place, the interviews maintained coherence, while also providing the opportunity to ask probing questions and explore unexpected insights.

When constructing the interview guide, the research questions and problem description were used as the basis for determining which questions to ask during the interview. Due to the nature of these research questions, the interview was divided into the following sections:

- **Part 1:** Introduction of interview
- **Part 2:** Main part of the interview
- **Part 3:** Closing of interview

Part 1: In this part, participants received an explanation of the layout and purpose of the interview, along with information about their right to withdraw at any time.

Part 2: This part was dedicated to gathering information related to the research questions. It encompassed various topics and corresponding questions aimed at eliciting responses from the participants. The questions can be found in Appendix A. The topics covered in this part were:

- **Topic 1:** Questions related to the participant's background and demographic.
- **Topic 2:** Questions related to the participant's ADHD and (some) perceived challenges.
- **Topic 3:** Questions related to the participant's usage patterns related to wearable technology.
- **Topic 4:** Questions related to the participant's opinions about the Swedish health care system.
- **Topic 5:** Questions related to the participant's physical movement, including physical activity and lifestyle habits.
- **Topic 6:** Questions related to the participant's mental health, including recurrence and perceived patterns.

Part 3: This section focused on the closing of the interview, allowing participants to share any additional thoughts they felt were not addressed. If there was nothing else to add, the participant was thanked for their participation.

The study aimed to investigate the various preferences and perceptions regarding wearables and other devices used by individuals with ADHD. However, considering the potential scenario where a participant might not utilise any technology, the interviewer anticipated the likelihood of receiving short responses. To address this possibility, additional questions were formulated to ensure depth in other aspects beyond technology. This approach was also employed to encourage participants to provide insights into their mental health, thereby enhancing the thoroughness of the study.

The interviewer anticipated that participants might overlook seemingly trivial details about their everyday lives. Gathering such information posed a challenge because participants had developed coping mechanisms for living with their ADHD over the

years, potentially leading them to overlook certain aspects as important information. The interviewer recognised the importance of formulating questions during the interview to elicit these details. These questions aimed to explore whether such seemingly trivial information could provide valuable insights into participants' daily routines and the potential ways technology could support them.

To minimise biases, a self-constructed interview guide was used during the semi-structured interviews. When the participant and interviewer strayed off topic to explore tangential subjects, the interview guide served as a lifeline to ensure that all predetermined questions were addressed.

To be able to get more insight the evaluation method of Why-why-why was employed to prompt users to consider the underlying reasons behind their answers [86]. This approach was crucial for understanding the thinking patterns behind the participants' opinions and ensuring that they did not simply provide default responses.

The interviews were scheduled for 30 to 45 minutes. Participants had the option to choose between online sessions via *Zoom* or an in-person meeting. Online interviews were recorded using *Zoom*'s built-in feature for high-quality audio, ensuring accurate transcription later. Participants were encouraged to select a comfortable location for the interview, preferably a place where they could relax and easily recall their daily interactions. This approach aimed to create a supportive and comfortable environment for participants, fostering open and insightful discussions on potentially sensitive topics. Probing questions and an interview guide were used to maintain focus and structure. When the conversation veered off-topic, the interviewer gently guided it back on track. Participants were informed of the possibility of time extensions beyond the planned duration to accommodate in-depth discussions. The flexibility to explore tangents was intended to ensure participants felt supported and heard, allowing for a comprehensive understanding of difficult topics.

4.2 Recruitment

Convenience and purposeful sampling methods were utilised. The participants were chosen based on the research problem requirements. Given the constraints of time and resources, convenience sampling was utilised to select participants for the interviews. However, within this sampling framework, participants were purposefully selected to ensure they met specific criteria:

- Have an ADHD diagnosis.
- Age above 18 years.
- Are attending university or have at least two years of work experience.

The recruitment strategy employed in this study leveraged social media platforms, specifically Facebook and Instagram, to attract a diverse range of participants. This approach offered several notable advantages. Firstly, the broad reach of social media facilitated the widespread dissemination of recruitment posts, increasing the likelihood of engaging a varied audience. Additionally, encouraging users to share these

posts further amplified visibility and expanded the participant pool. The use of convenience sampling also allowed for a more efficient recruitment process, enabling quicker participant selection.

In addition to social media, recruitment efforts included posting flyers at the university and reaching out to hospitals, clinics and federations associated with ADHD. However, none of these channels yielded any responses.

Despite these efforts, there were significant drawbacks to consider. While the potential for diversity existed, the study ultimately attracted a homogenous group of participants, all of whom were Swedish. This demographic limitation may have restricted the generalisability of the findings to other populations. Many participants had direct or indirect connections to the researcher, which could have introduced bias and affected the authenticity of their responses. Furthermore, those who expressed interest in participating may have been more comfortable sharing their experiences, potentially skewing the sample toward individuals who were more open and willing to discuss their habits. This tendency may have meant that valuable insights from individuals who were more reserved or hesitant to share were missed, limiting the overall understanding of ADHD experiences.

Lastly, the reliance on convenience sampling raised concerns about the representativeness of the sample, potentially impacting the validity of the research outcomes. While using social media for recruitment was effective in reaching a broad audience, it was essential to acknowledge and address the limitations that arose, particularly regarding diversity, bias and the varying willingness of individuals to share their experiences.

4.3 Pilot Study and Reformulation of the Interview Guide

Before the interviews, an extensive interview guide was constructed, anticipating every possible question. However, during a pilot test interview, it became clear that the guide was too comprehensive, leading the interviewer to feel stuck and disoriented. Consequently, the guide was revised to focus on key areas, with only a few targeted questions written down to support these themes.

The pilot study offered valuable insights for updating the interview guide. The final version, which can be found in Appendix A, was organised into specific topics, reflecting the adjustments made based on feedback from the pilot study. These topics are detailed in Section 4.1.

4.4 Data Analysis

The analysis method employed for the gathered data was TA, based on Braun and Clarke's approach [88]. This method involved identifying themes from the transcribed data. The process of TA consists of six phases, which are common to other

qualitative analysis methods as well.

Given that the data that was collected were solely qualitative, the TA approach focused on the information provided by participants, prioritising their perspectives over the theoretical background, thus eliciting the inductive TA. This decision was made to ensure that the inquiry remained flexible and responsive to the participants' contributions, avoiding the rigidity associated with GT analysis.

The six phases of this TA are [88]:

- **Phase 1:** Familiarise with the data
- **Phase 2:** Assign data to codes
- **Phase 3:** Find themes from codes
- **Phase 4:** Review the themes
- **Phase 5:** Define themes
- **Phase 6:** Report the themes

Phase 1: The interviews were conducted and recorded through *Zoom* and were later transcribed using the integrated tool *Transcribe* in MS Word [94]. Despite the tool's high accuracy, manual editing was necessary to ensure complete correctness of the transcriptions. This approach served to start to familiarise with the dataset.

Phase 2: When the coding process started the research questions were organised into main blocks. Subsequently, every piece of information that aligned with a research question was assigned a code corresponding to that specific information. If no existing code matched, a new one was created, under which the information was categorised.

To ensure rigor and trustworthiness in the analysis each part of the interviews was considered, 'What is this?', 'What does this say?' and 'How can this specific text be coded?', instead of trying to make the text match the codes already created, new ones were created when the other did not 100 % seem to match to ensure transparency.

The codes were later refined and contributed to the development of creating the themes, which is the third phase.

Phase 3: Once all interviews had been reviewed and all the relevant data had been coded, the initial themes could be formulated, which correspond to the third phase of the TA. Initially, sub-themes were derived from the codes, which then contributed to the development of broader themes. These themes represent the qualitative findings.

Phase 4: Two different analyses were made to make sure the findings aligned with each other, thus eliminating the possibility of the data falling victim to the possible biases that day or time.

The TA process involved two stages using different digital tools. Initially, the analysis was conducted in the digital tool Miro [95], followed by a subsequent iteration in NVivo [96]. These tools were utilised to dissect, assemble and combine the various

findings from the semi-structured interviews that were conducted. These digital tools have been chosen for their capacity to facilitate clean and unbiased extraction of themes.

The utilisation of both digital tools allowed for two independent TA of the data. By comparing the themes that emerged from both analyses, it was possible to ensure consistency and reduce the influence of potential biases introduced by timing, environment or personal assumptions. Miro and NVivo were chosen specifically for their ability to provide structured and systematic analysis, offering transparency and traceability throughout the process. This dual analysis approach, combined with the unbiased nature of the tools, helped ensure that the findings were based purely on the data itself, not the subjective influence of the researcher.

This iterative process allowed for codes to be associated with multiple sub-themes. However, the themes were refined to best capture the essence of the data, ensuring that each theme accurately represented the core findings of the analysis.

Phase 5: In the fifth phase, these sub-themes were refined into broader themes that could be used to tell a cohesive story in the report. As with any analysis, there were multiple potential areas of focus. While the research questions and interaction design focus guided the analysis, the dataset also revealed insights that could have been explored from a psychological perspective.

Therefore, in this phase, the themes were defined with clear and consistent definitions along with explanatory names. The sub-themes of each theme were also defined and supported by quotes from participants in the dataset.

Phase 6: The sixth and last phase is to report the themes. The final TA result can be found in the next chapter, Chapter 5.

4.5 Ethical Issues

This project posed no major ethical issues or risks. Participants were invited to share their perceptions and usage of wearable technologies. Informed consent was obtained from all participants to ensure their full understanding of the study's purpose, particularly considering the challenges individuals with ADHD may face in attending to or comprehending the information provided. Before the interviews began, participants were asked if they felt comfortable discussing questions related to mental health. All interview questions were carefully evaluated to avoid any potential triggers. Participants were also informed of their right to withdraw from the study at any time, and the data collected adhered to General Data Protection Regulation (GDPR) guidelines.

Additionally, the study addressed sensitive topics related to mental health. To ensure no harm was inflicted on participants, questions were asked with caution. This involved providing a clear outline of the interview process, encouraging open communication about any concerns, and making it clear that discussing mental health experiences was entirely voluntary. Participants were informed that they

were not obligated to share personal experiences or perceptions, and their privacy and confidentiality were strictly maintained.

5

Results

Recruitment efforts utilized social media platforms such as Facebook and Instagram. Posts encouraged users to share them further and facilitated the recruitment of participants were from diverse backgrounds, ages and lifestyles. Despite the broad reach of social media, respondents were predominantly Swedish and often had direct or indirect connections to the researcher.

Nine participants were ultimately selected for semi-structured interviews, employing a combination of convenience and purposeful sampling methods. Individuals who were self-diagnosed as having ADHD but did not have a formal diagnosis were politely disregarded and thanked for their shown interest in attending the study.

The nine participants selected for the semi-structured interviews in this study, aged between 25 and 34, comprised of four females and five males. All interviews were conducted in Swedish. The quotes presented in this chapter have been translated into English for this thesis. One participant was currently enrolled in university, while the remaining eight were employed. Among the employed participants, five had previously pursued higher education. These details are presented in Table 5.1. Probing questions and a predefined guide were utilised to maintain focus and struc-

Participant	**Gender**	**Age**	**Occupation**	**Highest Education**
P1	Female	25	Work	University
P2	Male	34	Work	High School
P3	Female	27	Work	University
P4	Male	27	Work	High School
P5	Female	34	Work	University
P6	Male	29	Work	University
P7	Male	27	Work	High School
P8	Male	29	Student	University (Ongoing)
P9	Female	27	Work	University

Table 5.1: Table with participants' demographic information.

ture during the interviews. Efforts were made to gently guide conversations back on track when participants veered off-topic. Participants were informed of potential time extensions beyond the initially planned 30-45 minutes so they could decide

whether to continue discussing the current topic or to steer back to the interview's focus. This approach allowed participants to feel supported and heard. The flexibility to explore tangents enabled discussions on related topics, providing a comprehensive understanding that might have been missed when constructing the interview guide. Consequently, the duration of the interviews varied profoundly, ranging from 20 minutes to 150 minutes. This reinforced the choice of utilising semi-structured interviews for this study. Probing questions sought clarity and deeper insights into participants' perspectives. The interview setting for this study was the digital meeting room *Zoom*, as participants chose to use the digital platform instead of meeting in person. The system's built-in recording feature was utilised, which was crucial since the student conducted these interviews alone [79]. Participants chose comfortable locations for the interview, which enhanced their relaxation. All participants chose to conduct the interviews from their homes which allowed them to rely on their spatial memory to recall their typical interactions and behaviour.

From these semi-structured interviews, information was gathered about the participants' usage patterns of wearable technology and the various strategies they employ in their daily lives. The investigation aimed to explore the potential of integrating these strategies with the support of wearable technology. Table 5.2 provides detailed information on participant engagement with smartwatches and other technology usage.

Participant	**Technology Usage**	**Overall Opinion on Smartwatches**
P1	Smartwatch, Smartphone, Headphones	Nothing in particular
P2	Smartwatch, Smartphone	Don't like it when it doesn't work
P3	Smartwatch, Smartphone, Headphones	Not very interested
P4	Smartphone	Not interested at all
P5	Smartphone, Headphones	Have previously owned one, but are not currently interested
P6	Smartwatch, Smartphone, Headphones, Speakers, Computer, Multiple Computer Screens	Interested
P7	Smartphone	Not interested at all
P8	Smartphone, Headphones, Multiple Computer Screens	Have previously owned one, but are still interested in the potential
P9	Smartphone, Headphones	Interested in a smartwatch, but sensory issues prevent wearing devices on the arm

Table 5.2: Table with participants' technology use information.

The inductive TA identified four main themes and 14 sub-themes that closely align with the research questions. These themes correspond to the research questions to provide a comprehensive overview of the thesis aim. Connections between these themes and their sub-themes are illustrated in Figure 5.1 and detailed in Table 5.3.

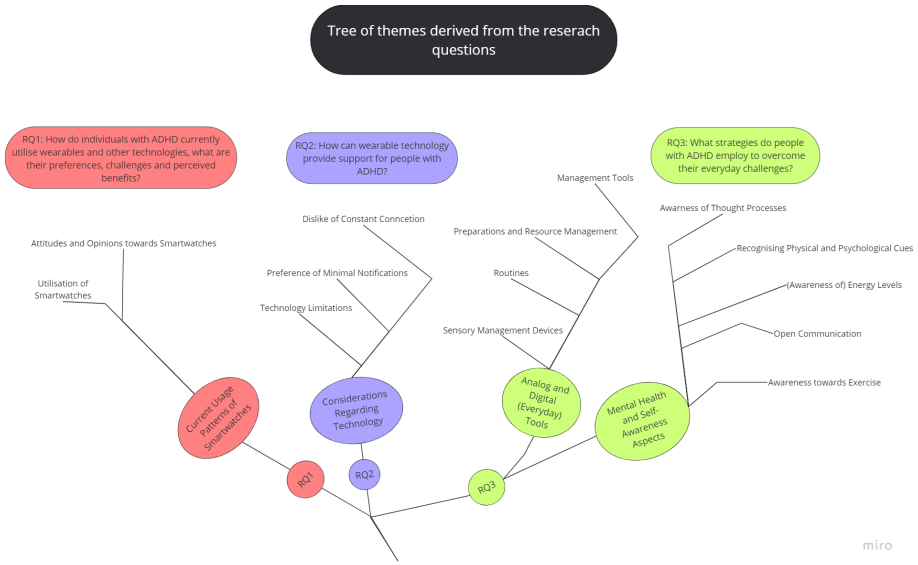

Figure 5.1: A family tree of how the themes and sub-themes are connected.

5.1 Current Usage Patterns of Smartwatches

The theme corresponding to the first research question (*How do individuals with ADHD currently utilise wearables and other technologies, what are their preferences, challenges and perceived benefits?*) is *Current Usage Patterns of Smartwatches*, which investigates how individuals with ADHD currently utilise wearables and other technologies and what their preferences, challenges and perceived benefits are. Since the participants primarily engaged with smartwatches, this theme will focus solely on their usage. While headphones may also be considered wearable technology, their usage patterns will not be included here.

This theme presents the usage patterns of smartwatches and provides insight into how the participants utilise these devices. It explored their preferences, attitudes and opinions regarding their specific smartwatch. Additionally, it examined how the participants integrate smartwatches into their daily lives, including their interactions, perceptions and preferences concerning this technology. The theme also encompasses the participants' opinions, behaviours and experiences related to their smartwatch usage. It explores various factors influencing their decision to adopt and utilise smartwatches. The sub-themes explored within this theme are:

- Utilisation of Smartwatches
- Attitudes and Opinions towards Smartwatches

	Research Question	Themes	Sub-themes
RQ1	How do individuals with ADHD currently utilise wearables and other technologies, what are their preferences, challenges and perceived benefits?	Current Usage Patterns of Smartwatches	Utilisation of Smartwatches, Attitudes and Opinions towards Smartwatches
RQ2	How can wearable technology provide support for people with ADHD?	Considerations of Technology	Dislike of Constant Connection, Preference of Minimal Notifications, Technology Limitations
RQ3	What strategies do people with ADHD employ to overcome their everyday challenges?	Mental Health and Self-awareness Aspects, Analog and Digital (Everyday) Tools	Awareness of Thought Processes, Recognising Physical and Psychological Cues, Awareness of Energy Levels, Open Communication, Awareness towards Exercise, Management Tools, Preparations and Resource Management, Routines, Sensory Management Devices

Table 5.3: Table of how the themes and sub-themes are related to the research questions.

5.1.1 Utilisation of Smartwatches

This sub-theme expresses the specific ways that the participants utilise smartwatches in their daily routines. Four participants, P1, P2, P3 and P6 currently use smartwatches and used it for different purposes. However, overall, they all use it to gather data about their health to get an overview of their sleep, steps and heart rate. The participants perceived their smartwatches in different ways. Participant P3 elaborated on the reasons behind their usage pattern:

> "I find it much easier to keep track of time when I have my wearable on my wrist. Actually, it could be any watch, I think. The watch is more easily accessible, and it gives me reassurance because I know somewhere that I always have it with me. The watch is attached to me physically, while a phone can be left somewhere. And with the phone, it's out of sight, out of mind. So it's good that the smartwatch is there on my arm, and it doesn't need to be charged very often either. Besides using it as a completely normal watch, I use it to collect [health] data." - P3

Participant P3 highlights the primary role of the smartwatch is telling time rather

than its other features. Nonetheless, the participant finds value in utilising its health data collection capabilities, not typically found in ordinary watches. Similarly, Participant P1 uses their smartwatch to tell time. However, they encountered a persistent distraction from notifications, by the inability to disable them on the smartwatch. Participant P2 and P6 emphasised the importance of collecting health data and expressed the importance of tracking their sleep, P6 mentioned that:

> "I like to gather data about my sleep. I have previously felt quite bad due to various reasons. But as my psychologist suggests, it's probably linked to my ADHD, which has led to me not being able to sleep well. And by exercising, I could sleep better, so it has been a big and important thing for me while also being able to keep track of my sleep. With my smartwatch, I can measure [my sleep], and it's quite accurate. Therefore, I have always wanted to measure it since then to see a bit of how I am feeling. Of course, it doesn't say everything, you still have to feel based on the data available. And that's why it's quite important for me, at least, to measure it." - P6

Participant P3 emphasised the importance of being able to tell the time, while Participant P6 stressed the significance of tracking their sleeping patterns. Participant P6 considered sleep to be linked to their well-being and exercise routine, explaining its importance. Despite them using their smartwatches for specific purposes, the participant also mentioned that there are additional features beyond what they currently utilise. These features have not been explored due to a lack of time and the executive function needed to implement them. While Participant P2 echoed the desire of being able to track their sleep, they primary utilised their smartwatch in combination with a leisure activity. Over time, Participant P2 have also learned more about their smartwatch features, such as the 'find my phone' function, which has proven to be useful multiple times since its discovery. The participant has also found that its smartwatch has a night time functionality that they have not yet figured out how to optimise and expressed:

> "I check the watch and think, 'Is it already that late? Well, I'll just do this real quick.' Then, because of the sleep mode of the clock, I don't see the time, and then I think the watch has died because you have to press it 10 times to turn it on. And then I see the time and it has been a few hours, which is not good." - P2

This participant continues to use the features that were present from the start, whether if the functionality works for them or not, without attempting to change the functionality that does not work for them. They simply accept it as it is. However, they also occasionally discover new functionality as time progresses.

5.1.2 Attitudes and Opinions toward Smartwatches

This sub-theme focuses on the participants' overall perceptions and attitudes toward their smartwatches, including their opinions on the devices' usefulness and convenience in their everyday lives.

Participant P3, among those who utilise smartwatches, highlighted that their previous smartwatch offered various features, including the ability to control music playback. However, they found it inconvenient that while they could control the music through the smartwatch, the actual playback still depended on the smartphone, as the headphones were only connected to the phone. This limitation was particularly frustrating due to their tendency to frequently misplace their phone. As a result, when purchasing a new smartwatch, they opted for a simpler model, prioritising basic functionalities like time display and activity tracking over advanced features. They expressed a preference for a watch that could operate independently from their phone, stating:

> "I previously had another watch with more functionality, but it required my phone to be nearby all the time, which was useless because when I didn't have my phone nearby, and the reason I had the watch was to not have to have my phone with me all the time. And when I needed to buy a new one, I didn't use all the extra features to justify the price for a new watch with features beyond showing the time and recording activity and steps." - P3

This participant did not perceive themselves as a technical individual, explaining that they only use what they need rather than exploring the full potential of existing technology. Consequently, the participant could not justify their new purchase and expressed:

> "I haven't really felt that I've needed to look for more functionality, and I've never been interested in those kinds of things. I'm quite a non-technical person." - P3

Another of the participants who utilised a smartwatch could find themselves interested in technology but did instead express that:

> "The older I get, the more of a grumpy old person I become. I think technology, apps, phones and stuff are great, but when they don't work, it's just rubbish." - P2

This participant expressed that when things do not work as expected, they would rather not use the technology at all. However, when it works as intended, they are not opposed to discovering more features from their smartwatch. Another participant expressed annoyance with their smartwatch, stating that:

> "My smartwatch isn't very high-tech. It sends all notifications from my phone to the watch, so I've had to turn off pretty much all notifications on my phone." - P1

The participant also expressed that the notifications have a huge negative impact due to distraction, but because some notifications are crucial and can not be turned off on their smartphone then the smartwatch received them as well. The experience of being distracted by notifications was also shared by the other three participants P2, P3 and P6 who also used smartwatches.

The preceding quotes are from participants who currently use smartwatches. The

following quotes feature the opinions of Participant P7, who has never used a smartwatch and Participants P5 and P8, who have previously owned one. Participant P7 has never used a smartwatch because they do not believe they need it. They expressed:

> "I don't have a smartwatch. Technology breaks. I have a phone for calls and texts, I don't care about the rest of the stuff. I don't care about apps either, although I do have a timer when I need to boil pasta." - P7

This participant used technology for entertainment purposes but is hesitant to utilise it for tasks they consider to be important, such as handling economics entirely through technology.

Participant P5 who has used a smartwatch before but who does not use it any more expressed that:

> "I became sort of manic, /.../, I felt that I needed to reach 10,000 steps every day, which ended with me walking around the apartment just to reach the step count if I hadn't done it otherwise. I guess I didn't buy a new one to get rid of my manic behaviour, kind of." - P5

This participant explains that it was not valuable for them to invest in a new smartwatch because they tend to become manic about reaching their step goals. While having a goal is good, they found it stressful to walk around the apartment just before midnight to meet their step count.

Participant P8 did not utilise a smartwatch but expressed the following opinion towards the potential of smartwatches. The participant expressed:

> "I've tried using a smartwatch, but it had poor battery life, which just added another complication. Here's the catch: a smartwatch can be really helpful in identifying things that stress you out. Or reminding you that you need to take breaks. Because hyperfocus with ADHD isn't always a strength. Hyperfocus is when you forget to take care of your basic needs because you're completely absorbed in what you're doing. So the smartwatch can help you partially keep track of things like your pulse, remind you to eat, and remind you to get up. But, even though all these things sound great, the notifications are not, and if I can't control them well enough, then the technology become more stressful than helpful." - P8

This highlights the advantage of utilising a smartwatch from the perspective of someone with ADHD. It acknowledges the potential benefits of using a device to manage symptoms and improve daily functioning. However, the participant also acknowledges the reality that even if a solution appears promising, its effectiveness can vary depending on how individuals perceive the overall usage and impression of the device. This participant can not justify investing in a new smartwatch due to uncertainty about whether the available technology can provide the extensive support they need.

5.2 Considerations regarding Technology

The theme corresponding to the second research question (*How can wearable technology provide support for people with ADHD?*) is *Considerations regarding Technology*. This theme explores the research question of whether wearable technology can be used to provide support.

This theme focuses on technological considerations essential for concluding the potential use of smartwatches and other technologies to support individuals with ADHD in their daily lives. It encompasses the considerations the participants have regarding technology, apart from the smartwatches they utilise and the desire to not be constantly connected, as well as their perception toward notifications. The sub-themes explored within this theme are:

- Dislike of Constant Connection
- Preference of Minimal Notifications
- Technology Limitations

5.2.1 Dislike of Constant Connection

This sub-theme explores the participants' preferences regarding their desire for being able to feel disconnected from technology. It encompasses their attitudes towards being constantly connected. The participants had a desire for periods of disconnection or reduced digital engagement. One of the participants expressed:

> "I feel the need to exist beyond technology. Just this social pressure to constantly be connected is highly problematic for me, as it leads to getting stuck in conversations or simply forgetting. 'Oh, I haven't replied to these messages,' or 'Oh, now I'm reminded of this too.' It's like being pulled in many directions all the time." - P8

This participant expressed a desire to disconnect occasionally and have the option to return to their technology without feeling overwhelmed by constant connectivity. Another participant had the same need and expressed:

> "I find it very comforting not to have my phone on me. I feel it's burdensome to be constantly connected. For example, people can message me and then I'm expected to reply. Personally, I can't read a message and not respond, because that's not how I operate. And if I don't have the opportunity to respond right away, I'll be thinking about a reply in the back of my head all day. I know you can turn off notifications, but then I think, what if I miss something important." - P9

This participant expressed that they cannot read a message without feeling compelled to reply and have attempted to change this behaviour without success. The perceived stress primarily arises from notifications from individuals who require and anticipate a response from the participant. Consequently, the participant turned off notifications from applications that did not involve communication. Thus, the stress

originates from the communication between individuals and the pressure exerted by these notifications. Both participants P8 and P9 felt the need to not always be connected at all times, particularly referring to their smartphones. These participants did not utilise smartwatches and did not provide insights regarding how this perception might differ. However, Participant P8 expressed that the need to disconnect from all forms of technology was crucial for their well-being and to avoid feeling overwhelmed.

Being able to disconnect from technology was crucial to not feel a constant feeling of being available. This was most experienced by participants P4, P7, P8 and P9.

5.2.2 Preference of Minimal Notifications

This sub-theme explores the participants' preferences concerning the frequency and nature of notifications from their devices. It encompasses their desire to minimise interruptions from notifications. The participants articulated their preference for receiving only essential or minimal notifications from technology. This reflects their aim to limit distractions and interruptions while still leveraging the benefits of technology. All of the participants expressed their displeasure with notifications. One participant expressed:

> "I can't have notifications on because I find it really irritating. So, I have notifications on for reminders and calendar events. But for things like email, Facebook, and Instagram, the notifications are turned off. I panic as soon as it pings because I feel like I have to check, but I don't want to check, or I don't want to keep checking all the time." - P5

This participant describes notifications as distractions, so they mute everything that is not crucial for managing their daily schedules, such as calendar events and reminders. Additionally, the participant mentioned that notifications that do not produce sound or appear on the phone's interface are easily forgotten because they never check this feature. The other participants also expressed that if they can not control the notifications well enough, the notifications will become more stressful than helpful, which Participant P7 voiced:

> "I get really stressed out by notifications. I find it very annoying. Because the phone is never quiet, it becomes a hassle instead. I get distracted by the notifications, so I've limited certain notifications. One has to find their own ways of how to handle things." - P7

When it comes to technology, it is therefore extremely important for the participants to have control over notifications, as these can be and are a significant source of stress and feeling overwhelmed. Incorporating and utilising technology in their everyday lives requires careful consideration of notifications and related factors.

5.2.3 Technology Limitations

This sub-theme includes advice from one of the participants on how to use applications without experiencing additional stress, or viewing them as a challenge to

overcome. Participant P6 expressed:

> "The menu I want should be a maximum of 2 clicks away. For example, if I need to add something to a list, it should take a maximum of 2 clicks; if it's more than that, I've noticed it becomes problematic. With 5 clicks, it's like entering a jungle, then it becomes almost harder, and I'd rather skip it. I try to minimise so that I have several apps but need to use fewer clicks. So I prefer it to be quick, easy and accessible instead of being very planned out, but then it takes longer to perform what I intended." - P6

This participant developed a strategy to use multiple applications without becoming overwhelmed or distracted. Each app was assigned a specific purpose, such as one for notes, another for grocery lists, a third for work-related tasks and a fourth for upcoming events. They emphasised that any action within the apps should require no more than two clicks. If it took more clicks, it became frustrating and discouraging. This approach allowed the participant to manage more tasks on their phone without feeling overloaded. Additionally, keeping everything digital reduced the chance of misplacing important lists or notes that might get lost if they were written on paper and moved around. By focusing on quick and easy access, the participant ensured that their workflow remained efficient and straightforward.

This strategy aimed to provide a solution that enhances application functionality and connectivity. At the same time, it seeks to minimize the feelings of overwhelm and distraction that are often associated with smartphones.

5.3 Mental Health and Self-awareness Aspects

The first theme corresponding to the third research question (*What strategies do people with ADHD employ to overcome their everyday challenges?*) is *Mental Health and Self-awareness Aspects*. This theme delves into the strategies accumulated by the participants over the years, both before and after getting their ADHD diagnosis. These strategies have been accumulated by the participants as a result of their experiences with comorbid anxiety and depression. These strategies are crucial for managing their mental health and enhancing self-awareness regarding their needs.

Through the data analysis, it was revealed how participants utilised their smartwatches and the challenges they faced due to comorbid conditions such as anxiety and depression. Although strategies were developed to cope with these challenges, it became evident that the current use of technology did not fully address their needs.

According to Socialstyrelsen guidelines, non-medical treatments are recommended for individuals with ADHD [21]. This theme explores the non-medical treatments discussed by participants, as reflected in the sub-themes. In Sweden, the support provided by healthcare systems varies depending on the participant's region. While some form of therapy is generally available, the perceived usefulness and effectiveness of these therapy sessions differ among participants. However, this aspect will not be discussed in this thesis.

This theme encompasses mental health and self-awareness aspects, derived from insights gained through participants' experiences, whether from therapy provided by the Swedish healthcare system, privately or through self-education. Eight out of the nine participants shared their experiences and recurring patterns related to mental health such as anxiety and depression, each expressing the intensity of their struggles differently. Discussing mental health can be challenging and self-awareness is central to understanding it, which is interwoven into the sub-themes of this theme.

The participants expressed some of their challenges and how they have accumulated strategies to become more self-aware about these challenges, emphasising the importance of addressing them. The first three sub-themes represent different aspects of self-awareness cultivated through therapy and self-reflection. The fourth sub-theme highlights how participants utilised their self-awareness to engage in open communication. The fifth sub-theme reflects their perspectives on exercise and its role in enhancing concentration and reducing anxiety. The sub-themes of this theme are:

- Awareness of Thought Processes
- Recognising Physical and Psychological Cues
- Awareness of Energy Levels
- Open Communication
- Awareness towards Exercise

5.3.1 Awareness of Thought Processes

This sub-theme explored the cognitive aspect of self-awareness, emphasising the participant's ability to monitor their own thoughts, impulses and attention patterns. It encompasses strategies for being more kind towards oneself. One participant explained the thought process that they try to implement in their everyday life to minimise the feeling of being ashamed, they expressed:

> "Implement a mindset where you can start something you have put up whenever you want, regardless of how long it has been. It's okay for it to take however long you need, and you can start and stop as often as you want or need, and that it does not mean that you have quit something. It doesn't mean you've actually quit, but it's just on pause right now to pick up later." - P8

The participant expressed that adopting this mindset would help minimise the shame that can arise when routines are not followed, thereby opening up a strategy for returning to routines or applying it to other relevant areas. Another participant learned something from a group therapy session and expressed:

> "What I took away from this group therapy was that you should ride the wave, not against it. [Participant makes gestures with hand]. The gestures have actually been good. It has helped me visualise when emotions become too much and I have difficulty managing them and lets me

> feel the emotions. I am aware that I feel emotions that are more than maybe relevant or proportionate to the situation." - P1

This participant also mentioned that they attempted to use specific applications to track fluctuations in emotions by noting them down, with the aim of identifying patterns. However, facing difficulties in tracking emotions through applications, they have found strategies from group therapy in the form of a thought process to be extremely helpful.

Both of these participants expressed a heightened awareness of how their thought processes have shifted to become more self-compassionate, indicating improved well-being and enhanced management of their ADHD.

5.3.2 Recognising Physical and Psychological Cues

This sub-theme focuses on the ability to recognise, identify and interpret physical and emotional cues. It includes being aware of signs of stress and overwhelm, as well as recognising the need for when and how to relax.

One participant uses their smartphone to help relax and recognise when they need a break to clear their mind and unwind. They expressed that:

> "To relax. I play a game on my phone in the morning as I'm waking up, and then in the evening, when I'm going to sleep, I have to listen to my audiobook to clear my mind." - P5

This participant needed to listen to an audiobook every evening to quiet their thoughts to be able to fall asleep. Without this routine, their sleep would be disrupted, negatively affecting them the following day. Additionally, the participant required specialised alarm applications to wake up in the morning, as regular alarms would be turned off without waking them up. After waking up, they would play a game to fully awaken. Recognising these patterns has been crucial for the participant to understand their body's needs, avoid feeling overwhelmed and to be able to self-regulate. Through trial and error, they developed strategies to manage their well-being effectively. Another participant expressed that their understanding and awareness of their physical and psychological cues when it comes to everyday life has helped in being more friendly toward themselves when the energy is not enough, the participant expressed:

> "I would probably say that the reasons why I don't have routines and structure, but still feel that I manage through the day nowadays, is because I listen to what my body is saying. If it says stop, then I actually need to stop even if I have a routine and a plan. So if my body says stop, then it has to stop. Because there's a difference between feeling like this doesn't work or just like you don't know what to do. So learning that and identifying when it happens has been a strategy." - P9

The participants' self-awareness of their physical and psychological cues has contributed to their overall well-being. Participant P9 expressed that their overall

well-being improved when they became aware of their body's signals, learning to recognise when to say no and to be more compassionate towards themselves.

Recognising the physical and psychological cues experienced by participants is a recurring theme in several sub-themes. However, in this particular sub-theme, this strategy is crucial for adapting to and understanding the participants' needs.

5.3.3 Awareness of Energy Levels

This sub-theme highlights some of the challenges of sustaining energy levels. It reflects their efforts on how to cope with difficulties and manage their energy levels in their everyday lives. One participant mentioned:

> "In order to provide a good environment for myself and my kids, I need to have sustainable conditions for myself, and that takes energy. But the energy reserves run out really fast because you give so much all the time." - P2

The participant expressed the challenge of regulating the energy reserves during the day and that the energy levels are depending on your own circumstances and expressed:

> "Everything revolves around eating, exercising, sleeping and how your morning has been. Everything depends on your own circumstances." - P2

This participant highlighted the difficulty with maintaining sustainable energy level and acknowledged the significant impact of their circumstances. They expressed that they have learned the importance of taking breaks during the day to recharge and said:

> "It depends on how much energy and what type of day one has had. Think before and after. I'm the type of person who needs breaks and to do things for myself. Often, but for a short time. So, I may need 5-10 breaks a day." - P2

This aligns with the sub-theme *Recognising Physical and Psychological Cues*, which indicates that the participants have learned to listen to what their bodies are telling them. They are trying to facilitate this by implementing breaks to sustain their energy levels. Another participant expressed the difficulty to not give everything you have, they explained:

> "You give 110 %, even if you might not really have the strength or energy for it. And then, just a few weeks later, it can suddenly drop to only being 10 % left. Your energy becomes quite erratic and uneven, you exhaust yourself. Even if others say 'You need to take care of yourself,' when you're in it, you think 'What do you mean take care of yourself? This is so much fun.' Everything goes very well and then you burn out." - P3

This participant also expressed that their energy can be described as:

> "It's very much like an on or off switch, if something is fun, it's much easier. And if it's something boring? Like folding laundry, it almost never gets done." - P3

The participant notes that energy levels are not a significant issue when engaging in enjoyable, interesting or novel activities. However, they find their resources depleted when these activities cease. Consequently, mundane tasks that do not elicit dopamine will therefore rarely get done.

Awareness of one's energy levels is crucial for minimising feelings of anxiety and overwhelm. The participants have accumulated more sustainable strategies to manage these challenges. These strategies include incorporating breaks and remaining mindful of the impact of energy levels on their well-being.

5.3.4 Open Communication

This sub-theme underscores the importance of open communication in aiding the participants in managing recurring challenges. It highlights the strategies employed by participants to ask for help when needing it, expressing their own needs and being honest with themselves. One participant expressed:

> "Since I've never received help, I've tried to give myself the help I need. So, it's partly about communication with people close to me who see things differently than I do, to gain perspective on behaviours. And also, opinions from people I trust and find sensible. And then also, a lot of self-reflection." - P1

This quote emerged after a discussion about whether the participants have noticed patterns in their behaviour related to understanding their own needs and managing their emotions. The goal of this discussion was to explore the possibility of detecting patterns associated with deteriorating mental health. Another participant expressed that since narrowing their friend group they have started to express their needs and starting having open communication with loved ones, the participant explains:

> "I have relationships where I get what I need, so all those fluffy contacts that just drain energy have been removed. And the other thing is that I have been very open with people in my surroundings. I have been open about how things work, when I need to say no to things or why. Or that if I stop feeling very excited and happy when we hang out, it's because I don't have any energy left and that it's not personal." - P9

This participant has learned to facilitate open communication towards their environment, expressing their perceptions and needs, thereby fostering an environment in which their well-being is being prioritised. Both participants P1 and P9 highlight the support they receive through open communication.

This sub-theme expresses the importance of open communication, which enables participants to seek and receive assistance. Such communication fosters an environment where the participants can be authentic and express their needs.

5.3.5 Awareness towards Exercise

This sub-theme will explore the participants' awareness of their mental health in relation to exercise. Eight of the participants have experienced recurring patterns of mental health degeneration and four of them (P1, P2, P6 and P8) consider exercise, amongst other aspects, crucial for maintaining their mental well-being.

While this study cannot draw definitive conclusions about the psychological factors involved, the researcher sought insight of the participants' perceptions of their mental health concerning exercise.

Participant P1 have experienced anxiety repeatedly throughout their life and has learned to recognise patterns preceding their deterioration. They expressed that:

> "My well-being depends on several factors, such as how well I eat, what I eat, how much junk food I eat. How much I sleep, what's happening in my life, if I hold onto things, basically my own mindset too. And how much I exercise as well." - P1

The perception of these patterns has been facilitated through trial-and-error, the participant also mentioned that because there has been no extended help, learning to communicate with loved ones has been crucial for their well-being. In regards to exercise, Participant P1 mentioned that:

> "I exercise to feel good, for my mental health. I feel like crap otherwise. Well, I mean, the anxiety attacks are crazy otherwise. And exercise helps a lot with concentration as well." - P1

Participant P1 used exercise to help with their mental health, specifically their mindset and anxiety. Additionally, their concentration improved as well.

This was also experienced by Participant P8, who noted that exercise helped with both concentration and anxiety. Additionally, they attempted to practice mindfulness but found that doing so at inappropriate times had negative effects and contributed to feelings of frustration.

Participant P2 highlighted the repercussions of discontinuing exercise, stressing the importance of consistency and commitment. However, this left little room for errors and affected the participant's determination to exercise, thus their thought process did not align with what Participant P8 expressed. Participant P2 explained:

> "If I don't exercise, there's a lot going on in my head. I've just had a break for a few months, and it's the longest I've ever had. There are so many things that demand my time and it affects the consistency of my exercise routine. When I want to do something, I want to do it wholeheartedly. It just doesn't work for me to exercise sporadically." - P2

However, this participant also expressed challenges in adopting a more compassionate mindset toward themselves. Participant P5 diverged from the experiences shared by other participants, as they did not perceive improved concentration during exercise, nor did they find enjoyment in it.

Regular exercise significantly influenced the participants' concentration and anxiety levels and have made them consider this as a crucial coping strategy in their daily lives.

5.4 Analog and Digital (Everyday) Tools

The second theme corresponding to the third research question (*What strategies do people with ADHD employ to overcome their everyday challenges?*) is *Analog and Digital (Everyday) Tools*, which explores the strategies participants have developed by creating both analog and digital tools to assist them in their daily lives.

This theme explores the various ways participants tackle challenges they encounter in their daily lives. It encompasses their efforts to utilise management tools, prepare and organise their surroundings, manage routines, as well as enhance focus and productivity. Insights gained from therapy can aid in understanding behaviours, contributing to the development of coping skills and strategies [1] among participants. However, participants more often accumulate coping skills and strategies over the years, independent of therapy.

The sub-themes of this theme represent different aspects of the strategies utilised by the participants. The four sub-themes of this theme are as follows:

- Management Tools
- Preparations and Resource Management
- Routines
- Sensory Management Devices

5.4.1 Management Tools

This sub-theme focuses on the various tools and strategies that the participants utilised to manage information and organise their daily lives. It encompasses both analog and digital approaches, as well as specific solutions and techniques for optimising these tools.

The participants have utilised and cultivated various strategies to aid their memory. These strategies include different technologies, physical attributes and the involvement of other individuals. One participant expressed:

> "I have physical post-its both at home and at work. During weekends, I try not to do much (though I'm not very good at it), but I still write down the little I need to do to know exactly what, and then I place it here on the desk by the keyboard. It's visible and I have to strike over it when it's done because otherwise it kind of doesn't exist. Then I have like a paper where I write what I need to do for tomorrow, and in combination with the calendar, I ensure I don't miss anything." - P6

The participant writes down what they need to do and uses a list to know exactly what needs to be done. They do this not only to avoid forgetting tasks but also to remind themselves of the next step. By always placing the list by the keyboard, the participant does not need to rely on memory to recall what needs to be done. They can instead just simply look at the list and start from there, thus avoiding feeling overwhelmed by the task of figuring out what to do next. Another participant expressed:

> "I use the following technique to remember things, I say something like 'remind me to call X at 8 o'clock.' But if I say it and ask you to remember it, then I will remember it. Because only when I've said it, then I won't forget it." - P2

This participant relied on other individuals to help remember tasks instead of writing them down. They had tried saying tasks out loud to themselves, but it did not have the same effect. By incorporating other individuals into their strategy, the participant was able to facilitate accountability and improve remembrance.

In addition to using analog post-its and involving others to remember important information and tasks, the participants employed various strategies for task management. Instead of utilising analog post-it notes and relying on other individuals, some participants used different technologies to remember important information and tasks not typically entered into their calendars. These technologies encompass applications utilised for task management, reminders, note-taking and organisation, highlighting their utility and effectiveness in supporting the mental load. Something that was not widely utilised by the participants was using different applications for different tasks. One participant used more applications than the others and expressed:

> "I use different apps for different tasks. I have a separate app for my shopping lists. Then I use Todoist and the reminders app on Apple, combined with the notes app. And I also use Google applications such as Google Keep." - P6

This participant tried to find digital solutions as much as possible to be able to always carry stuff on their phone and have easy access. They also mentioned that having multiple applications is preferable to having everything restricted to one application. As a result, this participant uses different applications for different tasks, making the integration of them more accessible. The motivation for this can be read in the sub-theme *Technology Limitations*. Another participant expressed:

> "I use the alarm app for various things. I use it to remind myself to go to bed, to wake up and I use it to time an activity." - P8

This participant used alarms to remind them of various tasks throughout the day. However, this dependence on alarms meant that the participant needed to have their phone with them at all times. Participant P9 adopted a similar approach for their morning routine, as their time blindness made it difficult for them to estimate time accurately. Consequently, Participant P9 developed a system where they set alarms for each step of their morning routine to ensure they stayed on track, relying heavily

on these reminders. From the participants' responses, it became apparent that they tended to remember information better when it was written down on paper rather than when using a computer or phone. Participant P9 expressed:

> "I'm very visual, so if I can see that I've written it down, then I usually remember it better. If I write it on my phone, it's not the same. But on paper, I can remember how I wrote it, I can remember how it looks on the paper. But I can't do that in the same way on the phone or on the computer." - P9

Participants who shared this included P2, P3, P4, P6, P7 and P8. However, each participant utilised this method in their own way. For instance, Participant P9 supplemented this technique by setting reminders as well. The participant expressed:

> "So I usually need to write down what I need to do, and then I always put it in the calendar or set a reminder. But it's the combination that helps me remember that I need to be somewhere and not just remember five minutes before, like 'now I should go'." - P9

Except for these strategies the participants utilised calendars as a fundamental tool for organising schedules, appointments and deadlines. It include both analog (such as paper planners or wall calendars) and digital (such as smartphone and desktop applications) formats, as well as instances where some participants use both analog and digital solutions in combination. One participant expressed:

> "I would never have managed without my phone with all the planning and organisational stuff I have in it, like calendars and schedules. I need it for organisation; I'm really big on organisation and love organising things." - P5

Rather than feeling stressed about the potential for notifications during planning and organising, this participant appreciated the convenience of easy access. Another participant expressed:

> "I use a physical paper calendar in combination with a digital calendar." - P6

with the motivation of:

> "I've tried going fully digital, and it has been a bit problematic because perhaps I remember a little better when I've written something with pen and paper. And when I've tried just going digital, it's like all the planning is here [points to the phone], and if I put it away, everything disappears." - P6

This participant combined analog and digital methods to enhance their memory. Incorporating both was crucial for the participant. They used their phone for reminders and notifications and writing tasks down on paper helped with recall. This approach was essential for the participant to manage tasks more effectively. However, another participant, Participant P8, experienced stress and anxiety when using a calendar during difficult times. However, they still recognised the importance of

having some form of calendar. This participant has tried both analog and digital calendars and expressed:

> "I have tried having both. I have tried to use only a physical calendar and only a digital calendar, but I can get stressed because of the overview. I also need the routine to check things in the physical calendar, which also becomes stressful, finding that it has a good enough space and stuff too. And then it doesn't remind me of an upcoming event." - P8

This particular participant continued to express:

> "With an analog calendar, managing the executive functions like erasing, adding, and keeping track of it all becomes too much to consider the calendar helpful. So for now, I prefer to use the calendar on my phone and rely on its built-in reminders to keep me updated automatically." - P8

Regardless, the participant was uncertain about how to proceed with using a calendar without it being an additional source of stress. They needed to use digital tools for reminders and notifications of upcoming events, but found the overview provided by calendars overwhelming. The analog option, while harder to update and fit things into, offered a different kind of support. They recognised the necessity of having some form of calendar, so for now, they have accepted that the reminders provided by the digital option are crucial, even though using a calendar can sometimes induce stress and anxiety due to their mental health conditions.

The participants utilised aids such as writing things down, involving others and using calendars and applications to improve their memory. While the methods of employing these strategies varied among participants, each tailored their own approach to suit their individual needs. However, these strategies require ongoing testing and adaptation, allowing the participants to determine what works best for them over time.

5.4.2 Preparations and Resource Management

This sub-theme focuses on efficiency and preparations the participants used to manage tasks. It included practical strategies for participants to optimise their environment, making tasks easier. For example, participants P6 and P8 used multiple screens for studying or work, allowing them to avoid toggling between screens and reducing the risk of losing focus on their assignments. Another practical strategy was utilising kitchen appliances for cooking, or making bulk purchases so that there are always supplies at home. Participant P7 expressed:

> "I prepare things a little differently than others. I hate buying cleaning supplies, etc., so once a year I go and buy a bunch of that stuff because otherwise I forget about it or it doesn't get done. I need to have these things at home because if I feel like I want to clean my apartment at 10 p.m., then I should be able to do that." - P7

This participant prepared their environment by having accessible aids readily available for when they felt ready to tackle mundane tasks, ensuring they were not limited by a lack of these aids at home.

Being able to recognise behaviours and find strategies to navigate challenges enabled the participants to accomplish mundane and boring tasks at their convenience. This readiness facilitated their ability to tackle tasks effectively and efficiently.

5.4.3 Routines

This sub-theme refers to finding, coming up with and establishing routines and strategies as well as taking advantage of recurring patterns of behaviours. The participants were divided in their opinions of routines. One participant mentioned:

> "It sounds silly to say this about having routines, but it really takes time and life force. Thinking that now I'm going to do this, and then now I'm going to do that... and maybe it would be good [to have routines], but because I am an extremely emotional person, when these routines need to be done and if I don't want to nor have the energy for it, emotionally it will feel like the whole world is collapsing. So it needs to constantly be balanced." - P9

Participant P9 then continued to explain that it is crucial to have flexibility and that there is no solution to solve it all. To strengthen this claim another participant mentioned:

> "That's the paradox. I've heard before from people with ADHD that they need a lot of structure, but also that structure can feel like a prison." - P8

This entails that routines are needed to have structure but that it can also feel like a prison. There was a consensus from the working participants that structure and routines at the workplace are a must. The overall consensus is that routines are good and practical but that it is hard to maintain. As supported by Participant P2 who expressed the realisation of understanding how routines are something that is needed and expressed:

> "This is also something that I'm terrible at maintaining but that I know is good for me and that I strive for, and that is routines." - P2

This participant found it easier to maintain their routines during weeks when they had their children. They structured their afternoons into manageable parts to ensure they could complete all tasks, such as having meals at specific times and ensuring their children brushed their teeth before bedtime. However, the participant struggled to maintain routines during weeks when they did not have their children. Another participant expressed that:

> "Sometimes you notice that the routine doesn't work, but it takes a while before you get into a new one. But that's always how it is." - P5

This participant experienced burnout before receiving their diagnosis. They emphasised the importance of experimenting with routines. If a routine proves ineffective, it's essential to try new ones until finding what works best. As the participant expresses below, they rely on routines to ensure tasks are completed. This participant also started to express that they need routines otherwise nothing gets done, they expressed:

> "I need to have routines. Otherwise it doesn't work. Weekends are much harder because then you get out of the routines. But weekdays work okay, with work and such. So, I think you're just forced into creating routines." - P5

Another participant expressed that they could never find a routine to get the cleaning done on a specific day. However, they noticed a pattern in behaviour of when an urge to clean appears once a week and then takes advantage of this to get the cleaning done. They expressed:

> "I get a kick out of hyperfocus. Probably, I experience it when I'm stressed or too tired to do something else as intended. Then, I feel the need to organise everything around me, and it usually results in me cleaning, which is good. And it usually happens once a week. I get a feeling of being fussy or picky, so then I start to clean. So I usually wait for that feeling, sometimes it might skip a week, but it's pretty regular nonetheless." - P9

This participant has learned that this particular behaviour occurs repeatedly, allowing them to rely on it to complete cleaning tasks. Additionally, the participant expressed that the urge to clean arises independently of the cleanliness of their surroundings suggesting that it occurs even in spotless environments. They emphasised that this hyperfocus persists regardless of the initial cleanliness, expressing that there is always another task to be organised and addressed once the hyperfocus occurs.

Having routines was a common goal among all participants, although Participant P9 emphasised the importance of flexibility. Understanding and adapting routines to fit the participants' needs and behaviours was essential for them.

5.4.4 Sensory Management Devices

This sub-theme focuses on the goal of enhancing concentration, encompassing the use of headphones and speakers as tools for managing the auditory sensory input. Although the primary focus of this thesis is on smartwatches as wearable technology, it is important to acknowledge that headphones also qualify as wearable devices due to their direct interaction with the body. However, their role as wearable technology is not explored in depth beyond their use for sensory management, as discussed in this sub-theme. Participants used these strategies and techniques to block out surrounding noise, optimising their focus and increasing productivity.

Specifically, in-ear, noise-cancelling headphones were predominantly used for this

purpose. One participant mentioned that:

> "I don't want people to look at me and think something about me being different because sometimes I need to wear my headphones even when we're in a large gathering. In order for me to focus on what the speaker is saying and not on what people around me are whispering about, I need to have my headphones on. If people see me wearing headphones it will trigger reactions from people, with in-ear headphones, it's not visible, my hair covers my ears which is not possible if they're on-ear." - P9

This observation was supported by another participant who instead described the necessity of headphones through:

> "I'm one of the people who takes in all the sounds around me. I hear every sound and I can hear everyone's conversations." - P5

This supports the claim that the most crucial feature of these headphones is their noise-cancelling capability. Participants P1, P3, P5, P6, P8 and P9 used the headphones for focus, concentration, and blocking out unnecessary sounds, with P1, P3, P5 and P8 using them most frequently. These participants also mentioned using headphones and speakers to unwind. In contrast, headphones were not explored in the same depth with participants P2, P4 and P7. While they faced concentration challenges, they did not explicitly identify headphones as a coping mechanism, as the other participants did.

Participants P5 and P6 also used headphones and speakers before bed to be able to sleep. Participant P6 played white-noise to be able to relax, while Participant P5 used an audiobook, focusing on the story to block out their own thoughts and prevent them from wandering.

The participants utilised headphones to minimise distractions and enhance concentration, utilised in a way that worked for them.

6

Discussion

This thesis aimed to investigate the perception of individuals with ADHD regarding wearables, examining their past usage, preferences, and perceived benefits. By exploring the potential integration of technological devices into their daily lives, the study sought to uncover how these tools could provide meaningful support for the challenges faced by individuals with ADHD.

In this chapter, the three research questions outlined in Section 1.1 will be discussed. The discussion will delve into the insights gained from semi-structured interviews with nine individuals with ADHD. Through these interviews, participants shared their experiences and attitudes toward wearable technology. The discussions centred on how these devices were perceived, the support they could provide, and the strategies participants employed to overcome everyday challenges.

6.1 Research Question 1

To investigate the use of wearable technology by people with ADHD, the first research question explores (*How do individuals with ADHD currently utilise wearables and other technologies, what are their preferences, challenges and perceived benefits?*).

The participants utilised smartwatches for different reasons, with two primary purposes standing out as time management and health data collection. Participants P1, P2, P3 and P6 utilised smartwatches to gain valuable insight into their well-being through health data. Smartwatches can track various personal data such as heart rate, sleep, step count and physical movement [11], [12]. The participants utilised these insights through their smartwatches, allowing them to track and identify fluctuations and triggers based on the overview that the smartwatch provides [74]. While they found this health data beneficial in their everyday lives, they did not correlate it with their ADHD. Instead, they used the data to understand its impact on their ADHD or how their ADHD affected their overall health.

Interestingly, participants did not view heart rate data as equally valuable compared to sleeping patterns and physical movements. For instance, Participants P2 and P6 found their smartwatches helpful in monitoring their sleep, which reassured them about their perceived sleep quality. In contrast, Participant P5 discontinued the use of their smartwatch due to an excessive focus on step count, which they found

unhelpful. This highlighted a critical aspect of wearable technology. While it offered valuable data, the relevance of that data varied significantly among users with ADHD.

To address time blindness, timers could be incorporated more frequently [46], [48], as suggested by Desrochers et al. [48], who proposed integrating multiple time management strategies into a single digital tool to enhance effectiveness among individuals with ADHD [48]. Many individuals with ADHD struggle with time-blindness and time perception issues, and having a watch constantly on their wrist helped them manage time more effectively. Unlike smartphones, which often became sources of distraction, smartwatches allowed participants to check the time without diverting their attention to unrelated tasks. This reduction in distractions was perceived as a key benefit, especially in avoiding the temptation to engage with phone notifications or other apps when only needing to know the time.

Participants P1 and P3, for instance, relied on their smartwatches for time management. Participant P3 used their watch as a constant reminder to adhere to specific work schedules. In contrast, several participants, including P1, P3, P6, P8 and P9, opted to use phone timers for managing their daily routines, indicating a preference for traditional time management tools. This underscores the importance of timers and alarms in their daily functioning.

While the seamless integration of health data tracking was appreciated, participants faced challenges with notifications on their smartwatches, which could be intrusive and difficult to manage. The overwhelming nature of these notifications diminished the overall utility of the devices, highlighting a complexity in their use. Nevertheless, the effortless provision of health data remained a significant benefit that all participants valued, reinforcing the potential of wearable technology as a supportive tool in their daily lives.

In summary, the key factors for the successful adoption of wearable technology among individuals with ADHD included the seamless integration of information and the need for the technology to remain unobtrusive. Ensuring that the devices provided useful data without requiring excessive mental effort or causing distractions was crucial to their perceived utility. Therefore, while wearable technology has the potential to support individuals with ADHD, careful consideration of user preferences and challenges is essential for optimising their effectiveness.

6.2 Research Question 2

To explore the potential of utilising wearable technology, the second research question (*How can wearable technology provide support for people with ADHD?*) examined the ways in which wearables, such as smartwatches, could support individuals with ADHD in their everyday lives. Participants expressed mixed feelings about the integration of technology into their routines.

While participants acknowledged the advantages of being connected through their devices, they also expressed a strong desire to disconnect. This was particularly

highlighted in the sub-theme *Dislike of Constant Connection*, where participants noted that excessive connectivity could lead to feelings of overwhelm and anxiety.

The participants preferences regarding smartwatch notifications emerged as a significant factor influencing their experience. The sub-theme *Preference of Minimal Notifications* indicated that participants wanted greater control over the frequency and nature of alerts, aiming to reduce distractions while still benefiting from the health data provided by their devices. For instance, while the seamless integration of health data tracking (such as heart rate and sleep patterns) was appreciated, the overwhelming nature of constant notifications could diminish the overall utility of the device.

Reflecting on the findings of this study, it appears that individuals with ADHD may benefit from wearable technology if designed with their unique needs in mind. The conflicting desires for connectivity and the need to manage sensory overload highlight the importance of user-centred design in wearable technology. For example, a smartwatch that allows users to customise notification settings could empower individuals to utilise the devices features without feeling overwhelmed. This aligns with existing literature, which suggests that devices should be unobtrusive and seamlessly integrated into users' daily routines without demanding extensive cognitive engagement [72].

Curiously, the participants utilised the health data provided by their smartwatches, which is a built-in feature that offers seamless integration of data collection without requiring any input from the participants. This functionality was appreciated, but participants pointed out that while it aided in understanding health patterns, it did not necessarily relate directly to managing their ADHD. Participants expressed the desire for a more tailored experience when using these technologies.

The sub-theme *Technology Limitations* provides advice for how to incorporate application technology for assistance without it being perceived as an additional challenge. In this sub-theme, Participant P6 suggested that the menu they want to interact with should be a maximum of two clicks away to avoid an overwhelming or distracting experience. This insight reflects how to approach principles of usability and accessibility in design, ensuring that interfaces can accommodate the cognitive needs of users with ADHD.

As for design purposes Can et al. [72] concluded in their review that devices should be unintrusive and integrated into a system capable of detecting stress in natural settings. This perspective echoed the interpretation accumulated from the participants' opinions regarding technology. Users want to benefit from a system without actively engaging with smartwatches as they autonomously perform tasks without requiring user involvement or conscious consideration, allowing them to utilise the functionality at their discretion without exerting executive effort. If a device necessitates active user involvement and fails to fit seamlessly into existing routines, its potential to provide support for individuals with ADHD may be significantly diminished.

However, it is important to note that participants P4 and P7 do not utilise smart-

watches and are overall not interested in integrating technological solutions into their daily routines. Participants P5 and P8, who had previously used smartwatches, discontinued their usage due to issues such as excessive focus on step count (P5) and poor battery life, which negatively impacted executive function (P8). Despite recognising the potential benefits, Participant P8, as expressed in the sub-theme *Attitudes and Opinions towards Smartwatches*, has not invested in a new smartwatch due to being unable to justify the purchase. This underscores that while there is potential for integrating smartwatches into the lives of individuals with ADHD, not all participants perceive the benefit.

In contrast, Participant P9 expressed a desire to utilise wearables but is unable to do so because of sensory issues, rendering the potential use of a smartwatch not feasible. This highlights the need for further research into the barriers to adoption of wearable technology among individuals with ADHD, particularly regarding sensory sensitivities.

These findings suggest that a one-size-fits-all approach to wearable technology will not be effective. Instead, a more personalised approach is necessary to be accessible to the varying preferences and experiences of individuals with ADHD.

Exploring the possibility of integrating smartwatches involves understanding how they can serve as support for individuals with ADHD. However, it is important to consider personal interests and adaptability when developing support features for smartwatches, as individuals may have varied needs and preferences. Given that all participants utilised health data due to its seamless integration and provision, it is beneficial to consider the potential for gathering data without requiring participants to actively engage their executive functions. Ultimately, the success of wearable technology in supporting individuals with ADHD depends not only on the technology itself but also on a comprehensive understanding of users' perceived experiences. This understanding is crucial to ensure that these tools enhance rather than complicate their daily lives.

In conclusion, while wearable technology holds promise for supporting individuals with ADHD, it is essential to acknowledge the significant variation in user preferences. Understanding personal interests and adaptability is key to developing effective, tailored support features. Participants emphasised the value of seamlessly integrating health data, which minimises the demands on executive functions.

Customisable notifications are vital for enhancing user experiences, enabling individuals to engage with features without feeling overwhelmed. This highlights the importance of usability and accessibility in design to cater to the unique needs of users with ADHD.

Ultimately, the success of wearable technology depends on a comprehensive understanding of users' preferences. By moving away from a one-size-fits-all approach and aligning tools with individual needs, designers can create unobtrusive devices that enhance daily life rather than complicate it, thereby underscoring the benefits of personalised solutions for individuals with ADHD.

6.3 Research Question 3

The third research question (*What strategies do people with ADHD employ to overcome their everyday challenges?*) aimed to explore the potential benefits of smartwatches by investigating the strategies employed by individuals with ADHD on how they overcome their daily challenges.

Considering that individuals with ADHD are more prone to anxiety and depression [5], [7], participants were asked about their mental health experiences to explore whether they could recognise patterns in their behaviour or lives leading up to the onset of these mental states. By becoming more aware of their patterns, individuals can identify avoidance behaviours and negative thought processes, which play a significant role in their mental health [68]. The participants expressed different experiences regarding their mental health and have developed various strategies to minimise the challenges they face, including avoidance behaviour, anxiety and depression.

The themes *Mental Health and Self-awareness Aspects* and *Analog and Digital (Everyday) Tools*, presented in Chapter **??**, directly address the third research question, focusing on various aspects of mental health and coping strategies. Strategies aimed at minimising negative thought processes are presented in the *Mental Health and Self-awareness Aspects* theme, while those addressing avoidance behaviours are highlighted in the *Analog and Digital (Everyday) Tools* theme. Throughout the study, participants demonstrated adaptability by effectively utilising the awareness and strategies outlined in these themes.

Individuals with ADHD experience challenges related to inattention, hyperactivity and impulsivity [1], which manifest in difficulties with organisation, remembering and executing tasks [2]. These difficulties often lead to avoidance behaviours connected with task management and responsibility. In response to these challenges, participants developed a range of coping strategies.

To address the challenges of task execution, participants employed strategies presented in the sub-themes *Routines*, *Sensory Management Devices*, and *Preparations and Resource Management*. These strategies include establishing routines, regulating auditory sensory input, and preparing their environment with suitable aids.

Participants expressed that establishing routines is something they strive for, although it is not always feasible. As Participant P5 noted in the sub-theme *Routines*:

> "Sometimes you notice that the routine doesn't work, but it takes a while before you get into a new one." - P5

Learning new routines is a process and while some routines may eventually prove effective for some individuals, they will not work for everyone. Nevertheless, all participants emphasised the benefits of routines. Participant P9 emphasised the importance of diverging from their routines when their body signals a need for rest. They noted that strict adherence to schedules can heighten stress and feelings of overwhelm. By prioritising these physical and psychological cues, as discussed in

the sub-theme *Recognising Physical and Psychological Cues*, P9 has adopted a more compassionate approach to self-care, leading to better emotional regulation and resilience.

In addressing auditory sensory input, participants frequently turned to using headphones to enhance their concentration and alleviate feelings of overwhelm caused by auditory sensory issues. This approach was particularly emphasised in the sub-theme *Sensory Management Devices*. Participant P6 reported that the use of white noise, as recommended by Söderlund et al. [50], helped them relax, while Participant P5 used audiobooks to block out their own thoughts. Interestingly, they also leveraged the noise-cancelling features of their headphones to block out distracting sounds [52], which they found particularly beneficial. This strategy proved effective in helping them focus in loud environments, especially as some participants explicitly used in-ear headphones in large gatherings. Such choices reflect a broader trend among individuals with sensory sensitivities, as they seek to create a more controlled auditory environment that fosters better concentration and reduces stress. The effectiveness of these tools illustrates how personalised sensory management strategies can play a crucial role in supporting individuals with ADHD in navigating everyday challenges.

Participants also noted that preparing their environment with suitable aids for the task at hand helped to overcome the challenges of executing tasks. The sub-theme of *Preparations and Resource Management* presents how the participants prepare their environment to accommodate their challenges and needs. For instance, participants P6 and P8 utilise multiple screens to reduce the likelihood of getting lost when toggling between them, thereby minimising the chance of becoming distracted by unwanted websites.

The guidelines from Socialstyrelsen [21], expressed in Chapter 2, advocate for the inclusion of non-medical treatments, such as CBT, as accessible support for individuals with ADHD. CBT helps individuals gain insight into their thinking patterns and behaviours [1]. During the semi-structured interviews, participants shared strategies developed through CBT, whether provided by the healthcare system or privately. These strategies aided participants in reducing feelings of overwhelm and executive dysfunction in their daily lives. By drawing insights from therapy and self-observations, participants improved their coping skills, communication, organisational skills and time management, aligning with existing literature [28].

The sub-theme *Awareness of Thought Processes* is particularly significant, as it highlights the participants journey towards mindfulness and self-reflection. By becoming more attuned to their thought patterns, individuals can identify moments of negative thinking that often lead to executive dysfunction. This awareness allows them to challenge and reframe these thoughts, thereby reducing their impact on mental health. Such cognitive shifts are supported by research suggesting that increased awareness can facilitate better emotional regulation and decision-making, crucial for those with ADHD who frequently struggle with impulsivity and inattention [1].

The sub-theme, *Recognising Physical and Psychological Cues*, emphasises the participants' awareness of their bodily signals in relation to mental health. By cultivating

this awareness, individuals become better equipped to identify patterns that may precede anxiety or burnout. This insight aligns with existing literature highlighting the significance of bodily awareness in managing stress and emotional dysregulation [68]. For individuals with ADHD, who frequently encounter heightened sensory input, the ability to recognise and respond to these cues emerges as a crucial skill, fostering resilience in their daily lives.

Similarly, the sub-theme *Awareness of Energy Levels* plays a crucial role in managing daily tasks and responsibilities. Participants noted that understanding their energy fluctuations throughout the day helps them recognise signals indicating when to take short breaks. However, even with this awareness, they have not consistently implemented these breaks. While these breaks are essential for maintaining focus and preventing burnout, the self-regulation strategy remains underutilised. This strategy not only supports task execution but also fosters a healthier balance between activity and rest.

Additionally, the sub-theme *Awareness towards Exercise* illustrates another vital aspect of the participants' coping strategies. Physical activity has been shown to improve executive functions and mitigate symptoms associated with ADHD, such as inattention and hyperactivity [31]. Participants P1, P2, P4 and P6 attempted to incorporate exercise into their lives to varying degrees. However, these participants did not elaborate on whether mindfulness or meditation was effective for them, despite Chimlik et al. [29] and Bigelow et al. [30] finding it beneficial in their research. Participant P8 highlighted that executing mindfulness at the wrong time could have negative effects and contribute to frustration. Nevertheless, the participants had not attempted to use yoga or mindfulness as strategies to address their hyperactivity and inattention. Instead, hyperactivity in the participants was managed through exercise, walking more often or having more physically demanding work or more active home environments. This highlights the need for personalised approaches to coping strategies, as what works for one individual may not necessarily resonate with another.

The sub-theme *Management Tools* addressed how participants enhanced their organisational skills and memory. It presented various strategies, including writing down tasks and reminders, involving others for accountability, and utilising calendars and applications specifically designed for memory support. These tools were not only practical but also served as cognitive externalisations, helping participants manage mental clutter and focus on executing tasks more efficiently. By integrating technology such as smartphone apps, including alarms and timers, participants aimed to gain a greater sense of control over their schedules. While this approach helped them attempt to manage their time more effectively, it did not fully eliminate feelings of anxiety associated with forgetfulness and disorganisation. Nevertheless, it underscores the potential of tailored management strategies to improve daily functioning.

In terms of participants' communication skills, the strategy was explored in the sub-theme *Open Communication*, which related to those who actively engaged in maintaining open communication with people in their surroundings. This approach

helped alleviate feelings of overwhelm and overthinking that arose when thoughts became stuck in their heads. Participants highlighted that open communication created a supportive environment, enhancing their sense of understanding and enabling them to navigate their challenges more effectively. Engaging in discussions about their experiences further contributed to their emotional well-being, indicating that the act of communicating served as a valuable tool for managing their ADHD. However, it is important to note that this strategy is not universally applicable, as not everyone may have the opportunity or ability to engage in open dialogue. This suggested that for those who can, open communication is essential not only for fostering relationships but also for promoting mental health and resilience.

While the methods of employing these strategies varied among participants, each tailored their approach to suit their individual needs. These strategies, accumulated over the years to be able to navigate the challenges are crucial for their overall well-being. These strategies require ongoing testing and adaptation to determine what works best for them over time.

In conclusion, the exploration of coping strategies employed by individuals with ADHD reveals a multifaceted approach to managing daily challenges. By focusing on self-awareness, recognising bodily signals, and implementing various tools and strategies, participants demonstrated resilience and adaptability. The significance of personalised coping mechanisms is underscored, as individuals navigate their unique experiences and challenges associated with ADHD.

These findings enhance our understanding of the diverse coping strategies utilised by individuals with ADHD and highlight the critical need for continued research and tailored support to improve their overall well-being.

6.4 Limitations

Several limitations were present in this study. First, the sample size was limited to Swedish individuals. Additionally, time constraints restricted the scope of the interviews, and the questions were confined to a single session. This resulted in potential gaps in the collected data and missed opportunities for further discoveries due to forgotten or omitted questions.

The sample size was not representative of a homogenous group. While the findings of this study may not capture the full spectrum of experiences among individuals with ADHD, it offers a comprehensive exploration of the challenges they encounter and the strategies they employ to address them. Despite potential limitations in representativeness, this research provides valuable insights into the nuanced experiences of individuals living with ADHD. Recognising the study's representational limitations sheds light on the potential lack of generalisability. For instance, generalisation could be problematic if the participants were solely university students studying the same program, as well as if all the participants came from the same work area. The diversity of participants may have made generalisations less feasible, as each individual brought unique perspectives and experiences to the study.

However, it offers valuable insights into the diverse experiences of individuals with ADHD.

During the interviews, managing interruptions and follow-up questions proved challenging, as captivating insights occasionally led to overlooking earlier points. Given the limitations of conducting this research independently, it would have been beneficial to schedule two shorter interview sessions, allowing for data analysis between them. This approach would create opportunities to revisit any questions that were overlooked.

Another limitation was the assumption regarding the honesty and integrity of the participants' responses. While it was hoped that the participants would provide sincere and truthful answers, the study could not verify the authenticity of their responses. Participants might have felt pressured to give socially desirable answers, or they might not have fully articulated their true feelings and experiences. Consequently, the sincerity of their responses cannot be determined, which could impact the reliability of the findings and the overall conclusions drawn from the study.

The diverse range of participants made it difficult to narrow down or determine the preferences and perceptions of a specific working group. As a result, any generalizations based on these findings will be implicit rather than providing an explicit guide for designing for individuals with ADHD. Instead, they offer insights into what should and should not be considered.

7

Contribution

This study investigated the use of wearable technology, specifically smartwatches, to determine if and how these tools are used to support individuals with ADHD in their everyday lives. Additionally, the strategies developed and employed by individuals with ADHD were examined to explore their potential for future integration with wearable technology.

Recommendations will be discussed in this chapter based on the results surrounding the three research questions. These recommendations will include specific examples of how to integrate effective strategies into wearable technology and provide guidance on how to proceed.

This thesis will contribute to the understanding that while people with ADHD use wearable technology, they often do not utilise it to address the specific challenges related to their ADHD. The findings of this research can serve as recommendations for designers creating technology tailored to individuals with ADHD. First, the sub-chapter *Implications for Wearable Technology* will focus on the strategies people with ADHD use to overcome daily challenges, highlighting how these strategies could be integrated into wearable technology to provide support as assistive technology in their daily lives. Lastly, the sub-chapter *Adoption and Systemic Implications* will cover an example of how individuals with ADHD can engage with wearable technology and explore its potential benefits through the healthcare system or an educational institution, without needing to purchase a product before deemed beneficial for them. However, the specifics of how these integrations could be implemented will not be covered, but this aspect could be explored in future work.

7.1 Implications for Wearable Technology

The methods for employing strategies in their everyday lives varied among participants, each tailoring their approach to suit their individual needs. These strategies have undergone ongoing testing and adaptation, allowing participants to determine what works best for them over time.

This section explains how wearable technology features can be incorporated to support individuals with ADHD in their everyday lives, based on the strategies presented in the results chapter of this thesis. The strategies, developed and employed

by the participants, are categorised into the sub-themes *Routines*, *Preparations and Resource Management*, *Management tools* and *Sensory Management Devices*. The following recommended smartwatch features aim to facilitate support in the daily lives of people with ADHD, thus functioning as assistive technology.

This section will provide recommended smartwatch features to be utilised by people with ADHD:

- **Recommendation F1:** Cognitive and Task Management Feature
- **Recommendation F2:** Auditory and Concentration Feature
- **Recommendation F3:** Customisable Feature

Recommendation F1: Based on the sub-themes *Routines*, *Management Tools*, and *Preparations and Resource Management*, people with ADHD seek strategies to manage and remember information, routines and tasks, as well as to prepare their environment to accommodate their challenges. The participants in this study have developed and employed various strategies, such as establishing routines for everyday tasks and employ management tools to improve organisational skills and memory, to address these needs. Smartwatches can support these strategies by incorporating features such as alarms, timers and reminders to facilitate the management of routines, tasks, and environment preparation.

The alarms, timers and reminders should:

1. Be easy to access without requiring to navigate through multiple menus.
2. Align with the user's routine and schedule, tailored to their specific needs and preferences, making them easy to adapt. The reminders should include trivial tasks like eating, drinking water and other routine activities.
3. Be adjustable to align with individual needs, including how often they occur and the types of tasks that need reminders.
4. Allow easy access to alarms and timers, enabling users to quickly set them when a new task needs to be addressed.
5. Additionally, the smartwatch should offer voice-recoding capabilities for taking notes and making other quick additions, helping users capture important information without the distraction of using their phone.
6. Additionally, the smartwatch should offer voice-recoding capabilities for taking notes and making other quick additions, helping users capture important information without needing to use their phone which might act as a distraction when interacted with.

Recommendation F2: Based on the sub-themes *Sensory Management Devices* and *Attitudes and Opinions toward Smartwatches* participants use speakers or headphones to enhance concentration, minimise overstimulation and unwind, thereby improving productivity. To enhance concentration the participants also expressed the need to disconnect to the technology.

The smartwatch's features should:

1. Work independently with the smartphone, thus eliminate the need for a phone to be present.
2. Be able to easily disconnect the smartwatch to everything that can act as a distraction from the smartwatch or sent from the smartphone.
3. Be able to connect to headphones or directly play audio.

Recommendation F3: Based on the sub-themes *Dislike of Constant Connection* and *Preference of Minimal Notifications*, people with ADHD prefer not to feel constantly connected to technology. The participants want the ability to control which notifications they receive and when.

The smartwatches must have easy to find customisable features to allow each user to tailor their experience to suit their individual needs. These features should ensure that:

1. Users can disconnect from technology if desired, such as by disconnecting the smartwatch from the system and only using it for specific functions.
2. Users can control all aspects of notifications to fit their preferences and needs to minimise distractions, including selecting which notifications the smartwatch receives.

As the participants have developed various strategies over the years to manage the challenges associated with their ADHD, these strategies are crucial for their overall well-being. Exploring how these strategies can be integrated with wearable technology warrants further research. However, the potential exists, providing that issues such as managing notifications and allowing opportunities for disconnection are properly addressed.

7.2 Adoption and Systemic Implications

The recommendations in this section are intended for people like participants P1, P2, P3, P5, P6 and P8, who use smartwatches, rather than those like participants P4 and P7, who are not interested in using technology as a support tool, or Participant P9, who experiences sensory issues that prevent the use of smartwatches. P1, P2 and P3 lack awareness of how smartwatches could benefit their daily lives. Participants P5 and P8 are concerned about the financial costs. Participant P6 has already recognised the potential benefits of integrating wearable technology into their daily life but has not yet fully integrated the smartwatch into their routine. The recommendations will provide participants P1, P2, P3, P5, P6 and P8 with the opportunity to learn about werarbale technology, trial the devices before purchase and configure their smartwatches to better support their daily activities.

This section offers three recommendations focusing on enhancing adoption and addressing systemic implications for individuals with ADHD. These recommendations are:

- **Recommendation AS1:** Education and Awareness
- **Recommendation AS2:** Hands-on Evaluation and Experience
- **Recommendation AS3:** Tailored Setup and Optimisation

Integrating wearables into contemporary society presents opportunities, yet participants in this study did not fully utilise these devices. The benefits of smartwatches may seem less relevant to individuals who are either not interested in adopting new technology, perceive it as more of a complication than a solution or lack awareness of how it can be integrated into their daily lives. Those less inclined towards technology might be hesitant to adopt wearable devices due to a lack of awareness, motivation or perceived difficulty in learning to use new tools.

Recommendation AS1: The first recommendation, *Education and Awareness*, is to develop programs within healthcare systems or educational institutions that provide individuals with ADHD with guidance on using wearable technology to assist them with challenges. Participants noted uncertainty about how to effectively use their smartwatches for daily support. Therefore, offering structured learning opportunities in these settings could help enhance their understanding and application of the technology.

Recommendation AS2: The second recommendation, *Hands-on Evaluation and Experience*, addresses concerns about investing in wearable technology without first evaluating its perceived usefulness. Some participants expressed hesitancy about spending money on a device they havent tried and arent sure will be beneficial. To address this, providing opportunities for individuals to trial the technology before making a purchase could be beneficial. This trial process could also be facilitated through healthcare systems or educational institutions.

Recommendation AS3: The third recommendation, *Tailored Setup and Optimisation*, suggests offering personalised sessions to help individuals with ADHD configure their smartwatches as effective assistive technology. Participants mentioned that while they were aware their smartwatches could provide support, they had not yet customised the devices to suit their preferences. Providing this support through healthcare systems or educational institutions could help users optimise their technology for their specific needs. Studies by Lanata et al. [69], Tsirmpas et al. [70] and Richards et al. [71] have explored with approach, investigating the involvement of volunteers or therapists in personalised sessions. These studies suggest that such additional support can be highly beneficial.

Past research by Lindstedt and Umb-Carlsson [39] has shown how assistive technology can enhance productivity, reduce mental load and enhance sleep quality. Similarly, Moëll et al. [46] investigated the use of existing smartphone features to improve daily functioning for adults with ADHD through an internet-based course called *Living Smart* [46]. Offering guidance on how to integrate smartwatches into daily life could help individuals with ADHD make the most of these devices. By introducing supportive techniques through programs offered by healthcare systems or an educational institutions, individuals with ADHD would have the opportunity to explore various technologies and methods. This approach would allow them to eval-

uate these options before making a purchase, ultimately facilitating the integration of new systems and products into their daily routines.

8

Future Work

While the semi-structured interviews yielded valuable insights, the information is somewhat scattered. Conducting additional interviews would be necessary to achieve a more comprehensive understanding of the preferences of individuals with ADHD. One approach to obtain broader insight is to design a questionnaire specifically targeting individuals with ADHD, focusing on their utilisation of smartwatches. This questionnaire could inquire about their reasons for using wearables, their preferences and the role of this technology in their lives. However, this approach would only suffice to get a more accurate number of individuals who use these technologies or not. When utilising a questionnaire, information can be gathered more widely, but the possibility to get more in-depth answers is not possible with this approach.

Future iterations of this thesis should prioritise either expanding the sample size to include both student and working perspectives or narrowing the focus to a specific area of personal or working interest to better accommodate the experiences and needs of the individuals. Currently, there is no definitive approach to integrating technology into the daily lives of individuals with ADHD. Understanding and addressing individual needs should take precedence, with a focus on providing tailored assistance rather than relying on generalised solutions.

Further work on how to proceed from this study could be to explore the types of data that could be gathered through wearable technology and how this data can be used to gain insights into the well-being of individuals with ADHD, particularly regarding their mental health and overall well-being. Developing a system that can provide users with insight into their levels of inattentiveness, hyperactivity or impulsivity and recommend actions could be beneficial. This data could help users determine which strategies may be useful in managing their symptoms.

Another aspect of future work could involve developing systems to support the strategies that participants have developed over time and exploring how these strategies could be facilitated through wearable technology, such as smartwatches. For example, creating systems to assist participant P9 in their morning routine without needing to adjust their morning alarms to match their wake-up time. This could involve integrating a system where users input their wake-up time, and the alarms for various morning tasks would provide reminders accordingly.

9

Conclusion

This research has explored the intersection of ADHD and wearable technology, focusing on how these devices can support individuals with ADHD in managing their challenges. ADHD presents a range of symptoms, including inattention, hyperactivity and impulsivity [1], which can significantly impact daily life and executive functioning. The high prevalence of comorbid mental health issues further complicates ADHD management [5], [7], underscoring the need for tailored support solutions.

The thesis investigation into wearable technology highlighted several strategies developed and employed by individuals with ADHD and how these strategies can be integrated into wearable technology. The study aimed to address the following research questions:

1. How do individuals with ADHD currently utilise wearables and other technologies, what are their preferences, challenges and perceived benefits?

2. How can wearable technology provide support for people with ADHD?

3. What strategies do people with ADHD employ to overcome their everyday challenges?

Research Question 1: Participants primarily used their smartwatches to manage time blindness and track health data such as physical activity and sleep patterns. However, they faced challenges with managing and restricting notifications, although they valued the seamless health data integration.

Research Question 2: To support individuals with ADHD, wearable technology must align with the specific needs of each user. The potential benefits of wearable technology vary among participants, highlighting the importance of accommodating individual preferences. When integrating the strategies developed and employed by the participants with wearable technology factors such as notifications, the feeling of constant connection and personal interest in using technology must be carefully considered. Notably, all participants who used smartwatches consistently utilised health data, particularly because the data gathers seamlessly and requires minimal effort to engage. When designing systems or functions for individuals with ADHD, the technology should gather data without requiring active interaction. Additionally, it should offer alarms, notifications and prompts that support users in a way that fits their needs and routines.

Research Question 3: Participants have developed personalised strategies to navigate the challenges presented by their ADHD, which are essential for their overall well-being. These strategies include recognising physical and psychological cues, managing energy levels, being aware of thought processes and maintaining open communication. Additionally, participants use auditory sensory inputs to enhance concentration and employ management tools to improve organisational skills and memory. Their strategies also involve establishing routines for everyday tasks, preparing their environment and incorporating exercise. These approaches, detailed as sub-themes in the results chapter, highlight the diverse strategies participants use to manage their ADHD. Each strategy is tailored to individual needs and accumulated over time, requiring ongoing testing and adaptation to determine what works best for each person.

Investigating the ability to utilise these strategies in combination with wearable technology requires further research, but the potential exists as long as considerations such as managing notifications and providing opportunities for disconnection are addressed. The participants have noted that smartwatches lacking notification control and the ability to minimise distracting features are perceived as less useful.

Based on the results, this thesis provides the following recommendations:

- **Recommendation F1:** Cognitive and Task Management Feature
- **Recommendation F2:** Auditory and Concentration Feature
- **Recommendation F3:** Customisable Feature
- **Recommendation AS1:** Education and Awareness
- **Recommendation AS2:** Hands-on Evaluation and Experience
- **Recommendation AS3:** Tailored Setup and Optimisation

Recommendation F1-F3: These recommendations propose how smartwatch features can support individuals with ADHD by offering customisable alarms, timers, and reminders that align with an individual's routines, along with quick note-taking through voice recording. They should also connect seamlessly to audio devices and allow users to control notifications, helping manage concentration and reduce distractions. These features could enhance daily functioning for those with ADHD, though further research is needed to fully harness this potential.

Recommendation AS1-AS3: These recommendations propose that healthcare systems or educational institutions offer programs to support individuals with ADHD. These programs would provide guidance on effectively utilising smartwatches, allow individuals to trial the technology before committing to a purchase, and offer tailored sessions to help configure the devices according to their specific needs.

Implementing these recommendations or conducting further research can improve how individuals with ADHD harness the full potential of wearable technology. Addressing these aspects not only enhances daily functioning but also leverages the

widespread use of smartphones and wearables in contemporary society. This research highlights the importance of adapting emerging technologies to meet diverse needs, promoting a more inclusive approach to technology and mental health. Integrating smartwatches into daily lives for individuals with ADHD offers potential support, but realising these benefits may require additional support from healthcare systems or educational institutions to fully exploit these technologies.

Bibliography

[1] National Institute of Mental Health (NIMH), *Attention-Deficit/Hyperactivity Disorder in Adults: What You Need to Know*, en. [Online]. Available: https://www.nimh.nih.gov/health/publications/adhd-what-you-need-to-know (visited on 02/28/2024).

[2] G. D. Rabinovici, M. L. Stephens, and K. L. Possin, "Executive Dysfunction," *Continuum : Lifelong Learning in Neurology*, vol. 21, no. 3 Behavioral Neurology and Neuropsychiatry, pp. 646–659, Jun. 2015, ISSN: 1080-2371. DOI: 10.1212/01.CON.0000466658.05156.54. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4455841/ (visited on 02/28/2024).

[3] T. Stibbe, J. Huang, M. Paucke, C. Ulke, and M. Strauss, "Gender differences in adult ADHD: Cognitive function assessed by the test of attentional performance," *PLoS ONE*, vol. 15, no. 10, e0240810, Oct. 2020, ISSN: 1932-6203. DOI: 10.1371/journal.pone.0240810. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7561166/ (visited on 02/28/2024).

[4] T. Li, N. R. Mota, T. E. Galesloot, *et al.*, "ADHD symptoms in the adult general population are associated with factors linked to ADHD in adult patients," en, *European Neuropsychopharmacology*, vol. 29, no. 10, pp. 1117–1126, Oct. 2019, ISSN: 0924977X. DOI: 10.1016/j.euroneuro.2019.07.136. [Online]. Available: https://linkinghub.elsevier.com/retrieve/pii/S0924977X1930433X (visited on 02/28/2024).

[5] M. A. Katzman, T. S. Bilkey, P. R. Chokka, A. Fallu, and L. J. Klassen, "Adult ADHD and comorbid disorders: Clinical implications of a dimensional approach," en, *BMC Psychiatry*, vol. 17, no. 1, p. 302, Aug. 2017, ISSN: 1471-244X. DOI: 10.1186/s12888-017-1463-3. [Online]. Available: https://doi.org/10.1186/s12888-017-1463-3 (visited on 02/28/2024).

[6] M. Ogrodnik, S. Karsan, and J. J. Heisz, "Mental Health in Adults With ADHD: Examining the Relationship With cardiorespiratory Fitness," *Journal of Attention Disorders*, vol. 27, no. 7, pp. 698–708, May 2023, ISSN: 1087-0547. DOI: 10.1177/10870547231158383. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10173354/ (visited on 02/28/2024).

[7] C. Sherman, *ADHD and Depression: Connection, Risks, Treatment*, 2019. [Online]. Available: https://www.additudemag.com/adhd-and-depression-symptoms-treatment/ (visited on 02/28/2024).

[8] ITU, *Facts and Figures 2023 - Mobile phone ownership*, en, publisher: ITU, 2023. [Online]. Available: https://www.itu.int/itu-d/reports/

statistics/2023/10/10/ff23-mobile-phone-ownership (visited on 02/28/2024).

[9] Statista, *Wearable device ownership 2023*, en. [Online]. Available: https://www.statista.com/forecasts/1101101/wearable-devices-ownership-in-selected-countries (visited on 02/28/2024).

[10] S. Kumar, P. Tiwari, and M. Zymbler, "Internet of Things is a revolutionary approach for future technology enhancement: A review," *Journal of Big Data*, vol. 6, no. 1, p. 111, Dec. 2019, ISSN: 2196-1115. DOI: 10.1186/s40537-019-0268-2. [Online]. Available: https://doi.org/10.1186/s40537-019-0268-2 (visited on 02/28/2024).

[11] S. K. Vashist and J. H. T. Luong, "Chapter 12 - wearable technologies for personalized mobile healthcare monitoring and management," in *Wearable Technology in Medicine and Health Care*, R. K.-Y. Tong, Ed., Academic Press, Jan. 2018, pp. 235–259, ISBN: 9780128118108. DOI: 10.1016/B978-0-12-811810-8.00012-9. [Online]. Available: https://www.sciencedirect.com/science/article/pii/B9780128118108000129 (visited on 03/03/2024).

[12] H. K. Thakkar, S. R. Chowdhury, A. K. Bhoi, and P. Barsocchi, "Chapter 11 - Applications of wearable technologies in healthcare: An analytical study," in *5G IoT and Edge Computing for Smart Healthcare*, ser. Intelligent Data-Centric Systems, A. K. Bhoi, V. H. C. de Albuquerque, S. N. Sur, and P. Barsocchi, Eds., Academic Press, Jan. 2022, pp. 279–299, ISBN: 9780323905480. DOI: 10.1016/B978-0-323-90548-0.00001-2. [Online]. Available: https://www.sciencedirect.com/science/article/pii/B9780323905480000012 (visited on 03/03/2024).

[13] C. Hill, J. L. Martin, S. Thomson, N. Scott-Ram, H. Penfold, and C. Creswell, "Navigating the challenges of digital health innovation: Considerations and solutions in developing online and smartphone-application-based interventions for mental health disorders," en, *The British Journal of Psychiatry*, vol. 211, no. 2, pp. 65–69, 2017, ISSN: 0007-1250, 1472-1465. DOI: 10.1192/bjp.bp.115.180372. [Online]. Available: https://pubmed.ncbi.nlm.nih.gov/28522435/ (visited on 02/28/2024).

[14] C. R. Psrelu, G. Andersson, and A. Dobrean, "Attention-deficit/ hyperactivity disorder mobile apps: A systematic review," *International Journal of Medical Informatics*, vol. 138, p. 104 133, Jun. 2020, ISSN: 1386-5056. DOI: 10.1016/j.ijmedinf.2020.104133. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S138650561830323X (visited on 02/28/2024).

[15] P. Song, M. Zha, Q. Yang, Y. Zhang, X. Li, and I. Rudan, "The prevalence of adult attention-deficit hyperactivity disorder: A global systematic review and meta-analysis," *Journal of Global Health*, vol. 11, p. 04 009, ISSN: 2047-2978. DOI: 10.7189/jogh.11.04009. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7916320/ (visited on 02/28/2024).

[16] Socialstyrelsen, *Nu kommer nationella riktlinjer för adhd och autism*, sv, 2022. [Online]. Available: https://www.socialstyrelsen.se/om-socialstyrelsen/pressrum/press/nu-kommer-nationella-riktlinjer-for-adhd-och-autism/ (visited on 02/28/2024).

[17] A. G. da Silva, L. F. Malloy-Diniz, M. S. Garcia, and R. Rocha, "Attention-Deficit/Hyperactivity Disorder and Women," en, in *Women's Mental Health: A Clinical and Evidence-Based Guide*, J. Rennó Jr., G. Valadares, A. Cantilino, J. Mendes-Ribeiro, R. Rocha, and A. Geraldo da Silva, Eds., Cham: Springer International Publishing, 2020, pp. 215–219, ISBN: 9783030290818. DOI: 10.1007/978-3-030-29081-8_15. [Online]. Available: https://doi.org/10.1007/978-3-030-29081-8_15 (visited on 02/28/2024).

[18] J. Martin, "Why are females less likely to be diagnosed with adhd in childhood than males?" *The Lancet Psychiatry*, vol. 11, no. 4, pp. 303–310, 2024, ISSN: 2215-0366. DOI: https://doi.org/10.1016/S2215-0366(24)00010-5. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S2215036624000105.

[19] SPSM, *Moment 2 girls and adhd in primary school*, sv, https://www.spsm.se/studiepaket-npf/studiepaket-npf-grundskola/adhd-i-grundskolan/moment-2--flickor-och-adhd-i-grundskolan/, Accessed: 2024-09-20, Mar. 2023.

[20] D. E. Attoe and E. A. Climie, "Miss. Diagnosis: A Systematic Review of ADHD in Adult women," *Journal of Attention Disorders*, vol. 27, no. 7, pp. 645–657, May 2023, ISSN: 1087-0547. DOI: 10.1177/10870547231161533. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10173330/ (visited on 02/28/2024).

[21] *Nationella riktlinjer 2024: Adhd och autism*, sv, Published online, Artikelnummer: 2024-3-8958, Mar. 2024. [Online]. Available: https://www.socialstyrelsen.se/kunskapsstod-och-regler/regler-och-riktlinjer/nationella-riktlinjer/riktlinjer-och-utvarderingar/adhd-och-autism/ (visited on 09/23/2024).

[22] *Startsida*, sv, Sep. 2024. [Online]. Available: https://www.socialstyrelsen.se/ (visited on 09/23/2024).

[23] The National Institute for Health and Care Excellence (NICE), *NICE | The National Institute for Health and Care Excellence*, eng, CorporatePage. [Online]. Available: https://www.nice.org.uk/ (visited on 02/28/2024).

[24] National Institute for Health and Care Excellence (NICE), *Attention deficit hyperactivity disorder: Diagnosis and management*, eng, 2018. [Online]. Available: https://www.nice.org.uk/guidance/ng87/chapter/Recommendations#managing-adhd (visited on 02/28/2024).

[25] V. Nimmo-Smith, A. Merwood, D. Hank, *et al.*, "Non-pharmacological interventions for adult ADHD: A systematic review," eng, *Psychological Medicine*, vol. 50, no. 4, pp. 529–541, Mar. 2020, ISSN: 1469-8978. DOI: 10.1017/S0033291720000069.

[26] APA, *What is Cognitive Behavioral Therapy?* en. [Online]. Available: https://www.apa.org/ptsd-guideline/patients-and-families/cognitive-behavioral (visited on 02/28/2024).

[27] N. Thoma, B. Pilecki, and D. McKay, "Contemporary Cognitive Behavior Therapy: A Review of Theory, History, and Evidence," en, *Psychodynamic Psychiatry*, vol. 43, no. 3, pp. 423–461, Sep. 2015, ISSN: 2162-2590. DOI: 10.

1521/pdps.2015.43.3.423. [Online]. Available: http://guilfordjournals.com/doi/10.1521/pdps.2015.43.3.423 (visited on 02/28/2024).

[28] K. Harper and J. P. Gentile, "Psychotherapy for Adult ADHD," en, *Innovations in Clinical Neuroscience*, vol. 19, no. 10-12, p. 35, Dec. 2022. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9776776/ (visited on 02/28/2024).

[29] A. L. Chimiklis, V. Dahl, A. P. Spears, K. Goss, K. Fogarty, and A. Chacko, "Yoga, Mindfulness, and Meditation Interventions for Youth with ADHD: Systematic Review and Meta-Analysis," en, *Journal of Child and Family Studies*, vol. 27, no. 10, pp. 3155–3168, Oct. 2018, ISSN: 1573-2843. DOI: 10.1007/s10826-018-1148-7. [Online]. Available: https://doi.org/10.1007/s10826-018-1148-7 (visited on 02/28/2024).

[30] H. Bigelow, M. D. Gottlieb, M. Ogrodnik, J. D. Graham, and B. Fenesi, "The Differential Impact of Acute Exercise and Mindfulness Meditation on Executive Functioning and Psycho-Emotional Well-Being in Children and Youth With ADHD," *Frontiers in Psychology*, vol. 12, 2021, ISSN: 1664-1078. [Online]. Available: https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2021.660845 (visited on 02/28/2024).

[31] A. Mehren, M. Reichert, D. Coghill, H. H. O. Müller, N. Braun, and A. Philipsen, "Physical exercise in attention deficit hyperactivity disorder evidence and implications for the treatment of borderline personality disorder," *Borderline Personality Disorder and Emotion Dysregulation*, vol. 7, p. 1, Jan. 2020, ISSN: 2051-6673. DOI: 10.1186/s40479-019-0115-2. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6945516/ (visited on 02/28/2024).

[32] A. E. Blackhurst, "Perspectives on applications of technology in the field of learning disabilities," en, *Learning Disability Quarterly*, vol. 28, no. 2, pp. 175–178, May 2005, ISSN: 0731-9487, 2168-376X. DOI: 10.2307/1593622. [Online]. Available: http://journals.sagepub.com/doi/10.2307/1593622 (visited on 03/03/2024).

[33] World Health Organization, *Assistive technology*, en, 2024. [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/assistive-technology (visited on 03/03/2024).

[34] World Health Organization and United Nations Childrens Fund (UNICEF), *Global Report on Assistive Technology*. Geneva: World Health Organization and United Nations Childrens Fund (UNICEF), 2022, Licence: CC BY-NC-SA 3.0 IGO, ISBN: 978-92-4-004946-8.

[35] *Assistive technology - an overview | sciencedirect topics*. [Online]. Available: https://www.sciencedirect.com/topics/medicine-and-dentistry/assistive-technology (visited on 07/31/2024).

[36] U.S. Congress, *Assistive technology act of 2004*, https://www.congress.gov/bill/108th-congress/house-bill/4278/text, PUBLIC LAW 108364OCT. 25, 2004 118 STAT. 1707, 2004.

[37] *Foundation for assistive technology research database*, en-US. [Online]. Available: https://fastuk.org/ (visited on 07/31/2024).

[38] E. Black and M. Hattingh, "Assistive technology for adhd: A systematic literature review," in *Innovative Technologies and Learning*, T.-C. Huang, T.-T. Wu, J. Barroso, F. E. Sandnes, P. Martins, and Y.-M. Huang, Eds., Cham: Springer International Publishing, 2020, pp. 514–523, ISBN: 978-3-030-63885-6.

[39] H. Lindstedt and Õ. Umb-Carlsson, "Cognitive assistive technology and professional support in everyday life for adults with adhd," *Disability and Rehabilitation: Assistive Technology*, vol. 8, no. 5, pp. 402–408, 2013, PMID: 23992459. DOI: 10.3109/17483107.2013.769120. eprint: https://doi.org/10.3109/17483107.2013.769120. [Online]. Available: https://doi.org/10.3109/17483107.2013.769120.

[40] C. Zeagler, M. Gandy, and P. M. A. Baker, "The assistive wearable: Inclusive by design," in *Assistive Technology Outcomes and Benefits*, J. L. Flagg, Ed., Volume 12, Summer 2018, Assistive Technology Industry Association (ATIA), 2018, pp. 11–36.

[41] ScienceDirect, *Wearable technology - an overview | sciencedirect topics*. [Online]. Available: https://www.sciencedirect.com/topics/engineering/wearable-technology (visited on 03/03/2024).

[42] P. K. Sahoo, H. K. Thakkar, and M.-Y. Lee, "A cardiac early warning system with multi channel scg and ecg monitoring for mobile health," en, *Sensors*, vol. 17, no. 4, p. 711, Apr. 2017, ISSN: 1424-8220. DOI: 10.3390/s17040711. [Online]. Available: https://www.mdpi.com/1424-8220/17/4/711 (visited on 03/03/2024).

[43] E. A. Adeniyi, R. O. Ogundokun, and J. B. Awotunde, "Iomt-based wearable body sensors network healthcare monitoring system," en, in *IoT in Healthcare and Ambient Assisted Living*, ser. Studies in Computational Intelligence, G. Marques, A. K. Bhoi, V. H. C. d. Albuquerque, and H. K.S., Eds., Singapore: Springer, 2021, pp. 103–121, ISBN: 9789811598975. DOI: 10.1007/978-981-15-9897-5_6. [Online]. Available: https://doi.org/10.1007/978-981-15-9897-5_6 (visited on 03/09/2024).

[44] J. Yoo and H.-J. Yoo, "Emerging low energy Wearable Body Sensor Networks using patch sensors for continuous healthcare applications," in *2010 Annual International Conference of the IEEE Engineering in Medicine and Biology*, ISSN: 1558-4615, Aug. 2010, pp. 6381–6384. DOI: 10.1109/IEMBS.2010.5627299. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/5627299 (visited on 03/03/2024).

[45] S. Ray, J. Park, and S. Bhunia, "Wearables, implants, and internet of things: The technology needs in the evolving landscape," *IEEE Transactions on Multi-Scale Computing Systems*, vol. 2, no. 2, pp. 123–128, Apr. 2016, ISSN: 2332-7766. DOI: 10.1109/TMSCS.2016.2553026. [Online]. Available: https://ieeexplore.ieee.org/document/7450639 (visited on 03/03/2024).

[46] B. Moëll, L. Kollberg, B. Nasri, N. Lindefors, and V. Kaldo, "Living SMART A randomized controlled trial of a guided online course teaching adults with ADHD or sub-clinical ADHD to use smartphones to structure their everyday life," *Internet Interventions*, vol. 2, no. 1, pp. 24–31, Mar. 2015, ISSN: 2214-7829. DOI: 10.1016/j.invent.2014.11.004. [Online]. Available: https:

//www.sciencedirect.com/science/article/pii/S2214782914000347 (visited on 02/28/2024).

[47] L. E. Ayearst, R. M. Brancaccio, and M. D. Weiss, "Improving On-Task Behavior in Children and Youth with ADHD: Wearable Technology as a Possible Solution," en, *Journal of Pediatric Neuropsychology*, vol. 9, no. 4, pp. 175–182, Dec. 2023, ISSN: 2199-2673. DOI: 10.1007/s40817-023-00152-6. [Online]. Available: https://doi.org/10.1007/s40817-023-00152-6 (visited on 02/28/2024).

[48] B. Desrochers, E. Tuson, and J. Magee, "Evaluation of Why Individuals with ADHD Struggle to Find Effective Digital Time Management Tools," en, in *The 21st International ACM SIGACCESS Conference on Computers and Accessibility*, Pittsburgh PA USA: ACM, Oct. 2019, pp. 603–605, ISBN: 9781450366762. DOI: 10.1145/3308561.3354622. [Online]. Available: https://dl.acm.org/doi/10.1145/3308561.3354622 (visited on 02/28/2024).

[49] S. Eriksson, F. Gustafsson, G. Larsson, and P. Hansen, "Takt: The wearable timepiece that enables sensory perception of time," in *Proceedings of the 2017 ACM Conference Companion Publication on Designing Interactive Systems*, ser. DIS '17 Companion, Edinburgh, United Kingdom: Association for Computing Machinery, 2017, pp. 223–227, ISBN: 9781450349918. DOI: 10.1145/3064857.3079150. [Online]. Available: https://doi.org/10.1145/3064857.3079150.

[50] G. Söderlund, S. Sikström, and A. Smart, "Listen to the noise: Noise is beneficial for cognitive performance in ADHD," eng, *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, vol. 48, no. 8, pp. 840–847, Aug. 2007, ISSN: 0021-9630. DOI: 10.1111/j.1469-7610.2007.01749.x.

[51] B. Moëll, "Living SMART, an internet course for adults with adhd," https://www.diva-portal.org/smash/get/diva2:716346/FULLTEXT01.pdf, M.S. thesis, 2012.

[52] P. R. Kulawiak, "Academic benefits of wearing noise-cancelling headphones during class for typically developing students and students with special needs: A scoping review," en, *Cogent Education*, vol. 8, no. 1, D. Schussler, Ed., p. 1 957 530, Jan. 2021, ISSN: 2331-186X. DOI: 10.1080/2331186X.2021.1957530. [Online]. Available: https://www.tandfonline.com/doi/full/10.1080/2331186X.2021.1957530 (visited on 03/09/2024).

[53] D. C. Mohr, M. N. Burns, S. M. Schueller, G. Clarke, and M. Klinkman, "Behavioral Intervention Technologies: Evidence review and recommendations for future research in mental health," *General Hospital Psychiatry*, vol. 35, no. 4, pp. 332–338, Jul. 2013, ISSN: 0163-8343. DOI: 10.1016/j.genhosppsych.2013.03.008. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0163834313000698 (visited on 03/02/2024).

[54] V. Harrison, J. Proudfoot, P. P. Wee, G. Parker, D. H. Pavlovic, and V. Manicavasagar, "Mobile mental health: Review of the emerging field and proof of concept study," en, *Journal of Mental Health*, vol. 20, no. 6, pp. 509–524, Dec. 2011, ISSN: 0963-8237, 1360-0567. DOI: 10.3109/09638237.2011.608746. [Online]. Available: http://www.tandfonline.com/doi/full/10.3109/09638237.2011.608746 (visited on 03/02/2024).

[55] K. Taylor, "Connected health: How digital technology is transforming health and social care," Deloitte Center for Health Solutions, Tech. Rep., 2015.

[56] R. Pettersson, S. Söderström, K. Edlund-Söderström, and K. W. Nilsson, "Internet-Based Cognitive Behavioral Therapy for Adults With ADHD in Outpatient Psychiatric Care: A Randomized Trial," en, *Journal of Attention Disorders*, vol. 21, no. 6, pp. 508–521, Apr. 2017, ISSN: 1087-0547, 1557-1246. DOI: 10.1177/1087054714539998. [Online]. Available: http://journals.sagepub.com/doi/10.1177/1087054714539998 (visited on 02/28/2024).

[57] D. B. Legge, R. M. DeBar, and S. R. Alber-Morgan, "The effects of self-monitoring with a MotivAiderő on the on-task behavior of fifth and sixth graders with autism and other disabilities.," en, *Journal of Behavior Assessment and Intervention in Children*, vol. 1, no. 1, pp. 43–52, 2010, ISSN: 2155-7853. DOI: 10.1037/h0100359. [Online]. Available: https://doi.apa.org/doi/10.1037/h0100359 (visited on 03/03/2024).

[58] D. Smit and S. Bakker, "Blurtline: A design exploration to support children with adhd in classrooms," in *Human-Computer Interaction INTERACT 2015*, Berlin, Heidelberg: Springer-Verlag, 2015, pp. 456–460, ISBN: 978-3-319-22722-1. DOI: 10.1007/978-3-319-22723-8_37. [Online]. Available: https://doi.org/10.1007/978-3-319-22723-8_37.

[59] V. Dibia, "Foqus: A smartwatch application for individuals with adhd and mental health challenges," in *Proceedings of the 18th International ACM SIGACCESS Conference on Computers and Accessibility*, ser. ASSETS '16, Reno, Nevada, USA: Association for Computing Machinery, 2016, pp. 311–312, ISBN: 9781450341240. DOI: 10.1145/2982142.2982207. [Online]. Available: https://doi.org/10.1145/2982142.2982207.

[60] E. Kim, J. Heo, and J. Han, "Attention to breathing in response to vibrational and verbal cues in mindfulness meditation mediated by wearable devices," en, in *Human-Computer Interaction. Interaction Techniques and Novel Applications*, M. Kurosu, Ed., vol. 12763, Cham: Springer International Publishing, 2021, pp. 415–431, ISBN: 9783030784645 9783030784652. DOI: 10.1007/978-3-030-78465-2_31. [Online]. Available: https://link.springer.com/10.1007/978-3-030-78465-2_31 (visited on 03/05/2024).

[61] M. Kressbach, "Breath work: Mediating health through breathing apps and wearable technologies," *New Review of Film and Television Studies*, vol. 16, no. 2, pp. 184–206, 2018. DOI: 10.1080/17400309.2018.1444459. eprint: https://doi.org/10.1080/17400309.2018.1444459. [Online]. Available: https://doi.org/10.1080/17400309.2018.1444459.

[62] Centers for Disease Control and Prevention, *About Mental Health*, en-us, 2023. [Online]. Available: https://www.cdc.gov/mentalhealth/learn/index.htm (visited on 02/28/2024).

[63] World Health Organization, *Mental disorders*, en. [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/mental-disorders (visited on 02/28/2024).

[64] "Adult adhd (attention deficit hyperactivity disorder)," Anxiety & Depression Association of America (ADAA). (), [Online]. Available: https://adaa.

org/understanding-anxiety/related-illnesses/attention-deficit-hyperactivity-disorder-adhd (visited on 02/28/2024).

[65] N. I. of Mental Health (NIMH), *Anxiety Disorders*, en. [Online]. Available: https://www.nimh.nih.gov/health/topics/anxiety-disorders (visited on 02/28/2024).

[66] CHADD, *When Depression Co-occurs with ADHD*, en-US. [Online]. Available: https://chadd.org/adhd-weekly/when-depression-co-occurs-with-adhd/ (visited on 02/28/2024).

[67] N. I. of Mental Health (NIMH), *Depression*, en. [Online]. Available: https://www.nimh.nih.gov/health/topics/depression (visited on 02/28/2024).

[68] L. E. Knouse, I. Zvorsky, and S. A. Safren, "Depression in Adults with Attention-Deficit/Hyperactivity Disorder (ADHD): The Mediating Role of Cognitive-Behavioral Factors," *Cognitive therapy and research*, vol. 37, no. 6, pp. 1220–1232, Dec. 2013, ISSN: 0147-5916. DOI: 10.1007/s10608-013-9569-5. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4469239/ (visited on 02/28/2024).

[69] A. Lanata, G. Valenza, M. Nardelli, C. Gentili, and E. P. Scilingo, "Complexity Index From a Personalized Wearable Monitoring System for Assessing Remission in Mental Health," *IEEE Journal of Biomedical and Health Informatics*, vol. 19, no. 1, pp. 132–139, Jan. 2015, ISSN: 2168-2208. DOI: 10.1109/JBHI.2014.2360711. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/6912930 (visited on 03/02/2024).

[70] C. Tsirmpas, M. Nikolakopoulou, S. Kaplow, *et al.*, "A Digital Mental Health Support Program for Depression and Anxiety in Populations With Attention-Deficit/Hyperactivity Disorder: Feasibility and Usability Study," EN, *JMIR Formative Research*, vol. 7, no. 1, e48362, Oct. 2023. DOI: 10.2196/48362. [Online]. Available: https://formative.jmir.org/2023/1/e48362 (visited on 03/02/2024).

[71] D. Richards, L. Timulak, E. O'Brien, *et al.*, "A randomized controlled trial of an internet-delivered treatment: Its potential as a low-intensity community intervention for adults with symptoms of depression," *Behaviour Research and Therapy*, vol. 75, pp. 20–31, Dec. 2015, ISSN: 0005-7967. DOI: 10.1016/j.brat.2015.10.005. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0005796715300450 (visited on 03/02/2024).

[72] Y. S. Can, B. Arnrich, and C. Ersoy, "Stress detection in daily life scenarios using smart phones and wearable sensors: A survey," *Journal of Biomedical Informatics*, vol. 92, p. 103 139, 2019, ISSN: 1532-0464. DOI: https://doi.org/10.1016/j.jbi.2019.103139. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S1532046419300577.

[73] M. L. González Ramírez, J. P. García Vázquez, M. D. Rodríguez, L. A. Padilla-López, G. M. Galindo-Aldana, and D. Cuevas-González, "Wearables for stress management: A scoping review," en, *Healthcare*, vol. 11, no. 17, p. 2369, Aug. 2023, ISSN: 2227-9032. DOI: 10.3390/healthcare11172369. [Online]. Available: https://www.mdpi.com/2227-9032/11/17/2369 (visited on 03/04/2024).

[74] B. A. Hickey, T. Chalmers, P. Newton, *et al.*, "Smart devices and wearable technologies to detect and monitor mental health conditions and stress: A systematic review," *Sensors*, vol. 21, no. 10, 2021, ISSN: 1424-8220. DOI: 10.3390/s21103461. [Online]. Available: https://www.mdpi.com/1424-8220/21/10/3461.

[75] Z. Cao, C.-T. Lin, W. Ding, M.-H. Chen, C.-T. Li, and T.-P. Su, "Identifying ketamine responses in treatment-resistant depression using a wearable forehead eeg," *IEEE Transactions on Biomedical Engineering*, vol. 66, no. 6, pp. 1668–1679, 2019. DOI: 10.1109/TBME.2018.2877651.

[76] N. Narziev, H. Goh, K. Toshnazarov, S. A. Lee, K.-M. Chung, and Y. Noh, "Stdd: Short-term depression detection with passive sensing," en, *Sensors*, vol. 20, no. 5, p. 1396, Jan. 2020, ISSN: 1424-8220. DOI: 10.3390/s20051396. [Online]. Available: https://www.mdpi.com/1424-8220/20/5/1396 (visited on 03/11/2024).

[77] M. Elgendi and C. Menon, "Assessing anxiety disorders using wearable devices: Challenges and future directions," *Brain Sciences*, vol. 9, no. 3, 2019, ISSN: 2076-3425. DOI: 10.3390/brainsci9030050. [Online]. Available: https://www.mdpi.com/2076-3425/9/3/50.

[78] Interaction Design Foundation, *What is quantitative research?* 2024. [Online]. Available: https://www.interaction-design.org/literature/topics/quantitative-research (visited on 02/27/2024).

[79] H. Sharp, J. Preece, and Y. Rogers, *Interaction Design: Beyond Human-Computer Interaction*, 5th ed. Indianapolis, IN: John Wiley and Sons, 2019, ISBN: 9781119547259.

[80] Interaction Design Foundation, *What is Qualitative Research?* 2024. [Online]. Available: https://www.interaction-design.org/literature/topics/qualitative-research (visited on 02/27/2024).

[81] J. W. Creswell, *Research design: qualitative, quantitative, and mixed methods approaches*, 3rd ed. Thousand Oaks, Calif: Sage Publications, 2009, OCLC: ocn192045753, ISBN: 9781412965569, 9781412965576.

[82] R. Timans, P. Wouters, and J. Heilbron, "Mixed methods research: What it is and what it could be," en, *Theory and Society*, vol. 48, no. 2, pp. 193–216, Apr. 2019, ISSN: 1573-7853. DOI: 10.1007/s11186-019-09345-5. [Online]. Available: https://doi.org/10.1007/s11186-019-09345-5 (visited on 02/27/2024).

[83] N. C. Jenn, "Designing A Questionnaire," en, *Malaysian Family Physician : the Official Journal of the Academy of Family Physicians of Malaysia*, vol. 1, no. 1, p. 32, 2006. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4797036/ (visited on 02/27/2024).

[84] M. Q. Patton, *Qualitative research and evaluation methods*, 3 ed. Thousand Oaks, Calif: Sage Publications, 2002, ISBN: 9780761919711.

[85] M. Rosala and K. Pernice, *User Interviews 101*, en. [Online]. Available: https://www.nngroup.com/articles/user-interviews/ (visited on 02/27/2024).

[86] J. Löwgren and E. Stolterman, *Thoughtful Interaction Design - A Design Perspective on Information Technology*, eng. Cambridge: The MIT Press, 2019, OCLC: 1191035769, ISBN: 9780262256575.

[87] D. H. Mortensen, *How to Do a Thematic Analysis of User Interviews*, 2024. [Online]. Available: https://www.interaction-design.org/literature/article/how-to-do-a-thematic-analysis-of-user-interviews (visited on 02/27/2024).

[88] V. Braun and V. Clarke, "Using thematic analysis in psychology," en, *Qualitative Research in Psychology*, vol. 3, no. 2, pp. 77–101, Jan. 2006, ISSN: 1478-0887, 1478-0895. DOI: 10.1191/1478088706qp063oa. [Online]. Available: http://www.tandfonline.com/doi/abs/10.1191/1478088706qp063oa (visited on 02/27/2024).

[89] Y. Chun Tie, M. Birks, and K. Francis, "Grounded theory research: A design framework for novice researchers," *SAGE Open Medicine*, vol. 7, pp. 1–8, 2019, ISSN: 2050-3121. DOI: 10.1177/2050312118822927. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6318722/ (visited on 02/27/2024).

[90] V. Timonen, G. Foley, and C. Conlon, "Challenges When Using Grounded Theory: A Pragmatic Introduction to Doing GT Research," en, *International Journal of Qualitative Methods*, vol. 17, no. 1, p. 160 940 691 875 808, Dec. 2018, ISSN: 1609-4069, 1609-4069. DOI: 10.1177/1609406918758086. [Online]. Available: http://journals.sagepub.com/doi/10.1177/1609406918758086 (visited on 02/27/2024).

[91] V. Lopez and D. Whitehead, "Sampling data and data collection in qualitative research," *Nursing & midwifery research: Methods and appraisal for evidence-based practice*, vol. 123, p. 140, 2013.

[92] I. Etikan, "Comparison of convenience sampling and purposive sampling," en, *American Journal of Theoretical and Applied Statistics*, vol. 5, no. 1, p. 1, 2016, ISSN: 2326-8999. DOI: 10.11648/j.ajtas.20160501.11. [Online]. Available: http://www.sciencepublishinggroup.com/journal/paperinfo?journalid=146&doi=10.11648/j.ajtas.20160501.11 (visited on 05/16/2024).

[93] L. A. Palinkas, S. M. Horwitz, C. A. Green, J. P. Wisdom, N. Duan, and K. Hoagwood, "Purposeful sampling for qualitative data collection and analysis in mixed method implementation research," *Administration and policy in mental health*, vol. 42, no. 5, pp. 533–544, Sep. 2015, ISSN: 0894-587X. DOI: 10.1007/s10488-013-0528-y. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4012002/ (visited on 05/16/2024).

[94] Microsoft, *Transcribe your recordings - Microsoft Support*. [Online]. Available: https://support.microsoft.com/en-us/office/transcribe-your-recordings-7fc2efec-245e-45f0-b053-2a97531ecf57 (visited on 03/06/2024).

[95] "Miro: The Online Collaborative Whiteboard Platform," Miro. (), [Online]. Available: https://miro.com (visited on 05/24/2024).

[96] *NVivo*, en-US. [Online]. Available: https://lumivero.com/products/nvivo/ (visited on 02/27/2024).

A

Appendix: Interview Guide

Topic 1: Questions related to the participants background and demographic.

- Name
- Age
- Gender and pronouns
- Level of education
- Occupational status

Topic 2: Questions related to the participants ADHD and (some) perceived challenges.

- How do you experience your ADHD and what does ADHD mean to you?
- What is the biggest way ADHD affects your life?

Topic 3: Questions related to the participants usage patterns related to wearable technology.

- Do you use technology?
- Do you use technology to make your daily life easier?
- What kind of technology do you use regularly?

Topic 4: Questions related to the participants opinions about the Swedish health care system.

- Do you have a prescription for medication? Yes or no?
- Do you have any addictions? For example, coffee, soda, excessive/extreme exercise, snuff, smoking.
- Has the healthcare system helped you with your daily life since you received your diagnosis?
- Do you feel that you would have liked to receive more help than what you have gotten?

Topic 5: Questions related to the participants physical movement, including physical activity and lifestyle habits.

- Are you physically active?
- How often do you exercise?
- Why do you exercise? And if not, why not?
- How does physical activity help you in your daily life?

Topic 6: Questions related to the participants mental health, including recurrence and perceived patterns.

- Have you previously experienced depression, anxiety or stress? Diagnosed or not?
- How many times have you experienced longer periods of depression, anxiety or stress?