DESIGN INTERVENTIONS TO IMPROVE NECK PAIN PATIENTS' MOTIVATION FOR ENGAGING HOME EXERCISE PROGRAMS: KEY CONSIDERATIONS FOR A MOBILE HEALTH APP

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ABSTRACT

DESIGN INTERVENTIONS TO IMPROVE NECK PAIN PATIENTS' MOTIVATION FOR ENGAGING HOME EXERCISE PROGRAMS: KEY CONSIDERATIONS FOR A MOBILE HEALTH APP

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During the home-based rehabilitation stage of physiotherapy, patients are usually given photocopies or brochures with brief descriptions and pictures of the exercise programs they need to follow. This information is often insufficient to meet the patients' needs during their exercise routines, resulting in less effective treatment. This research focuses on the role of home exercise programs in enhancing the motivation and adherence of patients with neck pain. It aims to first understand the challenges and needs these patients face during home rehabilitation, and second to provide a design solution to boost their motivation to exercise at home. The research included interviews with both patients and experts, and the findings were analyzed using the Self Determination Theory's basic psychological needs: autonomy, competence, and relatedness. The study identified key elements that a mobile health application should include to improve patient motivation. These elements were found to be pain reduction, professional interaction, knowledge competence, social interaction, progress monitoring and goal achievement, and personalization. A prototype of a mobile application incorporating the following elements: personalization and autonomy; progress tracking and competence; social

support and relatedness; adaptive and interactive content; and integration with professional care was then designed in a digital environment. This prototype was evaluated by patients, who provided feedback on how well it met their expectations and how it could be further developed. The results of this research are thought to contribute to the treatment process of physiotherapists, mobile health application designers, and patients with neck pain.

Keywords: Neck Pain, Home Exercises, Interaction Design, User-Centered Design, Motivation

ÖZ

BOYUN AĞRISI HASTALARININ EVDE EGZERSİZ YAPMA MOTİVASYONUNU ARTIRMAYA YÖNELİK TASARIM MÜDAHALELERİ: MOBİL SAĞLIK UYGULAMASI İÇİN TEMEL UNSURLAR

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Fizyoterapi sürecinin evde rehabilitasyon aşamasında, hastalara genellikle egzersiz programlarının kısa açıklamaları ve resimlerini içeren fotokopiler veya broşürler verilir. Bu bilgiler, hastaların egzersiz rutinleri sırasında ihtiyaçlarını karşılamak için genellikle yetersizdir ve tedavinin daha az etkili olmasına yol açar. Bu araştırma, boyun ağrısı olan hastaların motivasyonunu ve uyumunu artırmada ev egzersiz programlarının rolüne odaklanmaktadır. Araştırmanın amacı, öncelikle bu hastaların evde rehabilitasyon sırasında karşılaştıkları zorlukları ve ihtiyaçları anlamak, ardından evde egzersiz yapma motivasyonlarını artıracak bir tasarım çözümü sunmaktır. Araştırma, hem hasta hem de uzman görüşmelerini içermekte olup, bulgular Öz-Belirleme Teorisi'nin temel psikolojik ihtiyaçları (özerklik, yeterlik ve ilişkili olma) doğrultusunda analiz edilmiştir. Çalışma, bir mobil sağlık uygulamasının hasta motivasyonunu artırmak için içermesi gereken temel unsurları belirlemiştir. Bu unsurlar ağrının azalması, profesyonel etkileşim, bilgi yeterliği, sosyal etkileşim, ilerleme takibi ve hedefe ulaşma ve kişiselleştirme olarak bulunmuştur. Kişiselleştirme ve özerklik; ilerleme takibi ve yeterlik; sosyal destek

ve ilişkililik; uyarlanabilir ve etkileşimli içerik; ve profesyonel bakım ile entegrasyon olarak belirlenen unsurları içeren bir mobil uygulamanın prototipi dijital ortamda tasarlanmıştır. Prototip hastalar tarafından değerlendirilmiş ve beklentilerini ne kadar karşıladığı ve nasıl daha da geliştirilebileceği konusunda geri bildirim alınmıştır. Araştırma sonuçlarının, fizyoterapistler, mobil sağlık uygulama tasarımcıları ve boyun ağrısı olan hastaların tedavi sürecine katkıda bulunabileceği düşünülmektedir.

Anahtar Kelimeler: Boyun Ağrısı, Ev Egzersizleri, Etkileşim Tasarımı, Kullanıcı Merkezli Tasarım, Motivasyon

My dear cousin, Suzan Önder, who always brings joy to my family and me with her presence, I wish to be as strong and cheerful as you in your absence.

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LIST OF ABBREVIATIONS

ABBREVIATIONS

GBD – Global Burden of Disease

EMS – Electrical Muscle Stimulation

HEPs – Home Exercise Programs

IASP – International Association for the Study of Pain

MSDs – Musculoskeletal Disorders

NDI – Neck Disability Index

NMES – Neuromuscular Electrical Stimulation

TENS – Transcutaneous Electrical Nerve Stimulation

TÜİK – Turkish Statistical Institute

WHO – World Health Organization

YLD – Years Lived with Disability

CHAPTER 1

INTRODUCTION

1.1 Background and Motivation for the Research

In the classification of chronic pain, the International Association for the Study of Pain (IASP) mentioned neck pain as cervical spinal pain as pain perceived anywhere in the posterior region of the cervical spine, from the superior nuchal line to the first thoracic spinous process. (Merskey, 1994). This topographical definition indicates that neck pain is usually sensed posteriorly (Yoshida et al., 2023). Chronic neck pain is a familiar sensation, often accompanied by irritation and hypersensitivity to passive and active movements, ligaments, and muscles. Neck pain revealed by clinical examination is similar to many other painful conditions of the musculoskeletal system (Ylinen, 2007).

Neck pain is a common health problem worldwide. Different epidemiological studies and evaluations of various health systems worldwide have obtained quantitative data and statistics about patients with neck pain. In Poland, one study found that more than 48% of respondents reported complaints of musculoskeletal disorders (MSDs) in the past 12 months, with neck pain being the most frequently reported symptom (17.05% of respondents) (Malińska et al., 2021). In addition, according to a literature review, neck pain is one of the most common musculoskeletal disorders, with an age-standardized prevalence rate of 27.0 per 1000 population in 2019. This literature review describes the global epidemiology and trends associated with neck pain. (Kazeminasab et al., 2022).

Mechanical neck pain also affects a large population in Turkey. According to statistics from the Turkish Statistical Institute (TÜİK) for 2016 to 2019, neck pain ranked as the second most common disease among individuals aged 15 years and over. Neck pain was reported or diagnosed more frequently than hypertension

among health issues (TÜİK, 2019). In 2022, when the types of diseases seen in individuals aged 15 years and over were analyzed, low back problems ranked first at 24.6%, followed by neck problems at 17.2%, hypertension at 16.1%, diabetes at 11.4%, and allergies at 9.6% (TÜİK, 2022).

The Turkish healthcare system has undergone significant reforms since 2003 to achieve universal health coverage and improve access to health services (Tirgil et al., 2018). In the Turkish Health System, neck pain treatment involves various approaches, including manual therapy (i.e., a hands-on, physical approach to treating multiple musculoskeletal and neuromuscular conditions), strength training, endurance training, and home-based rehabilitation (K. Demirel, personal communication, November 30, 2022). Home-based rehabilitation is prescribed after manual therapy for patients with high-level diagnoses (i.e., cervical hernia, compression of the cervical vertebrae) or as a whole process for patients with low-level pain (K. Çetin, personal communication, November 30, 2022). In the home-based rehabilitation process, although many different exercise approaches have been used in general, they all aim to reduce pain in weak muscles, strengthen, reduce the mechanical load on vertebral structures, increase conditioning, stabilize hypermobile segments, correct posture and improve movement (Jackson & Brown, 1983). Regular exercise is a therapeutic phase whose importance is emphasized during home-based rehabilitation processes. Exercise is a tool that has long been a significant treatment modality for chronic pain (Moffett & McLean, 2005).

Home exercise programs (HEPs) are plans given by physiotherapists to patients that outline specific exercises for individuals to perform at home-based rehabilitation (Argent et al., 2018). Home exercises are particularly beneficial for patients with chronic neck pain, with HEPs giving the most significant effect sizes on pain reduction when combined with another treatment (Nikander et al., 2006). Although HEPs can benefit those with mechanical neck pain, they come with meaningful challenges, primarily related to adherence problems. The World Health Organization (WHO) defines adherence as "the extent to which a person's behavior - taking medication, following a diet and implementing lifestyle changes - follows

the agreed recommendations of a health care provider." (Sabaté, 2003, p. 3). Lack of adherence to home exercise programs is when patients stop making significant progress in their recovery. Patients negatively affect the process by not adhering to exercise, limiting their progress, and delaying recovery.

In the current practices of the Turkish Health System, home exercise programs as part of the treatment recommendations are often distributed on paper-based brochures or on simple photocopy paper (K. Çetin, personal communication, November 30, 2022). This strategy may not engage and motivate the user to participate in the workouts. Patients may face periods of frustration or discouragement that can prevent them from continuing their rehabilitation. Poor adherence is one of the main reasons for inadequate treatment outcomes (Turk & Rudy, 1991). It is important to use strategies that prescribe exercises and inspire and support patients to stick to their home exercise program. Motivating patients to adhere to home exercise programs is crucial to successful rehabilitation.

It is necessary to engage the patient in treatment with different methods. A study examining the effects of written, illustrated, and oral reinforcement paper prescriptions found that various approaches to giving patients instructions for at-home exercises had varying outcomes (Schneiders et al., 1998). As a result of a study, support from close relatives was related to facilitating adaptation to HEPs, so expanding it to a broader network in the community should be encouraged. This result shows the positive effects of community creation on patients (Okezue et al., 2019).

Integrating motivation strategies for developing products, systems, and services can be pivotal in sustaining patient adherence to home exercises. For example, Self Determination Theory (SDT), developed by Deci and Ryan (2000), is a psychological framework that delves into the underlying motivations driving human behavior and the conditions conducive to optimal development. SDT concerns itself with human motivation, personality, and optimal functioning rather than just the amount of motivation, and it focuses on different types of motivation

(B. Şener-Pedgley, ID734 Lecture Notes, March 22, 2023). This theory posits three fundamental psychological needs for an individual's well-being and intrinsic motivation. SDT seems especially useful in the design process as it gives designers a basis for providing the necessary factors that users look for in products/services (B. Şener-Pedgley, ID734 Lecture Notes, March 22, 2023). By aligning the features of the digital intervention with these psychological needs, the aim is to create an environment that not only addresses the specific physical challenges associated with mechanical neck pain but also develops a sense of empowerment and motivation in the user.

The rapid growth of technology and the increasing use of digital health interventions can also be pivotal in sustaining patient adherence to home exercises. For instance, Colombo et al. mentioned that by providing feedback on performance, the gaming elements included in the two rehabilitation robots helped keep patients' attention and interest high, and the exercises were accomplished (2007).

The motivation for this research on mechanical neck pain began with the researcher's dual role as a basketball player and coach. She completed her undergraduate graduation project (2018-19 Spring) with a project on athlete health, reflecting on her and her friends' injuries during their basketball years. Following this project, she began working at a medical company designing products for orthopedic patients. There, she observed the demotivation of patients during the home-based rehabilitation, realizing that this negatively impacts the recovery process. According to the researcher, motivation to adhere to home exercise programs is crucial for patients with neck pain. The research findings provide valuable insights into using digital health interventions to support patients with mechanical neck pain and inform the development of future design interventions in this area.

1.2 Aim and Objectives of the Research

The research aims to explore ways to increase motivation and engagement among patients receiving home rehabilitation for mechanical neck pain by investigating specific needs and challenges faced by patients. Also, it aims to present a comprehensive approach to designing a digital intervention by examining the foundations of SDT, exploring its applications in health technology, and targeting the unique needs of mechanical neck pain patients.

To fulfill these aims, the following objectives are set for the research: i) to examine the primary information sources from which patients acquire information during home-based rehabilitation, ii) to investigate how the three basic needs from SDT can serve as a foundation for enhancing patients' motivation and can be integrated into the design of a mobile digital health app for mechanical neck pain, and iii) to present the integration of a digital health application to home-based rehabilitation.

By addressing these objectives, the research aims to provide valuable information to improve the home-based rehabilitation experience of patients with mechanical neck pain, ultimately enhancing their treatment experiences and outcomes.

1.3 Research Questions

The research questions addressing the aim and objectives are as follows.

- What specific needs, challenges, and expectations do patients with mechanical neck pain encounter during treatment, especially in home-based rehabilitation?
- What are the primary ways patients acquiring information during home-based rehabilitation?
    - What are the patient's thoughts on the strengths and weaknesses of different information sources (e.g., HEP brochures, videos, etc.)?

- What are the primary motivation sources for engaging and adhering to home-based rehabilitation?
- How can a mobile health app be incorporated into home-based rehabilitation to support patients with mechanical neck pain?
    - How might the design of a mobile health app for mechanical neck pain be informed by the three basic psychological needs of Self Determination Theory while also serving to motivate patients?

1.4 Scope of the Research

This research focuses on the home-based rehabilitation experiences of patients aged 18 and older with mechanical neck problems. Participants were intentionally not selected based on pain levels, aiming to comprehensively capture patients' experiences across all pain levels. Rheumatic and infectious neck pain patients were excluded from the scope of this research. The research included patients who underwent a home exercise program for mechanical neck pain and received services from private or public health institutions in Turkey. The design recommendations of this research focus on mobile apps rather than products with which users physically interact, such as massagers and home equipment used during home exercise.

1.5 Structure of Thesis

The thesis is structured under six chapters, as detailed in the following.

Chapter 1: Introduction. This chapter presents an overview of the research background, which includes brief information about the definition of mechanical neck pain and statistics of mechanical neck pain worldwide and in Turkey. In addition, the treatment process of mechanical neck pain in the Turkish Health System provides brochures and home exercise programs in this process. The adherence problems faced by patients with mechanical neck pain during home-

based rehabilitation and motivation, research aims, objectives, research inquiries, and the overarching thesis structure are provided.

Chapter 2: Literature Review. This chapter has two parts; the first part briefly introduces the risk factors for, and problems caused by mechanical neck pain. It continues with a comprehensive review of the existing literature on home rehabilitation of neck pain. User experience literature for design recommendations is mentioned, exploring the role of digital health platforms in promoting physical well-being and motivation among patients. Positive design, positive technology, and motivational strategy (i.e., Self Determination Theory) are reviewed for motivation and well-being. In addition, second part includes the review of the existing mHealth app based on SDT.

Chapter 3: Methodology. This chapter presents the methods of the two-stage user research conducted as part of the research aimed at exploring ways to increase motivation and engagement among patients receiving home rehabilitation for mechanical neck pain. First one is consultation expert meetings, second one is patient interviews.

Chapter 4: Results and Analysis. This chapter presents the results and analysis of three-staged research and proposes design recommendations aimed at developing a mobile health application during home-based rehabilitation of patients with mechanical neck pain. The results of the research are discussed with a particular focus on the importance of patients' motivation. In addition, factors affecting user motivation when designing a digital health application using SDT are explained.

Chapter 5: Mobile App Design. This section includes the design process of a mobile application and eight participants' first impressions on the mobile app.

Chapter 6: Conclusion. In this final chapter, the research questions are revisited, and the researcher's reflections on the study are shared. Acknowledgment of the limitations of the research is made, and suggestions for future studies in digital health interventions for neck pain rehabilitation are offered.

CHAPTER 2

LITERATURE REVIEW

This chapter presented the literature review in two parts. The first part began with the review of existing academic literature that includes three headings. First heading 'Mechanical Neck Pain and Treatment Modalities' included the definition, causes, and problems associated with mechanical neck pain followed by treatment modalities, particularly the home-based rehabilitation process. At the end of the first part, the focus shifted to information sources used by patients with mechanical neck pain, including exercises and a review of materials related to exercise therapies delivered outside the clinical setting. The second heading reviewed designing for motivation through positive technology. The review covered the definition of motivation, motivation theories, factors contributing to a lack of motivation during home-based rehabilitation, methods for motivation during rehabilitation, and design for motivation through positive technology. This provided a foundation for the field, followed by a review of design for motivation, examples, and studies using Self Determination Theory (SDT) for motivation for adherence to home-based rehabilitation. The literature review concluded with a discussion on mechanical neck pain treatment and motivation through positive technology in home-based rehabilitation in the third heading. In addition to first part, second part was the reviewing of the existing mHealth app to understand the market.

PART I: Review of Existing Academic Literature

2.1 Mechanical Neck Pain and Treatment Modalities

Mechanical neck pain is felt in the posterior region of the cervical spine from the top of the neckline to the first thoracic spinal process (Merskey, 1994) (see Figure 2.1). As Ylinen (2007) noted, mechanical neck pain usually causes widespread tenderness and pain in the skin, ligaments, and muscles during the sensation of passive and active movements. Approximately half of all individuals experience at least one clinically significant episode of neck pain during their lifetime (Yoshida et al., 2023). In a commonly accepted and simplified explanation, mechanical neck pain is characterized by discomfort or stiffness in the neck, typically resulting from factors like poor posture, muscle strain, or overuse, rather than a specific injury or medical condition.

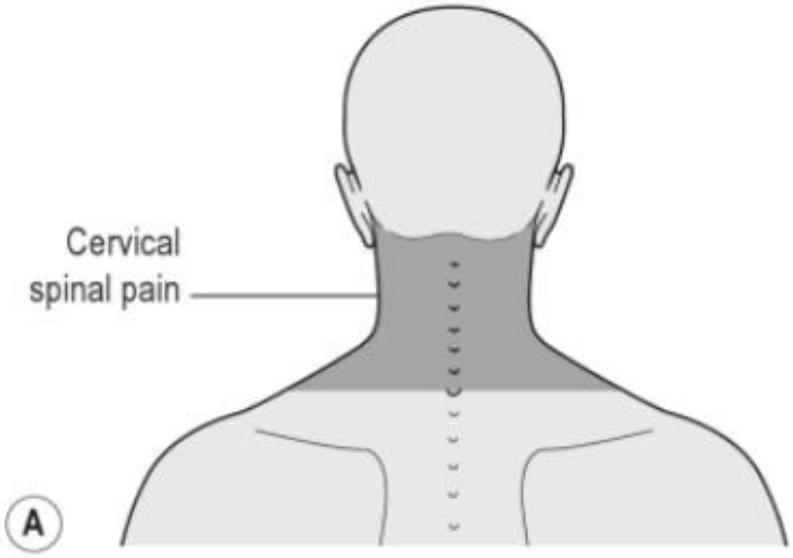


Figure 2.1. Demonstration of cervical spinal pain area (Fernández-De-Las-Peñas et al., 2015)

2.1.1 Prevalence of Mechanical Neck Pain

The analysis of Global Burden of Disease (GBD) 2019 data reveals that around 1.71 billion people globally suffer from musculoskeletal conditions, including lower back pain, neck pain, and fractures. Musculoskeletal conditions are prevalent across all ages and geographical regions, with a greater impact observed in high-income countries. These conditions contribute significantly to "years lived with disability" (YLDs) –a measure reflecting the impact an illness has on quality of life before it resolves or leads to death totaling approximately 149 million YLDs worldwide, making up 17% of all YLDs (Cieza et al., 2020).

Low back pain is the primary contributor to musculoskeletal conditions, affecting 570 million people globally and responsible for 7.4% of global YLDs. Other contributors include fractures, osteoarthritis, neck pain (222 million people; 22 million YLDs), amputations, rheumatoid arthritis, gout, and other musculoskeletal conditions (WHO, 2022). Using data from the Global Burden of Disease Study between 1990 and 2017, we reported point prevalence, annual incidence, and rates and trends in years lived with disability for neck pain in the general population of 195 countries. Among the countries assessed, Norway, Finland, and Denmark recorded the highest age-standardized point prevalence rates of neck pain in 2017, suggesting considerable geographical variation in the impact of the condition. The most significant increases in age-standardized point prevalence estimates from 1990 to 2017 were seen in the United Kingdom, Sweden, and Kuwait. Studies have reported different prevalence rates with estimates ranging from 7% to 86.8%. In addition, gender analysis showed a higher prevalence in women than men, although the difference was not statistically significant. In terms of age, prevalence peaked in the 70-74 age range and then declined. (Safiri et al., 2020; Son et al., 2013). Korhonen (2003) reported a 34.4% annual incidence of neck pain among office workers working with video imaging units. Furthermore, a study conducted in public sector universities of Faisalabad found that 36.4% had mild, 37.1% moderate, and 26.6% severe mechanical neck pain, (Gull et al., 2021). The

prevalence of chronic neck pain in Finland was reported to be 7% in women and 5% in men (Ylinen et al., 2003). Furthermore, the lifetime prevalence of neck pain is estimated to be between 67% and 71%, suggesting that approximately two-thirds of all individuals will experience neck pain at some point in their lives (Hoving et al.,2004).

Numerous people in Turkey are similarly suffering from mechanical neck pain. Neck pain was the second most common disease from 2016 to 2019, according to statistics compiled by the Turkish Statistical Institute (TÜİK). Among the health issues that TÜİK tracked, neck pain was reported or diagnosed more frequently than hypertension (2019). With a 20.5% ranking, an investigation of low back disorders came first in 2022. The most common conditions after problems with the low back were neck issues (17.2%), hypertension (16.1%), diabetes (11.4%), and allergies (9.6%) (TÜİK, 2022).

2.1.2 Risk Factors and Consequences

This part of the review examines the risk factors associated with mechanical neck pain and its consequences. The results are analyzed using the headings of commonly used questionnaires, such as the NDI and Bournemouth Neck Pain Questionnaire, as the main problems that patients may be facing.

Mechanical neck pain can affect individuals across various demographics. It is also a multifactorial condition influenced by various demographic factors. It can be influenced by for example, age, sex, pain intensity, disability levels, pain duration, mental distress, psychosomatic complaints, daytime tiredness, posture, occupation, and socioeconomic status (Xie et al., 2020; Jahre et al., 2020; Kazeminasab et al., 2022; Khired, 2022; Gull et al., 2021; Nandita et al., 2018; Chauhan et al., 2021; Aldukhayel et al., 2021; Jun et al., 2020; Jahre et al., 2021; Zheng et al., 2022). It has been reported that chronic nonspecific neck pain, a common type of mechanical neck pain, affects approximately two-thirds of the population

(Momenzadeh et al., 2022). Additionally, the prevalence of neck pain is higher in females compared to males (Zheng et al., 2022).

Understanding the risk factors is crucial for developing targeted interventions and management strategies for individuals affected by mechanical neck pain. Risk factors can be identified as either modifiable or non-modifiable. A risk factor is considered modifiable if measures can be taken by the individual patient or health professional to change it (e.g., depression, strength, posture). In contrast, non-modifiable factors suggest they cannot be changed (e.g., age, gender, heredity). Most reported risk factors are considered modifiable. (Kim et al., 2018). The review examines modifiable risk factors to understand similar patient behavior. Neck pain is a common problem involving numerous modifiable risk factors from physical and psychological domains.

Numerous physical risk factors contribute to neck pain. One of the most significant risk factors involves maintaining the body in an improper position for extended periods, serving various purposes under different conditions. A common contributor is the sustained adoption of a position than it should be, causing damage and pain. Prolonged bending of the neck can also place an excessive strain on the cervical spine. Approximately 14 % of all neck and upper limb pain cases in the community (and 12 % of 'severe' cases) can be attributed to prolonged neck bending. This continual stress on the neck muscles and structures may lead to discomfort and, over time, contribute to the development of neck pain (Sim et al., 2006). In everyday life, extended use of phones, extended periods spent looking at computers and screens while working and maintaining incorrect body positions during sleeping cause considerable pain. Factors such as prolonged work positions, repetitive movements, and poor posture have been associated with neck pain, particularly among office workers (Houle et al., 2021). Computer use in the office environment is associated with a high prevalence of complaints of upper (i.e., fingers, hands, wrists, elbows, arms, shoulders) and lower limbs, lower back, and especially musculoskeletal disorders, mostly related to the neck, both in developed and developing countries (Riccò et al., 2016).

In addition to subjective evaluation, pillow height has been shown to affect cervical spine alignment and muscle activity of the neck and shoulder (Radwan et al., 2021). Additionally, repeated lifting of heavy objects is a known risk factor for neck pain. Jobs or tasks that involve frequent and heavy lifting can lead to muscle fatigue and strain in the neck region, and the repetitive nature of this activity puts a considerable load on the cervical spine, potentially causing structural damage and discomfort. Adequate training, ergonomic considerations, and the implementation of proper lifting techniques are crucial in mitigating the risk associated with repeated heavy lifting, thereby reducing the likelihood of neck pain in occupational settings (Sim et al., 2006). The impact of sports movements was also acknowledged, with reports surfacing of neck strain resulting from improper execution of sports maneuvers or engaging in strenuous activities. It can be difficult to distinguish between an acute traumatic injury and an overuse injury that causes a traumatic injury in the acute setting. Therefore, inappropriate sports movements that cause immediate injuries should not be overlooked (Igolnikov et al., 2018). Also, for professional swimmers, occasional or frequent neck pain was present in 55 of 61 athletes (Rinonapoli et al., 2023). Sports involving prolonged bending positions, such as cycling, pose a risk for neck pain. Triathletes engaged in cycling, swimming, and running exhibit a high lifetime prevalence of approximately 48.3% (Farahbakhsh et al., 2018).

The psychological dimension of neck pain also affects the lives of patients. Stress and anxiety, common in today's fast-paced world, manifest physically as muscle tension in the neck and shoulders. The review revealed that various psychological factors associated with mood, self-assessed occupational distress, or work-life imbalance may contribute to neck pain (Kim et al., 2018). These findings emphasize the interaction between mental well-being and factors related to neck pain. Perceived stress is a risk factor for current pain, for pain development, and for the number of years with pain. Elevated work/study demands are associated with both existing pain and the duration of pain over the years, particularly when these demands negatively affect home life (Grimby-Ekman et al., 2009).

Mechanical neck pain has become a serious health and socioeconomic problem in the modern era. It is one of the leading causes of physical disability and approximately 70% of the population will experience neck pain in their lifetime. Neck pain is often associated with poor health, social impairment, psychological problems, and previous neck injuries (Tariq et al., 2020). Beyond being a source of physical discomfort, mechanical neck pain engenders a cascade of challenges that extend into various aspects of an individual's life. Neck pain is an unpleasant sensory and emotional experience in the neck area. Although not life-threatening, it can cause a feeling of unwellness and significant levels of pain.

According to the studies, neck pain index questionnaires determine how neck pain affects daily life. These questionnaires gather the opinions of the patients and determine their disability rates. These questionnaires draw attention to the challenges that patients face in their daily lives. For example, The Neck Disability Index (NDI) is a ten-item questionnaire based on the Oswestry Low Back Pain Index that assesses disability associated with neck pain and whiplash (Hains et al., 1998).

Essentially, the questionnaire recognizes that pain intensity and headache can underlie various difficulties, and addressing these specific areas provides a comprehensive assessment of how neck pain affects different aspects of daily functioning. In the ‘Personal Care’ section of the NDI Questionnaire, individuals rate their ability to attend to self-care-related daily tasks. The scale ranges from being able to manage personal care without causing extra pain to having trouble and slowness to requiring assistance for various aspects of self-care, ultimately culminating in an inability to get dressed, wash with difficulty, and remain in bed. The ‘Lifting’ section assesses the ability to lift weights, ranging from heavy weights without extra pain to an inability to lift or carry anything. The Reading section evaluates reading capabilities, ranging from being able to read without pain to severe pain causing an inability to read. In the ‘Concentration’ section respondents evaluate their ability to concentrate, ranging from no difficulty to an inability to concentrate. The Work section assesses work-related capabilities,

varying from being able to do as much work as desired to an inability to perform any work at all. The ‘Driving’ section examines the ability to drive a car, from driving without neck pain to a complete inability to drive due to severe neck pain. The ‘Sleeping’ section evaluates sleep disturbance, ranging from having no trouble sleeping to complete sleep disruption. The ‘Recreation’ section assesses engagement in recreational activities, from participating without neck pain to being unable to engage in any recreational activities due to neck pain.

According to a study by Lee (2016), in fulfilling daily activities, whether the activities are specifically neck-related or not, their usual pain ratings are based on disability questionnaires. In a separate study conducted by Tariq et al., (2020), the influence of neck pain on activities of daily living is highlighted, revealing challenges in self-care. Accordingly, of the 50 participants, 23 (46%) reported being able to care for themselves without pain, 20 (40%) reported being able to carry heavy loads without pain, and 25 (50%) reported feeling mild pain while reading. Approximately 19 (38%) participants reported mild difficulty concentrating, and 20 (40%) reported being able to drive a car with mild pain.

The NDI Headlines show how neck pain can affect users' lives. Subsequent sections within the NDI, covering the other eight domains: a. Personal Care, b. Lifting, c. Reading, d. Concentration, e. Working, f. Driving, g. Sleeping, and h. Recreation, collectively provide a nuanced understanding of the wider impact of mechanical neck pain on individuals' daily lives.

a. **Personal Care and Neck Pain.** Neck pain can significantly impact personal care activities such as washing and dressing. Individuals experiencing neck pain may find that these routine tasks become challenging, affecting their overall quality of life.

b. **Lifting and Neck Pain.** Neck pain can pose challenges in lifting activities, ranging from heavyweights to everyday objects. Individuals with neck pain

may experience discomfort or limited mobility when engaging in lifting tasks.

c. **Reading and Neck Pain.** Neck pain can impact reading abilities, influencing the comfort and ease with which individuals engage in this cognitive activity. The discomfort associated with neck pain may lead to decreased reading duration or hinder one's ability to concentrate.

d. **Concentration and Neck Pain.** Cervical discomfort may impact concentration levels, and individuals with neck pain may find it challenging to maintain focus and attention.

e. **Working and Neck Pain.** Neck pain can significantly affect work-related tasks, influencing productivity and overall job performance. Individuals with neck pain may experience limitations in their ability to carry out work duties, potentially leading to absenteeism or decreased efficiency.

f. **Driving and Neck Pain.** Neck pain can influence one's ability to drive comfortably and safely. The discomfort associated with neck pain may pose challenges in maintaining focus on the road and executing driving maneuvers.

g. **Sleeping and Neck Pain.** Neck pain can disrupt sleep quality and contribute to sleep disturbances. Individuals experiencing neck pain may struggle to find a comfortable position, leading to decreased sleep duration and quality.

h. **Recreation and Neck Pain.** Engaging in recreational activities may be hindered by neck pain, affecting an individual's ability to enjoy leisure pursuits. Neck pain can limit participation in sports, hobbies, and other forms of recreation.

While the NDI is the most used scale to assess disability in neck pain it primarily addresses pain and disability at the time, ignoring the consideration of cognitive and emotional factors. Furthermore, the psychosocial consequences of chronic neck pain should not be ignored. Beyond its immediate physical effects, it can lead to mental health problems (Özel Aslıyüce, 2018). Hence, the Bournemouth Neck Pain Questionnaire proves highly effective in reflecting the clinical progression of the patient. The questionnaire consists of seven questions probing the intensity of pain, inadequacy in activities of daily living, inadequacy in social activities, anxiety, emotional aspects of depression, kinesiophobia, and pain control (Bolton & Breen, 1999). The tendency to depression in individuals experiencing active pain depends on the severity of symptoms and may increase depending on its duration. Studies indicate a reciprocal relationship between mood disorders and chronic pain, where chronic pain can trigger mood disorders (Von Korff & Simon, 1996). Pain and depression are believed to share similar physiological mechanisms in the body and are thought to be transmitted to higher centers (Croft et al., 1995). For all these reasons, the psychological effects of mechanical neck pain should also be considered.

2.1.3 Treatment Modalities for Mechanical Neck Pain

Mechanical neck pain is a common issue faced by many individuals, and various approaches have been explored to address this problem. In the management of mechanical neck pain, the goal is to enhance the strength and endurance of both the deep and superficial cervical muscles. This involves increasing the flexibility of the cervical muscles, ensuring a normal range of motion of the joints to be able to move painlessly in daily life, and fostering the habit of maintaining proper posture to discourage actions that amplify the load on the cervical region. Treatment encompasses medical, surgical, and physiotherapy methods.

The most common physiotherapy methods for addressing mechanical neck pain include manual therapy applications, exercise therapy, and electrotherapy

(Thoomes et al., 2013). Manual therapy applications stand out as one of the approaches employed in physiotherapy for individuals suffering from mechanical neck pain. This approach involves the skilled use of hands-on techniques by trained healthcare professionals to assess, diagnose, and treat various musculoskeletal conditions affecting the neck. Manual therapy includes a range of methods such as mobilization, manipulation, soft tissue release, stretching, and motion exercises (Figure 2.2). Mobilization techniques involve low-velocity gradual forces to spinal joints in tolerable ranges that aim to restore joint function and alleviate pain. Neck manipulation involves the application of controlled, high-velocity force to spinal joints, specifically the cervical spine. It is commonly used to improve joint function and increase the range of motion, which can contribute to neck pain and restricted movement. A systematic review conducted by Gross et al. (2007) found that manual therapies, including both mobilization and manipulation, yielded positive outcomes in terms of Pain Reduction and functional improvement in adults with mechanical neck disorders. Cleland et al. (2018) reported that manual therapy, when combined with specific exercises, effectively reduced neck pain and improved neck-related disability. Recent reviews by Gross et al. (2010) highlighted the benefits of manipulation, mobilization, or exercise as valuable single-modal treatment approaches for individuals suffering from neck pain. Soft Tissue Techniques, such as myofascial release and trigger point therapy, are employed to address muscle tension and tightness in the neck and surrounding areas. Another method involves the incorporation of stretching and range of motion exercises within mechanical neck pain treatment plans, aiming to improve flexibility, reduce muscle tension, and enhance overall neck function.

Figure 2.2. Hands-on manual therapy (Fernández-De-Las-Peñas et al., 2015)

Exercise therapy has attracted attention in the management of mechanical neck pain. Specific exercise programs within exercise therapy show promise in alleviating chronic neck pain and improving functional outcomes. Ylinen et al. (2007) reported a significant reduction in neck pain because of stretching exercises performed twice weekly. Similarly, Lin et al., (2021) found that patients with chronic neck pain exhibited significant improvement in disability, pain, and isometric neck muscle strength after six weeks of exercise training.

The use of electrotherapy in the management of musculoskeletal conditions, including mechanical neck pain, has garnered considerable attention. This approach encompasses a range of modalities based on different principles, such as pain modulation, tissue healing, muscle relaxation, and neuromuscular re-education.

These include Transcutaneous Electrical Nerve Stimulation (TENS: pain relief via electrical impulses), ultrasound (tissue heating for healing), Electrical Muscle Stimulation (EMS: muscle stimulation for strength), and Neuromuscular Electrical Stimulation (NMES: targeted muscle contraction for rehab), among others.

A comprehensive strategy compassing medical interventions, physiotherapy, and exercise is implemented to address neck pain and improve the overall well-being of affected individuals. This endeavor within the healthcare system aims not only to alleviate pain but also to improve the functional capacity of patients dealing with the challenges posed by mechanical neck pain. In cases of chronic neck pain, the objectives are to enhance the strength and endurance of the both deep and superficial cervical muscles, to increase the flexibility of the superficial cervical muscles, restore normal range of motion, enable pain-free movement in daily life, foster the habit of maintaining proper posture, and discourage movements that increase the load on the cervical region (Özel Aslıyüce, 2018). The positive effects of home-based rehabilitation on physical function and disability have been demonstrated across various health conditions. Research indicates that home-based rehabilitation is associated with improvements in mobility, daily activity, instrumental activity, and balance, especially in hip fracture and stroke cases (Wu et al., 2018). Moreover, home-based rehabilitation programs have proven to be cost-effective, with increased patient participation due to the convenience of performing exercises at home (Akıncı & Olgun, 2011; Lee & Lee, 2021). Various exercises, such as aerobic exercises, strength and flexibility training, muscle relaxation exercises, posture correction exercises, and proprioceptive exercises, are effective in treating individuals with neck pain (Moffett & McLean, 2005). Exercises are planned by the clinician to increase muscle strength and endurance, increase mobility, and correct proprioception and posture disorders (Dusunceli et al., 2009).

2.1.3.1 Home-based Rehabilitation

Home-based rehabilitation refers to the delivery of rehabilitation services to individuals in their homes with professional interventions. It extends beyond the traditional confines of clinical settings by providing individuals with the tools and guidance to perform prescribed exercises in the familiar and supportive environment of their home. Interdisciplinary home rehabilitation has demonstrated promising outcomes in improving independence in activities of daily living for older individuals recovering from hip fractures (Johannason et al., 2021). The effectiveness of home rehabilitation has been observed in diverse conditions, including chronic obstructive pulmonary disease (COPD) and cardiac rehabilitation.

Wolin et al. (2012) suggest that exercise can be considered a therapeutic intervention with physiological effects, like its role in other clinical settings. Fu Levine (2018) advocates the consideration of exercise and non-pharmacological interventions for patients with postural orthostatic tachycardia syndrome, emphasizing their simplicity, cost-effectiveness, and minimal side effects. Studies indicate that home-based rehabilitation can be as effective as, or even more effective than center-based rehabilitation in terms of readmission rates, activities of daily living (ADL), and social functioning (Siemonsma et al., 2014). Home-based cardiac rehabilitation programs have also been found to have a greater potential to improve the recovery and health of cardiac patients in the long term (Nso et al., 2022). In Sweden, older adults reported that home rehabilitation provided a sense of security and improved their home care, positioning them as an active and integral part of the rehabilitation process (Johansson et al., 2021).

The convenience and accessibility of home-based rehabilitation not only increases the practicality and sustainability of the treatment but also fosters a deeper sense of patient involvement and commitment. Thus, it can be interpreted that home-based implementation of rehabilitation can be much more effective for patients. Empowering patients to regularly exercise at home provides them with a better

insight into the recovery process. Consequently, they become more aware of their actions and feel more comfortable practicing exercises in a setting outside of a hospital environment. Von Koch et al. (1998) mention that the biggest difference in patient behavior is that patients observed at home take initiative and express their goals.

This underscores the impact of implementing home-based rehabilitation in a patient's daily life on the recovery process. It has also been emphasized that the effectiveness of home-based rehabilitation can be maximized by providing comprehensive guidance including exercise, education, motivational support, and environmental modification based on the knowledge of rehabilitation professionals and the values of the patients (Lee & Lee, 2021). Home-based rehabilitation is emerging as a transformative and holistic phase in the rehabilitation continuum. Kuan Chua et al. (2021) argues that a 6-week home exercise program, including group training, neck muscle stretching, and endurance exercises, can improve neck mobility, muscle strength, and endurance and thus reduce neck disability in individuals with non-specific neck pain.

Home-based rehabilitation encompasses a wide array of materials and interventions aimed at maximizing the functionality of patients within the comfort of their homes. The implementation of home-based rehabilitation programs is influenced by several determinants, including the commitment of professionals and a smooth transition to the home environment (Siemonsma et al., 2014). These programs can be categorized into different fields, such as home aids/modification, home nursing and family help, social support, home-based primary care, and novel models/methods (Rezaei et al., 2019). Additionally, the incorporation of telerehabilitation programs at home has been associated with earlier discharge from rehabilitation hospitals and long-term therapy for patients far from rehabilitation facilities (Piron et al., 2008).

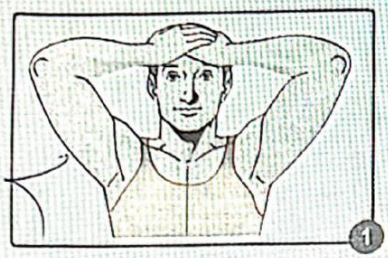
Paper-based HEPs are a vital component of rehabilitation and physiotherapy, typically tailored by professionals to meet the specific needs of individual patients.

These programs are typically provided on paper handouts and aim to encourage patients to take responsibility for their health and recovery. To gain a deeper insight into instructional materials like paper-based home exercise programs within the context of home-based rehabilitation, a two-page instruction form from the Ministry of Health in the Turkish health system was examined as an illustrative example (see Figures 2.3 a, b, and full-size visuals can be seen in Appendix A).

FORM

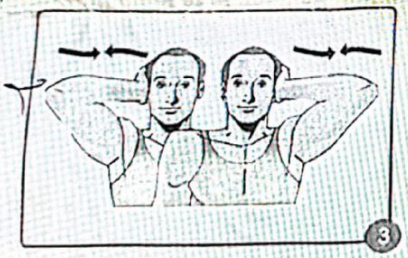
BOYUN EGZERSİZLERİ

DOKÜMAN NO: HB.FR.012	YAYIN TARİHİ: 11.08.2010	REV. TAR./REV. NO:02.02.2016/02	Sayfa 1 / 2



Ellerinizi alnınıza koyun, başınızı öne doğru itmeye çalışırken, ellerinizle engel olmaya çalışın

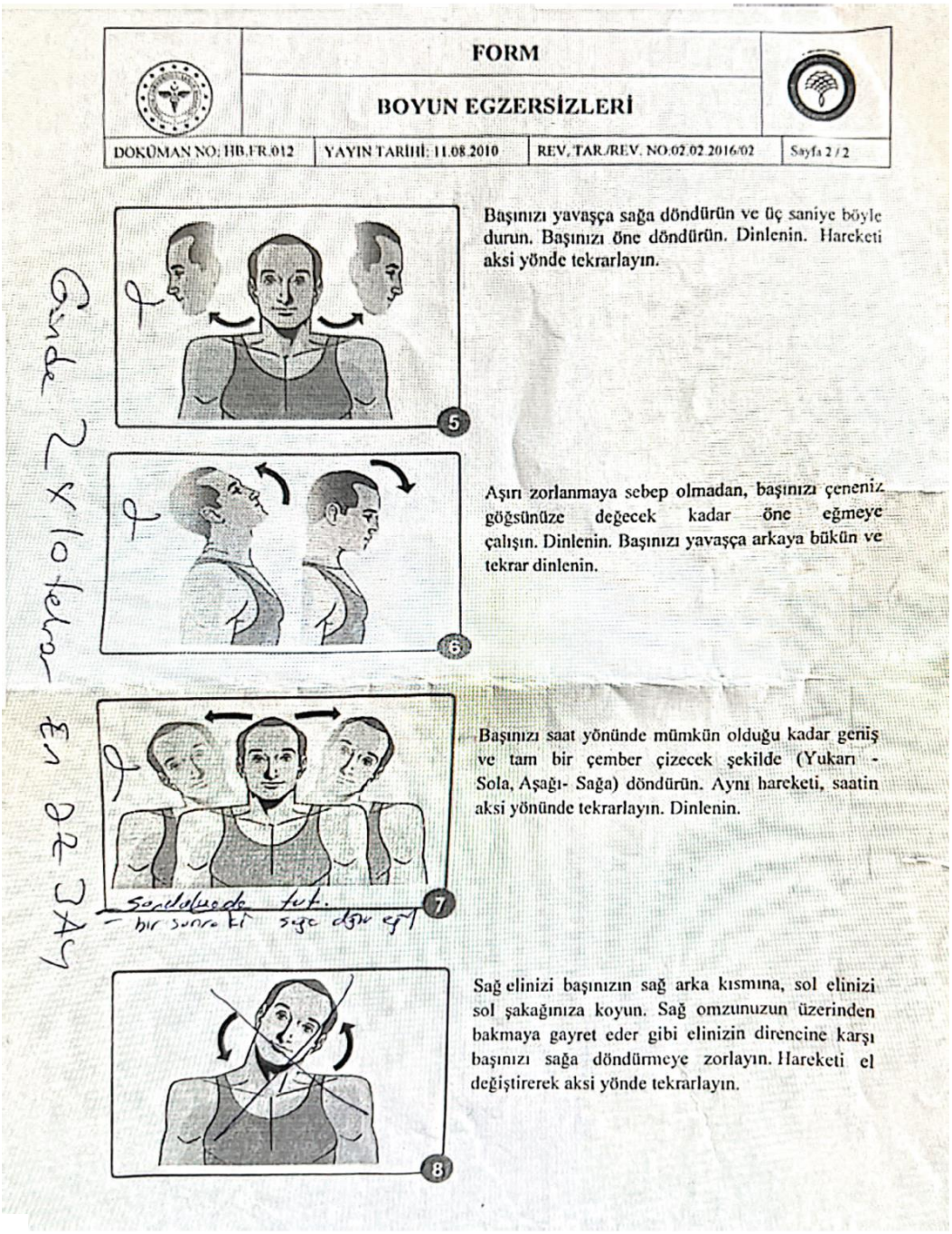
Ellerinizi başınızın arkasına (enseye değil) koyun ve başınızı arkaya itmeye çalışırken, ellerinizle engel olmaya çalışın.



Sağ elinizi yüzünüzün sağ tarafına koyun ve başınızı sağa doğru itmeye çalışırken, sağ elinizle engel olmaya çalışın. Aynı hareketi bu defa sol elinizle sola doğru tekrarlayın.

Sağ elinizi başınızın sağ arka kısmına, sol elinizi sol şakağınıza koyun. Sağ omzunuzun üzerinden bakmaya gayret eder gibi elinizin direncine karşı başınızı sağa döndürmeye zorlayın. Hareketi el değiştirerek aksi yönde tekrarlayın.

a.



FORM

BOYUN EGZERSİZLERİ

DOKÜMAN NO: HB.FR.012	YAYIN TARİHİ: 11.08.2010	REV. TAR./REV. NO:02.02.2016/02	Sayfa 2 / 2

Başınızı yavaşça sağa döndürün ve üç saniye böyle durun. Başınızı öne döndürün. Dinlenin. Hareketi aksi yönde tekrarlayın.

5

Aşırı zorlanmaya sebep olmadan, başınızı çeneniz göğsünüze değecek kadar öne eğmeye çalışın. Dinlenin. Başınızı yavaşça arkaya bükün ve tekrar dinlenin.

6

Başınızı saat yönünde mümkün olduğu kadar geniş ve tam bir çember çizecek şekilde (Yukarı - Sola, Aşağı- Sağa) döndürün. Aynı hareketi, saatin aksi yönünde tekrarlayın. Dinlenin.

7

Sağ elinizi başınızın sağ arka kısmına, sol elinizi sol şakağınıza koyun. Sağ omzunuzun üzerinden bakmaya gayret eder gibi elinizin direncine karşı başınızı sağa döndürmeye zorlayın. Hareketi el değiştirerek aksi yönde tekrarlayın.

8

b.

Figures 2.3. a. First page of neck exercises information sheet; b. Second page of neck exercises information sheet

Considering the usage of paper-based home exercise programs has been a traditional approach for rehabilitation, but recent studies have compared their effectiveness with other methods, such as mobile video-guided programs and tablet-based training. Chung et al. (2020) conducted a study comparing the effectiveness of mobile video-guided and paper-based home exercise programs for patients with stroke. The study aimed to assess exercise adherence, self-efficacy, and functional outcomes over a three-month follow-up period. The results of the study demonstrated the effectiveness of the video-guided exercise program in improving exercise adherence, self-efficacy, and functional outcomes compared to the instructions given on a standard paper-based home exercise program. Similarly, in Bizzarini et al.'s (2022) study, a mobile app for home-based exercise was compared to using Fisiofriend against traditional paper-based exercise instructions over a 6-week intervention focusing on upper limb exercises. Fourteen male SCI subjects participated, divided evenly into two groups: one using the app (APP group) and the other using paper instructions (PAPER group). The study concludes that using a mobile app like Fisiofriend is feasible for home-based exercise programs for SCI patients. The physiological outcomes were positive for both groups, yet the data from questionnaires suggest a potential subjective benefit for those in the APP group. This group rated the app more favorably regarding its pleasantness, engagement, and perception. In addition, in the context of stroke rehabilitation, home-based telerehabilitation has emerged as a novel and effective approach, offering convenience and cost-effectiveness while being as effective as conventional rehabilitation (Chen et al., 2018). Moreover, the provision of instructional videos demonstrating the rehabilitation process and exercises has been identified as a valuable component of home-based rehabilitation, particularly in the context of anterior cruciate ligament reconstruction (Rhim et al., 2020).

Traditionally, patients are given written notes and pictures as reminders when prescribing home exercises. However, these paper-based programs can sometimes be difficult for patients to follow. The way information is presented can make a difference in terms of recall and compliance, and visual information alone seems to

be more useful than verbal information (Emmerson et al., 2016). However, several limitations can affect the effectiveness of such paper-based instructions. Paper-based instructions rely heavily on static images and text descriptions. This can make it difficult for some users to understand the precise movements required, especially if the exercises are complex or require movement in multiple planes. Static images and text are less engaging than interactive or video-based instructions.

Lack of interactivity can reduce motivation and adherence to the exercise program, which is crucial for exercises to be effective. One of the most important disadvantages of paper-based instruction is the lack of feedback. Users may accidentally exercise using poor technique, which can lead to reduced effectiveness and even injuries. In contrast, digital platforms can sometimes offer real-time feedback. Paper-based exercise programs are often generic and may not be tailored to the individual needs of the user. This can reduce the effectiveness of the exercise program, as individual differences in physical abilities, limitations, and goals are not considered. It is more difficult to track progress with paper instructions, as there is typically no built-in mechanism for recording repetitions, resistance levels, or subjective effort. The limitations of paper-based home exercise programs have been highlighted in several studies. It has been shown that patients undergoing upper limb stroke rehabilitation derived limited benefit from paper-based home exercise programs (Swanson et al., 2023). Furthermore, the limitations of traditional paper-based methods in delivering home exercise programs for children with disabilities compared to an online exercise prescription tool have been highlighted (Johnson et al., 2020).

A systemic review of the effectiveness of home exercise interventions has shown that digital interventions can increase adherence to home exercise programs in the short term. The research included ten randomized controlled trials in a variety of clinical populations including various musculoskeletal complaints and stroke conditions. In seven of these studies, digital interventions statistically significantly increased adherence to exercise programs. However, the quality of these data

ranges from low to moderate and does not provide clear evidence of long-term effects. The use of digital tools for home exercise offers unique advantages to participants. Firstly, these tools, especially mobile apps, are easily accessible through smartphones that users always carry with them. The quality images and videos offered by these apps allow users to learn exercise techniques correctly, which can increase the effectiveness of exercise while reducing the risk of injury. Furthermore, such content can increase comprehensibility and therefore motivation, especially for users with visual and auditory learning styles.

On the other hand, digital tools offer an adaptive experience according to users' personal preferences. Users can choose their preferred types of exercise, set personal goals, and track their progress. For example, apps such as MyFitnessPal and Strava allow users to plan their exercise routines, track nutrition, and interact with other users through social features. These personalization and calendaring features allow users to develop a routine that suits them and set reminders to motivate them. Furthermore, thanks to social media integration, users can share their achievements with friends, providing an additional source of motivation. This is a concrete example of how digital tools can be more effective in the home exercise era, enabling users to maintain and even improve their exercise habits.

2.2 Designing for Motivation through Positive Technology in Home-Based Rehabilitation

Design for motivation is a critical aspect of developing interventions that encourage individuals to actively participate in their rehabilitation journey and involves creating environments, systems, or products that inspire individuals to act, persist in their efforts, and achieve their goals. Design strategies for user engagement may differ depending on the context of use, the nature of the targeted interactive systems, the intended use, and extrinsic and/or intrinsic motivators (Chasanidou, 2018). Whether in the form of mobile applications, interactive platforms, or wearable devices, incorporating motivational design elements can

significantly impact user engagement. Design for motivation draws upon principles from psychology and human-computer interaction to understand what drives human behavior and how to design interventions that encourage positive outcomes. By incorporating elements of positive psychology into technology design, positive technology seeks to support users in leading more fulfilling and meaningful lives. The ability of Positive Technology to enhance motivation is crucial for the individual's personal development and has broader implications for societal well-being.

In connection with this, this chapter will address the definition of motivation, theories of motivation, issues related to lack of motivation during home-based rehabilitation, and a review of previous studies on motivation for home-based rehabilitation. Following this, the application of SDT in designing for motivation, the role of positive technology, and integrating technology to enhance motivation will be presented. This chapter presents the relationships between motivation, positive technology, and home-based rehabilitation under two main headings, Motivation and Engagement in Home-Based Rehabilitation and Positive Technology and Implementation in Home-Based Rehabilitation, to illuminate this research.

2.2.1 Motivation and Engagement in Home-Based Rehabilitation

Motivation and engagement are crucial factors in the success of home-based rehabilitation programs. Motivation can be defined as the driving force that energizes, directs, and sustains behavior toward achieving specific goals or fulfilling certain needs (Ryan & Deci, 2000). It is influenced by a combination of individual characteristics such as personality, beliefs, attitudes, and abilities, as well as environmental factors (Urdan, 2023).

This section examines Motivation and Engagement in Home-Based Rehabilitation under the headings, Understanding Patient Motivation Within Home-Based

Rehabilitation, Motivation Theories Application in Home-Based Rehabilitation, and Self Determination Theory and Implementation in Home-Based Rehabilitation. Although SDT has begun to appear in different fields, it does not appear rarely in the field of design (Şener et al., 2022). For this reason, it was examined as a third heading to include SDT in the design processes and to present the outputs on this subject.

2.2.1.1 Understanding Patient Motivation Within Home-based Rehabilitation

Home-based rehabilitation offers several advantages, such as aligning the rehabilitation process with the patient's daily activities and increasing accessibility to rehabilitation services (Steihaug et al., 2016). However, addressing the barriers and challenges associated with home-based rehabilitation is essential, such as lack of motivation. Lack of motivation has been highlighted as a key reason for poor compliance in-home rehabilitation, indicating its significance as a predictor of rehabilitation outcome (Goršič et al., 2017). Depending on the definition, the number of patients completing exercise prescriptions varies; however, despite these differences, estimates are expected to have a compliance rate of 50% or less (Sluijs et al., 1993; Iversen et al., 2003). Additionally, research mentions the need to understand patients' experiences with home-based rehabilitation, focusing on facilitators and barriers, to enhance its effectiveness (Poulsen et al., 2022). This section includes the importance of motivation during home rehabilitation and factors affecting participation.

The impact of motivation on rehabilitation outcomes has been recognized in various medical conditions, including schizophrenia, where motivation is considered essential for functional outcomes (Choi et al., 2014). Patient perspectives on home-based rehabilitation have revealed that motivation plays a crucial role in driving participation and influencing the desired effects for older adults (Johansson et al., 2021). Furthermore, the effectiveness of nurse-led, home-

based pulmonary rehabilitation in patients with COPD indicated the potential of such interventions in a home setting (Akinci & Olgun, 2011). Stressed the importance of comprehensive guidance in home-based rehabilitation, including exercise, education, motivational support, and environmental modification, to maximize its effectiveness for patients undergoing hip fracture surgery (Lee & Lee, 2021). Studies have emphasized the critical role of motivational elements in increasing the duration and intensity of exercise during home rehabilitation Goršič et al. (2017).

According to a study, different reasons for adherence to home-based rehabilitation, and exercise programs are defined. These included adherence to previous Home Exercise Programs (HEPs) environmental factors, self-efficacy, clarification of doubts, satisfaction, and good adherence to the duration component. In contrast, there were fewer univariate associations for adherence to duration, including participation in another HEP and low adherence, fit of exercises into daily routine, emotional support, self-efficacy, and supervision (Medina-Mirapeix et al., 2009). Patient characteristics such as socio-demographic variables, adherence history, motivation, and social support are the factors that affect directly the motivation. Additionally, the patient's illness and environment play a role, along with aspects related to the prescribed program and the healthcare provider (Bassett & Phty, 2003). Certain factors, such as perceived barriers related to daily routines or self-efficacy, have consistently emerged as predictors of adherence across various studies (Sluijs et al., 1993). On the other hand, factors like pain intensity are inconsistently implicated and show variability as predictors of adherence (Sluijs et al., 1993; Iversen et al., 2003). Studies have highlighted decreased tolerance, intentional or unintentional 'cheating,' and avoidance of rehabilitation exercises as consequences of reduced motivation Webster & Çelik (2014). Lack of motivation stands out as a critical factor affecting adherence to prescribed exercises in home-based rehabilitation for mechanical neck pain. According to a systematic review, the following items are important to understanding the reason for patients' lack of motivation (Bachmann et al., 2017), a. Social support, b. Guidance, c. Several

exercises, d. Self-motivation, e. Self-efficacy, f. Previous adherence behavior, g. Low level of physical activity or aerobic capacity at baseline, h. Attention to exercise, i. Worsening pain during exercise, j. High levels of helplessness, depression, and anxiety.

a. **Social support.** The study found that inadequate social or familial support was a barrier to treatment adherence. Research shows that people can get more benefits from class-based exercise. The physical performance test had six tasks in all. However, only four were improved in the home-based group, whereas all six tasks were improved in the class-based group.

b. **Guidance.** In individuals with musculoskeletal pain, a lack of positive feedback from a physiotherapist emerges as an important determinant of non-adherence to a home exercise program integrated into physical therapy rehabilitation. In addition, it is possible to see the positive effects of physiotherapists and caregivers during home exercise. If physiotherapists and caregivers supervise patients during home exercise programs and give appropriate feedback, patients benefit from the exercises and adherence to home exercise programs.

c. **Several exercises.** It was noted that a high number of exercises in an exercise program leads to a lack of motivation for patients to participate.

d. **Self-motivation.** Self-motivation has been reported to directly influence exercise motivation.

e. **Self-efficacy.** One study demonstrated that patients with greater self-efficacy tend to be more adherent to outpatient physical therapy.

f. **Previous adherence behavior.** Patients who have previously shown good adherence or poor adherence to home-based exercise are more likely to be currently adherent.

g. **Low level of physical activity or aerobic capacity at baseline.** Patients undergoing home-based exercise are more likely to adhere to the home-based exercise program if they were physically active at baseline.

h. **Attention to exercise.** Possible barriers to exercise include not being able to fit exercise into daily life, forgetting to exercise and not finding the time.

i. **Worsening pain during exercise.** Worsening pain during exercise is a barrier to adherence to home exercises.

j. **High levels of helplessness, depression, and anxiety.** Depression, anxiety, and helplessness are also barriers to treatment adherence. One study confirms that depression can affect patients' adherence to home-based exercise.

The review suggests that different ways of delivering exercises to patients may encourage them to develop different approaches to increasing motivation and engagement. Hence, the following part reviews motivation theories and how these theories can be adapted to home-based rehabilitation.

2.2.1.2 Motivation Theories and Implementation in Home-Based Rehabilitation

In this part of the chapter, the concept of motivation in general, the approaches and tools used in similar concepts to home-based rehabilitation, and finally the previous studies focusing on the relationship between motivation and home-based rehabilitation are reviewed respectively. This chapter explored the application of several key motivational theories in the field of design, with a particular focus on product design and digital design. It is mentioned how a. Maslow's Hierarchy of Needs, b. Expectancy Theory, c. Flow Theory, d. Fogg Behavioral Model, e. Goal Setting Theory, and f. Gamification are integrated into design research and how they practically influence the development of products and digital experiences.

These theories provide a fundamental understanding of human motivation, guiding the creation of user-centered designs that increase engagement, satisfaction, and overall user experience.

a. Maslow's Hierarchy of Needs. Maslow's Hierarchy of Needs, introduced by psychologist Abraham Maslow, outlines a pyramid of human needs arranged in a hierarchical structure. At the base are physiological needs such as food and shelter, followed by safety, love/belonging, esteem, and self-actualization at the pinnacle. Abraham Maslow, an American sociologist, investigated how human needs influence actions, and developed a straightforward model to help predict motivation and behavior (1997). According to a study, Maslow's hierarchy of needs model has been used to improve the quality of life of older people. Abraham Maslow's hierarchy of needs model suggests that people seek to satisfy progressively higher human needs, starting from physical needs such as food and shelter, to safety and security, belonging and love, respect and self-actualization. It is important to consider the current need levels of users, the different needs of patients and caregivers, the degree of behavioral change expected at different need levels, and the unintended consequences of technologies. Insights from Maslow's model can help developers, researchers, providers, and consumers in the process of producing, evaluating, recommending, and purchasing technologies for older adults. Many technologies that aim to improve quality of life may not directly address specific needs such as health and independence. Various variables influence users' adoption of technologies that do not meet their current needs (Thielke et al., 2011). Maslow's hierarchy of needs is a framework that outlines human motivation from the most basic physiological needs to higher psychological needs, and it ends with self-actualization. This concept can guide user-centered design by ensuring that products meet basic user needs before addressing higher-level desires, thus increasing user satisfaction and engagement. Additionally, Maslow's original hierarchy of needs may not be directly related to design. However, it can be amended to provide a handy guide to the development of products that offer high levels of value to the user. Keeping the design hierarchy of

needs in mind during your design projects will result in better user experiences (Needs Before Wants in User Experiences – Maslow and the Hierarchy of Needs., 2016). According to a study, basic needs are a powerful source for product redesign and idea generation. Because the set of basic human needs represents a set of fundamental drivers of human behavior, it offers designers insight into (almost) everything people might want to get out of the product experience. In addition, developing products with sub-needs based on basic needs also positively affects user motivation. An example of a design based on this strategy is designer Karen Gonzalez's Journey to Yourself fitness tracking app. The original design met the need for fitness by focusing on the sub-need for physical exercise. Redesign according to needs shows that it has expanded the scope by meeting other fitness sub-needs such as the need for good nutrition and mental health (Desmet & Fokkinga, 2020).

b. Expectancy Theory. Expectancy theory and related expectancy-value theory have been rigorously researched and developed for over 80 years (Vroom, 1964; Lawler, 1971; Eccles & Harold, 1991; Gao et al., 2008). According to expectancy theory, a person's motivation to perform a particular task is influenced by how they perceive their ability to perform the task and the reward that will come from performing the task. It incorporates three key elements: effort-performance expectations, performance-reward expectations, and the attractiveness of the rewards. The theory underscores the importance of perceived connections between effort, performance, and rewards, emphasizing that individuals are most motivated when they believe their efforts will lead to a favorable outcome. According to research, if a person sees the link between effort and performance (expectancy) and the link between performance and reward (instrumentality) and values a nutritious diet, they should be motivated to have a healthy eating lifestyle and stick to it. The study states that effective consumer health promotion should present healthy eating as realistic and valuable, emphasize achievable outcomes, and provide the necessary support. According to the Expectancy Theory, motivation is influenced by the belief that effort will lead to certain outcomes, the expectation of rewards,

and the perceived value of those rewards. To successfully promote healthy eating, it should emphasize the achievability and value of outcomes and influence the motivational factors that drive behavior change (Blotnicky et al., 2015). According to another research study, the expectancy-value model suggests that expectancy beliefs are more related to actual achievement or performance, while incentives are more related to task selection in physical education and persistence in sports (Gao et al., 2008).

c. Flow Theory. Csikszentmihalyi (1975) was interested in understanding what makes an activity enjoyable and went on to investigate what motivates individuals such as amateur athletes, chess masters, rock climbers, dancers, and music composers to continue their activities in the absence of external rewards. Flow occurs when an individual's skill level matches the challenge presented by the task, resulting in an immersive and satisfying experience. This theory highlights the importance of balancing skill and challenge to maximize motivation and engagement in various activities, from work to leisure. Csikszentmihalyi's concept of flow, a state of complete immersion and focus, has been frequently applied to the design of interactive experiences. Technology that induces flow can significantly elevate a user's motivation and overall engagement with the tool (Csikszentmihalyi, 1990).

"To engender flow, technological interfaces must present challenges that are commensurate with the user's skill level, providing a balance that can captivate and motivate sustained interaction" (Nakamura & Csikszentmihalyi, 2002, p. 89).

According to research, it is crucial to eliminate negative thoughts and feelings to enhance children's participation in physical activities. Negative feedback and parental pressure have been linked to decreased interest in participation. Therefore, parents, coaches, and instructors should provide positive and constructive feedback to foster a stress-free environment. Physical education and sports should be positive experiences, allowing children to feel good about themselves and manage potential failures. Discouraging negative comments from peers and others is vital.

d. Fogg Behavior Model. Another important reference is the Fogg Behavior Model by Dr. BJ Fogg, which suggests that behavior change is most likely to occur when motivation, ability, and triggers converge. Designing for motivation according to this model involves making tasks easier to perform, increasing motivation through rewards or incentives, and prompting users at the right moment to act. Empirical studies have demonstrated that technology that provides immediate positive feedback can reinforce motivation and encourage habit formation. According to Fogg's Behavior Model, when a user's motivation intersects with ability and triggers, the likelihood of an action being taken increases (Fogg, 2009).

"Technological environments that offer immediate rewards and acknowledgments for users' actions can significantly bolster motivation, turning sporadic engagement into regular usage" (Fogg, 2009, p. 15).

e. Goal-Setting Theory. Pioneered by Edwin Locke and Gary Latham, Goal-Setting Theory asserts that specific and challenging goals lead to higher levels of motivation and performance (1990). The theory emphasizes the importance of setting clear, measurable objectives that individuals can strive to achieve. Goals provide direction and purpose, and when coupled with feedback and commitment, they enhance motivation and drive individuals to accomplish tasks with increased effort and focus. This theory has practical applications in organizational settings, where goal setting is a common strategy for improving performance and productivity. Single-subject studies incorporating difficulty were effective, but between-subject studies showed no significant differences. Specific goals in single-subject studies were mostly effective, while between-subject studies varied in their outcomes. Some studies showed improved outcomes when combining short- and long-term goals, while others found no significant differences between temporal considerations. Regarding goal types, two studies found that combining performance and outcome goals resulted in superior performance, while no significant differences were observed between process and performance goal groups.

f. Gamification. The concept of gamification, as described by Deterding et al., involves incorporating game elements (such as points, badges, and leaderboards) into non-game contexts to motivate and engage users. Designing for motivation using gamification principles can make tasks more enjoyable, increase engagement, and drive behavior change. Gamification, rewards systems, and personalized feedback are examples of motivational design strategies that can transform the rehabilitation experience into a more engaging and dynamic process. Signers can tailor interventions to inspire and sustain individuals' commitment to their rehabilitation routines by understanding the psychological and environmental factors and lack of motivation.

2.2.1.3 Self Determination Theory and Implementation on Home-Based Rehabilitation

The theoretical framework provided by SDT facilitates the categorization and systematic analysis of motivational factors. Incorporating SDT into the design process is seen as a methodical guide to facilitate the design process while being effective in discerning the nuances of user motivation. Hence, this research will examine the integration of SDT into home-based rehabilitation. Although SDT has started to appear in different fields and attracted the attention of design researchers, it is not very common in design processes. For this reason, it was decided to investigate SDT, include it in design processes, and present outputs in this study.

For designers, extrinsic motivation can motivate users to do various things or behave in certain ways. Therefore, SDT tells designers how to provide the necessary factors that users look for in products/services within the design processes (Şener et al., 2022). In addition, according to an end-of-course questionnaire regarding using SDT in the design process, half of the students stated that the SDT aspect adopted in the project was "definitely useful." In contrast, the remaining half stated that it was "useful". The survey showed that SDT helped students to empathize with the persona they had developed (Şener et al., 2022).

SDT, proposed by Deci and Ryan, is central to understanding the interplay between technology and motivation. SDT suggests that motivation quality is contingent upon the satisfaction of basic psychological needs: autonomy, competence, and relatedness (Deci & Ryan, 2000). When technology is designed to satisfy these needs, it can catalyze intrinsic motivation, leading to more profound and sustainable engagement (Ryan & Deci, 2017).

"*The application of SDT to technology use reveals that when users feel a sense of volition and connection to their actions while using technology, their intrinsic motivation is amplified"* (Ryan & Deci, 2017, p. 123).

According to the SDT, individuals have three fundamental psychological needs that, when satisfied, lead to higher self-determined motivation (Ryan & Deci, 2000b). Motivation can be intrinsic, stemming from internal desires and inherent reasons, or extrinsic, driven by external rewards or encouragement. These needs are competence, autonomy, and relatedness. Competence reflects the desire for mastery and effectiveness in producing outcomes. Autonomy pertains to the need for ownership over one's behavior and the freedom to choose which behaviors to engage in. Relatedness involves the desire for a sense of connection and security through social interaction. Autonomy, as the first need, emphasizes the importance of feeling in control, fostering intrinsic motivation. Competence reflects the desire for efficacy, and Relatedness highlights the necessity of connection with others. In the realm of design for well-being and motivation, the application of psychological frameworks is increasingly crucial for enhancing healthcare interventions and user engagement (Baumeister & Leary, 1995; Ryan & Deci, 2000b;). Designing for motivation involves incorporating elements that support these needs, such as providing choices (autonomy), offering challenges that match individuals' skills (competence), and fostering connections with others (relatedness).

Previous research has explored the relationship between SDT and the design of interventions to enhance motivation in a variety of contexts, including rehabilitation. SDT has received increasing interest and support for examining

people's motivation to exercise (Deci & Ryan, 1985). Studies have investigated how the incorporation of SDT principles into the design of home-based rehabilitation programs influences individuals' motivation levels and thus the outcomes of the rehabilitation process. Self-determination motivation was shown to predict future exercise behavior and positive exercise behavior. Relationships between need satisfaction and self-determined motivation were also observed, as predicted by Self Determination Theory (Russell & Bray, 2009). SDT proposes a motivational continuum from motivation to intrinsic motivation. When a person engages in a behavior because of inherent enjoyment, that person is intrinsically motivated, which is most representative of the self-determination order. At the other end of the spectrum, a person may be in a state of non-action, which is called motivation. Between motivation and intrinsic motivation, four types of extrinsic motivation are placed on a continuum based on how self-determined the arrangement is. The least self-determined is extrinsic regulation, followed by internalized regulation, defined regulation, and integrated regulation (Ryan & Deci, 2000a, 2000b).

Extrinsic regulation and internalized regulation are classified as "controlled" forms of extrinsic motivation. In the case of extrinsic regulation, behavior is performed to receive extrinsic rewards or to satisfy an extrinsic demand (e.g., one may have been advised to exercise by a doctor). Behaviors regulated by internalized regulation are performed to receive intrinsic positive reinforcement, e.g. feeling proud, or to avoid intrinsic negative reinforcement, e.g. feeling guilty. Often individuals may be externally motivated to engage in behaviors that may be self-determined, but not intrinsically motivated (Russell & Bray, 2009)

According to research conducted with cardiac rehabilitation patients, increased autonomy satisfaction during the program reduced motivation and external regulation and increased intrinsic motivation. Autonomy appears to be of central importance in the internalization of behavioral regulations for exercise. Competence satisfaction predicted an increase in intrinsic motivation, physical quality of life, habitual physical activity, and decreased depression during the

supervised CR exercise program. Increases in relationship satisfaction significantly predicted increases in identified regulation and mental well-being. Thus, feeling connected to the exercise environment may contribute to the internalization process whereby individuals begin to identify with the values of exercise (Rahman et al., 2015). According to a study conducted on young people and adults with physical disabilities, SDT process model was tested during a 3-week physical activity rehabilitation process. This study reveals that rehabilitation often focuses on the health requirements of physical activity, but autonomy support and autonomous motivation play an essential role for individuals with disabilities in their adoption of physical activity. Over time, participants will internalize the behavior becoming more autonomous and competent and more willing to make healthy behavioral changes and sustain these changes (Sæbu et al., 2013). Competence support includes providing tools for self-diagnosis and treatment, training participants in self-diagnosis and behavior change skills, and regularly sharing pain reduction outcomes. Autonomy support emphasizes providing a meaningful rationale, encouraging personal goal setting, acknowledging participants' feelings, and using persuasive language. Relationship support focuses on encouraging social interaction, facilitating shared experiences, and building rapport between researchers and participants. This comprehensive strategy aims to empower individuals to manage neck and back pain through SMR while promoting autonomy and a sense of community. The SDT-based motivational strategies were effective in motivating the participants to engage in the program (M. Lee et al., 2018).

2.2.2 Positive Technology and Implementation in Home-Based Rehabilitation

Positive Technology is a concept that refers to the application of technology to improve the quality of personal experience to enhance health and human potential. Positive technology is the application of technology to promote well-being and

enhance human potential (Seligman & Csikszentmihalyi, 2000). It focuses on utilizing technology to improve individuals' quality of life, mental health, and overall happiness. Positive technology aims to create tools and systems that foster positive emotions, engagement, relationships, and a sense of accomplishment. The theory underpinning Positive Technology is derived from Positive Psychology, which focuses on promoting positive emotions, developing individual strengths, and supporting mental health, as opposed to the traditional approach that focuses on treating mental illness. Seligman and Csikszentmihalyi argue that psychology should deal with human strengths as well as weaknesses, and this has important implications for technology design (2000). Focusing on motivation, Positive Technology aims to engage with users in a way that supports their psychological well-being rather than simply facilitating tasks. Also, it aims to the design and use of technology to improve the quality of personal experiences. The term underscores the potential of digital tools to foster well-being and enhance motivation (Riva et al., 2012).

2.2.2.1 Understanding Positive Technology and Effects on Motivation in Home-Based Rehabilitation

Motivation in the context of Positive Technology is often framed through the technologies that cater to these needs and can enhance motivation by aligning with the user's intrinsic goals and providing a sense of accomplishment and social connection. The significance of Positive Technology in enhancing motivation is multifaceted. Firstly, it can transform mundane activities into engaging experiences, which is essential for maintaining user engagement over time. In a study, it is mentioned that well-designed technologies can support individuals' development, performance, and well-being by embedding motivational affordances into technology, designers can create products that are not only more enjoyable to use but also encourage personal growth and fulfillment (Ryan et al., 2006). The potential of Positive Technology to enhance motivation is substantial. By

leveraging theoretical frameworks and empirical insights, designers can create digital tools that facilitate desired behaviors and contribute to the user's psychological well-being and intrinsic motivation in home-based rehabilitation.

Utilizing positive technology in home-based rehabilitation has shown promising results in motivating patients and improving their outcomes. Home-based technologies offer unique opportunities and benefits to provide rehabilitation to patients at home, improving their physical function and internal motivation (Chen et al., 2021). These technologies offer a time- and cost-efficient alternative to traditional face-to-face sessions, making rehabilitation more accessible and convenient for patients (Kuroda et al., 2020). Furthermore, integrating new technologies such as virtual reality systems and wearable sensors has been shown to increase adherence and motivation in patients undergoing rehabilitation (Argent et al., 2019). Furthermore, the use of technology in rehabilitation has the potential to monitor and analyze patients' emotional states, motivation levels, and engagement, providing valuable information for personalized care (Masmoudi et al., 2024). Furthermore, technology-based interventions are promising tools to promote physical activity and support patients during key recovery periods (Mawson et al., 2016).

The effectiveness of technology-based feedback in enhancing gait parameters in patients with gait abnormalities and the feasibility of telerehabilitation for complex postoperative recoveries, such as after esophageal cancer surgery, highlight the adaptability and potential of technology in rehabilitation Egmond et al. (2020). Additionally, the development of do-it-yourself rehabilitation devices for stroke-induced lower limb weakness and the use of robotic aids in upper limb recovery for stroke patients and physiotherapy for spinal cord injuries demonstrate notable improvements in rehabilitation outcomes and emphasize the role of technology in increasing patient motivation and engagement, crucial elements for successful recovery in home-based settings (Shim et al., 2023).

Additionally, telerehabilitation has been compared to conventional rehabilitation in motivating patients, preventing psychological distress, and improving quality of life, indicating the potential of technology-based interventions in enhancing patient motivation and psychological well-being (Spindler et al., 2022). Furthermore, the use of virtual and augmented reality applications in medicine has been associated with higher average numbers of citations in clinically related research areas such as psychology and rehabilitation, suggesting the growing interest and potential impact of these technologies on the psychological aspects of rehabilitation (Yeung et al., 2021). Additionally, using pedometers and self-determined motivation for walking in cardiac telerehabilitation programs has been linked to increased intrinsic motivation, supporting the idea that technology can enhance patient motivation and engagement in rehabilitation programs (Thorup et al., 2016).

2.2.2.2 Technology Improvements for Home-based Rehabilitation

The integration of positive technology in physiotherapy and rehabilitation has shown significant potential in enhancing patient outcomes and motivation. Positive technology, including interactive technologies, robotics, virtual reality (VR), and wearable sensors, has been increasingly utilized to promote positive functioning and improve rehabilitation processes. Rehabilitation robots, for instance, have been identified as ideal complements to conventional therapy in clinical settings and have the potential for continued therapy and assistance at home, offering great potential for the treatment of sensorimotor deficits (Gassert & Dietz, 2018). Additionally, the use of artificial intelligence-based wearable robotic exoskeletons has been recognized as a promising approach to upper limb rehabilitation, with a need for more reliable systems through clinical validation to positively impact the rehabilitation process (Vélez-Guerrero et al., 2021).

Moreover, the application of VR technology in motor-cognitive neurorehabilitation has been highlighted as a vehicle to empower rehabilitation outcomes, emphasizing the potential of positive psychology and positive technology to impact the

rehabilitation path heavily. Virtual reality (VR) systems offer immersive environments that can simulate physical activities and exercises, making therapy sessions more engaging and effective. The use of innovative technologies, such as virtual reality (VR) and configurable arm rehabilitation games, has shown promise in enhancing motivation and engagement in home-based rehabilitation (Tsujikawa et al., 2021). Furthermore, the iterative design of upper limb rehabilitation games with tangible robots has been proposed as a promising strategy for home-based therapy (Ozgur et al., 2018). Similarly, the combination of VR technology and rehabilitation medicine has been found to enable more patients to train regularly at home or in the community, stimulating interest and improving participation (Fan et al., 2023). Furthermore, the incorporation of psychological strategies into robot-assisted physiotherapy has shown the potential to promote better trust and acceptance of rehabilitation robots, indicating the positive impact of integrating psychological aspects into technology-assisted rehabilitation (Zhong et al., 2019).

The future of home-based rehabilitation is poised for further innovation, with emerging technologies offering new possibilities for treatment and support. Artificial Intelligence (AI) has the potential to revolutionize personalized therapy programs by analyzing vast amounts of data to predict and respond to individual patient needs. The integration of the Internet of Things (IoT) devices in the home environment could further enhance monitoring and support, automating certain aspects of care and ensuring a safer rehabilitation environment. In a paper, a human pose-based system that extracts key point information from images to detect speed with high accuracy is developed. Furthermore, based on this system, intelligent sensing has been realized while solving the detection of the relatively static position of the human body. Data were collected while the participant was walking/running at different speeds on a treadmill. The model can meet the accuracy requirements of speed detection. In the actual working process, the system completed the detection task. Such AI studies can also be used for home exercise applications and studies (Zhao et al., 2020).

Wearable sensors offer a wide range of applications, from remote health monitoring to sports performance tracking, and have already begun to revolutionize healthcare by enabling health monitoring outside clinical settings and predicting health events (Dunn et al., 2018). Also, as an example, Neckio, an interactive application, consists of a wireless angular sensing device that can be mounted on the headset often used by office workers. The interactive exercise program is suitable for the workplace, and Neckio can be referred to as a method designed to increase engagement in neck pain home exercise programs (Markopoulos et al., 2020). Also, according to research, designing new forms of care requires a holistic, systemic approach to healthcare. It also requires specific, well-designed interventions, e.g., products, services, and procedures used to facilitate the care processes of patients, caregivers, and medical professionals (Melles et al., 2020).

Overall, the literature supports the positive impact of integrating various forms of positive technology, such as robotics, VR, wearable sensors, and artificial intelligence, in physiotherapy and rehabilitation. These technologies have shown the potential to enhance patient motivation, improve rehabilitation outcomes, and offer new opportunities for home-based rehabilitation. Therefore, the shift towards mHealth and the integration of mobile applications thus stand as promising solutions in advancing healthcare accessibility, improving self-management capabilities, and fostering a more engaged and informed approach to individual health and well-being.

PART II: Review of the Existing mHealth Apps

2.3 Exploring and Evaluation of Neck Exercise Mobile Apps with Regards to SDT's Three Basic Needs

The utilization of smartphones for healthcare applications aligns with the advantages of mHealth in leveraging mobile devices for healthcare services (Mosa et al., 2012). A particularly noteworthy advantage of mHealth is the utilization of smartphones as opposed to traditional personal computers.

This chapter reviewed seven mobile apps on the AppStore that offer neck exercises for mechanical neck pain, following the three core needs of SDT. To summarize, feeling autonomous is to have a sense of control or choice over the intentions and related outcomes of an activity. Competence is about feeling confident and effective in meeting challenges supported by a sense of mastery over a task. And finally, relatedness can be considered as the sense of belonging in a social environment where one feels cared for and connected to others. SDT and three core needs have related features, so research held on based on these features.

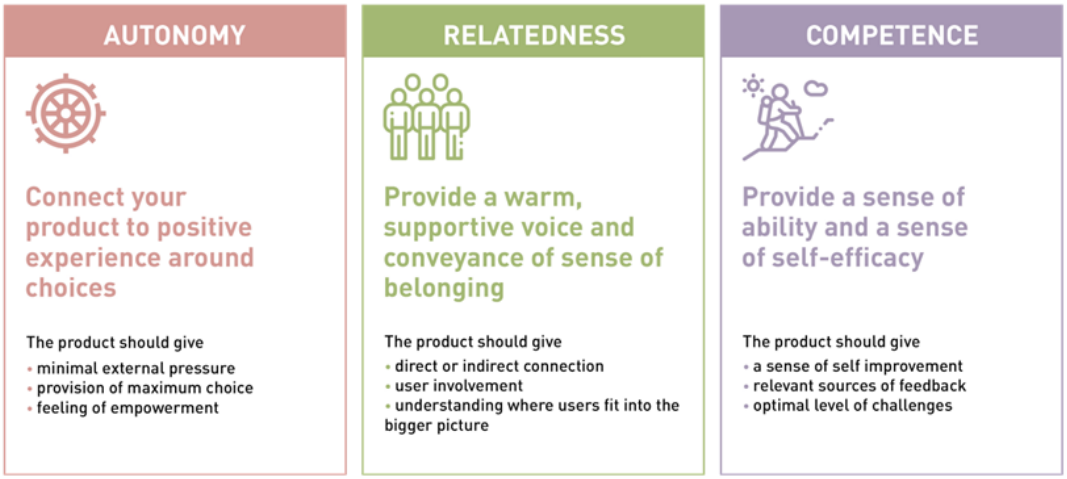


Figure 2.4. Autonomy, Competence and Relatedness related features presented in ID734 Lecture (B. Şener-Pedgley, 2023)

The applications were selected as the first related 7 applications that appeared by searching "Neck Pain Exercises" at the AppStore like a user. When selecting the apps, the selection criteria was that the app should be an app that offers specific exercises or solutions for neck pain. An English language search was performed in AppStore Turkey, Ankara, to find possible popular applications. Like a user, 'Neck Pain Exercises' was typed directly in the search field. The results included neck-specific applications. These mobile applications were i) Neck Exercises, ii) TextNeck, iii) NeckFit, iv) DailyNeck Exercise, v) Neck Check- Up, vi) Get Moving, and vii) Moovbuddy.

i) Neck Exercises

This app offers a range of neck Pain Reduction stretches, workout creation options, and exercises aimed at improving forward head posture. It is a comprehensive tool for individuals seeking to relieve neck tension and strengthen their muscles through guided routines.

Autonomy. The Neck Exercises app empowered users with a sense of autonomy through its “Create Workout” feature. By providing a platform where users could per- signalize their exercise plans, the app ensured that individuals had control over their fitness routines, tailoring them to suit their unique preferences and needs.

Competence. To enhance users’ sense of competence, the app incorporated “Challenges” as a motivational tool. These challenges serve as benchmarks, allowing users to track their progress and gain a deeper understanding of their improvement over time. Additionally, the inclusion of quick “Minutes Glories” workouts contributes to a feeling of accomplishment and competence.

Relatedness. While the app exceled in addressing autonomy and competence, there is currently a gap in terms of relatedness. Social interaction was notably absent within the app.

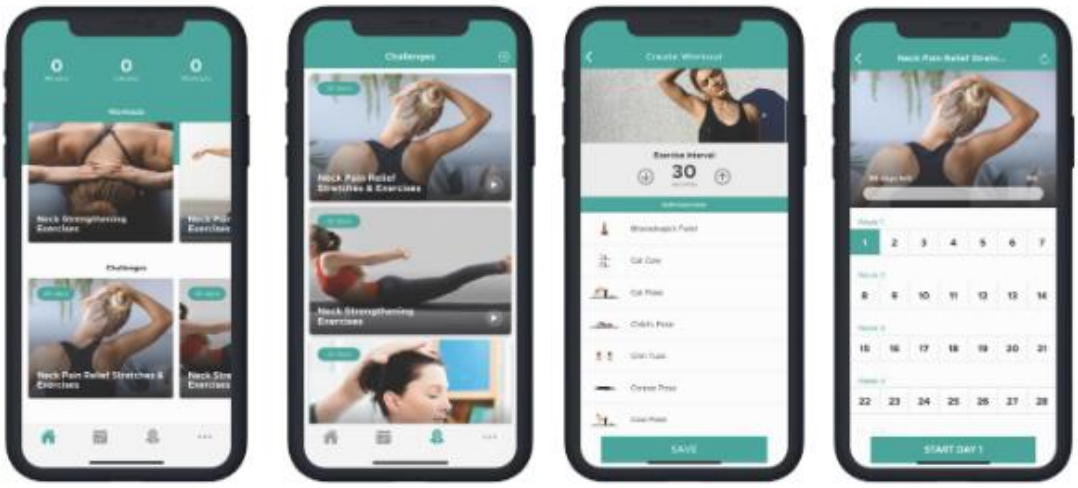


Figure 2.5. Example screenshots from ‘Neck Exercises’

ii) TextNeck

Focusing on correcting forward head posture, TextNeck offers back pain relief and neck pain prevention exercises. The app is based on scientific research in Medicine and Physiology, providing an optimal training program for health and posture correction. It features guided workouts, user interface improvements, and subscription options for an ad-free experience and premium updates. Focusing on correcting forward head posture, TextNeck offers back pain relief and neck pain prevention exercises.

Autonomy. TextNeck app prioritizes user autonomy through its innovative features, such as making users do wall exercises and understand the level of the condition. The diagnosis page gave users a self-assessment tool to gauge their neck health. This empowers users to take charge of their well-being by offering a personalized diagnosis.

Competence. The app enhanced users’ sense of competence by offering comprehensive metrics. Key indicators such as “Total Time” and “Workouts Total” gave users a clear overview of their commitment and progress. Incorporating a “Streak” feature acknowledges users’ consistency, fostering a sense of

accomplishment and competence as they achieved and maintain workout streaks. Additionally, including an information button about Neck Pain ensured that users have access to valuable insights, enabling them to make informed decisions about their neck health independently.

Relatedness. While the TextNeck app excels in autonomy and competence, it currently lacks features for social and professional interaction.

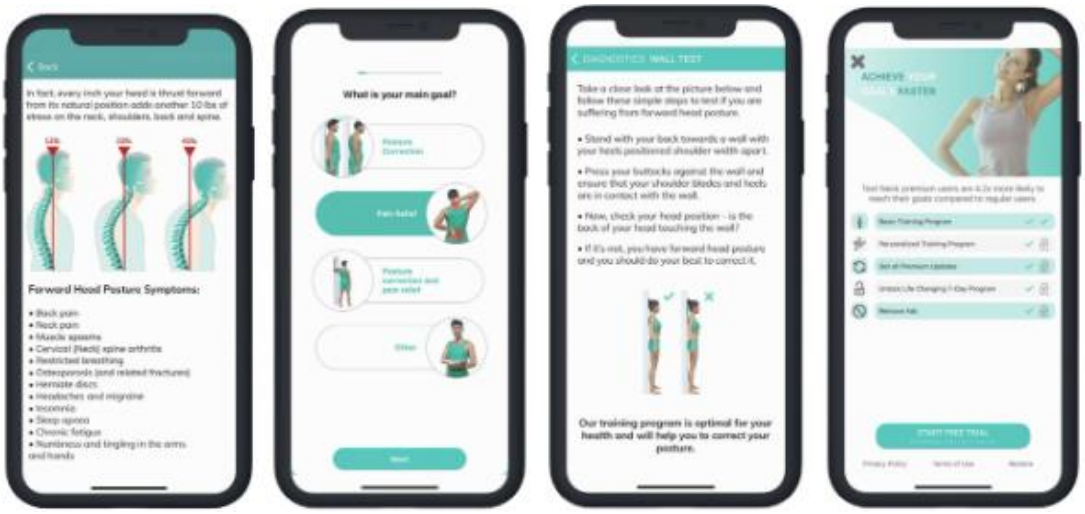


Figure 2.6. Example screenshots of ‘TextNeck’

iii) NeckFit

Tailored to relieve tension in the muscles of the cervical spine, NeckFit promotes blood flow and improves neck mobility with a set of exercises and workouts that can be done from home without special equipment. The app provides a flexible workout configurator and subscription plans for full access to all programs. Tailored to relieve tension in the muscles of the cervical spine, NeckFit promotes blood flow and improves neck mobility with a set of exercises and workouts that can be done from home without special equipment.

Autonomy. The NeckFit app emphasized user autonomy by offering tailored exercise programs based on experience levels. While there was no fixed personal plan, the app offered exercises with different fitness levels. A Create Workout

option further empowered users to customize their routines according to individual preferences, providing flexibility in their fitness journey.

Competence and Relatedness. The NeckFit app currently lacks features related to competence and relatedness.

Figure 2.7. Example screenshots of ‘NeckFit’

iv) DailyNeck Exercise

The "DailyNeck Exercise" app is designed to combat the discomfort and pain associated with 'Tech Neck,' a common issue arising from prolonged screen usage. Recognizing the impact of neck pain on daily activities, especially for those spending extensive hours on computers for work or study, the app offers a practical solution. It features regular neck stretching exercises that are easy to perform right at your desk. With the convenience of reminders for quick two-minute breaks, the app encourages users to stretch their necks, alleviate tension, and enhance posture. These straightforward exercises are intended to significantly reduce neck pain and improve neck posture, aiming to make 'Tech Neck' a concern of the past and ensure a more comfortable day for its users. The "DailyNeck Exercise" app is designed to combat the discomfort and pain associated with 'Tech Neck,' a common issue arising from prolonged screen usage.

Autonomy. Daily Neck Exercise app prioritized user autonomy by offering a flexible approach to fitness. While there is no fixed personal plan, users have the freedom to choose their exercises based on their preferences. The app's option to select specific exercises empowers users to tailor their routines to meet their individual needs.

Competence. The app enhanced users' sense of competence through quick exercises lasting 30 seconds, providing a time-efficient way to incorporate neck workouts into daily routines. Additionally, the inclusion of tips for users' exercise days provided valuable guidance, allowing users to make informed decisions about their daily neck workout and made them to improve their knowledge.

Relatedness. Daily Neck Exercise app currently lacks social interaction and relatedness features.

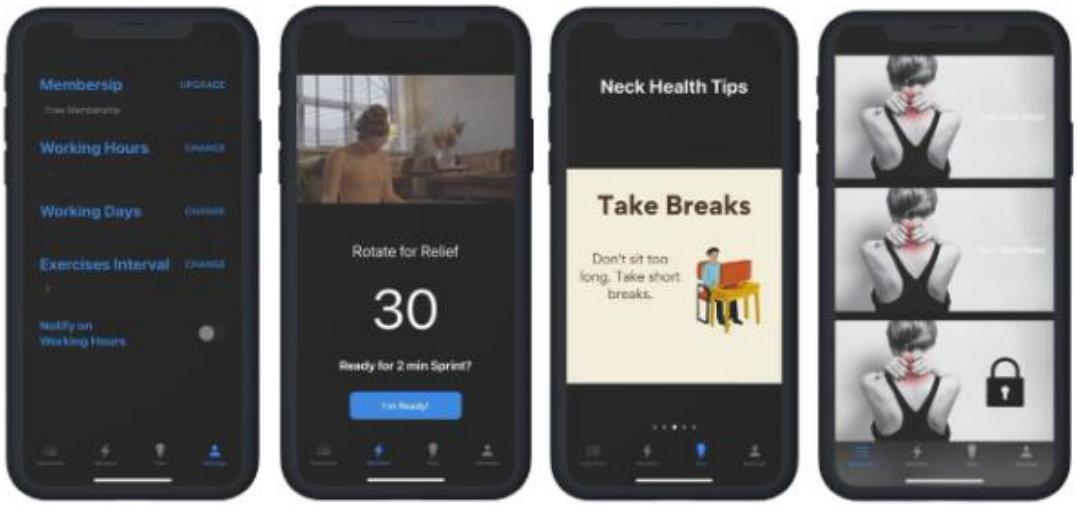


Figure 2.8. Example screenshots of 'DailyNeck Exercises'

v) Neck Check-Up

The NeckCheckUp app is designed for individuals who experience neck tension due to prolonged periods spent looking down at laptops and smartphones. It aims to prevent future neck pain through various features, including simple daily stretches tailored to busy schedules to help release neck tension. There is an AI-powered camera to monitor neck mobility and determine if it is within a normal range of

motion. It is an assessment tool for evaluating desk setups, offering recommendations for posture improvement. The app emphasizes that while it provides valuable tools for neck health, it is not a substitute for professional medical advice. Users are encouraged to consult healthcare practitioners for diagnoses or before making any medical decisions.

Autonomy. Neck Check Up app empowers users with autonomy by incorporating personal neck measurements with camera. Users could reach their own neck measurements; the mobile app enabled them to track changes over time and gain insights into their neck health. The app also provides personalized offline video guides, giving users the flexibility to access guidance and exercises tailored to their specific needs at their own convenience.

Competence. To enhance users' sense of competence, the app includes a neck measurement history. This allowed users to track and review their neck measurements over time, providing a visual representation of progress. The ability to monitor changes in neck measurements contributes to a greater understanding of one's health and encourages users to be motivated.

Relatedness. However, the Neck Check Up app currently lacks features related to relatedness.

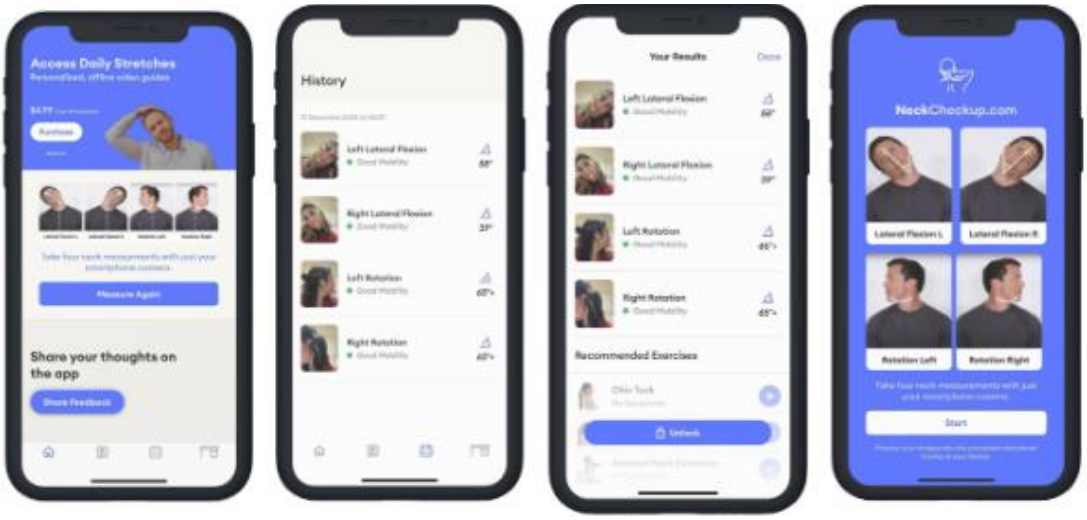


Figure 2.9. Example screenshots of 'Neck Check-Up'

vi) Get Moving

The Get Moving app introduces an engaging eye care game designed to exercise the eyes fully. It features adjustable sensitivity for each eye direction to tailor the user experience and ease the process. The game aims to alleviate eye fatigue, making it particularly beneficial for individuals who require prolonged eye usage. Leveraging AR eye-tracking technology, Get Moving facilitates easy eye exercises, enhancing overall eye health through interactive gameplay. The Get Moving app introduces an engaging neck care game designed to exercise the neck and eyes fully.

Autonomy. Get Moving app does not emphasize user autonomy.

Competence. The app enhances users' sense of competence through Eyes and Neck Challenges, providing eye tracking and neck moving games. Additionally, the inclusion of a level-up system and rewarding animations acknowledges users' progress, fostering a sense of accomplishment and motivation. These features contributed to a dynamic and engaging experience that encourages users to strive for continuous improvement.

Relatedness. While the app excels in autonomy and competence, it also addresses relatedness through a share button for scores. This feature allows users to share their achievements and challenge scores with others, fostering a sense of connection.

Figure 2.10. Example screenshots of 'Get Moving'

vii) Moovbuddy

Moovbuddy is an app powered by an artificial intelligence algorithm designed to create personalized exercise plans tailored to individual goals. Users start by installing the app and taking a test, which informs the creation of a customized exercise plan by a health coach based on their responses. The app focuses on fixing posture and relieving pain with exercises targeted at the back, neck, and other body parts. It also offers strength and stretch training, daily ergonomic tips, health advice, and short exercises to improve mental health by reducing anxiety and stress through breathing exercises. Moovbuddy is designed to enhance overall health and fitness levels, promote correct posture, increase attractiveness through improved posture, enhance flexibility and balance, keep users active with short and effective exercises developed by doctors and physical therapists, alleviate pain, reduce stress and anxiety, motivate users with home workouts, and allow for tracking of data through Apple HealthKit.

Autonomy. Moovbuddy app prioritizes user autonomy by offering a personalized plan, allowing users to tailor their workouts based on their fitness goals and preferences. The inclusion of a workout calendar further empowered users by providing a visual representation of their exercise routine, fostering a sense of control over their fitness journey.

Competence. To boost users' competence, Moovbuddy incorporated a Posture Tracker, enabling individuals to monitor and improve their posture over time. Daily goals and short 2–3-minute exercises provided achievable targets, contributing to a sense of accomplishment and continuous improvement. The app also includes a streak feature, acknowledging users' consistency and motivating them to maintain a regular exercise routine. Ergonomic tips enhance competence by offering guidance on optimizing workout environments and enrich users' motivation.

Relatedness. Moovbuddy addresses relatedness by offering the option to consult with experts for personalized advice. Users could seek guidance from fitness professionals or even consult with doctors for specialized recommendations, fostering a sense of connection and support. This expert consultation feature enhances the overall user experience by providing a comprehensive approach to fitness and well-being.

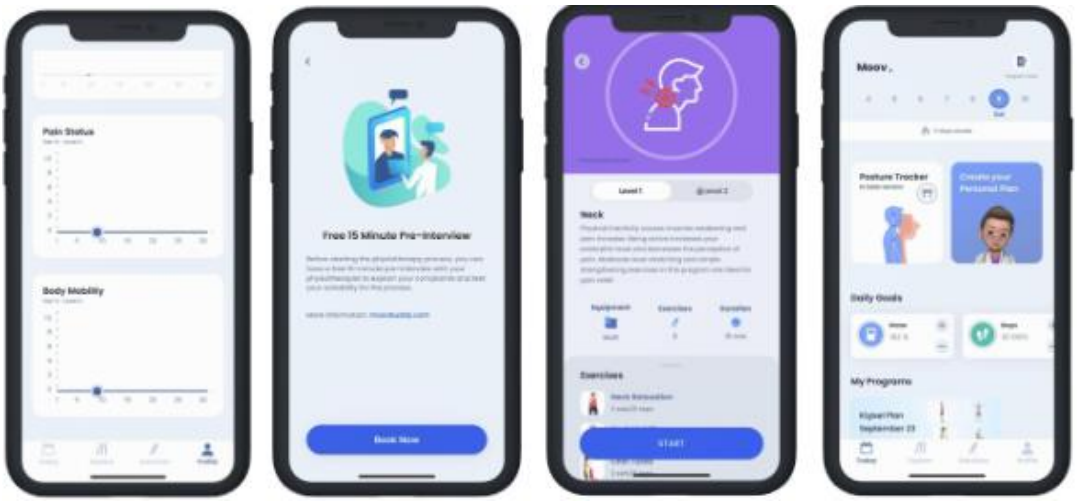


Figure 2.11. Example screenshots of ‘Moovbuddy’

This research and evaluation underlined the critical importance of integrating motivational elements into mobile apps. This review was conducted to point out existing shortcomings and find features or opportunities that could serve as an example for a new mobile app to be designed. Accordingly, considering the information obtained, it was discussed how the features of the reviewed apps will affect the user experience and the features to be taken as examples when designing a new app. Under this heading, findings of the mobile app features and motivation relationship are examined from the perspective of Self Determination Theory (Deci & Ryan, 2000) and three psychological needs: i. autonomy, ii. competence, and iii. relatedness.

i. Autonomy

First, users' desire to have control over what they can do with apps can be directly related to the need for autonomy. For example, customization options are important for users in social interaction features, and this indicates that sense of choice and sense of control has a positive effect on overall experience. Most of mobile applications had autonomy features for users (6 out of 7). This rate shows the main motivation sources seem customization, personalization, and freedom to choose exercises their needs and levels. Overall, to provide users with a more positive experience, it is important not to ignore the need for autonomy and to provide users with a sense of control over exercise type, level, and time.

Personalized Exercise Programs. Apps like NeckFit and Moovbuddy offer tailored exercise programs based on users' experience levels. This customization allows users to choose exercises that suit their level and preferences, providing a sense of autonomy in designing their exercise routines.

Flexibility in Exercise Selection. Daily Neck Exercise and NeckFit provide users with the freedom to choose specific exercises based on their preferences. This flexibility allows individuals to tailor their workouts to their individual needs and goals, enhancing their autonomy in their exercise period.

Calender and Personal Plan. Moovbuddy offers a personalized plan feature, allowing users to tailor their exercises based on their goals and preferences. The inclusion of an exercise calendar further enhances autonomy by providing users with a visual representation of their exercise routine, enabling them to plan their exercises according to their schedule and preferences.

ii. Competence

Most of mobile applications had competence features for users (6 out of 7). Overall, the competence features within the various neck exercise apps offer a range of tools and approaches to enhance users' sense of skill, mastery, and accomplishment in their exercise journey.

Challenges and Benchmarks. Incorporating challenges and benchmarks, as seen in the Neck Exercises app, provides users with tangible goals to strive towards, allowing them to track progress and feel a sense of accomplishment as they achieve milestones.

Comprehensive Metrics and Progress Tracking. Apps like TextNeck and Moovbuddy offer detailed metrics and progress tracking, such as total workout time, workouts completed, and posture tracking. These features give users a clear overview of their commitment and improvement over time, enhancing their sense of competence.

Streaks and Consistency Recognition. Both TextNeck and Moovbuddy include streak features that acknowledge users' consistency in their exercise routines. This not only fosters a sense of accomplishment but also motivates users to maintain regularity in their exercises.

Quick Workouts and Achievable Targets. Daily Neck Exercise and Moovbuddy incorporate quick workouts or short exercise sessions, providing users with time-efficient options to incorporate neck exercises into their daily routines. Setting achievable targets and providing ergonomic tips further enhance users' sense of competence by making the exercise period manageable and rewarding.

Tracking Features. Neck Check-Up, incorporate features that allow users to take measurements using their phone's camera and track changes over time. By giving users control over their measurements and health data, the app promotes competence in monitoring and tracking neck health. Also, The TextNeck app includes a self - assessment tool for users to gauge their neck health. By empowering users to conduct their own assessments, the app promotes autonomy in monitoring and managing their well-being.

iii. Relatedness

According to evaluation results, it can be said that most of apps does not offer relatedness to user (5 out of 7). To address relatedness, integrating social elements

or professional guidance within the app could enhance the user motivation. Incorporating forums for users to share experiences or connect with healthcare professionals for advice would create a supportive environment, fostering a sense of relatedness among users with shared concerns about neck health.

Social Interaction. Many of the apps lack social features that promote interaction among users or with professionals. Incorporating social elements, such as sharing achievements or connecting with a community of users, could enhance users' sense of relatedness and provide additional motivation and support. Get Moving allows users to share achievements on social media and with friends.

Expert Consultation. Moovbuddy stands out by offering the option for users to consult with fitness professionals or doctors for personalized advice. This feature not only fosters a sense of connection and support but also enhances users' confidence in their fitness journey by providing expert guidance.

2.4 Discussion on Mechanical Neck Pain Treatment and Designing for Motivation Through Positive Technology in Home-Based Rehabilitation

This chapter explored the multifaceted approach to treating mechanical neck pain within the context of home-based rehabilitation, emphasizing the critical role of motivation and the innovative use of positive technology. The integration of treatment modalities, instructional materials, and motivational strategies has emerged as a vital component in facilitating effective rehabilitation processes. The key findings reflect the implications of designing motivation in technology-enhanced home rehabilitation.

2.4.1 Treatment Modalities and Informational Materials

The effectiveness of home-based rehabilitation for mechanical neck pain relies heavily on the integration of various treatment modalities and instructional materials. Tailored exercise programs, ergonomic advice, and self-management strategies, supported by clear, user-friendly instructional content, have proven essential in encouraging adherence and promoting positive outcomes.

2.4.2 Enhancing Motivation through Positive Technology

The application of positive technology, which incorporates elements of gamification, personalized feedback, and virtual coaching, has shown significant promise in boosting motivation among individuals undergoing home-based rehabilitation. This approaches not only engages users but also fosters a sense of achievement and progress, key factors in maintaining long-term engagement to rehabilitation programs.

The integration of positive technology in home-based rehabilitation offers a potential to enhance user motivation. By providing interactive experiences that align with individuals' personal goals and preferences, positive technology can overcome traditional barriers to engagement and adherence. Hence, the integration of artificial intelligence (AI) and human pose estimation into home-based rehabilitation represents a significant shift towards leveraging cutting-edge technology to enhance patient engagement and treatment efficacy. By employing AI algorithms and human pose estimation techniques, rehabilitation programs can offer personalized, adaptive experiences that closely align with each individual's specific recovery goals and preferences.

2.4.3 Implementation of SDT to Design Process

Self Determination Theory (SDT), within the design process for home-based rehabilitation, offers a deeper insight into the nuanced ways motivation can be enhanced. SDT emphasizes the importance of fulfilling the intrinsic needs of autonomy, competence, and relatedness to increase motivation. By integrating these basic needs into the design of rehabilitation technologies, developers can create more engaging and personalized experiences that resonate with users on a deeper level. For instance, allowing users to choose their rehabilitation activities (autonomy), providing progressive challenges that adapt to their skill level (competence), and enabling a sense of connection with a supportive community or therapist (relatedness) can significantly improve motivation. The application of SDT in the design process ensures long-term engagement and adherence. Incorporating these motivational theories into the development of positive technology facilitates a more user-centered approach, ensuring the rehabilitation experience about physical recovery.

CHAPTER 3

METHODOLOGY

This chapter presents the methodology of the two-stage research to explore ways to increase motivation and engagement among patients receiving home rehabilitation for mechanical neck pain. Accordingly, an overview and aim of the study, data collection methods, and a detailed explanation of the different stages of the study are presented.

3.1 Aim and Objectives of the Research, Research Questions

The research aims to investigate specific needs and challenges faced by patients receiving home rehabilitation for mechanical neck pain to find ways to increase motivation and engagement. The user research objectives are i) to gain insights into the treatment of mechanical neck pain and ii) to understand the needs and challenges patients face in home-based rehabilitation for mechanical neck pain. The research questions addressing the aim and objectives are as follows.

- What specific needs, challenges, and expectations do patients with mechanical neck pain encounter during treatment, especially in home-based rehabilitation?
- What are the primary ways patients acquiring information during home-based rehabilitation?
    - What are the patient's thoughts on the strengths and weaknesses of different information sources (e.g., HEP brochures, videos, etc.)?
- What are the primary motivation sources for engaging and adhering to home-based rehabilitation?
    - How can a mobile health app be incorporated into home-based rehabilitation to support patients with mechanical neck pain?

- How might the design of a mobile health app for mechanical neck pain be informed by the three basic psychological needs of Self Determination Theory while also serving to motivate patients?

3.2 Data Collection Tools and Methods

Aligning with the research aim and research questions, the first stage of research was consultation with experts, and the second stage was an interview with patients. These semi-structured interviews allowed patients to freely express their thoughts and feelings about their rehabilitation journey, providing an in-depth understanding of the factors influencing patient motivation and engagement in home-rehabilitation. According to a study, the versatility of semi-structured interviews, stating that this method provides flexibility and allows researchers to explore important ideas that may emerge during the interview (DiCicco-Bloom & Crabtree, 2006). This approach facilitates a dialogue where specific objectives guide the conversation, yet the flexibility for spontaneous, in-depth responses is maintained. Attitudinal data is the focus, exploring patients' subjective experiences, feelings toward rehabilitation, and personal motivators and barriers. As a cross-sectional study, it captures a comprehensive picture of current patient experiences (Yargın et al., 2018). This research consists of the following two stages. All of research steps were presented in Figure 3.1.

Stage 1: Consultation with Experts. Two consultation meetings were held with a PM&R doctor and physiotherapist to understand the mechanical neck pain treatment process. Since PM&R doctors and physiotherapists are involved in different parts of the process in the Turkish Health System, both professions were consulted to understand the process in its totality. PM&R Doctors examine patients, diagnose conditions, and determine the appropriate treatment plan. This management might include medication, referrals for physiotherapy, and surgical interventions if needed. They also coordinate the patient's overall rehabilitation process. On the other hand, physiotherapists assess patients and apply various

treatment techniques to improve or restore physical function losses. These techniques include manual therapy, exercise programs, and electrotherapy. While consulting the experts, the semi-structured interview technique was used, and experts were consulted with specific questions. Information was obtained from the doctor and physiotherapist before the patient interview to understand the mechanical neck pain treatment process; the outcome of this stage informed the planning of Stage 2.

Stage 2: Patient Interview. The research aims to explore ways of motivation and adherence by investigating the specific needs and challenges that patients with mechanical neck pain face during home-based rehabilitation. Questions in the interview were designed according to the timeline of neck pain and treatment process (pre-examination, during the treatment process, home-based rehabilitation) to find out what the specific needs and challenges of the patients during the treatment process and home-based rehabilitation, and ways to motivate patients to home exercise programs. The main objective of Stage 2 was to explore the motivational strategies and adherence challenges faced by patients during home rehabilitation. The semi-structured interview method was chosen for the first stage of the research, which aimed to discover insights to guide the enhancement of engagement and motivation of patients suffering from mechanical neck pain.

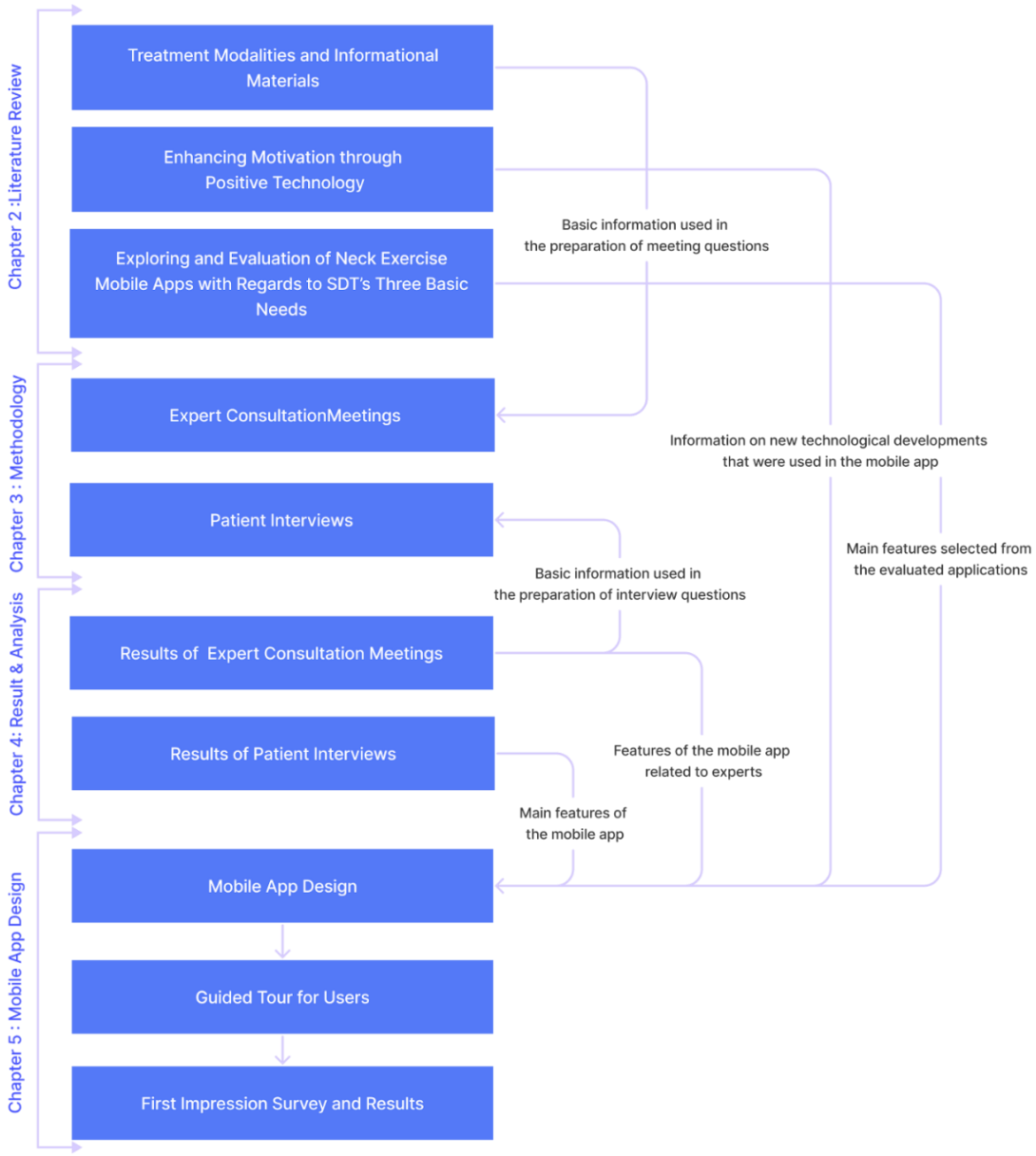


Figure 3.1. A diagrammatic representation of research

3.2.1 Stage 1: Expert Consultation Meetings

In Stage 1, the research aimed to gain insights into the treatment of mechanical neck pain and the experts' opinions about home-based rehabilitation. Consultation meetings were conducted with physiotherapy doctors and physiotherapists to achieve this. For the experts to convey the patients' motivations in the home

rehabilitation process more clearly, 10 questions were asked to the experts under the headings of common disease diagnoses, treatment processes, home rehabilitation process, and tracking of the treatment process. Additionally, these meetings provided an opportunity to explore practices in public and private hospitals and understand the factors influencing patient care.

3.2.1.1 Selection of Experts

In this stage of the research, online meetings with participants were planned. All participants were from Turkey, and it was decided that one of the experts would be a physiotherapist and the other a physiotherapy doctor because patients first consult a doctor and then continue their treatment with a physiotherapist. Therefore, to understand the whole treatment process of the participants, interviewing different professionals working in the same field was believed to diversify the data collected. The physiotherapist is selected from a private hospital, and the doctor is from a public hospital. This is because, in Turkey, patients are treated and monitored differently when they go to public and private hospitals. Understanding these differences by choosing experts from two hospitals and institutions helped to understand treatment variety. Experts working in Turkey were interviewed. One of the experts is a doctor who specializes in the Physiotherapy Department of Hacettepe Hospital. The other expert was a physiotherapist at Lokman Hekim Hospital, a private hospital.

3.2.1.2 Consultation Venue and Equipment

All interviews were conducted via Zoom video conferencing tool (Zoom Video Communications, Inc.). The Zoom platform was chosen because of its popularity, easy access, and familiarity for the participants. Online interviewing offers numerous advantages, including increased popularity and convenience, reduced time commitments. These interviews can resemble face-to-face interactions in

many respects and have been used as a useful substitute for traditional interviews. However, challenges exist, including difficulties in reading non-verbal cues, concerns about confidentiality and access, and loss of contextual information. Despite these drawbacks, online interviews offer a valuable alternative where they can provide easier discussion of sensitive topics and convenient timing (Pocock et al, 2021; Davies et al, 2020). The interview sessions were simultaneously recorded on computer software to be used as a reference during the analysis.

3.2.1.3 Consultation Procedure

Consultation meetings were conducted in Turkish on a one-to-one basis. Participants were encouraged to express their opinions, experiences, and ideas throughout the meetings. The following procedure was followed in both sessions.

First, the experts were welcomed, reminded of the study's operation. Then, the experts were asked warm-up questions. Following this, ten questions were asked to the experts. The questions aimed to understand the mechanical neck pain treatment process, patient-expert communication, and treatment stages. The researcher conducted the consultation meetings following structured interview questions.

At the end of the questions, the participants were thanked for their contributions. The session ended, and the same procedure was repeated for all participants. Each of the two sessions with two experts took approximately 30 minutes.

3.2.1.4 Interview Questions

The interview guide included ten questions (Appendix B) covering the following four subject areas.

Common Disease Diagnose. In this section, questions aimed to determine which diseases they most frequently encounter and diagnose in health institutions. The content of the diseases and diagnoses were asked for mechanical disorders. The

reason for asking these questions was to elucidate which mechanical health condition the thesis research should be focused on.

Treatment Process. The study aimed to learn about the treatment process of mechanical disorders, especially mechanical neck pain, and how patients are grouped. Participants were also asked what they pay attention to when making a diagnosis and how they decide which conditions require surgery and which do not. These questions were asked to understand which patients should participate in the study and how patients were categorized.

Home-based Rehabilitation. Regarding the home-based rehabilitation period, whether the diagnosed disease needs to have a specific characteristic for exercises to be performed was asked. The questions were asked to understand the relationship between home exercises and the level of the disease. They were also asked to find out how the home-based rehabilitation process is perceived by the experts.

Tracking the Treatment. In the final part of the interview, during the home exercise period, doctors' expectations from patients, how specialists follow the treatment process of patients, the most frequently asked questions to doctors by patients, the roles of the specialist and the patient in patient follow-up, and the methods used in patient follow-up were asked. In response, it was also asked whether there is a certain period for process follow-up and how it was determined.

3.2.2 Stage 2: Patient Interview

Interviews with patients were aimed to understand and address the specific needs and challenges faced by patients with mechanical neck pain during rehabilitation, focusing on home-based rehabilitation. The semi-structured interviews were conducted due to their flexible nature, which enables a better understanding of the process and its management by exploring relevant ideas that may emerge during the interview (Dearnley, 2005). It further enhances understanding by allowing the

researcher to explore relevant ideas that may emerge during the interview. This method involves in-depth conversations between the researcher and the interviewer, firmly guided by the interviewer's perceptions, opinions, and experiences (Cridland et al., 2016). These interviews allowed patients to share their experiences, concerns, and suggestions from initiating their treatment journey.

3.2.2.1 Participant Selection

The selection criteria for participants were established based on information obtained from the experts during Stage 1 of the research. As a result, participants included individuals over the age of 18 experiencing mechanical neck pain and with previous experience in home exercise rehabilitation. Participants were sought among patients treated at home, in hospitals, or both for neck discomfort within the past year. The goal was to reach the desired number of participants by using social media tools (e.g., Instagram, Linked-in, WhatsApp groups) and by reaching the participants' acquaintances through the snowball method.

Neck pain caused by rheumatism or infection was not included in the study. In total, 20 participants were recruited. According to 2022 data from the Turkish Statistical Institute (TÜİK,2022), the prevalence rate of neck pain was 10.8% for men and 23.4% for women in Turkey. Most participants recruited for the research were women, reflecting the distribution of neck pain across genders in the country (14 out of 20).

3.2.2.2 Interview Venue and Equipment

All interviews were conducted online using the video conferencing tool Zoom (Zoom Video Communications, Inc.). Zoom was chosen due to its popularity and the researcher's accessibility. Interview sessions were recorded on computer software simultaneously to be used as a reference during the analysis stage.

3.2.2.3 Interview Procedure

All interviews were conducted on a one-to-one basis and in Turkish. The following procedure is followed in all sessions.

First, the experts were welcomed and then reminded of the study's operation. Then, as warm-up questions, participants are requested demographic and occupational information. After the warm-up, the questions were asked successively to better understand the participants and facilitate analysis. They were prepared under three main headings: experiences pre-examination, experiences during the examination, and experiences during the home-based rehabilitation.

Second, the researcher added three examples of home exercise programs to the interview questions to remind patients who lost or forgot the paper-based exercise programs used in home-based rehabilitation and to get their opinions on home exercise programs. Two examples are paper-based, and one is a digital information source (Appendix C).

At the end of the questions, the participant is thanked for their contribution. The session recording is ended, and the same procedure is repeated for all participants.

3.2.2.4 Interview Questions

To understand the motivation during the home rehabilitation period, warm-up questions, demographic information, and occupational information are asked to participants. Then, 36 questions were asked (see Appendix C) to the patients under the three headings: a. demographic characteristics, b. pre-examination, c. hospital-based treatment, d. home-based rehabilitation.

a. Demographic Characteristics. The questionnaire aimed to indicate participants' age, gender, and occupation as warm-up questions. Participants were asked about their opinions about the effects of their profession on neck pain and their

experiences on how occupational factors contribute to neck pain while mentioning their occupation.

b. Pre-examination. This section aimed to understand the participants' experiences in the pre-examination phase, including feelings of discomfort, stiffness, or pain associated with mechanical neck pain, and how these symptoms intertwined with daily activities.

Factors Causing Neck Pain. The study aimed to learn participants' personal experiences during the pain process and when they experienced neck pain. The pain's severity, duration, frequency, and triggers were discussed. Participants' opinions about situations or behaviors that trigger neck pain were taken, and they were asked about examples in which they said, "If I did not do this, my neck would not hurt."

Consequences of Neck Pain. In this section, the aim was to obtain information about participants' personal experiences with restrictions in their daily lives. Participants were asked about their personal experiences with physical alerts and symptoms to understand how they understand their neck problems.

Duration of Pain and Decision of Treatment. Participants were asked about their personal experiences with the duration of their neck pain and how long they experienced it, which is focused on. The user's experiences and needs were tried to be understood by focusing on the participants' decision to consult a doctor and the reasons for postponing this decision.

c. Hospital-Based Treatment. In this section, participants were asked about their general experiences with the treatment, their experiences with the diagnosis and relevant doctors, and their experiences and expectations with the treatment method and process.

d. Home-based Rehabilitation. This section asked questions about starting exercises and motivation, physical therapy and home treatment experiences, treatment methods and approaches, exercise habits, and adherence.

Environmental Factors during Home-Based Rehabilitation. The environment in which the person is rehabilitating includes questions asked to assess the impact of motivation on the participant. Understanding and addressing these factors will be useful in learning about the patient's experience and outcomes in their recovery journey.

Information Source Usage during Home-based Rehabilitation. During the home exercise stage, the participants are asked questions about the information given by the expert, the participants' opinions about the recommended information sources, websites, paper brochures, or similar sources, the different methods the participants used, the people they met, and the sources you obtained information from, apart from the information sources recommended by the experts. Participants are shown three different home exercise program resources. The first source is a paper brochure designed by the Ministry of Health to give to patients in government institutions. Secondly, a paper brochure from Fizyoo.com and a digital home exercise site from HEP2go are shown (see Appendix C). Participants are shown these resources and asked what they thought about photographs, drawings, and visuals, what they thought about content and articles, and what they thought about video content.

Motivation during Home-based Rehabilitation. Participants are asked about their experiences of starting and continuing exercise during the home exercise process, their' motivation strategies, and external factors that made them feel good about starting and continuing exercise during the home-based rehabilitation process. They are also asked whether their communication with the doctor or physiotherapist continued in detail during the home exercise process and how their motivation would be affected if they continued to stay in touch.

Digital Health Intervention Suggestions. In the final part of the survey, participants are asked about which digital environments they frequently use, the digital products they have used before for exercise, the materials they use for information and motivation during home exercise, their thoughts on the content and

applications of these materials being available in a digital environment, and their thoughts on communicating with experts in a digital environment.

3.2.2.5 Pilot Study

A pilot study containing the semi-structured interview in Stage 2 was conducted with a 45-year-old mechanical neck pain patient. The interview was conducted face-to-face. The previously described interview procedure (Section 3.2.2.3) was followed during the pilot interview. In the pilot interview, the flow of the questions and the overall interview were checked, and the opportunities for the participant to express feelings, thoughts, and relevant information were observed. In addition, at the end of this session, the estimated time for an interview was determined. At the end of the pilot study, no corrections were needed, and the interview procedure was not changed. Therefore, the pilot study results were combined with the rest of the study in the analysis section of the research.

3.2.2.6 Ethical Considerations

Participants were asked about personal information and disease diagnoses used in the health field, and a participant request form was prepared and applied to the ethics committee. The necessary ethical approval is obtained from the Applied Ethics Research Centre of the Middle East Technical University, with approval number 0200-ODTU˙IAEK- 2023.

CHAPTER 4

RESULTS & ANALYSIS

This chapter presents the results and analysis of the two-stage research conducted to investigate specific needs and challenges faced by patients receiving home rehabilitation for mechanical neck pain to find ways to increase motivation and engagement with related discussions.

A semi-structured interview was conducted with a physiotherapy doctor and physiotherapist to understand the mechanical neck pain treatment process in Stage 1. In Stage 2, a semi-structured interview was conducted to explore neck pain and treatment process (pre-examination, hospital-based treatment, home-based rehabilitation) aiming to identify the specific needs and challenges of patients during treatment and rehabilitation at home-based rehabilitation, as well as strategies to motivate patients engage in home exercise programs.

4.1 Results and Analysis of Stage 1: Expert Consultation Meetings

This part presents the results of a consultation with two experts in relation to insights into the treatment of mechanical neck pain and the experts' opinions about home-based rehabilitation. One of the experts was a physiotherapist specializing in physiotherapy at Hacettepe University Hospital, a university hospital in Ankara; the other was a physiotherapist specializing in manual therapy, functional exercise and orthopedic/neurologic rehabilitation at Lokman Hekim Hospital, a private hospital. The aim was to learn how treatment processes are handled in different institutions and professions in Turkey. The interviews were conducted individually online, with each expert responding to a set of ten questions. Results are presented with the following headings: i) Common Disease Diagnoses, ii) Treatment Processes, iii) Home-based Rehabilitation Process, and iv) Tracking the Treatment Process.

4.1.1 Common Disease Diagnoses

This research specifically focused on patients experiencing chronic pain in their daily lives, with the aim of providing solutions. Chronic patients were considered more suitable due to the significant variability in pain levels among patients who had undergone surgery, which limited the feasibility for home exercises under medical supervision. Given the emphasis on home exercises in this research, the focus was on patients who had not undergone surgery.

The first participant, a physiotherapy doctor at Hacettepe University Hospital, mentioned that mechanical, lower back, and neck pains were the most common in Turkey. This information, supported by Turkish Statistical Institute (TÜİK, 2019) statistics, indicates that lower back pain is the most prevalent, followed by neck pain. The second expert, a physiotherapist at a private hospital, provided insights into the questions. In Turkey, experts mostly encounter back and neck pain.

Both experts were asked which diseases they most frequently encounter in health institutions, and which diagnoses they typically make. The content of the diseases and diagnoses was asked concerning mechanical disorders. The reason for asking this question was to find a solution to a common ailment in Turkey and gather information from the experts to address it. As the treatment processes for post-surgery patients differ from those of chronic patients, they were asked about conditions not necessitating surgery and the prerequisites for surgical intervention.

4.1.2 Treatment Processes

Experts were questioned about the treatment methods for mechanical disorders, particularly mechanical neck pain, and how they categorize patients in the Turkish health system. They were also inquired about their considerations when diagnosing patients and determining the necessity for surgical intervention. Additionally, questions were posed regarding the planned treatment approaches for chronic diseases and their maintenance, focusing on conditions not necessitating surgery.

Furthermore, they were asked whether specific criteria are required for patients to engage in home exercises for their condition.

The doctor at the state hospital mentioned that patients had been following home exercise programs until their scheduled physiotherapy sessions. It was also noted that if their pain had subsided, they might not receive treated at the hospital due to overcrowded departments. In a public hospital, treatment could be provided based on the severity of the pain. For example, treatment would not continue if the pain disappeared. Patients had stopped exercising when the pain vanished, which interrupted the healing process of neck pain, as stopping the exercises led to a quick return of pain. If the patient's pain had not improved, different treatment options were available. Patients were treated in the hospital to strengthen their muscles, using methods such as hot application methods and electrical treatments that they could not utilize at home.

The second specialist mentioned that disorders that significantly affect the quality of life were typically directed towards surgery. Conversely, discomforts that did not significantly impact daily life were mostly attempted to be resolved without surgery through physiotherapy. According to the Health Practices Communiqué – SSI, patients were allowed to receive thirty days of treatment per year (The Official Gazette, 24.03.2013, issue: 28597). During these treatment sessions, patients received hot application electrotherapy, and ultrasound treatment for one hour. According to the Communiqué, orthopedic diseases were generally treated with home exercises, which could vary depending on factors, such as age, weight, joint mobility, and active/passive periods of the disease (The Official Gazette, 24.03.2013, issue: 28597).

4.1.3 Home-based Rehabilitation

Experts were questioned about home exercise programs, how they could be used, and other potential examples of exercise instruction methods. Subsequently, they

were asked about the content of these home exercise programs. This section also addressed whether patients received a personalized exercise program tailored to their needs or whether these plans were given according to a specific program.

Both experts explained that they provide home exercises to patients with mechanical pain, and these exercise programs were generally composed of daily exercises that everyone should perform. The exercises aim to strengthen muscles and increase the range of motion of the joints, primarily targeting neck pain. It was stated that the exercises in the home exercise program were not personalized, and standard exercise programs were given to patients.

Home exercise programs typically consist of static pictures and written descriptions. According to both experts, patients' understanding of the exercises in the program varies. Therefore, the second expert adopted a method where they recorded videos of the patient performing the exercises and then instructed the patient to repeat the exercises at home by watching these videos. In this method, the patient does the exercises and then repeats them at home by watching their videos. However, there was no tracking system in place to monitor whether the patient was consistently performing the exercises. The second expert said that this method helped to ensure that the exercises were understood and remembered by the patient.

4.1.4 Tracking the Home-based Rehabilitation

In the final questions of the consultation, the specialists were asked about patient tracking. These questions included doctors' expectations from patients during the home exercise period, how specialists monitor patients' treatment processes, the roles of both the specialist and the patient in patient tracking, and the methods used in patient tracking.

The first specialist noted that if patients were considered to have low levels of mechanical neck pain, they usually begin to experience effects after the third week.

If a patient's pain had decreased after three weeks with medication and exercise, they were not expected to return to the hospital. However, if the pain persisted, patients may have adopted an attitude of returning to the hospital. In other words, if a patient's pain had decreased, they may have entered a phase of self-determination, potentially leading to a breakdown in communication between the doctor and the patient. According to both experts, this gap needed to be augmented through methods that supported users and enhanced their adherence to home exercise rehabilitation.

According to the physiotherapist consultant, there was a need to improve patient tracking. The second expert mentioned that the exercises could not be continued with the current methods. In private hospitals, patients were provided with exercise sheets and access to videos on the website, but this method did not ensure proper tracking of patients. The physiotherapist needed assistance in determining whether the patient had watched the video or performed the movements online. While verbal communication methods were utilized, the second expert could not be certain whether the patient was the truthful. Patients could skip the exercises and falsely claim to have completed. When patients were given a personal number of physiotherapists and asked for video or visual evidence for practicing exercises, it could be asked for video or visual evidence of practicing exercises, it could potentially individual rights.

4.2 Results and Analysis of Stage 2: Patient Interviews

Interviews with patients aimed to understand and address the specific needs and challenges faced by patients with mechanical neck pain during rehabilitation, focusing on home-based rehabilitation. As mentioned in the Methodology Chapter (see 3.2.1), the online interview consisted of 36 questions categorized into four headings with their subheadings (see Figure 4.1): Demographic Characteristics, Pre-Treatment Period, Hospital-Based Treatment, Home-Based Rehabilitation.

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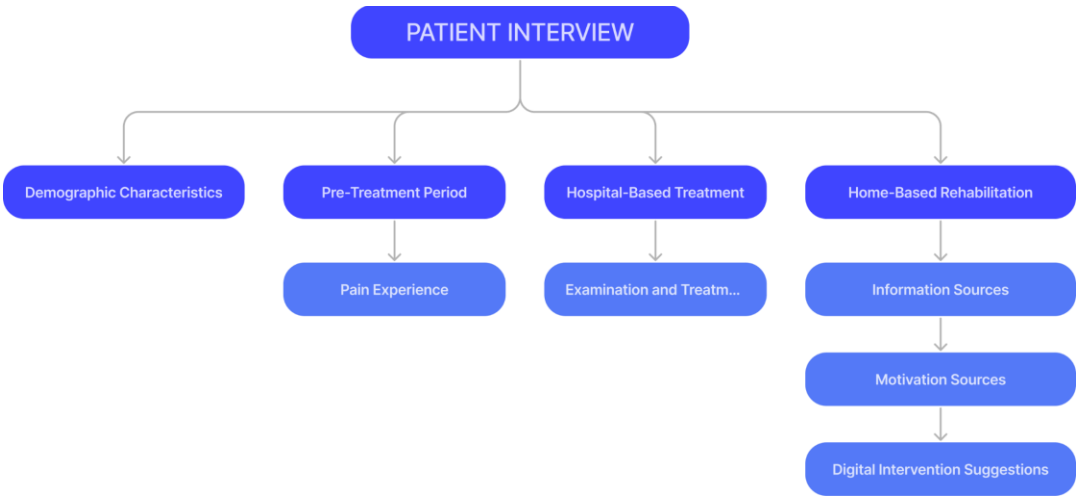


Figure 4.1. Headings and subheadings for the interview questions

In total, 20 participants were interviewed on an individual basis. The interviews varied in duration, ranging from 18 to 68 minutes, with an average length of 35 minutes. All audio files recorded during the sessions were transcribed into Microsoft Word using audio transcription methods. The data collected from the users were organized in a matrix format, with the patients listed on the x-axis from left to right and the questions on the y-axis from top to bottom, making it easier to analyze grouped data. Airtable, a cloud-based platform for creating relational databases, was used for further analysis. The matrix created in Airtable made seeing information grouped under specific headings easier (see Figure 4.2).

	Number	Occupation	Gender	Computer	Age
1	P1	Teacher	Female	No computer	40-55
2	P2	Interior Architect	Female	Computer Usage	26-40
3	P3	Teacher	Female	No computer	26-40
4	P4	Computer Engineer	Female	Computer Usage	26-40
5	P5	Finance Manager	Female	Computer Usage	40-55
6	P6	UX Designer	Female	Computer Usage	26-40
7	P7	Environment Engineer	Female	Computer Usage	26-40
8	P8	Teacher	Male	No computer	55-70
9	P9	Laboratory Worker	Female	No computer	55-70
10	P10	Student (Industrial Design)	Male	Computer Usage	18-25
11	P11	Student (Industrial Design)	Female	Computer Usage	18-25
12	P12	Civil Engineer	Male	No computer	26-40
13	P13	Interior Architect	Female	Computer Usage	26-40
14	P14	Seat Washer	Male	No computer	18-25
15	P15	Architect	Female	Computer Usage	26-40
16	P16	Industrial Engineer	Female	Computer Usage	26-40
17	P17	Volleyballer	Female	No computer	18-25
18	P18	3D Artist	Female	Computer Usage	26-40
19	P19	Carpenter	Male	No computer	26-40
20	P20	Product Designer	Male	Computer Usage	26-40

Figure 4.2. An example of screenshot from Airtable Analysis

As a result, the analysis was carried out in several steps to extract key ideas from the transcribed and matrixed data. Because thematic analysis is a qualitative research method that allows for the identification, organization, analysis, and reporting of patterns within data sets, offering insights into lived experiences and complex accounts of information. This approach is known for its flexibility in identifying emergent themes and providing a rich and detailed understanding of the data (Griffiths et al., 2011), thematic analysis was the main method in generating meaningful insights from qualitative data, contributing to a deeper understanding of complex responses. Initially, the raw data was simplified by identifying repetitive phrases or sentences close (in meaning) to each other. Subsequently, the simplified matrix was further analyzed in the second stage and grouped with various tags and keywords. At the end of this stage, the resulting keywords/phrases were specified in

Airtable using different tags. Among the specified keywords, predictions that are similar or can be sub-headings of each other were listed and explained (see Figures 4.3 and 4.4).

	A Question	P1	P2	P3
1	Boyun ağrısı çektiğiniz dönemlerde...	Genellikle baş ağrısı yapıyor, har...	Var ben daha önce bel fıtığı...	Omzuma doğru ağrı iniyod...
2	Eğer şunu yapmasaydım boynum a...	Sebebini ben uzunca saatler der...	. Ağır taşımam kesinlikle ya...	Telefona sürekli bakmasayd...
3	Mesleğiniz nedir?	Öğretmen	İç Mimar- Masa Başı	Öğretmen
4	Ağrı konusunda bir etkisi olduğunu...	tahta kullanıyorum. Aktif sınıfı d...	Ya şöyle meslekle ilgili kesi...	Çok fazla tetiklediğini düşü...
5	Yaklaşık ne kadar süre boyun ağrısı...	Çektim evet çektim bir süre fizy...	Bir hafta şiddetli olduğu sü...	Yaa çok uzun süredir boyun...
6	Doktora başvurmaya ne zaman kar...	Artık böyle hiç bir şey kaldırama...	. Bir hafta işlerim aksadı ve ...	2 sene önce başvurdum. 8 ...
7	Doktora gitmeyi ertelediğinizden b...	Tabi..tabi.. Beni engelleyen şey ş...	Mesela o an işim vardı fizik...	erteledim çünkü artıp azalı...
8	Tedaviye başlama sürecinizden bah...	Ya işte rahatsızlık başlayınca bu ...	Şöyle yine aynı şeyi söylicm...	Ben ilk gittiğimde bana şey...
9	Tedaviye başlangıç süreci ile ilgili d...	Çalışanların işlerinin parçası aynı...	O gün gittiğimde fizik teda...	Harreketlerin yaşam şekli ol...
10	Muayeneden sonra ev egzersizi ted...	İlk başlarda yapabildim hareketl...	15 günün sonunda ağrıları...	Doktor iiçin önemsiz olabili...
11	Ev egzersizi sürecinde kendinizi ev ...	Ya aslında, kendime ayırdığım ç...	Akşam 6da gidiyodum hast...	Ev ortamında egzersizlerin ...
12	Egzersizler için hatırlatmalar oluyor...	Olmuyor	İlk bir ay boyunca yapailme...	Her sabah
13	Siz ne tür yöntemler kullanıyorsunu...	Sıcak tutmak çok iyi geliyor. Yas...	Ya da annem gelip hatırlatı...	-
14	Hastanede aldığınız egzersizler ve ...	Ben de o hareketi fizyoterapist ...	Hastaneyle ilgili şöyle çok a...	-
15	Ev egzersizi aşamasında size uzma...	Videoyu ben daha önce tedavi ...	Bana kağıt üzerinde görsell...	sadece o kağıdı verdi ve ba...
16	Önerilen bilgi kaynakları, internet si...	Bu sefer gittiğimde fizyoterapist...	Sadece kağıt verilseydi ne k...	Bir kağıt verildi kağıtların ü...
17	Bu materyaller ve içerikleri hakkınd...	Bence boyun ağrısında önce far...	Bununla ilgili aplikasyon ya...	Benim broşürümde hiç yazı...
18	Uzmanların önerdiği bilgi kaynaklar...	Youtube kullanıyorum. Fizyotera...	Önceki tecrübelerim sayesi...	Pilatese gitmiştim pilates s...
19	Fotoğraflar çizimler görseller hakkı...	Evet, tamam. Benimkine benziy...	Şimdi öncelikle türk milleti ...	Anlaşılabilirdi hareket ve ya...
20	İçerikler yazılar hakkında ne düşün...	Evet, tamam. Benimkine benziy...	Ama açıklamayı da okuyun...	Daha güzel ve daha verimli...
21	Video içerikler hakkında ne düşünü...	Videolu olması daha etkili olur, ...	Yaşlılar bile videolu ve açıkl...	Kişiye özel olması verimli b...
22	Evde egzersiz sürecindeki egzersize...	Şöyle motive ediyorum. ,'Ağrın ...	Bugün sabah yapayım yarın...	Ev ortamında egzersizlerin ...
23	Motivasyonunuzu nasıl sağlıyorsun...	Şöyle motive ediyorum. ,'Ağrın ...	. Bu senin dinlenme süren k...	Genellikle ertlemelerle sonl...
24	Motive olmakta zorlanıyor musunu...	Evet.Aslında düzenli yapsam dü...	-	Evet
25	Ev egzersizi sürecinde egzersizlerini...	Oluyor Evet.	Oluyor	Evet
26	Oluyorsa sebepleri nedir/nelerdir b...	Vakit sıkıntısı var, o gün kendimi...	& diye kendimi şartladığım...	-

Figure 4.3. An example screenshot from Airtable illustrating questions and answers with no grouping

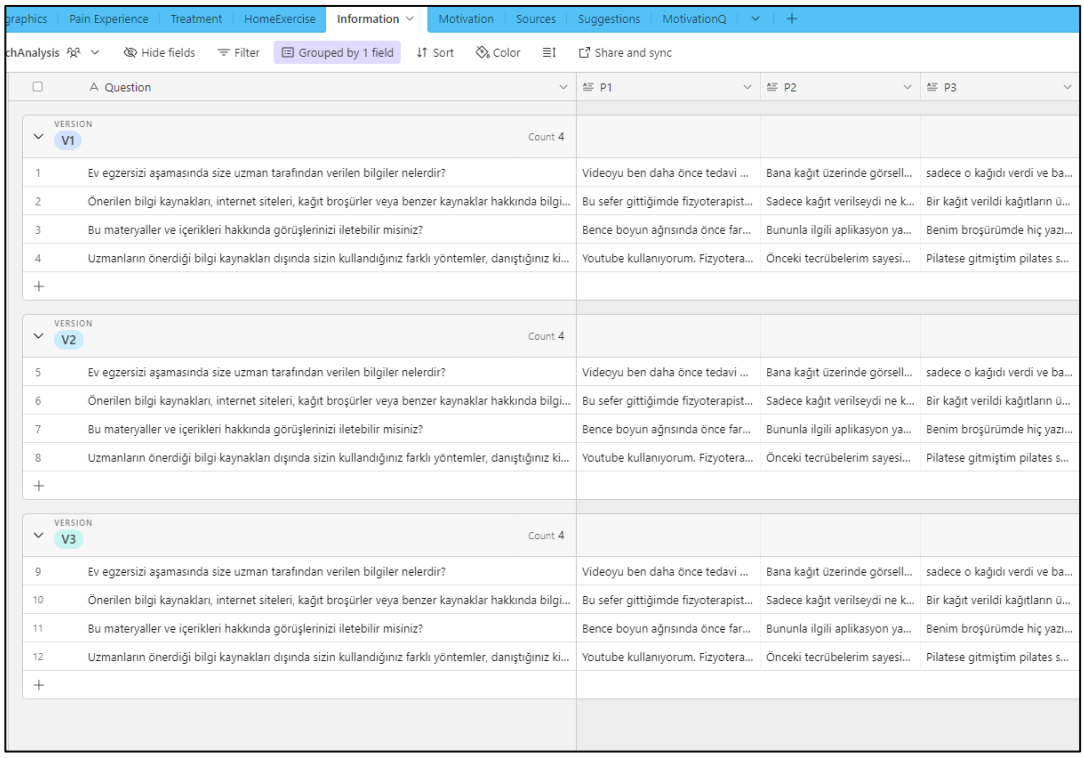


Figure 4.4. An example screenshot from Airtable illustrating questions and answers with grouped and eliminated

Because the participants answered the questions open ended, it led them to respond to questions in a holistic view. In other words, similar answers were given to questions under different headings, highlighting interrelated themes. For example, one of participants answered it under the information sources' questions, but one participant answered the information sources questions under the home-exercise questions. Therefore, while questions were posed under specific headings, a holistic approach was adopted during the analysis process. Hence, thematic analysis was used to define the themes. The connections established were presented from an inclusive perspective within the framework of the four main headings. The results and the analysis of Stage 2 'Patient Interview' presented under the following headings: i) Participants Characteristics, ii) Pre-Treatment Period, iii) Hospital-based Treatment, and iv) Home-based Rehabilitation (see Figure 4.5)

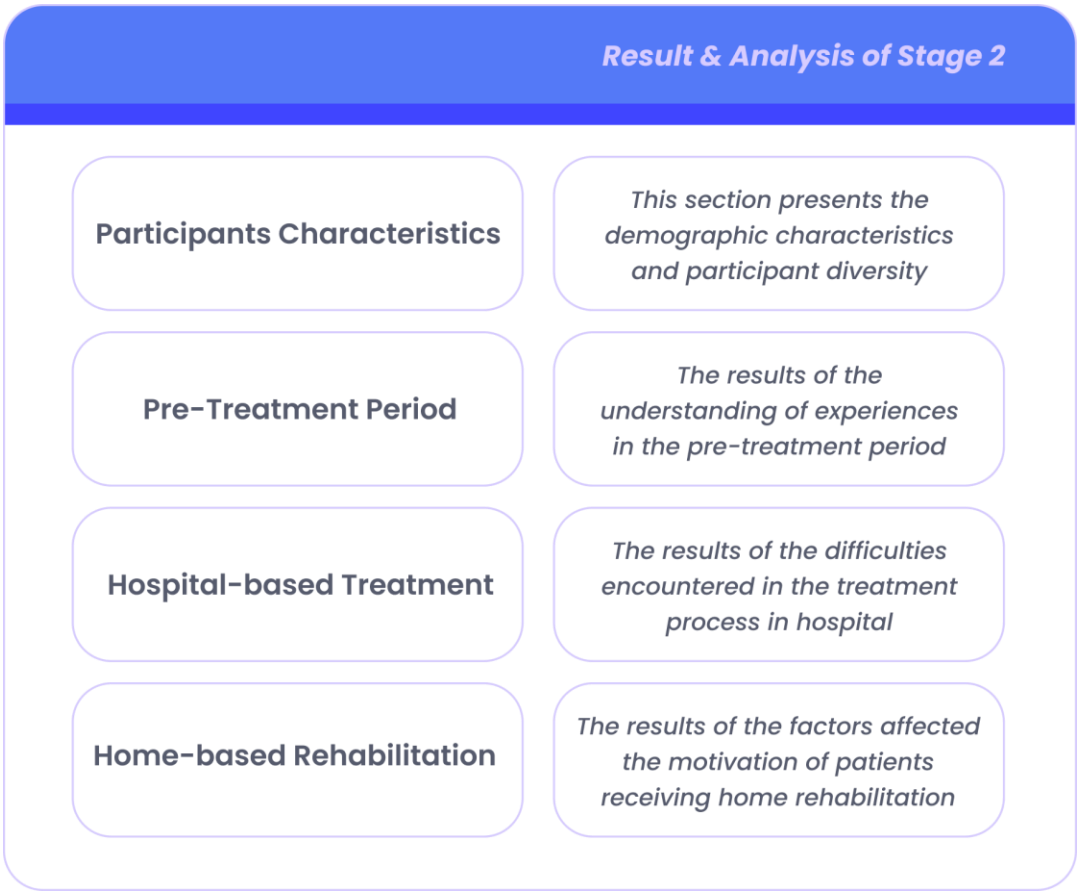


Figure 4.5. Summary of Stage 2 – Result and Analysis

4.2.1 Participants Characteristics

According to the answers given by the participants to the questions under the title of demographics, the analyses were shown in graphs under the title of demographic characteristics. Under the subheading of participant diversity, the emotional states of the participants were analyzed and presented according to their answers to the pre-treatment, hospital-based treatment and home-based rehabilitation questions. This chapter is presented under two headings: demographic characteristics and participant characteristics.

4.2.1.1 Demographic Characteristics

In the initial part of the interview, participants were asked to indicate their age range, gender, and occupation. They were then questioned about their views on how their occupation affects neck pain and their experiences regarding the contribution of occupational factors to neck pain.

a. Age Range

The age distribution graph of the participants showed that the 26-40 age group had the highest number of participants, with 12. The 18-25 age group had moderate participation, with 4 participants, while the 40-55 and 55-70 age groups were the least represented, with 2 participants each. Age average was 34 (Figure 4.6).

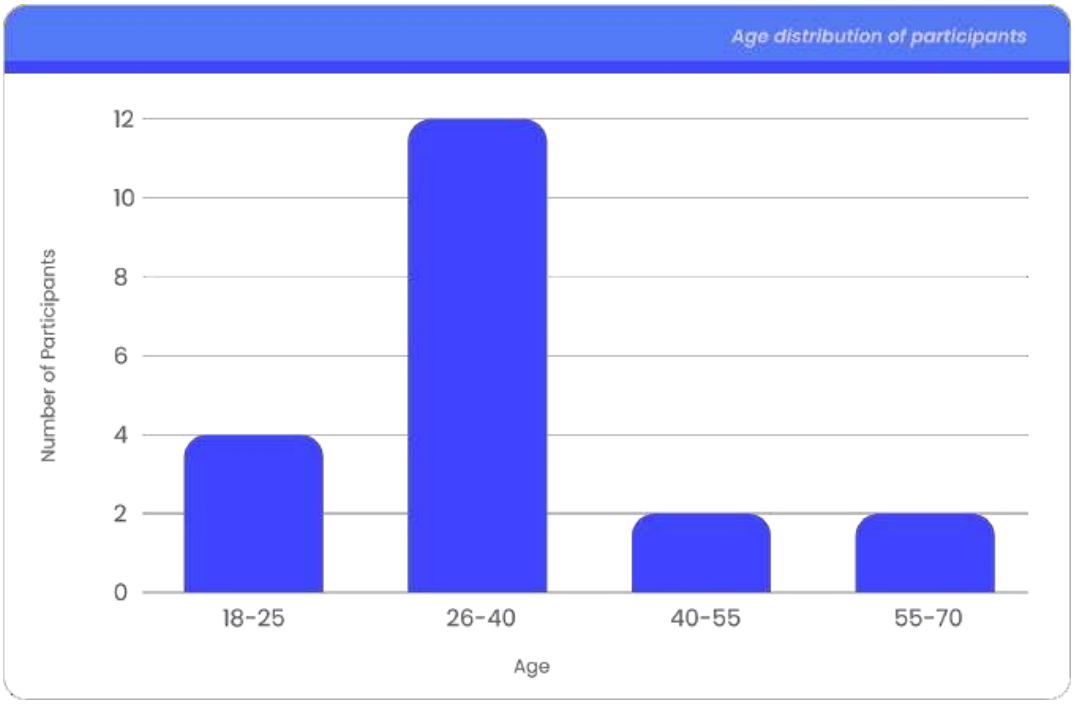


Figure 4.6. Age distribution of 20 participants

b. Gender

As can be seen in Figure 4.7, 70% of the 20 respondents were female (14 out of 20). According to data published by the Turkish Statistical Institute, this participant

gap was similar across the country, with 20.5% reporting problems for neck conditions in 2019, with a higher proportion of women (27.9%) than men (12.8%). In 2022, overall reporting had fallen to 17.2%, with male reports falling to 10.8% and female reports falling to 23.4% (TÜİK, 2023).

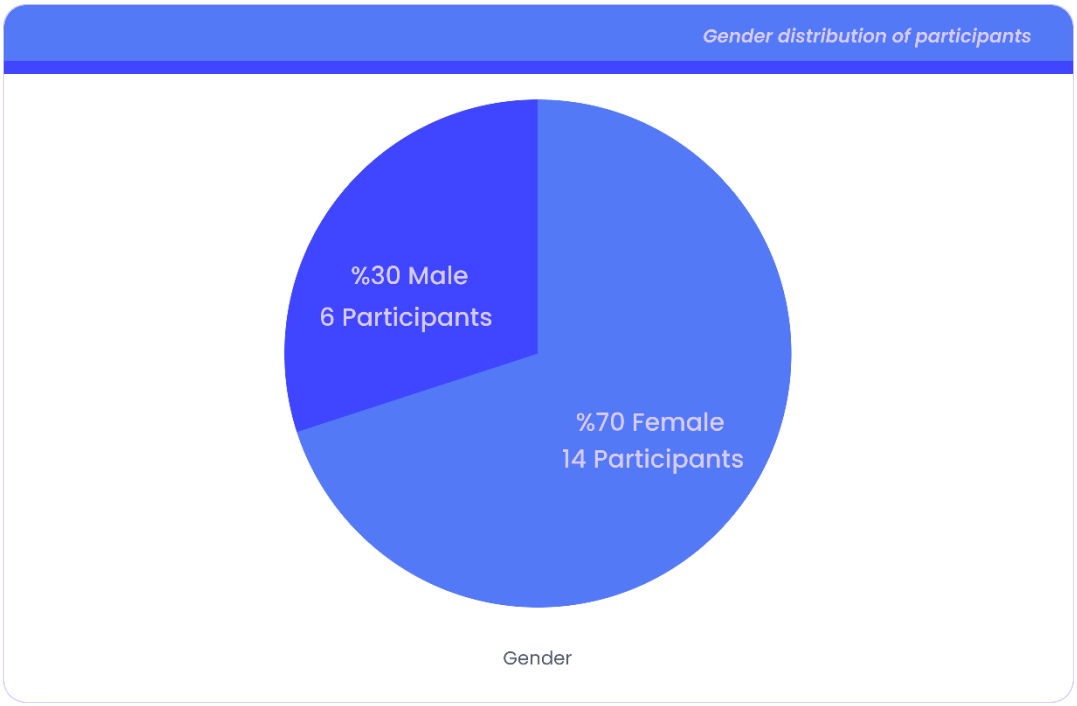


Figure 4.7. Gender distribution of the 20 participants

c. Occupation

Participants were asked about their occupations and whether the neck pain they experienced was related to their work. Questions about occupations were included among those about the causes of neck pain. Occupational groups participating in the study included: Primary/High School Teacher, Interior Architect, Computer Engineer, Finance Officer, UX Designer, Environmental Engineer, Laboratory Technician, Industrial Design Student, Civil Engineer, Seat Washer, Architect, Industrial Engineer, Physiotherapy Student - Volleyball Player, Motion Designer, Woodworker, and Industrial Designer. Participants were asked about the extent to which their occupation influences neck pain and the main characteristics of their

workplace. All participants (20/20) indicated that constantly bending forward during work can lead to neck pain. Specifically, laboratory work, involving prolonged desk work, was cited as a common cause of neck pain, especially when working in the same position for long periods of time. For example, all participants engaged in desk work mentioned that working at a desk causes neck pain due to sedentary behavior and forgetting to take breaks.

4.2.1.2 Participant Diversity

Through the pre-treatment period, hospital-based treatment, and home-based rehabilitation, understanding participants' emotional states is essential for designing mobile application for neck pain.

According to the results of the one-on-one interviews with the participants, it was evident that participants could be clearly categorized into two groups. These two participant groups were a. participants who were self-motivated to adhere to Home Exercise Programs (HEPs), and b. participants who were not self-motivated to adhere to HEPs. The first group, with 6 participants and the second group, with 14 participants. More than half of the participants found it challenging to participate and sustain their engagement with the exercises.

a. Participants who are pain-driven are motivated to adhere to HEPs

The primary reason for the participants' adherence and continuation of home exercises was the pain intensity and fear of the surgery, since their doctors had informed them of the possibility of needing surgery. According to the results of the research, the level of pain and the prospect of surgical treatment influenced the participants' behavior in regarding participating in exercise programs. The age of the participants in this group was not related to the pain intensity, but it is noteworthy that all participants were women.

b. Participants lacking motivation to adhere to the HEP

Since the pain characteristics of the participants in the second group fluctuated and surgery was not involved, it was observed that they either participated in the home exercises with insufficient continuity or did not participate at all.

The differences in participants' emotional states regarding their participation in home exercise programs, as observed in the two groups, were examined, and explained in more detail under the following three headings: pre-examination, during treatment, and home-based rehabilitation, and were represented by the Patient Journey Map (Figure 4.8), which illustrates these three periods.

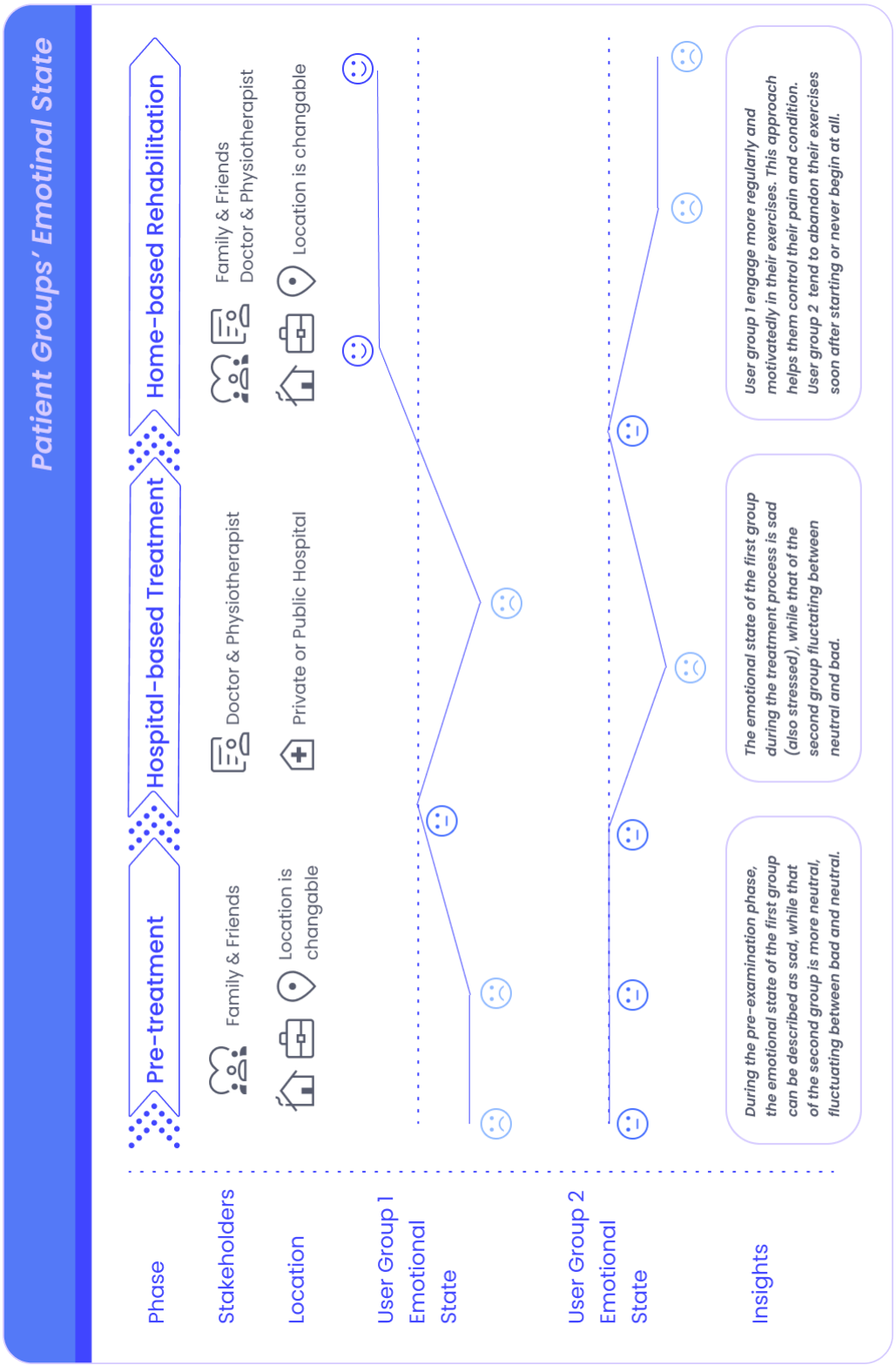


Figure 4.8. Summarizing the 20 participants' (Patient Group) emotional state during pre-treatment, hospital-based treatment and home-based rehabilitation

Pre-Treatment Period. During the pre-treatment period, participants who are pain-driven are motivated to adhere to HEPs and participants lacking motivation to adhere to the HEPs maintained communication with their families and friends, with their pain affecting various aspects of their lives. However, the difference between the two groups during the pre-examination period was noted in how their pain impacted their daily lives. Participants in the first group experienced more restrictive challenges in their everyday activities before starting the exercises compared to the second group. For example, a participant in the first group mentioned being unable to drive and having difficulty turning their neck while driving. In contrast, participants in the second group primarily faced issues related to prolonged inactivity. Therefore, during the pre-examination period, the emotional state of the first group could be described as sad, while that of the second group was more neutral, fluctuating between bad and neutral.

Hospital-Based Treatment. During the treatment process, participants in both groups expressed curiosity and concerns about their treatment. A primary concern was the lack of information. Participants in the first group, particularly close to undergoing surgery, sought detailed information to understand their condition and ensure the benefits of the process. Similarly, participants in the second group desired information, but their main goal was to achieve body awareness, reduce pain, and quickly recover from their discomfort.

Home-Based Rehabilitation. It observed that the participants in the first group were pleased with the improvement in their condition. After transitioning from hospital- based treatments to home exercises, participants in the first group, motivated by a desire to avoid surgery, consistently engaged in their exercises with greater motivation. This approach helped them in managing their pain and condition effectively. However, participants in the second group, lacking motivation, tended to abandon their exercises soon after starting or not initiate at all. Consequently, their condition tended to become more chronic.

4.2.2 Pre-Treatment Period

This section provides the results and analysis of experiences at the pre-treatment period, including the discomforts associated with mechanical neck pain and how these symptoms intertwine with daily activities. Participants shared personal experiences during episodes of neck pain, providing insights into the severity, duration, frequency, and triggers of pain. The analysis extended to participants' thoughts about situations or behaviors that act as catalysts for neck pain and discussed the causes and consequences of their neck pain, focusing on situations where they expressed, "If I avoid it, my neck won't hurt". Participants also shared their awareness of the root causes of neck pain, the duration of their discomfort, and their decision-making process regarding seeking specialist care. Reasons for procrastination were listed. In this section, the data obtained are presented under the headings of: Risk Factors and Consequences of Neck Pain, Timing of Specialist Care.

4.2.2.1 Risk Factors of Neck Pain

In this section, the results include both physical and psychological causes obtained from participants' responses to the questions "What are the situations or behaviors that you believe would not cause neck pain if you did not engage in them?", and "Are there any situations that trigger these pains while performing your profession?". The most frequently mentioned reason was standing in the wrong position for a long time. 18 out of 20 participants mentioned that keeping their neck in an improper position for an extended duration while using a computer or phone leads to neck pain. The risk factors causing neck pain will now be presented in two groups: a. Physical, and b. Psychological factors.

a. Physical Factors

Prolonged body holding in the wrong position. This was a risk factor that involves maintaining an incorrect posture for extended periods, leading to

discomfort and pain. Most respondents (18 out of 20) identified prolonged incorrect positioning as a critical factor for neck pain, often resulting from immobility for long periods of time. According to users, this was due to improper posture when using digital devices or working at a desk. Participants were assigned numbers for the purpose of anonymization and will be referred to as 'P' from now on. Examples from the participants statements include:

"This is a discomfort of mine from the university period; whenever I have to read something at a desk for a long time, it triggers neck pain." (P01)

"After a while, I didn't realize that my body shape was distorted, and it affected me to stay almost zero distance from the screen." (P07)

"Working at a desk for long periods is the biggest reason" (P18)

"I have to lean forward all the time in the lab." (P09)

Prolonged Standing. Some of participants reported that prolonged standing contributed to neck pain (4 out of 20). This emphasized the importance of maintaining proper posture not only when sitting but also when standing.

"Prolonged standing was awful for neck pain" (P08)

"I am a teacher who actively walks around the classroom. When you are on the shift, you are always on your feet, so it causes pain." (P01)

Sudden Movements. Participants stated that sudden or rapid movements can cause pain by unexpectedly straining the neck muscles (4 out of 20). This risk factor was characterized as a common occurrence in daily activities. Examples mentioned included suddenly looking back, and nervous and impulsive movements.

"I believe that sudden movements are now already constantly triggering." (P13)

"Then I'll say that if I don't make sudden movements, my neck won't hurt." (P14)

Heavy Lifting. Some of the participants attributed their neck pain to frequent heavy lifting (3 out of 20 participants). They stated that heavy lifting habits cause neck pain.

"If I could only say one thing, I would say to carry it heavy." (P02)

Incorrect Pillow Use. Improper pillow use played an important role in neck pain, as reported by 3 out of 20 participants. Specifically, using a pillow that did not properly support the neck during sleep led to misalignment and discomfort.

"You know, I used that pillow in the house where I went as a guest so there would be no shame, and I thought that if I hadn't used it, I would have gone to bed." (P05)

Incorrect Movement in Sports. Participants cited incorrect or improper movements in sports as the cause of neck strain (3 out of 20). This finding emphasized the importance of maintaining correct techniques and good posture during physical activities. One participant mentioned the situation that led to his injury in sports as follows.

"I was doing something as simple as that I jumped into the water, but I didn't do anything. I don't know if people go into the sea, do they warm up?" (P20)

b. Psychological Factors

Stress. Some participants (6 out of 20) attributed their neck pain to stress. They mentioned that stress could cause muscle tension in the neck and shoulders, leading to pain, and that they felt the connection between psychological well-being and physical health.

"Since my stress is very high during the thesis, that is, during the period of writing a master's thesis, yes, obviously, I think it contributes to the pain." (P07)

Anger, Nervousness, Tension. Emotional factors such as anger, nervousness, and tension, mentioned by 3 out of 20 participants, also contributed to neck pain. These

emotional states could lead to physical disturbances like muscle tension in the neck area or causing pain.

4.2.2.2 Consequences of Neck Pain

This section presents participants' responses to the question "Can you describe what you experience when you have neck pain?". In addition, the problems experienced prior to treatment are also presented in two groups: a. Symptoms and Complaints, b. Restriction of Daily Activities.

a. Symptoms and Complaints

The prevalence of various symptoms and complaints was analyzed among 20 participants, all of whom suffered from neck pain. Following neck pain, the most common symptom was arm numbness, reported by (7 out of 20) of the group. Headaches were also relatively common, occurring in (3 out of 20) of participants. Less common symptoms included shoulder pain, neck stiffness, and dizziness, affecting 6 out of 20 participants. This distribution indicates that besides neck pain, other problems also affected the daily lives of the participants (See Figure 4.9).

"The back of my head goes numb for a very long time, my arm goes numb, and it hurts, so I can't hold my arm up for a long time anyway." (P11)

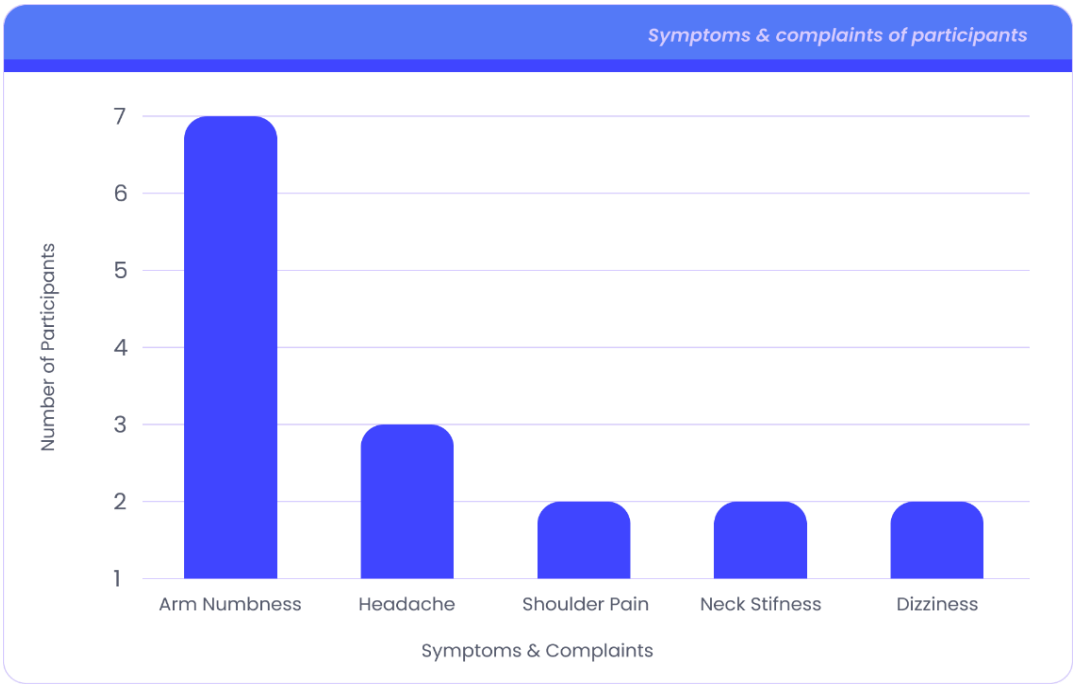


Figure 4.9. Symptoms and complaints of the participants during pre-treatment period

b. Restriction of Daily Activities

Participants reported significant limitations in their daily lives due to movement restrictions, reduced range of motion, and discomfort all closely related to neck pain and profoundly impacting their ability to perform daily tasks.

Restricted mobility leads to difficulties moving their necks and challenges with activities that require turning or tilting the head, such as driving a car or looking at a computer screen. Also, participants reported that reduced range of motion made it difficult to lie down, stretch, or engage in physical activities without discomfort or pain. The lack of comfort reported by the participants indicated a constant struggle to find positions or postures that did not worsen their neck pain, affecting sleep, work, and overall quality of life.

"I woke up one day, I was going to go to a presentation, I went to the presentation, but I drove the car crying, I had neck pain" (P18)

"It even changes the way I talk to people. I cannot look sideways and talk." (P01)

"I suffered a lot of neck pain while writing a thesis" (P07)

4.2.2.3 Decision of Consultation for Treatment

In this part, results of the questions concerning the duration of pain and timing of treatment were presented in three headings: a. Duration of Pain, b. Timing of Treatment, and c. Reasons for Postponing Medical Consultation.

a. Duration of Pain

This section detailed insights into participants' neck pain, focusing on two main aspects: the length of time they suffered from the pain and their experiences before seeking medical consultation. It also provided detailed information on how long everyone endured the neck discomfort and the length of time before they decided to consult a health professional. The questions "Approximately how long have you suffered from pain, and have you had neck pain for a long time?" and "When did you decide to consult a doctor?" were posed to 20 participants, and their responses are summarized in Figure 4.10.

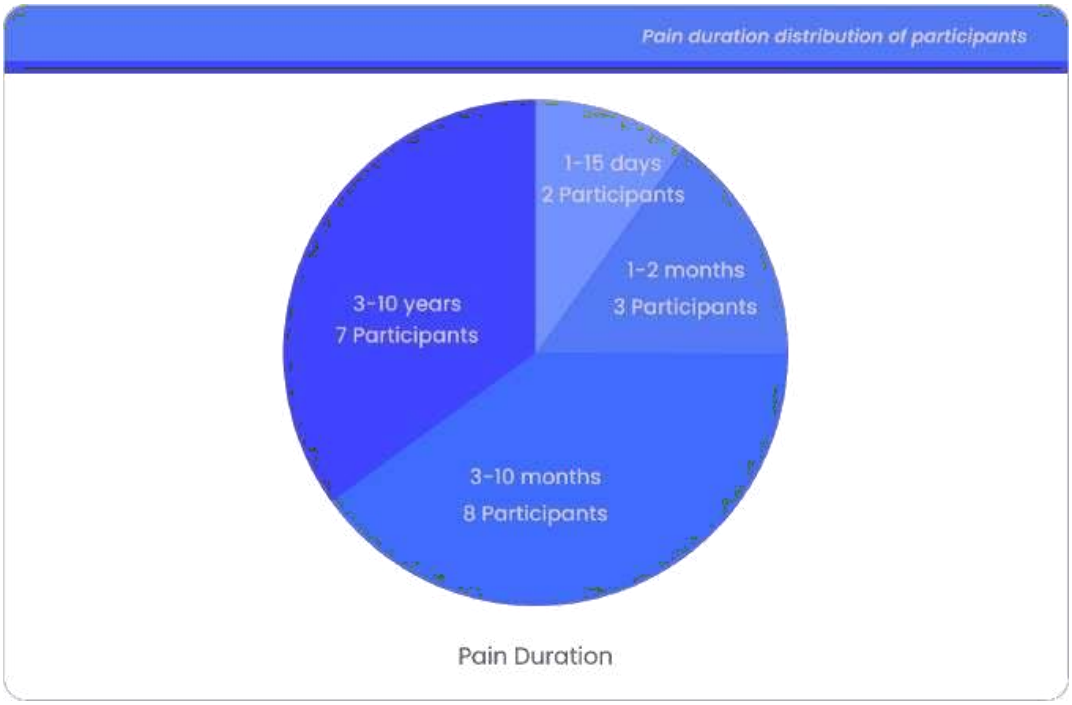


Figure 4.10. Distribution of pain duration among participants

15 out of the 20 participants stated that they were not aware that they suffered from chronic neck pain and thought the pain to be temporary. Most participants reported suffering from mechanical neck pain for approximately 3-10 months. Surprisingly, the second most common duration among respondents was 3- 10 years, reported by 7 out of 20 participants. Some participants who were uncertain about exact duration of their pain, within the range of 3-10 years, mentioned experiencing pain on and off since high school and university.

b. Timing of Treatment

According to the responses regarding neck pain and the timing of treatment, participants' experiences varied greatly. Among the 9 out of 15 participants, perceived neck pain as a moderate and intermittent problem. They typically experienced pain durations ranging from 1 to 8 months. These participants often waited for the pain to go away on its own, only deciding to consult a doctor when it became unbearable.

"I applied when it became unbearable for a week when it was severe. I can say that there was 1-1.5 months before that week." (P03)

"I suffered it very easily for one, two, three months. I mean, when my headache started to occur every day, I started to have a headache at the end of every day, at the end of every evening." (P09)

Additionally, 4 out of 15 participants reported long-term neck pain, enduring discomfort for years. These individuals usually sought medical attention when their pain became more severe. Although the pain was persistent, it was often ignored or normalized in their daily lives.

"I have been suffering from neck pain for a very long time, it took 10 years." (P03)

Furthermore, 2 out of 15 of participants reported that their neck pain was triggered by sports activities, especially sudden movements during sports. They consulted a doctor after 1-15 days of severe pain. Participants in this group experienced acute, intense pain that was often excruciating and caused them to seek emergency medical attention. The pain was significant and had a sudden and dramatic effect on their daily lives.

"There was a sudden pain, and I had to go to the emergency room." (P12)

c. Reasons for Postponing Medical Consultation

There were several common reasons why participants delayed seeking medical treatment, ranging from personal circumstances to logistical challenges. As mentioned in the previous section, participants often sought medical attention long after they started to feel pain.

Fluctuating Pain and Neglect. The intermittent nature of some pain, such as neck pain that fluctuated in intensity, led participants to neglect their condition. This variability in pain levels created the false impression that the pain was temporary

and did not require immediate medical attention. Participants often perceived their pain as acute and did not realize that it had developed into chronic pain. This situation led to the belief that the pain was manageable and would not become a long-term problem, resulting in delayed medical intervention (7 out of 18).

Time and Workload Issues. Most participants stated that they had difficulty allocating time for physical therapy, postponed treatment due to working hours, and had difficulty taking time off from work. This group included individuals who delayed treatment due to workload, inability to find a suitable time slot, and overall lack of available time. (7 out of 18).

Personal Evaluation and Priorities. Some participants prioritized other aspects of their lives over their health and delayed treatment due to personal considerations. This group included reasons such as not feeling valued enough to prioritize their health, and laziness. (4 out of 18).

Health Concerns and Prejudices. Some patients reported that they postponed visits to the doctor because of fears about the treatment process, particularly fears related to of confined spaces such as those experienced during MRI scans (2 out of 18).

4.2.3 Hospital-based Treatment

During the hospital-based treatment process, participants were asked about their pain experience, as well as their experiences and expectations as well as the treatment initiation. This section presents the analysis of the participants' responses, highlighting the difficulties encountered, expectations and concerns throughout the treatment process. The data analysis process was structured to provide a holistic understanding of the participants' needs and expectations. Concerns about Hospital environment and Organization, and Doctor and Communication were presented.

4.2.3.1 Hospital Environment and Organization

Participants preferred doctors based on recommendations from trusted acquaintances. Patient transport logistics and personal space availability within the hospital were also essential considerations for respondents. Also, participants reported higher satisfaction and better adherence when health professionals treated them with genuine concern for their health (8 out of 19). It was noted that a system that remembers and respects patient profiles can significantly improve the patient experience. However, this was mentioned as a priority by a smaller proportion of patients (6 out of 19). Additionally, it was found that when participants were not adequately informed about their treatment process, their trust in the treatment process and the success of the treatment diminishes.

"I asked people around me who had similar problems to recommend a doctor. I went to the doctor according to suggestions. I preferred it to be close to my home." (P02)

Patients often faced time constraints and registration problems prevented them from attending appointments. Additionally, they found it inconvenient to make and book appointments (5 out of 19).

"Let me start with the difficulties I had while registering; let me put it this way, then an appointment process was too much." (P14)

Patients reported difficulties in obtaining the necessary resources and information to enable them to follow their treatment plan effectively. Challenges such as understanding prescribed exercises without appropriate guidance or lack of accessible educational materials were cited as barriers to their recovery. Participants also wanted to access organization and doctor information, hospital information.

"In fact, it would be very useful to have easy access to many doctors, their methods, ideas, and opinions, and to be able to access the studies." (P19)

4.2.3.2 Doctor and Communication

Most participants found the doctor's involvement and quality of communication necessary. 18 out of 20 participants emphasized the importance of the doctor's ability to show empathy and understanding. Participants preferred both private and public healthcare facilities, often influenced by recommendations from friends and family (3 out of 19). In addition, participants placed great value on the doctor's caring behavior and ability to communicate clearly and effectively.

Several aspects of neck pain were essential for participants in their interactions with doctors. First, they emphasized the importance of good communication with the doctor. Secondly, participants indicated that they valued the doctors' genuine interest in their condition, as the personalization of the treatment experience made them feel valued. It was also crucial for the participants that all necessary examinations were carried out thoroughly, giving them comprehensive care and attention. Finally, it was essential to receive detailed information about the treatment process. This included understanding what to expect during treatment, possible side effects, and the overall process. Figure 4.11 shows the preference percentage of the participants' communication needs.

Figure 4.11. Percentage of expectations related to expert and communication

"It is good if you can have good communication with the doctor. It was better with my first doctor and the staff, it was useful." (P01)

"I said neck, but he also wanted to look at my back because he saw a curve, I mean, I don't know, he saw it, and this, for example, made me more confident because he paid attention to me." (P06)

In addition, participants strongly desired a treatment regime tailored to their situation. They expressed the wish that doctors were knowledgeable about the details of the treatment plan and that it corresponded to their diagnosis. The lack of such knowledge made the patient fearful of being treated incorrectly in the treatment process. Additionally, participants wanted their treatments to be integrative, considering their daily lifestyle, which suggested a preference for more active participation in their treatment journey.

"So there needs to be something patient-specific like that. So, you don't see the reflection of this. Because everything is up in the air saying do this." (P20)

"Honestly, probably everyone's treatment is the same. Maybe it depends on the degree of the patient, but I think it should be special for everyone." (P01)

4.2.4 Home-based Rehabilitation

Interviews revealed that regular exercise was crucial in the home-based rehabilitation process. Participants engaged in home exercise programs, usually prescribed after a thorough medical examination. These programs typically included a series of exercises designed to aid recovery by alleviating pain in weakened muscles, strengthening muscles, minimizing mechanical stress on spinal structures, improving conditioning, correcting posture, and increasing overall mobility (See Section 2.2.1 Home-based Rehabilitation).

During the interview, questions were asked about the exercise programs in the home- based rehabilitation process (Appendix C). As a primary finding, most participants stated that the methods presented at the beginning of the process did not help motivate them to exercise (14 out of 20). All participants acknowledged the importance of regular exercise to avoid interruptions in treatment but stated that they needed motivating factors to start and continue exercising during the home-based rehabilitation process (20 out of 20). The common characteristics of motivated participants were that they had a higher disease level and took their condition more seriously than other participants (6 out of 20).

As the research aimed to understand strategies to increase motivation and engagement in patients receiving home rehabilitation for mechanical neck pain by analyzing users' experiences, the results obtained from the semi-structured interviews conducted for this purpose were analyzed from a holistic perspective and presented under specific headings. The main factors affecting the participants' motivation was divided into two categories: Location Related Factors, Information Sources.

4.2.4.1 Location Related Factors

This section included location related factors affecting patient motivation during home-based rehabilitation. Participants were asked questions such as "How do you feel in the home environment and external factors during the home exercise process? and "Can you tell us about the positive and negative features of the exercises you received in the hospital and home exercises?" (Appendix C). Insights obtained from the 20 questions were analyzed, resulting in two sub-headings: a. Home Environment, and b. Alternative Environments for Exercise.

a. Home Environment

According to the participants, exercising at home provided significant benefits, especially regarding personal time management and comfort. Some participants appreciated the privacy and convenience of exercising at home (5 out of 20). Conversely, some of them reported challenges related to the home environment such as lack of professional attention and structured exercise plans, which hindered their ability to exercise effectively (7 out of 20).

"When I'm at home, but it's very comfortable, it's wide; now I have a wall, for example, to make empty wall movements, I could already do it by standing." (P06)

"Since there is no obligation at home, even if it is human health, it may get tired after a while and not do it." (P04)

b. Alternative Environments for Exercise

Participants who tried to exercise outside home mentioned public settings such as workplaces, bank waiting rooms, and personal settings such as the car as different environments. The fact that the neck exercises consisted mostly of upper body

movements made it easier to exercise outside the home and allowed participants to quickly decide on a time and place. For example, it was noted that exercises were performed in schools, at workplaces, and during break times (8 out of 20).

"Sometimes I do my exercises in the school environment. They ask if there is an illness, and I tell my friends that I need to do these." (P08)

"I do one set of every time I get in the car. I coded myself a task like that." (P05)

4.2.4.2 Information Sources

This section gathered information about the participants' experiences with the instructional materials they received during the home-based exercise, such as brochures and resources recommended by healthcare professionals. Initially, data was categorized under subheadings and then general headings by coding common concerns and behaviors. Participants were asked about brochures and other informational materials supplied by healthcare professionals. Questions regarding instructional materials were given during home-based rehabilitation (Appendix C).

These questions specifically addressed the content of such resources and how they guided participants through their rehabilitation process at home; all 20 participants answered these questions. Sample sources were presented for evaluation to participants who either did not receive any brochures from their healthcare professionals or needed assistance recalling the sources of information during the interview. These samples included a neck pain exercises brochure from the Ministry of Health (Ministry of Health, 2019), an online brochure (Fizyoo.com, 2023), and a website featuring video demonstrations (HEP2go Inc., 2023) (Appendix C).

Headings were divided into four sub-headings based on the participants' experience to gain a comprehensive understanding of information sources. The groups were as follows: a. Information Received from Healthcare Professionals, b. Receiving Information from Personal Networks, c. Online Instructional Materials, d. Receiving Information from social media and Mobile Apps.

a. Information from Experts

This section includes participants' experiences of receiving rehabilitation information directly from health care providers, typically in the form of printed brochures or verbal instructions. Although most participants received a home exercise program on paper, a few were solely provided verbal instructions for their exercises (3 out of 20). As the proportion of exercise programs described verbally was low, questions were based on the paper program.

Participants described their experiences with printed materials provided by healthcare professionals (14 out of 20). These resources often consisted of paper-based exercise programs prescribed to patients and guided by healthcare professionals. The participants indicated a lack of adequate information, and their concerns are described as following.

Participants were concerned about the importance of having a good balance between pictures and written instructions. They said that it is not enough to just have photos, the instructions need to be clear and step by step. This was an issue raised by majority (15 out of 20) of the participants. They also said that there should be more detail on how to do the exercises correctly. Additionally, some mentioned key points to be emphasized more prominently during the exercises to avoid misunderstandings or misapplications. The video resources were highly appreciated for their ability to accurately demonstrate the movements. Participants believed that video explanations could improve understanding and reduce the risk of errors during exercises.

"If there is a visual and text somewhere, we look at the image first. When we think the visual is not enough, we read the text." (P02)

"Since the purpose is to give information, it is okay to place it neatly, but I think the visuals should be larger; the text will provide additional information for me, but the visuals are too small." (P10)

Participants believed that exercise programs tailored to individual diagnoses would be more effective. It was also emphasized that everyone has unique needs, and exercises should be customized accordingly. It was important to acknowledge that each patient has different needs and to create exercise routines taking these differences into account. It was crucial for doctors or physiotherapists to recommend individualized exercises (5 out of 20).

"It can be beginner level or advanced level. I think the given exercise is valid for the basic level. There are six on this page, but I will only do two. I'm carrying the other four for nothing." (P09)

"I think not everyone's neck straightening is the same." (P06)

b. Information from Personal Networks

Participants mentioned using individuals in their close circle as sources of information. For example, one participant (P11) said that she received extra exercise suggestions from a physiotherapist friend. She shared her situation and needs with her friend, who then provided her with special exercises. The participant explained that her friend helped her in this regard, by sending her photos and suggesting tailored exercises. Another participant (P16) stated that she consulted her mother and trusted her advice. She stated that her mother advised her on the pharmaceutical names and gave advice on individuals experiencing similar problems. It should be realized that this method is a very wrong way of getting information. Patients often make this mistake.

c. Information from Online Materials

In this section, questions were asked regarding online information sources among those utilized by the participants during the home-based rehabilitation process. Participants indicated their use of websites, digital brochures, and educational videos as sources of support for rehabilitation and exercise online (4 out of 20). Participants who received limited information from their doctors attempted to seek additional details on their own; after acquiring basic information, they tried to

expand their knowledge through the internet or their research (12 out of 20). Others relied solely on online platforms for exercise videos and aimed to learn the movements visually.

Based on the responses, participants' concerns, priorities, and experiences will be discussed under the following headings: Reliability of Online Sources, Internet Fraud Concerns, Searching and Filtering, The Impersonalize of Online Information.

Reliability of Online Sources. Almost half of the participants (8 out of 20) had serious concerns about the reliability of information. As the internet is a platform where anyone can share content, the risk of being exposed to inaccurate or unsafe information was high. As a result, there was a risk of relying on misleading information that could lead to health problems and injuries. Although internet resources are often used to gather information, participants also expressed concern about misinformation. They tended to trust hospital-affiliated websites more. Whether health professionals and specialists provide information on Internet sites was an important factor for participants.

Internet Fraud Concerns. The internet contained misleading advertisements for health and exercise products that pose financial risks and health and safety hazards. It was stated that this type of deceptive content caused problems in participants' use of online sites. (3 out of 20).

Searching and Filtering. During the interviews, it was mentioned that more assistance was required to identify accurate and reliable sources from the vast amount of internet data. Participants highlighted the time-consuming nature of discerning reliable information as a challenge. They mentioned that, since they tend to access easily available sites, they often turn to sites that rank first in search engines or social media platforms that they know and frequently use (4 out of 20).

The Impersonalize of Online Information. In interviews, participants stated that general information did not address their individual health history, abilities, and

goals, so they were unable to benefit from general information. They reported feeling panicked or stressed because they were uncertain whether the information, they obtained online was relevant to their diagnosis (3 out of 20).

d. Information from Social Media and Mobile Apps

This section presents conclusions drawn from interviews with individuals who relied on specific practices to inform their rehabilitation and utilized various tools and programs to aid recovery. A small group reported using unique apps or online programs to guide exercise routines (3 in 20). These tools often help patients in following their rehabilitation processes more regularly and systematically. A participant (P05) stated that a website that used colorful special clothes that showed muscles during exercise helped the participant understand body movements. He added that then website offered a variety of courses and programs that focus on movement, physical health, and fitness, which help individuals improve their body awareness, movement efficiency, and general physical health. Additionally, (P06) described using a yoga app offered neck exercises and explained the movements individually, allowing users to select their preferred exercise levels. Another participant (P03), who used a mobile app, stated that she set an alarm on the app to remind her to exercise and followed this reminder to perform the exercises.

4.3 Motivation Sources for Engagement to Home Exercise Programs

In semi-structured interviews (see Section 3.2), participants were asked eight questions concerning exercise motivation. These questions addressed extrinsic motivations, such as environmental factors and external influences, as well as intrinsic motivations, such as self-motivation. This section presents patients' experiences, their adherence to home exercise programs, and the factors that influence their adherence. This section included three main subheadings: a. Challenges and b. Motivation Sources c. Digital Intervention Suggestions of the Participants

4.3.1 Challenges

In the interviews, situations such as not being able to continue exercising regularly and decreasing motivation over time were mentioned. It was emphasized that increasing motivation and acquiring the right habits played an important role in this process. This section outlines the challenges of adapting to home rehabilitation in three primary areas: time management, need for social and professional support, and fluctuating pain and intensity.

Time Management. The participants expressed that busy schedules and demanding workloads greatly affected their ability to allocate time for exercise. This challenge was highlighted by personal accounts that demonstrated the difficulty of balancing personal care alongside other responsibilities (9 out of 20).

"The days are busy in two ways, and I have no time for myself" (P01)

"I must work hard. It just must catch up" (P07)

Need for Social and Professional Support. The presence of a companion or some form of encouragement often seems necessary. Participants also highlighted the tendency to postpone exercise when alone. It was stated that the influence of family and the immediate environment also plays an essential role in a person's motivation to exercise. Participants mentioned that they found it challenging to exercise alone and preferred being with a friend or trainer with them (15 out of 20).

"I don't be motivated from the side, but for example, because there is no one. If I had my mum to motivate me, she would say get up; it's time to exercise." (P13)

As participants noted, tracking progress during the home-based rehabilitation period proved challenging. It was also highlighted that there needed to be more communication between healthcare professionals and patients. This challenge prevented participants from receiving information about their progress or where they were in treatment. This situation created concern among more than half of the participants (11 out of 20). They also expressed concerns about doing the exercises

incorrectly. These concerns further emphasized the importance of staying in touch with the doctor (6 out of 20).

"After the treatment was over, I would be very, very happy if the specialist who did my treatment asked me how you feel after 10 days and a week." (P09)

"I wondered if I was doing the movements properly and if I was going to spoil it even more, I had this fear." (P06)

Fluctuating Pain and Intensity Participants mentioned that they remembered to exercise during periods of constant pain and discomfort. However, as the pain decreased, it became difficult to exercise regularly and for extended periods (6 out of 20). They also expressed that sometimes exercises were uncomfortable or increased their pain. Participants stated that they had difficulty maintaining their motivation to exercise, especially when experiencing sensitivity in their necks due to pain while exercising (4 out of 20).

"As the pain decreased, my motivation decreased, and I said I didn't need it." (P02)

"When I do the movements, sometimes I make a clicking sound, and I get scared and leave it because it hurts me." (P02)

4.3.2 Motivation Sources

The six factors that motivated participants during the home exercise period were ranked from most to least based on participants' comments: i) Pain Relief, ii) Professional Interaction, iii) Knowledge Competence, iv) Social Interaction, v) Progress Monitoring and Goal Achievement, vi) Personalization.

i) Pain Reduction. During the interviews, 20 participants were asked the question, "If you could achieve a concrete success, what would it be?" A large percentage of the participants, 18 out of 20, expressed a desire to get rid of their pain and

alleviate their discomfort. Therefore, participants' thoughts about relieving pain emerged as their most significant source of motivation.

Participants should have been reminded to start exercising before they felt pain. The most frequently stated reason participants began their exercise routines was that they started to feel pain. Participants who did not use alarms or reminders said they started exercising when they felt pain (6 out of 20). Thus, the participants indicated that they exercised to reduce their pain, but they lacked discipline in initiating exercise routines beforehand.

"Well, because it constantly reminds me of itself; usually, when I sit doing nothing, I pretend to rest, because it doesn't make me forget." (P05)

"*There is no such thing as a reminder. When I think about it, it's like being in that environment at that moment, doing this when I feel a slight pain. There is no specific method."* (P08)

ii) Professional Interaction. Most of participants thought that the doctor's involvement and quality of communication were very important. 18 out of 20 patients emphasized the importance of the doctor's empathy and understanding.

Doctor-Patient Communication. Participants were required to increase the depth and frequency of communication between doctors and patients to address any information gaps and reduce anxiety. Considering the participants' concerns, it was noticed that 15 out of 20 participants needed expert communication during the home exercise period.

"*After the treatment is over, I would be very happy if the specialist who treated me asked me how I feel after 10 days or a week."* (P09)

Progress Follow-up by Expert. It was stated that commitment and motivation were required to monitor and control the participants' exercises. Participants periodically sought feedback and progress information from experts during the home exercise period (15 out of 20). It was understood that creating an environment where experts could give feedback would increase motivation.

"*Communicating with the doctor and staying in touch with the doctor would lead to a certain progress. You know, it could make you feel like you were truly successful. You know, when I was practicing these exercises because I would be able to see my progress and what I was doing."* (P11)

iii) Knowledge Competence. Although the participants were asked about Information Sources and Motivation under separate headings during the interviews, it was found that obtaining sufficient information had a direct positive impact on the participants' motivation. (16 out of 20).

Information about Exercises. To increase motivation, providing resources detailing how specific exercises benefit specific muscle groups and health conditions were found to motivate participants (12 out of 20).

"I wondered if I was doing the movements properly and if I was going to spoil it even more, I had this fear." (P06)

Information about Medical Problem and Process. Detailed information about the treatment process to allay fears and satisfy curiosity also motivated participants. Participants mentioned that they could have been motivated by medical advice and educational information that will create body awareness. (8 out of 20).

"*When I want to start something, there is both fear and curiosity. I would feel better if I had received information about the process earlier."* (P02)

"*When you hold a human model, you can see how the human body moves. Look, it happens like this, it happens like this, it shows muscle, knowing these, I know my body better."* (P20)

Reliable Information Sources. Difficulties in identifying accurate and reliable sources from the large amount of internet data were mentioned in the interviews. The time-consuming process of discerning reliable information. Participants tend to open sites that are easy to access, so they tend to go to the first site that comes up in search engines or to social media platforms that they know and use frequently. (4 out of 20)

iv) Social Interaction. The effects of family members and close friends could also play an important role in a person's motivation to exercise. Also, participants found it challenging to exercise alone and prefer the presence of a friend or instructor. (15 out of 20).

Collaboration and Responsibility. Participants were more willing to exercise if they felt responsible for being with their exercise partners or family members. Another said that the influence of family and immediate surroundings can also play an essential role in a person's motivation to exercise, highlighting the tendency to postpone exercise alone (16 out of 20). Participants also felt they would be influenced by the experiences of people with the same disease and encouraged to take a proactive approach toward their health. For example, it was stated that being in the treatment process with friends who have the same disorders increased motivation (2 out of 20 people).

"I am motivated by my friends. My friends used to motivate me. For example, me and my friend motivate each other a lot." (P10)

"*Sometimes I used to do my exercises in the school environment and some of my friends would sometimes do them with me. When they do it, people feel relaxed and want to exercise with them."* (P08)

"Sometimes she says she's been through these processes before and gives you suggestions, at least just knowing that you're not alone is helpful, I think." (P06)

Participants also mentioned that they could benefit from community support, such as group therapy or online support groups, where people come together to deal with similar health issues. They mentioned that sharing experiences with others and receiving mutual support can be motivating (14 out of 20).

"*A few of my friends said the same thing when I told them. For example, they somehow gained strength and went to the doctor, started physical therapy, or started playing sports. On the other hand, it feels good. You support their process because you touch other people's lives somehow."* (P06)

Positive Feedback. Sharing positive experiences and success stories to create a more encouraging environment of the treatment process. Participants were more motivated when they saw their exercise results or received positive feedback (4 out of 20).

"Social praise and compliments from outside influence me very well from the outside." (P17)

"After I started the treatment, I heard things like 'Do you realize that your posture has improved?' and my friends said, 'Look, you are standing upright. It motivates me. Hearing positive things motivates me." (P02)

Support for Exercises. Participants were more willing to exercise when encouraged by family members, friends, or partners. Exercising with friends or following a program together could be motivating (1 out of 20).

"For example, my mom says if you're going to exercise, I'll get a hot water bottle." (P02)

"Because I had trouble bending and getting up, turning somewhere, etc., my mother was doing the other work around the house, my wife was doing it." (P07)

v) Progress Monitoring and Goal Achievement. It was important for participants to ensure that the treatment process remained appropriate to the patient's evolving needs. Participants emphasized the importance of utilizing visuals and texts to show progress and explain health status at each exercise step. They noted that obvious and felt changes, especially physical improvement, or increased muscle strength, would provide motivation.

Progress of Recovery. Participants expressed that they felt motivated when they experienced positive sensations or observed progress while exercising. Additionally, participants expressed a desire to receive information about treatment follow-up and recovery processes (6 out of 20).

"I saw improvement. I saw a decrease in my pain, which was also a sign that I was getting better. That also gave me motivation." (P06)

Goal Setting. Participants stated that keeping goals small and progressing step by step would help maintain motivation. Those who wanted to observe their progress and feel motivated as they got closer to their goals mentioned that they could continue exercising without getting discouraged (2 out of 20).

"I was minimizing my goals. I start swimming to move my neck by 1km and then complete it by 2 km. I do it step by step, so I don't get discouraged." (P10)

vi) Personalization. Participants stated that each patient has unique physical conditions, fitness levels, and personal goals. A personalized system ensured that the exercises were tailored to meet these specific needs: muscle building, improving flexibility, or rehabilitation. 8 out of 20 participants found ensuring effectiveness and sustained motivation essential.

Personalized content. It was necessary to recognize the importance of adapting treatment to individual needs and to update these plans regularly as progress was made. Additionally, images and descriptions should have been adapted to personal preferences and needs for greater motivation. Participants thought that personalized exercise programs would be more effective. They mentioned that everyone has different needs and exercises should be arranged accordingly (7 out of 20).

"There are brochures; I prefer to make them because they are designed according to my weight and height. Things designed according to my mobility are special when they enter the camp. They make a program by changing the variations according to your problem and disease." (P17)

Lifestyle Integration. Emphasizing that exercise should be a permanent lifestyle choice, not just a temporary measure, the participants expressed that they needed guidance on seamlessly incorporating these movements into daily routines. They also mentioned that offering exercises according to the environment where users are located, and their available hours will motivate them more.

"I made a rule for myself that I will always do half an hour before going to the kitchen to do at least three exercises for 10 minutes after I come home from work and change my clothes." (P09)

4.3.3 Digital Intervention Suggestions of the Participants

In the patient interviews, participants were asked for their suggestions through specific questions (Appendix C). As the result of the response analysis six headings were presented as participants' suggestions.

4.3.3.1 Expert Support

Participant stated, having expert support available in digital exercise environments is vital to ensure users perform movements correctly and safely. Expert guidance can prevent injuries and help users get the most out of their workouts by providing professional advice and corrections (18 out of 20).

"It's important to have expert support in the digital environment to ensure correct physical activity movements." (P02).

4.3.3.2 Visuals and Video Guides

Participants noted, detailed visual explanations and video demonstrations of exercises are essential for understanding and performing movements correctly. These guides provide clear, step-by-step instructions that can help users learn new exercises and improve their technique, leading to better results and reduced risk of injury (8 out of 20).

"Having detailed visual explanations and video demonstrations of exercise movements is very important." (P01)

4.3.3.3 Reminders and Notifications

Participant remarked, regular reminders and notifications are important to keep users on track with their exercise routines. These prompts can help maintain consistency and ensure that users incorporate physical activity into their daily schedules, which is key for achieving long-term fitness goals (6 out of 20).

"Reminders and notifications to ensure regular exercise would be a preference." (P01)

4.3.3.4 Customizable Applications

Participants emphasized, customizable applications were crucial as they allow users to tailor their exercise routines, set personalized reminders, and receive feedback based on their individual progress. This level of customization ensures that users can adapt their workouts to meet their specific fitness goals and preferences, enhancing overall engagement and effectiveness.

"I want customizable applications for tracking exercise movements, setting reminders, and receiving feedback." (P01)

4.3.3.5 Social Media Integration

According to one participant integrating exercise content with social media platforms is important because it leverages the motivational power of social networks. Sharing progress and engaging with a community can boost motivation and accountability, making it more likely for users to stick to their fitness routines.

"Exercise videos and content can be made more motivating by integrating with social media." (P04)

4.3.3.6 Motivational Elements

Participants pointed out, "Incorporating motivational elements such as music playlists, daily goals, and post-exercise surveys can significantly enhance the exercise experience. These features help maintain interest, set clear objectives, and provide a way for users to reflect on their progress and emotional state, promoting a holistic approach to fitness (3 out of 20).

"Features like music playlists, daily goals, and surveys to assess your feelings after exercise would be beneficial." (P03)

4.3.3.7 Suitable Digital Platform

Patient interviews revealed that participants turned to their phones for health reminders and tracking. Integrating health activities with a computer or television was more appealing, especially for those who predominantly worked on computers or preferred the larger screens of these devices. Furthermore, with the growing popularity of smartwatches and tablets, participants noted the functionality and portability of these devices. However, in one-on-one interviews with twenty respondents, 14 said they would prefer an app on their mobile phone. Participants said they use their phones frequently and use the alarm and stopwatch features for reminders. They had previously used platforms such as YouTube and Instagram for exercise. Following the insights, it was decided to design a mobile application as a continuation of the research. It was decided to design a mobile application that would include motivational features based on research results and mobile application evaluation analysis, which would serve as an example for designers who want to design a digital platform to increase exercise participation.

4.4 Integrating Self Determination Theory into the Process of Designing Motivation

Self Determination Theory is known as Motivation Theory, founded in the mid-1980s by researchers Edward L. Deci and Richard M. Ryan. SDT provides a comprehensive framework for understanding human motivation and personality. It emphasizes the importance of not only the amount of motivation but also the different types of motivation that influence human behavior. The theory focuses on how motivation relates to human personality and optimal functioning and suggests that different types of motivation play crucial roles in achieving well-being and personal development. (B. Şener-Pedgley, ID734 Lecture Notes, March 22, 2023). When there is a known reward associated with a task or outcome, people are more likely to be extrinsically motivated to complete the task. This principle can be effectively applied by designers to influence user behavior by adding clear and attractive rewards. These rewards can fulfill three psychological needs that will keep users motivated. SDT emphasizes three basic psychological needs: autonomy, competence, and relatedness. Autonomy refers to a sense of choice and validation in a task where individuals feel empowered when they feel that they are performing their actions on their own initiative. Competence involves the experience of mastery over a task or a specific domain and promotes a sense of effectiveness in one's environment. Relatedness emphasizes social connections and a high concern for others, where individuals feel cared for and have a sense of belonging (B. Şener- Pedgley, ID734 Lecture Notes, March 22, 2023) (see Figure 4.12).

According to researcher, organizing content according to the user's characteristics, which gives them the ability to make their own decisions, was considered autonomy. The features that the user can improve himself/herself and follow the development are grouped as competency. Relatedness features in a mobile application can be any feature that provides social interaction. In this part, result of the analysis design suggestions for digital interventions that can motivate

people to do neck pain exercises were listed under the headings of autonomy, competence, and relatedness and digital intervention suggestions of the participants presented.

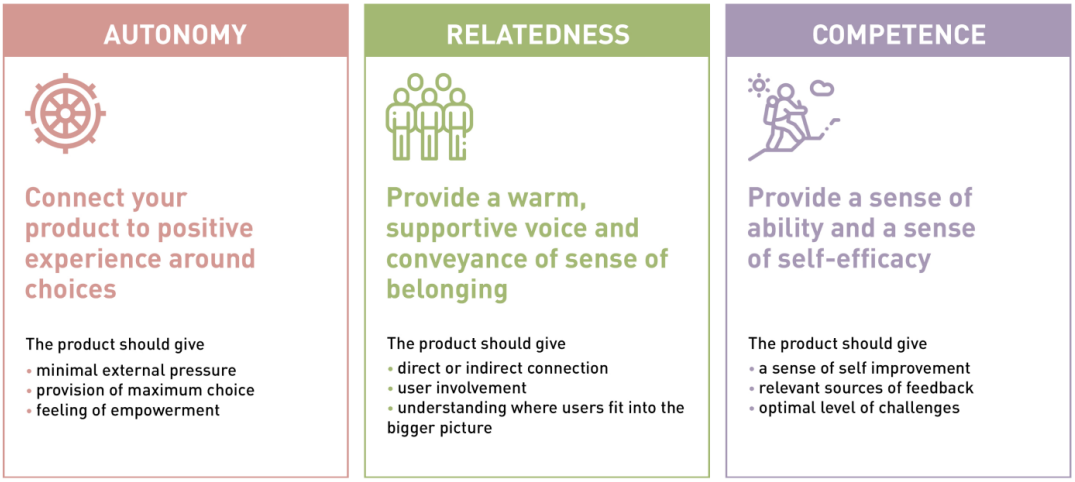


Figure 4.12. Autonomy, Competence and Relatedness related features presented in ID734 Lecture (B. Şener-Pedgley, 2023)

i) Autonomy

Autonomy focused on control and personalization in users' experiences. Making users feel in control and giving them the freedom to make their own choices is important. Personalization, identified as a motivation source based on participants' responses, and Autonomy, a psychological need according to Self Determination Theory, were concepts that focused on the same motivational factors because both concepts focus on tailoring the person experience to individual users, ensuring that content and features are relevant, adaptable and under the user's control. This alignment increases user engagement, satisfaction and motivation by making the experience feel more personal and less generic. By empowering users to make choices and adjustments, these concepts foster a sense of ownership and self-efficacy, which are crucial for maintaining long-term adherence to exercise programs.

These features listed as: a. Customizable Interfaces, b. Adaptive Content/Exercises c. Scheduling Tools and Reminders Personalized Reminders d. User Profiles e. Location-Based Services f. Providing a Personal Plan

a. Customizable Interfaces. gives users control over their experience by allowing them to adjust the look and feel of the app to their preferences. It also supports personalization by allowing users to change the look and feel of the platform and autonomy by allowing users to choose which features are displayed and used.

b. Adaptive Content/Exercises. Adapting the platform experience to individual diagnoses and preferences helps meet users' need for autonomy. Even if users do not choose the exercise content themselves, having it tailored to their diagnosis and treatment fulfills this need.

c. Scheduling Tools and Reminders. The use of scheduling tools like calendars and the platform of personalized reminders to integrate exercise days and times into users' daily lives meet the need for autonomy.

d. User Profiles. Allows users to access their personal health data, doctor, and hospital information. Thus, having a personal space with medical reports satisfies the need for autonomy.

e. Location-Based Services. Considering neck pain exercises, it mentioned by users (4 out of 20) that they can do their exercises in different locations as they are easy and involve the upper body. Utilizing user comments to adapt exercises to the user's current location and situation can fulfill the need for autonomy.

f. Personal Plan offers a tailored exercise plan based on the user's specific needs and conditions. This feature supports personalization by customizing plans to individual health conditions and autonomy by allowing users to follow a plan that is specifically designed for them, enhancing their sense of control.

ii) Competence

Competence, one of the three psychological needs of Self Determination Theory, and progress monitoring and goal achievement, the motivators derived from participants' responses, are similar because both concepts focus on developing the user's sense of achievement and effectiveness. Competence involves users feeling skilled and capable in their activities, while Progress monitoring and goal achievement provide measurable milestones and feedback that reinforce this sense of skill and capability. Both aim to motivate users by showing tangible results and encouraging a sense of achievement. At the same time, Knowledge Competence and Competence are similar because they both focus on empowering users through knowledge and control. Sufficient information enables users to understand why they are doing what they are doing, which increases their competence by making them feel capable and effective. These features can be listed as: a. Progress Stages, b. Step-by Step Presentation of The Treatment Process, c. Tracking Process, d. Pain Level Monitoring, e. Before-After Visuals, f. Access to Expert Knowledge and Informational Content g. Detailed Exercise Information

a. Progress Stages. Showing users which stage of the treatment, they are in provides a clear roadmap of their journey. This feature enhances users' sense of competence by making them feel they are progressing through a structured plan. It also marks clear milestones that users can aim for and achieve, providing them with a sense of direction and accomplishment as they move through their treatment.

b. Step-by-Step Presentation of the Treatment Process. This feature provides clear guidance and structure, helping users understand and follow their treatment process effectively. By breaking down the process into manageable steps, it enhances users' sense of competence, making them feel capable of following through with the treatment. Additionally, it allows users to see their progress through each stage, giving them a sense of advancement and helping them track their journey towards their health goals.

c. Tracking Progress. Enabling users to monitor their progress is crucial for showing them that they are advancing and achieving their goals. This feature reinforces the users' sense of effectiveness by displaying their progress, thus enhancing their competence. Visual feedback on goals achieved and milestones reached provides a tangible sense of accomplishment, motivating users to continue their efforts and strive for further improvements.

d. Pain Level Monitoring. tracks pain levels and provides suitable exercises, ensuring the app responds dynamically to the user's pain level. Personalization is achieved as exercises are adapted to match the user's pain levels, while autonomy is supported as users have control over tracking their pain and adjusting their exercises accordingly.

e. Before-and-After Visuals. Visually showing users the changes in their posture or physical condition reinforces the results of their efforts. This feature helps users see tangible results of their activities, boosting their confidence in their skills and enhancing their sense of competence. By offering visual proof of progress, it motivates users to continue their efforts and provides a clear, visual representation of their journey towards their health and fitness goals.

f. Access to Expert Knowledge and Informational Content. Providing users with reliable information and guidance from experts significantly enhances their understanding and performance. This access to professional knowledge boosts users' competence, as they feel more capable and informed about their activities. Moreover, expert tips help users set realistic goals and track their progress towards these goals, ensuring they have a clear roadmap for their health journey and can see their progress against expert benchmarks.

g. Detailed Exercise Information. Offering detailed information on the purpose, difficulty level, duration, repetitions, and sets of exercises helps users understand what they are doing. This educational aspect increases users' competence by

making them feel knowledgeable and skilled in their activities. Furthermore, it allows users to track their performance and improvements over time, aligning their exercises with their Progress monitoring and goal achievement.

iii) Relatedness

Relatedness, one of the three psychological needs of Self Determination Theory, and Social Interaction, Professional Interaction obtained from participants are similar because they both focus on developing the user's sense of connection and belonging. Engagement involves feeling cared for and connected, while social and professional interactions provide platforms for communication, shared experiences and support. Relatedness features can be listed as: a. Communication with Experts, b. Shared Goals and Progress, c. Group Exercises

a. Communication with Experts. This feature allows for direct interactions with professionals, providing users with personalized advice and support. It builds a supportive relationship between users and experts, fostering a sense of care and connection. By ensuring users have access to professional guidance, this feature enhances users' trust and confidence in the platform.

b. Shared Goals and Progress. This feature enables users to share their progress and successes with friends, family, and peers. It strengthens social bonds by allowing users to celebrate achievements together, enhancing their sense of belonging. Facilitating communication and shared experiences within the app promotes a supportive community environment.

c. Group Exercises. Offering opportunities to participate in group exercises conducted by an expert promotes shared experiences. This feature encourages users to bond with others who share similar goals and challenges, fostering a sense of community. Additionally, it ensures exercises are conducted under professional supervision, enhancing the quality and safety of the workouts.

CHAPTER 5

MOBILE APP DESIGN

This chapter presents the stages of designing a mobile app design for patients suffering from mechanical neck pain. Based on the research results and mobile app evaluation analysis, it was decided to design a mobile app incorporating motivational features. This app aims to serve as an example for designers seeking to create digital platforms to enhance exercise participation. Furthermore, it sets an example for how the results presented in Chapter 4 (Results and Analysis) can be used by a designer. In this, the researcher used her personal experiences as an industrial design graduate and practitioner working in the areas of UX and UI design.

Recommended mobile application features were presented based on the motivational sources identified by the Self Determination Theory (SDT) and participant responses. This included: i) Technology Integration ii) Information Architecture; iii) Prototyping and Guided Tour of the Mobile Application; and iv) The First Impression Survey sections, which covered mobile application design and user comments.

5.1 Information Architecture for a Mobile Application

Information Architecture (IA) plays a crucial role in the design of mobile applications, ensuring that content is organized logically and efficiently to enhance the user experience. In essence, IA focuses on structuring and categorizing information to make it easily discoverable and navigable by users (Rosenfeld & Morville, 2006, p. 18). A mobile app creates an information hierarchy aligned with user expectations and behaviors. Another essential aspect of IA in mobile apps is creating user flows and wireframes that outline the path

users will take to complete specific tasks. A well-structured IA is the backbone of a successful mobile app, as it directly impacts the user's ability to interact with the app and achieve their goals effectively.

The mobile application was adapted and included 25 features that would increase motivation and engagement in patients receiving home rehabilitation for mechanical neck pain. These 25 features were grouped and listed into the three psychological needs of SDT: autonomy, competence and relatedness (Table 5.1). Using SDT in the design process is believed to help designers go through the process systematically, using these psychological needs as a guide. The mobile app features were designed and developed to meet all the needs identified under SDT.

Table 5.1 Total of 25 features and the 12 categories

Autonomy	**Competence**	**Relatedness**
Customizable Interfaces	Progress Stages	Communication with Experts
-Adjustable visual elements of the application	*-Presentation of the stage of the treatment process* *-Step-by-step presentation of the treatment process* *-Presenting before-and-after photos of the user's posture* *-Offering short-term exercises (2-3 min) throughout the day*	*-Experts monitoring the information on the process/statistics page* *-Feature to communicate with experts through appointments* *-Monitoring the pain level by experts*
Adaptive Content/Exercises	Tracking Progress	Shared Goals and Progress
-Exercises suitable for the pain level *-Offering exercises tailored to location and condition*	*-Conducting posture analysis and development tracking with artificial intelligence* *-Monitoring the mobility and development with artificial intelligence*	*-Allowing users to share their progress and successes through social media tools* *-Presentation of processes of individuals who have received the same treatment and succeeded*
Scheduling Tools and Reminders	Access to Expert Knowledge and Informational Content	Group Exercises
-Use of calendar and planning tools for exercises *-Use of reminder and notification tools for exercises*	*-Access to expert knowledge and instructional content* *-Finding answers to frequently asked questions with a chatbot* *-Providing information with known sources about the process and discomfort*	*-Opportunity to participate in group exercises conducted with an expert upon request*
User Profiles	Detailed Exercise Information	
-Personal health data and doctor/patient information	*-Offering exercises at easy, medium, and hard levels* *-Presentation of the purpose of exercises, their structure, and the muscles they work* *-Presentation of exercises with duration, repetition, and set information*	
Personal Plan		
-Providing a personal plan for exercises		

Customizable Interfaces give users control over their experience by allowing them to adjust the app's look and feel to their preferences.

- Adjustable visual elements of the application

Adaptive Content/Exercises Adapting the platform experience to individual diagnoses and preferences helps meet users' autonomy needs.

- Exercises suitable for the pain level
- Offering exercises tailored to location and condition

Scheduling Tools and Reminders The use of scheduling tools like calendars and the platform of personalized reminders to integrate exercise days and times into users' daily lives meets the need for autonomy.

- Use of calendar and planning tools for exercises
- Use of reminder and notification tools for exercises

User Profiles Allow users to access their personal health data, doctor, and hospital information. Thus, having a personal space with medical reports satisfies the need for autonomy.

- Personal health data and doctor/patient information

Personal Plan offers a tailored exercise plan based on the user's needs and conditions.

- Providing a personal plan for exercises

Progress Stages: Showing users which stage of the treatment, they are in provides a clear roadmap of their journey.

- Presentation of the stage of the treatment process
- Step-by-step presentation of the treatment process
- Presenting before-and-after photos of the user's posture
- Offering short-term exercises (2-3 min) throughout the day

Tracking Progress: Enabling users to monitor their progress is crucial for showing them that they are advancing and achieving their goals.

- Conducting posture analysis and development tracking with artificial intelligence
- Monitoring the mobility and development with artificial intelligence

Access to Expert Knowledge and Informational Content: Providing users with reliable information and expert guidance significantly enhances their understanding and performance.

- Access to expert knowledge and instructional content
- Finding answers to frequently asked questions with a chatbot
- Providing information with known sources about the process and discomfort

Detailed Exercise Information: Offering detailed information on the purpose, difficulty level, duration, repetitions, and sets of exercises helps users understand what they are doing.

- Offering exercises at easy, medium, and hard levels
- Presentation of the purpose of exercises, their structure, and the muscles they work
- Presentation of exercises with duration, repetition, and set information

Communication with Experts: This feature allows direct interactions with professionals, providing users with personalized advice and support.

- Experts monitoring the information on the process/statistics page
- Feature to communicate with experts through appointments
- Monitoring the pain level by experts

Shared Goals and Progress: This feature enables users to share their progress and successes with friends, family, and peers.

- Allowing users to share their progress, success through social media tools

- Presentation of processes of individuals who have received the same treatment and succeeded

Group Exercises: Offering opportunities to participate in group exercises conducted by an expert promotes shared experiences.

- Opportunity to participate in group exercises conducted with an expert upon request

As shown in Table 5.1, the researcher proposed a total of 25 features to address the 12 categories of needs identified in Chapter 4 (Results and Analysis). The information architecture for the 25 mobile application features was established and decisions were made regarding their placement within the app. The information architecture is outlined as follows: The researcher, drawing on expertise in design, prioritized placing the most essential features on the homepage. Other features were organized into different sections of the navigation bar, categorized by their purpose: the first is the homepage, the second is the progress, the third is the exercises, the fourth is community, and the fifth is the user profile (APPENDİX E).

The features displayed on the homepage consist of those most needed by users, as identified through participant responses. To address these needs, autonomy, and competence were prioritized and made the first elements users see on the homepage. Following these, progress features were included to further support users' competence needs. This section was placed third because personal plans, which are readily available on the homepage, precede it. The fourth section, community, was designed to meet users' needs for relatedness and competence. User profiles were positioned last as they provided general information. This section, located at the bottom right of the interface, was chosen as the fifth section for easy accessibility with users' thumbs. Information architecture consists of six main pages and features. Dark blue indicates the main pages, light blue indicates the features and green color indicates the exercise features that should be in the app like duration, level etc. (Figure 5.1) (Appendix D).

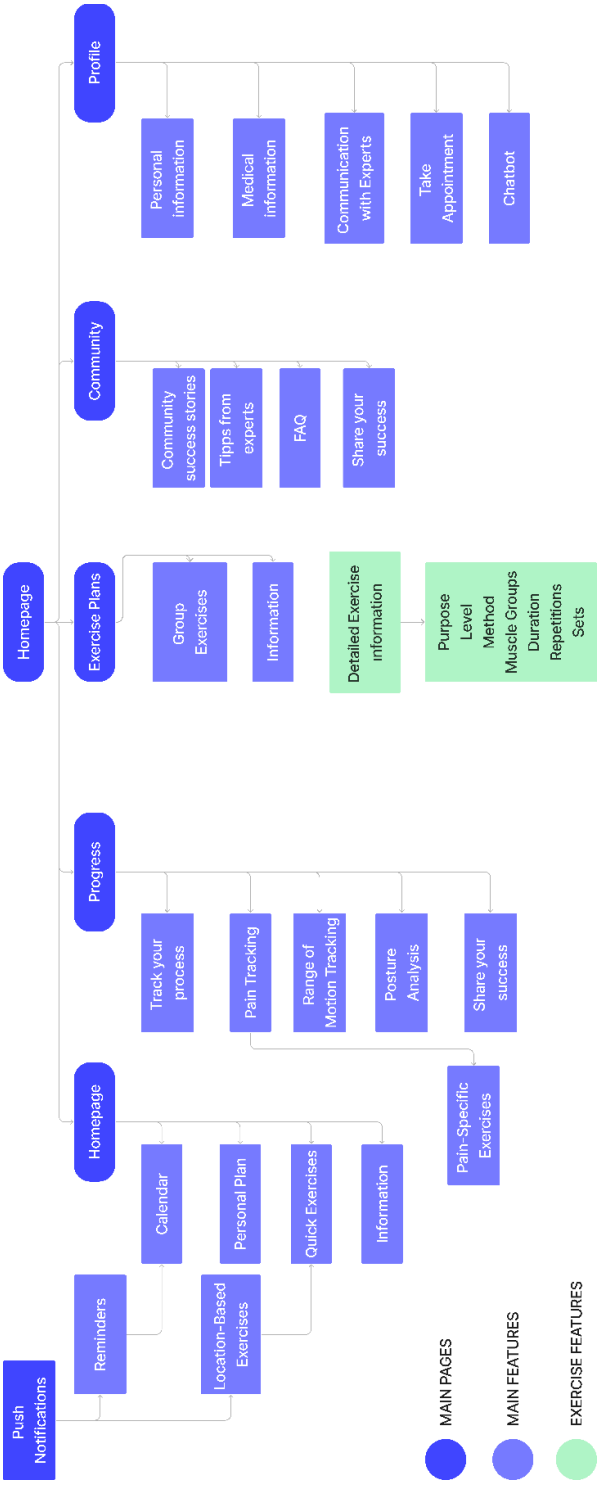


Figure 5.1. Information Architecture for the proposed Mobile App design

5.2 UI Related Design Decisions and Prototyping

The features of the application, whose navigation was determined according to Information Architecture, were visualized with low fidelity wireframes and the first phase of UI design was completed (Figure 5.2).

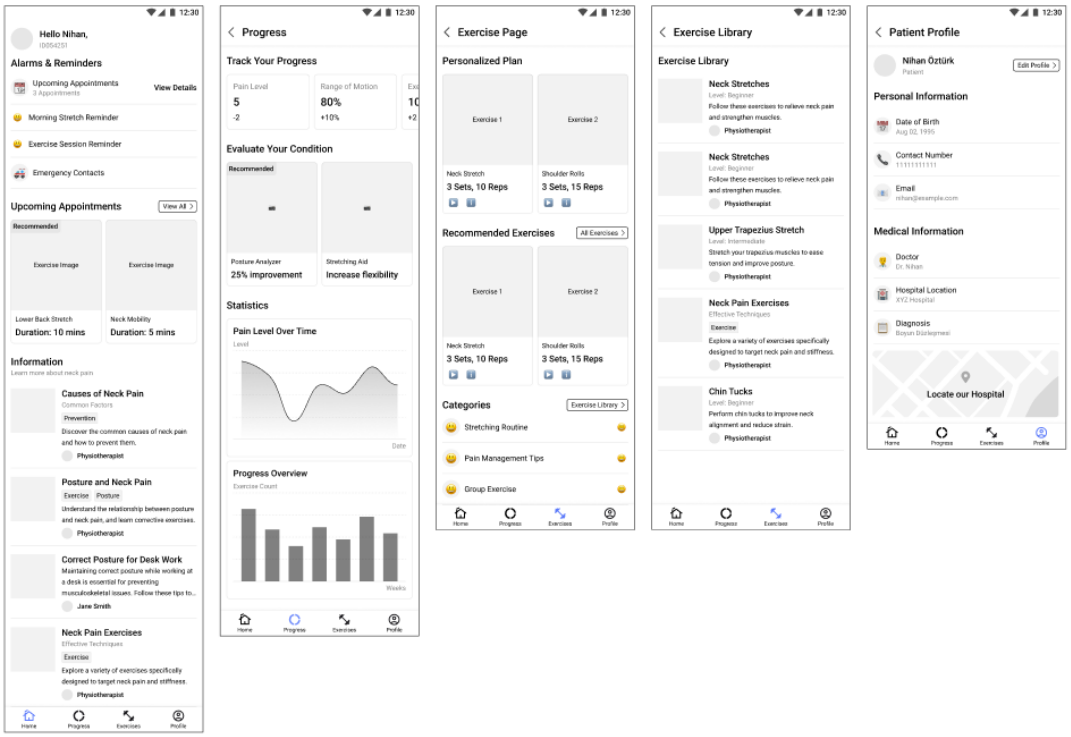


Figure 5.2. An example screenshot from Figma illustrating low fidelity wireframes

With the preparation of the low fidelity wireframes, UI decisions were made, and a design system was prepared in Figma Inc. to prepare a prototype. The design system included color codes, fonts, and components to be used in the application. Design system included, i) colors, ii) typography, iii) icons, iv) UI elements and components and v) stock photos.

i) Colors

A study highlights how using calming colors like blue in medical apps can significantly reduce patient anxiety and increase trust in digital health environments (E. Yalım, ID365 Lecture Notes,2017). Therefore, a more vibrant

shade of blue was chosen for exercise motivation in the application where shades of blue were chosen. The warning and information colors in the application were added to the system as red and green colors that users are familiar with other mobile apps. The text colors have also been adjusted from black to gray in order not to tire the eyes of the users (Figure 5.3).

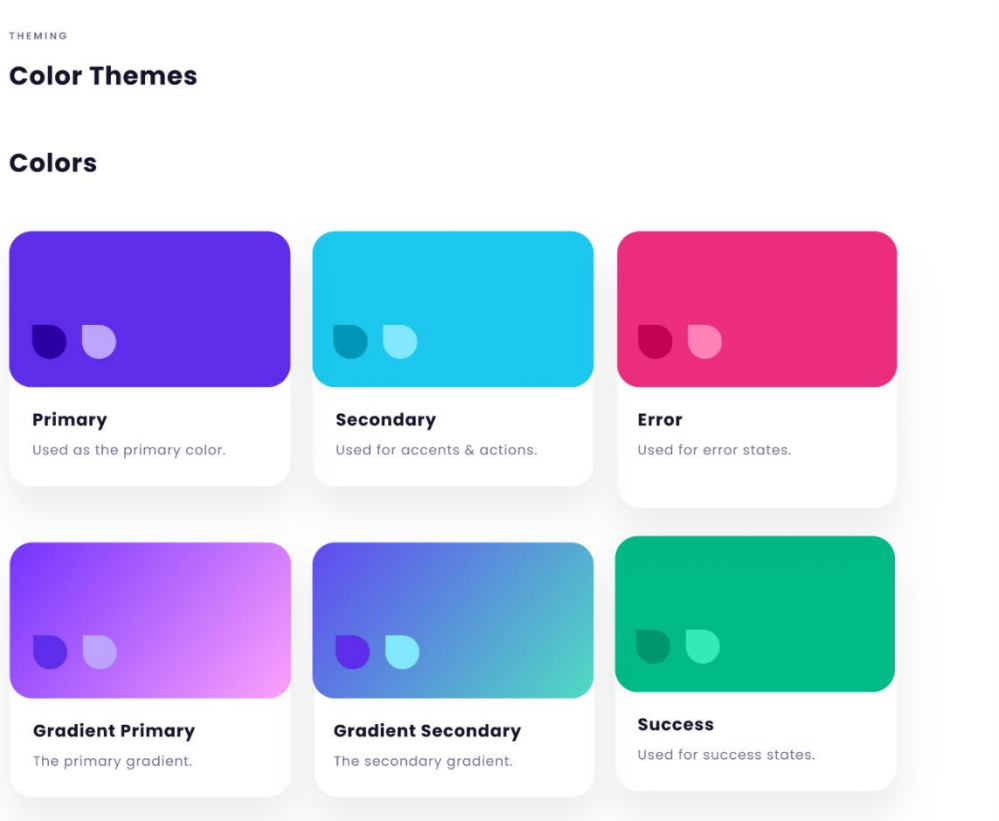


Figure 5.3. Screenshot from Figma illustrating color set

ii) Typography

The POPPINS font, which users are familiar with from other mobile apps, was chosen and its size was adjusted according to the use area like heading, long text etc. The font size was reduced by 2px each in the headings from 18px to 12px. Thus, hierarchy was provided for the text in the mobile app (Figure 5.4).

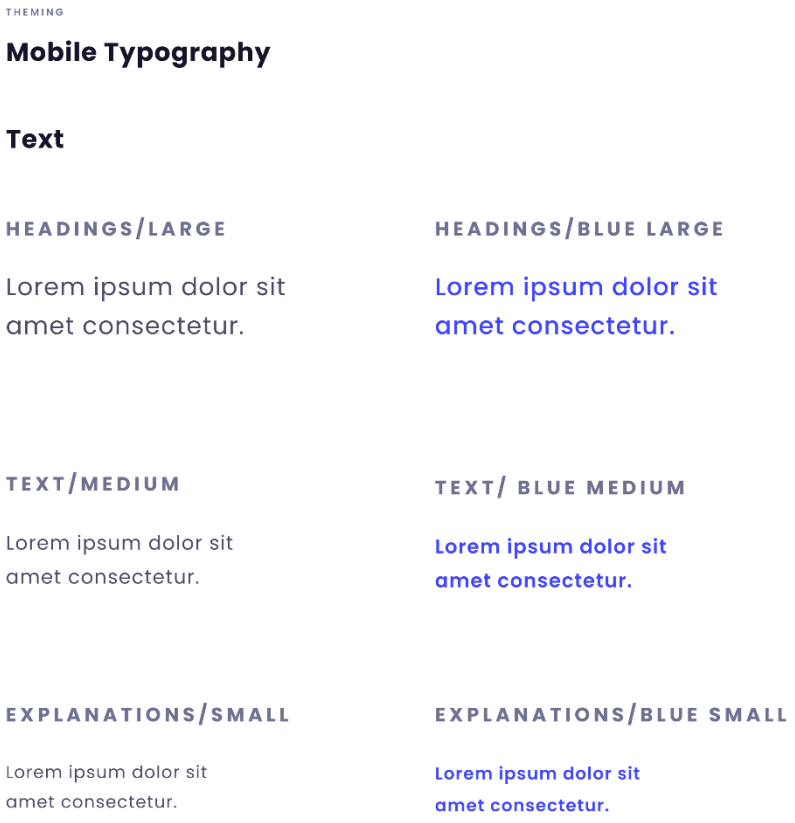


Figure 5.4. Screenshot from Figma illustrating typography

iii) Icons

The icons were chosen with minimal designs and thin lines to make it easier for users to understand the functions. The icons were chosen from familiar, standard icons that users encounter in other mobile apps (Figure 5.5).

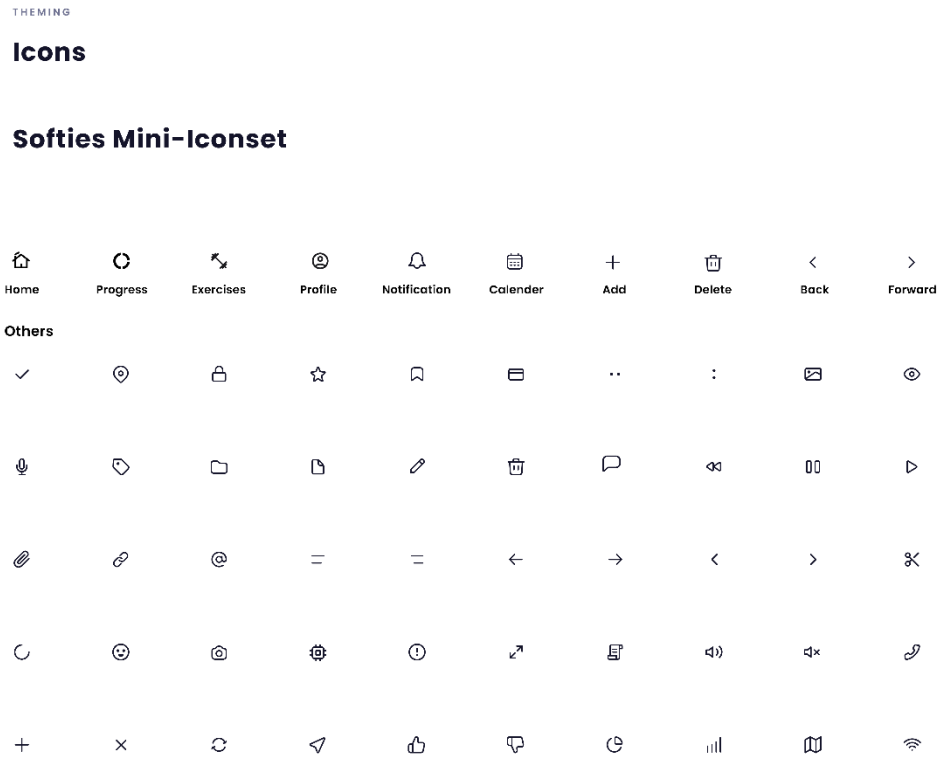


Figure 5.5. Screenshot from Figma illustrating icon set

iv) UI Elements and Components

Characterized by their round, capsule-like design, pill-shaped buttons add a playful and friendly aesthetic to user interfaces, making them a popular choice for more casual digital environments. This design choice can increase user engagement by providing visual cues that are easy to interact with due to their distinctive and tactile nature (Setproduct, 2023; Fanguy, 2018) Figure (5.6).

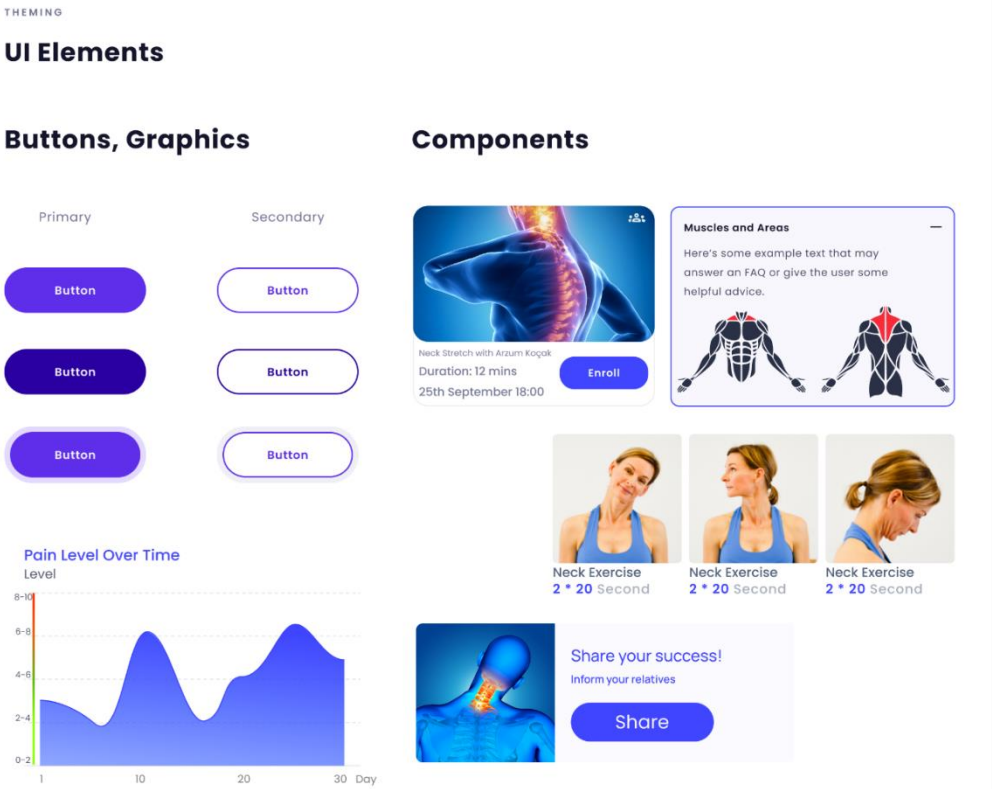


Figure 5.6. An example screenshot from Figma illustrating UI elements

v) Stock Photos

Lastly, photographs and images, which are important to users, were selected from stock photos. While these photos were used to give information, transparent anatomical photos were selected. The photos used to explain the exercises were selected from the photos of the models performing the exercise (Figure 5.7). The design system was determined based on users' visual suggestions in the Results & Analysis section. Participants indicated that detailed visual descriptions and video demonstrations of the exercises were essential for correct understanding and execution of the movements (see Chapter 4.3.3.2). Therefore, the selected visuals and explanations in the application were designed according to the needs of the participants. Participants stated that the animated characters were not useful in explaining how to do the exercise (4 out of 20).

"*Animation humans bother me in this regard. I mean, when I'm exercising, I like to see a live person doing the movement in front of me."* (P13)

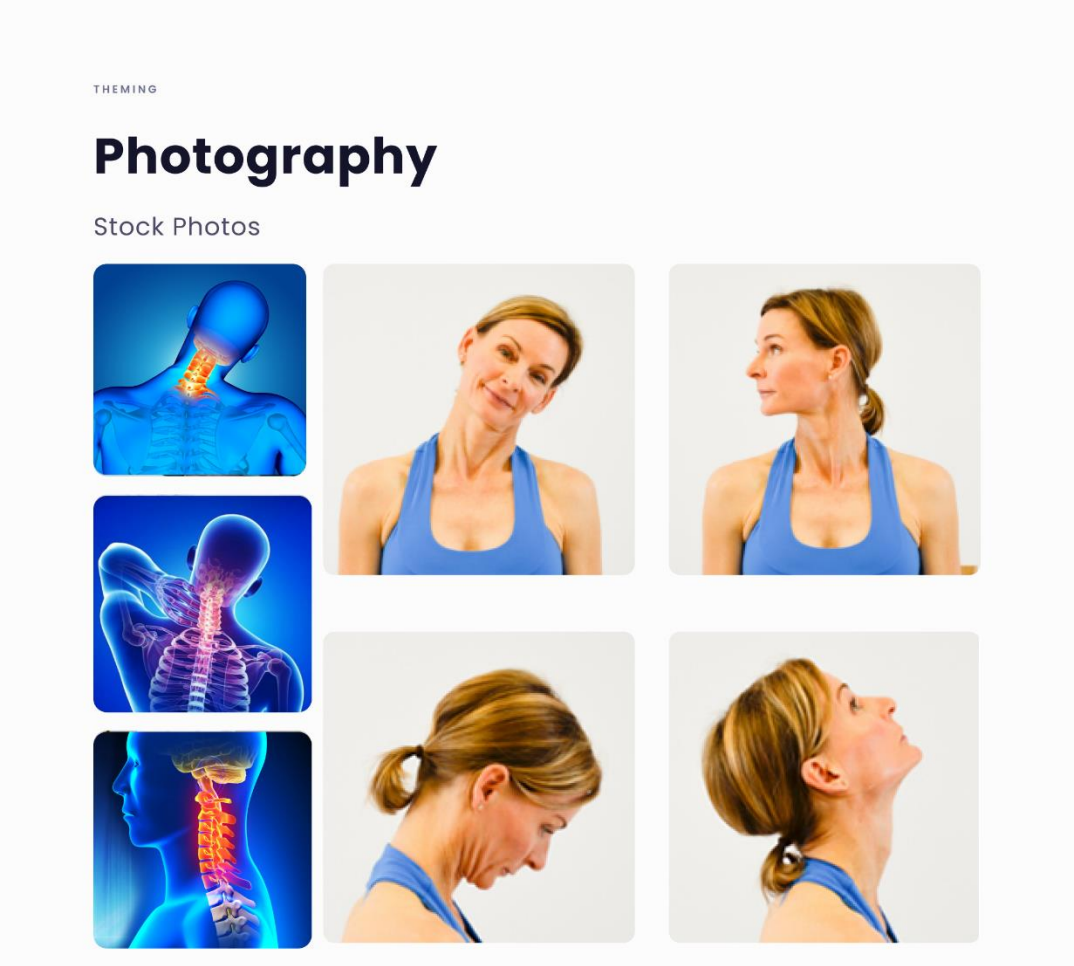


Figure 5.7. Screenshot from Figma illustrating photography set

5.3 Technology Integration

Technological advances that support mobile app features should enhance the user experience and increase satisfaction. While deciding on the information architecture and user interface elements of the mobile application, technological developments to be included in the application were also decided. It was decided to incorporate artificial intelligence (AI) technologies into the application and the technologies to be used were listed.

a. AI-based Home Exercise Programs

Integrating AI into home exercise programs, particularly for musculoskeletal conditions, offers significant opportunities to enhance healthcare. AI facilitates the development of tailored exercise programs, catering to individuals' specific needs and conditions, thus improving the effectiveness of rehabilitation and physical therapy. The ability of AI to process and adapt to the information it receives allows for more personalized and effective home exercise programs. This customized approach is crucial for managing musculoskeletal conditions, where exercises must be specifically designed to address individual pain levels, physical limitations, and rehabilitation goals

AI technology can recommend personalized exercise routines tailored to the users' pain level, ensuring that they can exercise safely without worsening the condition. Additionally, AI can create a personalized exercise plan adapted to development goals and current health status. By analyzing progress and adjusting plans, AI optimizes results and maintains motivation. This adds a layer of personalization to exercise apps, catering to individual needs and promoting long-term health and well-being.

b. AI-based Human Pose Estimation

Human posture estimation, critical for various applications, including exercise programs, is also an AI technology. Progress in human pose estimation techniques has contributed significantly to developing home-based exercise programs. For example, deep learning methods have led to significant advances in human pose estimation, especially in computer vision. These advances have enabled the development of accurate and fast human pose estimation methods, essential for creating effective home exercise programs (Zhang et al., 2019). Advancements in human pose estimation techniques, particularly in the context of computer vision, have paved the way for the development of accurate and fast methods essential for creating effective home exercise programs. The effectiveness and feasibility of home-based exercise programs have been demonstrated across various health

conditions, emphasizing their potential to improve functional outcomes and overall health. By utilizing the camera in conjunction with human pose estimation algorithms, fitness apps can provide real-time video feedback, enabling users to correct their posture during workouts.

In the current app design, this technology uses advanced image processing and machine learning techniques to analyze the user's body posture in real-time, identifying deviations from ideal postures and providing corrective feedback. For example, during exercises that may strain the neck, the app can alert the user when their neck alignment deviates from the recommended position, helping to prevent pain and injury. This integration of camera enhances the safety and effectiveness of exercise routines.

AI analyzes posture and movement patterns and guides the patient through corrective exercises with this information. Progress can be visualized to the user with Before/After comparisons. In addition, users can receive real-time feedback on their mobile phones thanks to human pose estimation technology.

5.4 Guided Tour of Mobile App

After selecting the user interface elements and deciding on the technological features, a prototype of the app was developed. Developing prototypes is the subsequent phase that builds upon the foundation laid by high fidelity wireframes. Prototypes are more advanced representations of the app, allowing designers and stakeholders to see the app's functionality in a simulated environment (Buxton, 2007). By presenting the prototype, users can provide valuable impressions about the app, enabling designers to make iterative improvements.

The application, designed for patients with mechanical neck pain, had its prototype initiated with different entry methods. The leading five pages on the navigation bar describe the features sequentially. As the prototype's purpose is to explain the features and general outline of the application to users, usability descriptions still

need to be provided. Name of the application was decided as ‘NeckEase’, and mobile app mentioned as ‘NeckEase’ in this chapter. The researcher, presenting the prototype to the users in a guided tour, explained the application according to the sections on the navigation bar, in the order of i) Login, ii) Onboarding / The Neck Disability Index (NDI) Questionnaire iii) Home Page, iv) Progress, v) Exercises, vi) Community, vii) User Profile, and viii) Notifications.

i) Log In

There are two main entry methods to the application. The first entry method is through email, which users are familiar with (Figure 5.8 a). The second method is for patients who receive application recommendations from the hospital, where they log in with their patient number and password (Figure 5.8 b). The difference in entry between these two methods is the timing of the onboarding/ The Neck Disability Index (see Literature 2.1.2) questions appearing after the application entry. Users entering via email answer the questions within the application. On the other hand, Patients entering the application with their patient number do not need to answer these questions because their doctors have diagnosed them and determined their exercises.

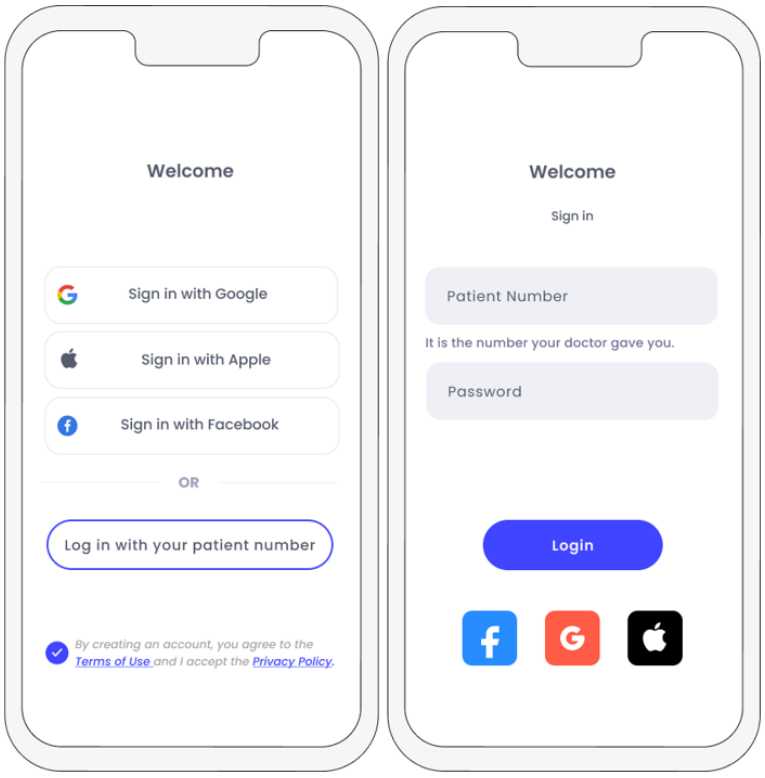
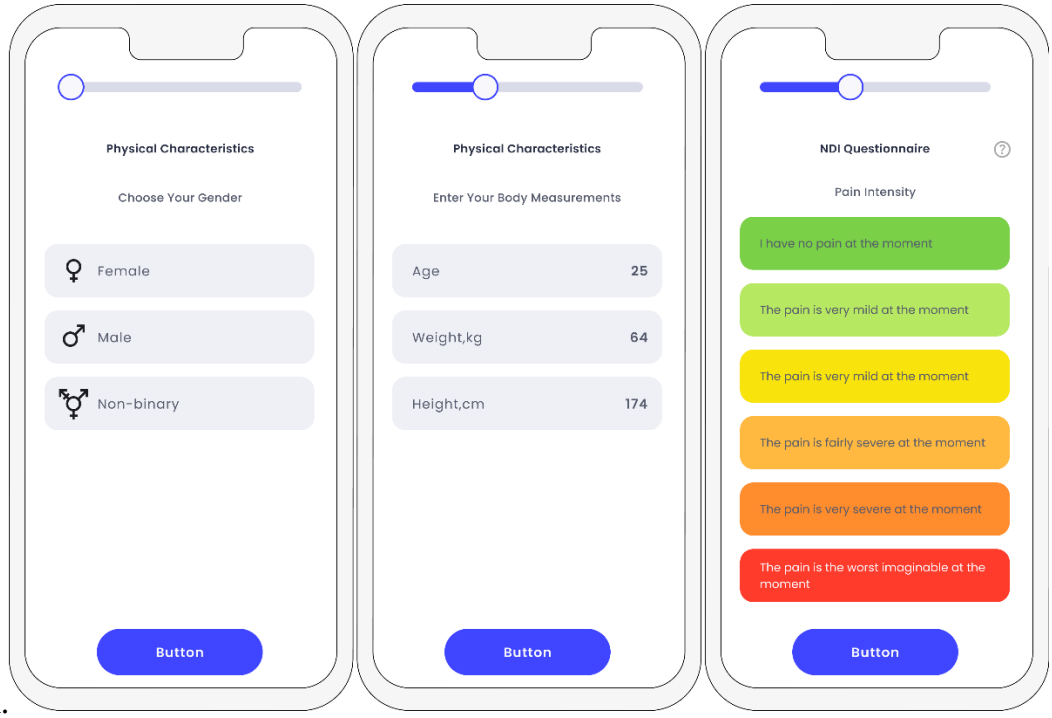


Figure 5.8. a: Entry method with e-mail b: Entry method with patient number

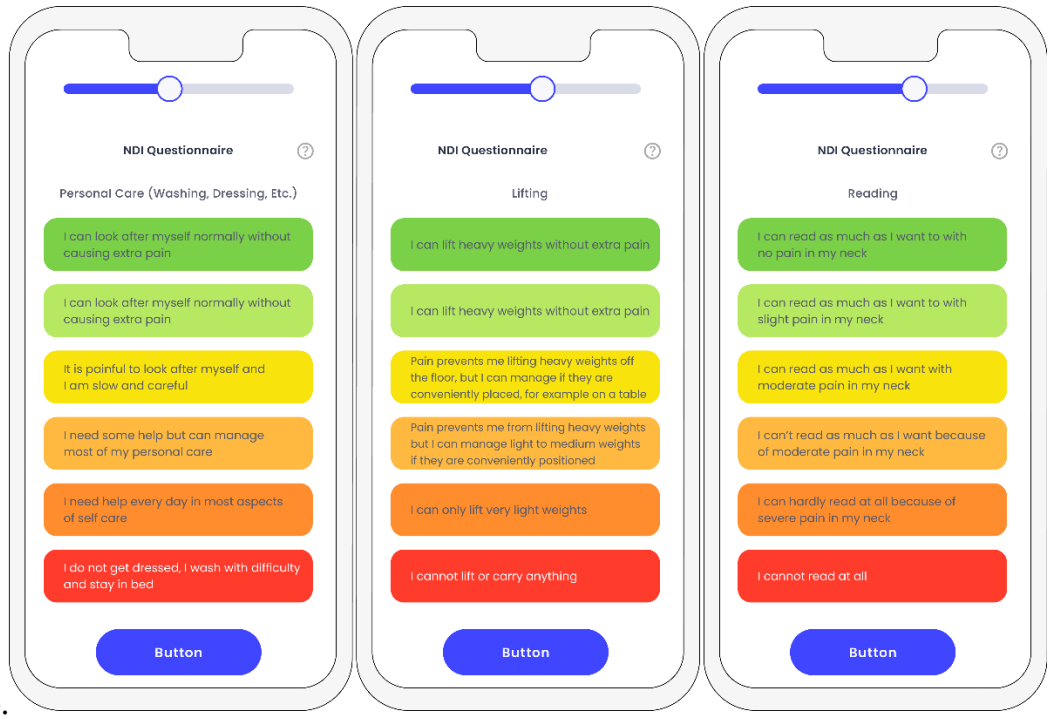
ii) Onboarding / The Neck Disability Index (NDI) Questionnaire

When entering the application for the first time, users were asked about their physical characteristics, and their information was scored using the questions in the Neck Disability Index survey (Hains et al., 1998), similar to how pain levels are scored in the medical literature. Users were then provided with a pain index, and a personalized program is created for them. The algorithm for creating personalized plans is structured based on the scores matching appropriate exercises. The Neck Disability Index (NDI) Questions consist of 10 questions designed to be asked to users who enter the application with their email to create personalized exercise plans. The titles of the questions are intended to be asked to users in written and visual form, using buttons that increase from green to red based on neck pain symptoms (Figures 5.9 a, b, c, d)

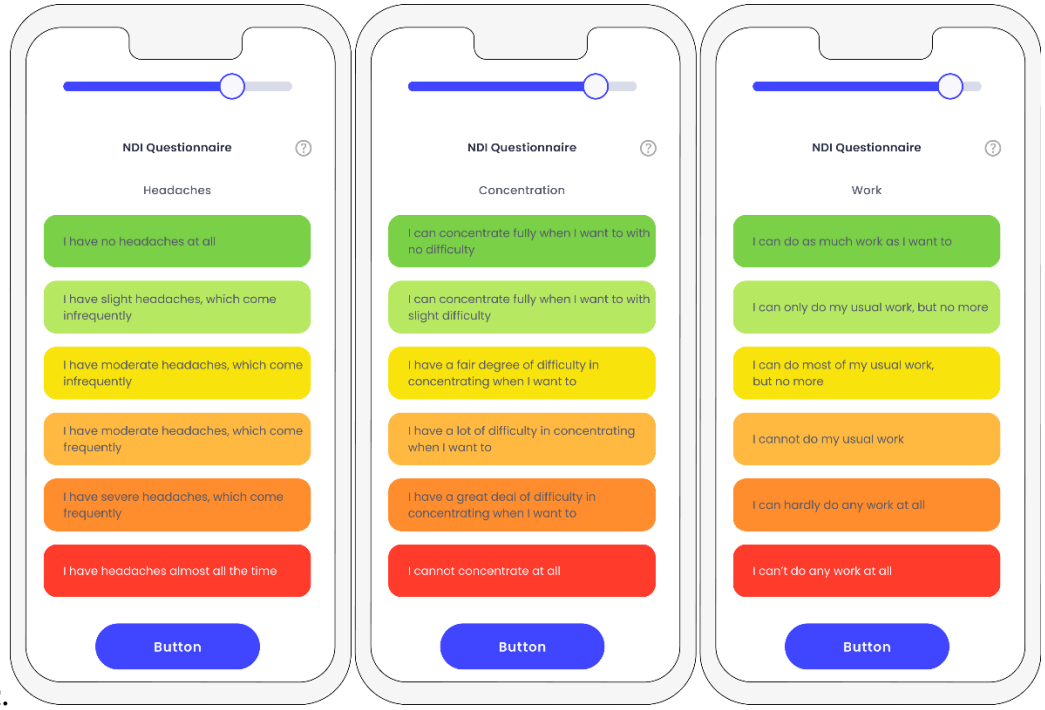
a.


Physical Characteristics
Choose Your Gender
Female
Male
Non-binary
Button
Physical Characteristics
Enter Your Body Measurements
Age 25
Weight,kg 64
Height,cm 174
Button
NDI Questionnaire
Pain Intensity
I have no pain at the moment
The pain is very mild at the moment
The pain is very mild at the moment
The pain is fairly severe at the moment
The pain is very severe at the moment
The pain is the worst imaginable at the moment
Button

b.


NDI Questionnaire
Personal Care (Washing, Dressing, Etc.)
I can look after myself normally without causing extra pain
I can look after myself normally without causing extra pain
It is painful to look after myself and I am slow and careful
I need some help but can manage most of my personal care
I need help every day in most aspects of self care
I do not get dressed, I wash with difficulty and stay in bed
Button
NDI Questionnaire
Lifting
I can lift heavy weights without extra pain
I can lift heavy weights without extra pain
Pain prevents me lifting heavy weights off the floor, but I can manage if they are conveniently placed, for example on a table
Pain prevents me from lifting heavy weights but I can manage light to medium weights if they are conveniently positioned
I can only lift very light weights
I cannot lift or carry anything
Button
NDI Questionnaire
Reading
I can read as much as I want to with no pain in my neck
I can read as much as I want to with slight pain in my neck
I can read as much as I want with moderate pain in my neck
I can't read as much as I want because of moderate pain in my neck
I can hardly read at all because of severe pain in my neck
I cannot read at all
Button

c.



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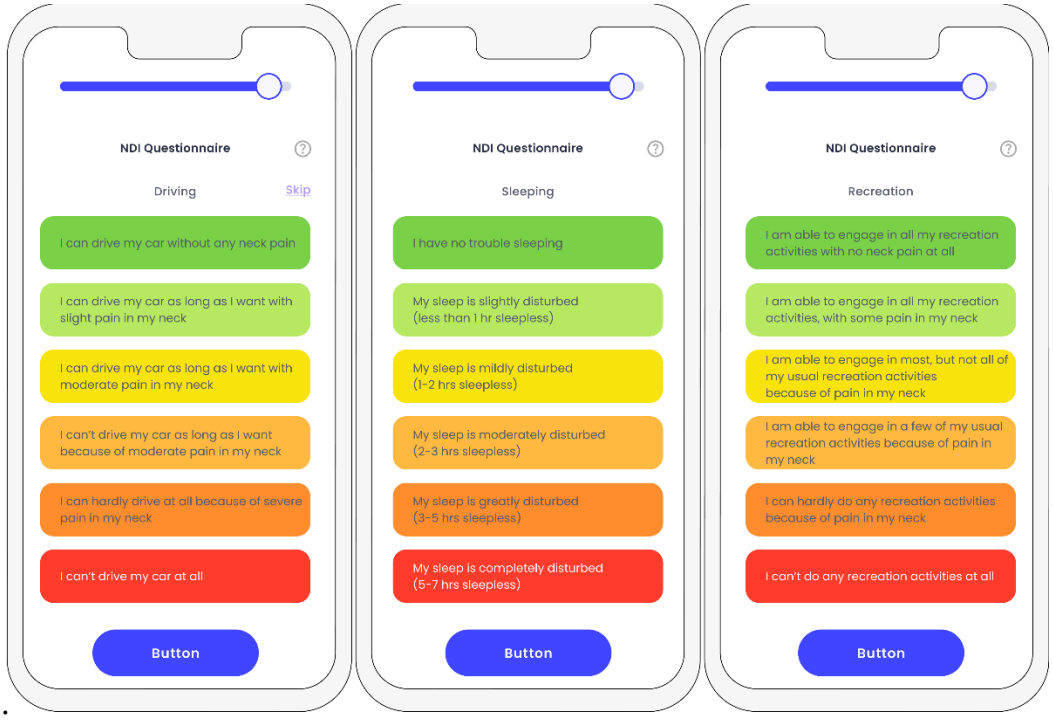
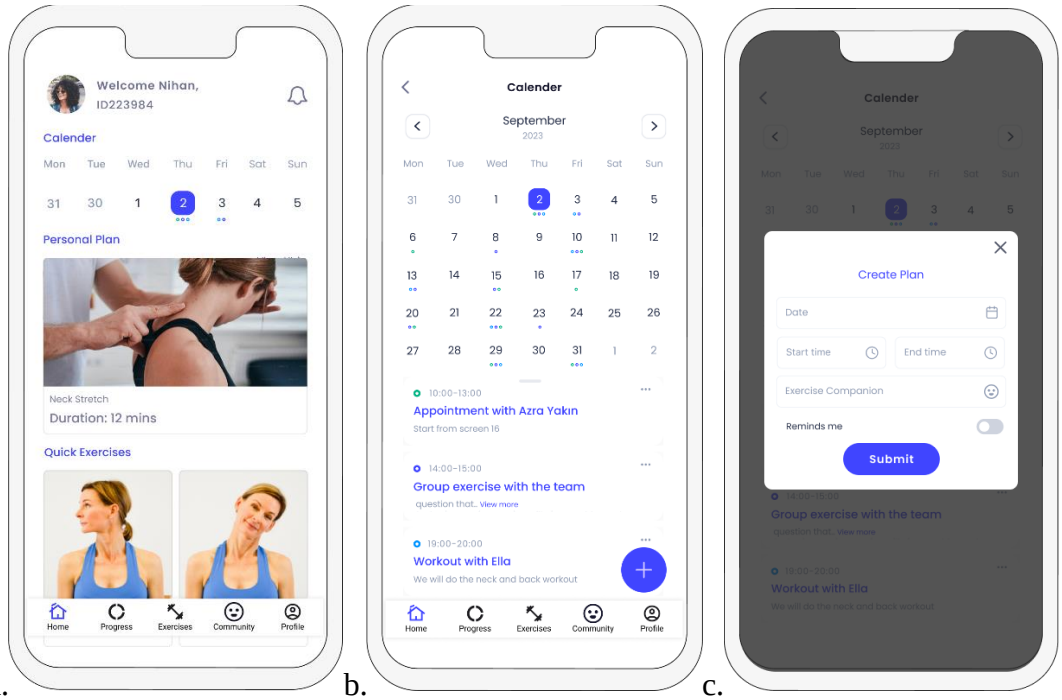


Figure 5.9. a. 1-3 Questions b.4-6 Questions c.6-8 Questions d. 8-10 Questions of Onboarding and NDI questions

iii) Home Page

Users who enter the application by answering onboarding questions and those with plans prepared under doctor supervision enter the application with the same home page. The arrangement of these features from top to bottom on the homepage is determined according to the priority of users' needs. The sections for a. Calendar, b. Personal Plan, c. Quick Exercises, and d. Information are considered the features users need the most, so they are placed on the homepage for easy access.

a. Calendar allows users to set up their plans and programs, see their plans at homepage including Personal Plans, and receive necessary notifications (Figure 5.10 a). This feature allows users to create a new plan, track appointments, and do group exercises (Figure 5.10 b). For this feature, an understandable calendar design and a section for making plans with basic questions are designed for usability and ease of use (Figure 5.10 c).



a. b. c.

Figures 5.10. a. Calender on Homepage b. Calender page c. Create Plan from 'NeckEase'

b. Personal Plan is determined for each user based on the NPI questions or diagnoses made by doctors. This plan includes exercises, duration, and levels specific to individuals' diagnoses. Exercise information and content provide users with the Purpose of the Exercise, Step-by-Step Explanation, and information about Muscles and Areas worked during the exercises. These details are hidden behind an expandable interface so users can access them when needed (Figure 5.11).

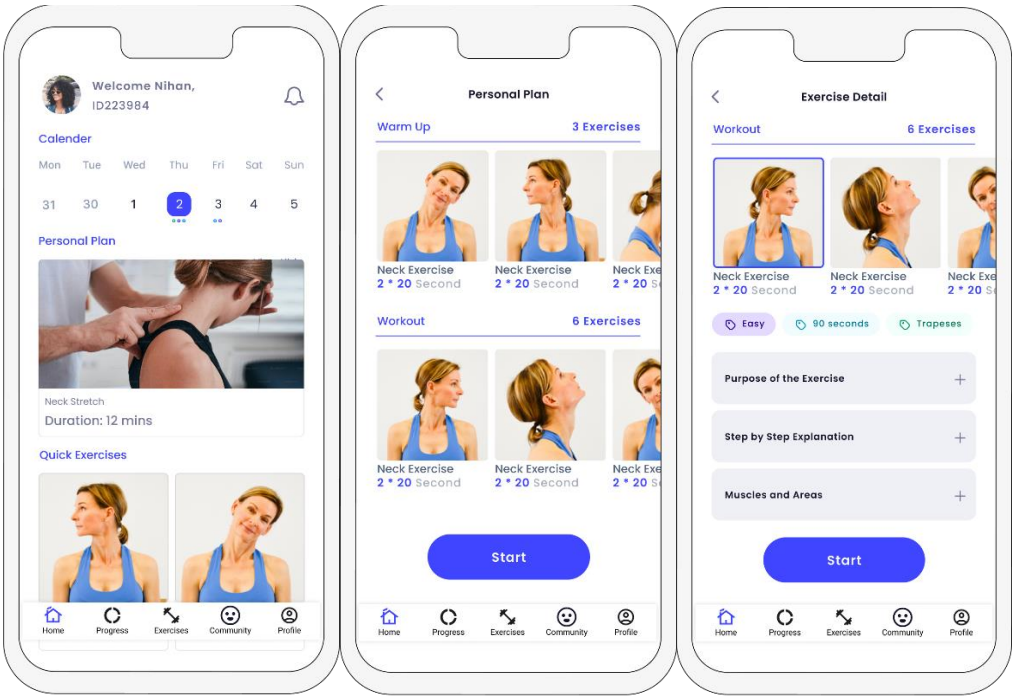


Figure 5.11. Details of personal plan pages

c. Quick Exercises When users cannot find time for exercises and have limited time, they can access exercises up to three minutes from the homepage. In Quick Exercises, users are directed to the exercise screen without showing goals or steps (Figure 5.12).

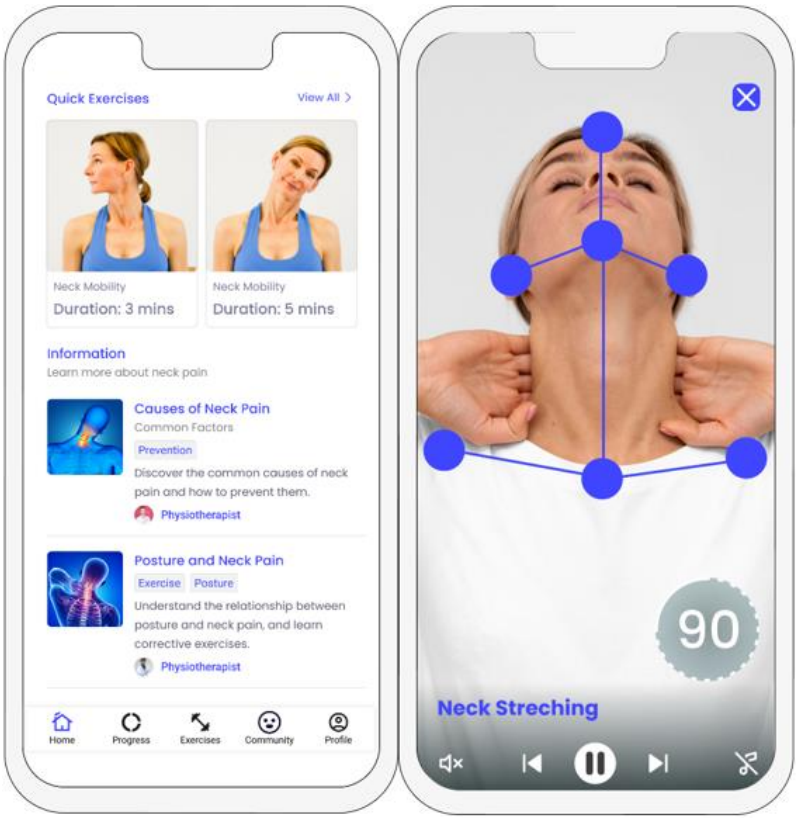


Figure 5.12. Quick Neck Exercises Suggested in NeckEase

d. Information The information section presented to users on the homepage is based on the importance of obtaining sufficient information from user research. Participants prioritize access to enough information to receive details of their diagnoses, treatment processes, and doctor recommendations from reliable sources provided on the homepage and references. Similar information is also placed below the content (Figure 5.13).

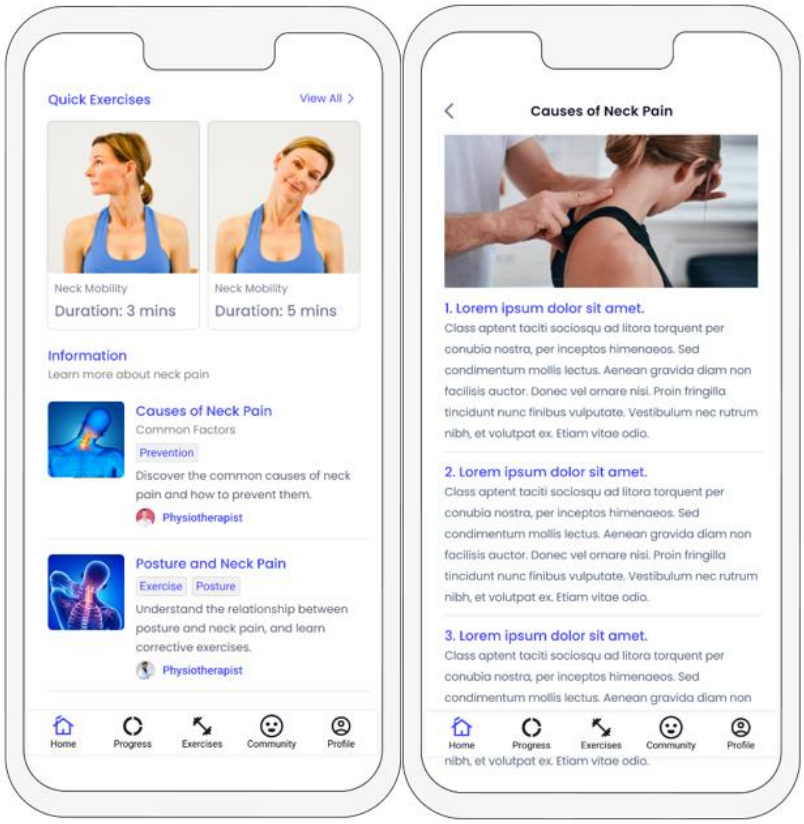


Figure 5.13. Details of information page

iv) Progress

The progress page, where users who want to perform their exercises continuously can track their progress with numerical and visual data, is positioned secondarily on the navigation bar. In the Progress section, features such as a. Track Your Progress, b. Pain Level Over Time, c. Range of Motion, d. Exercise Count, and e. Posture Analyzer (before-after) with present numerical and visual data and f. Share Your Success.

a. Track Your Progress 'Track Your Progress' section is a timeline-based representation method showing users their status and progress. This representation method aims to provide users with necessary information about the duration and progress of their treatments. According to user research, participants wanted to know where they were in their treatment process and how close they were to the end (Figure 5.14).

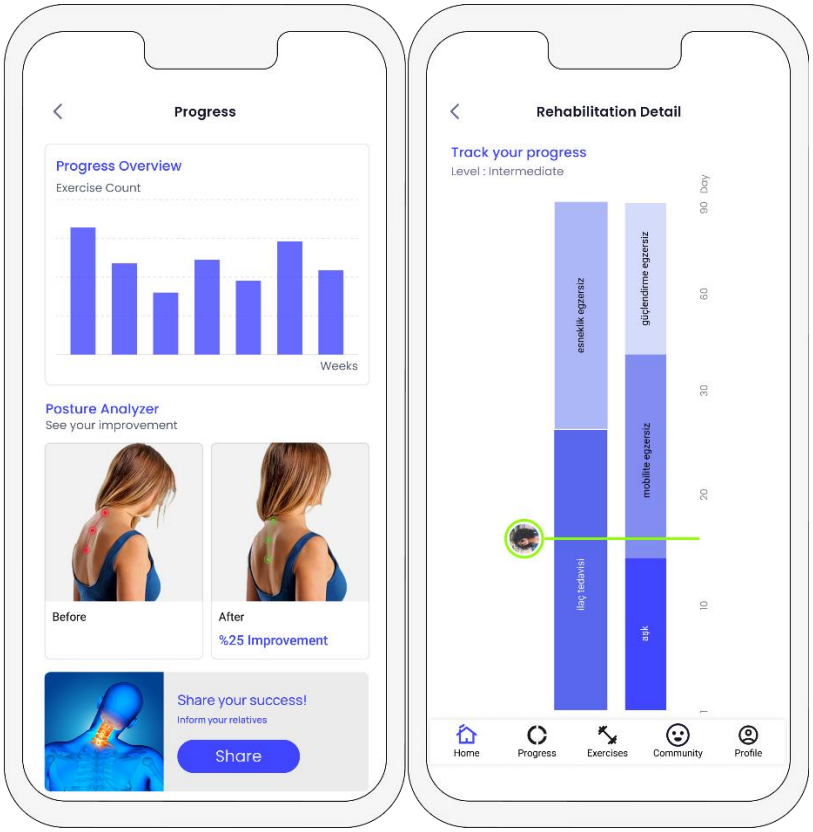


Figure 5.14. Details of ‘track your progress’ feature from NeckEase

b. Pain Level Over Time The pain tracking feature, where users can see the decrease in their pain over time and be motivated by this data, is presented secondarily to allow users to enter pain data at various times during the day, before and after exercises. The decrease in users' pain is the biggest motivation for them. Additionally, presenting exercises tailored to pain level is proportional to the participants' desires (Figure 5.15).

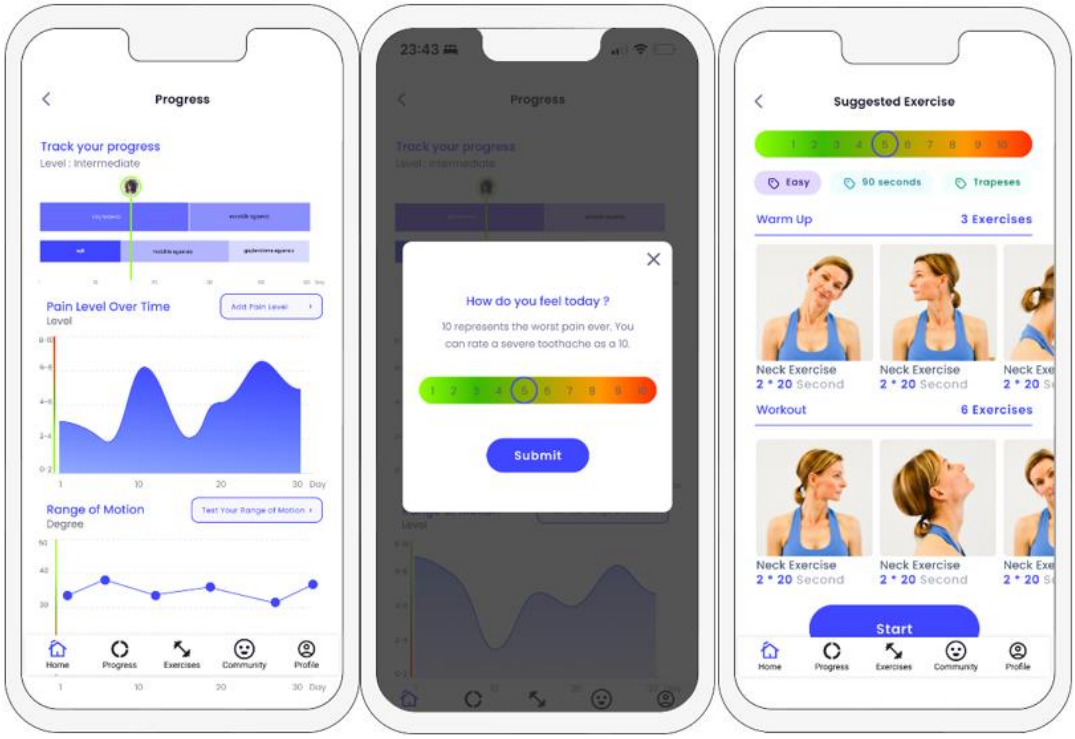


Figure 5.15. Pain level over time and suggested exercise

c. Range of Motion Daily tasks are complex, considering the problems caused by neck pain throughout the day, such as restricted neck movements and decreased range of motion. Therefore, the range of motion section is added to allow users to track their neck motion range and motivate them by seeing their progress (Figure 5.16 a). This feature is supported by human pose estimation technology examined in the literature review, which calculates users' neck angles with the phone camera to provide data to the user (Figure 5.16 b, c).

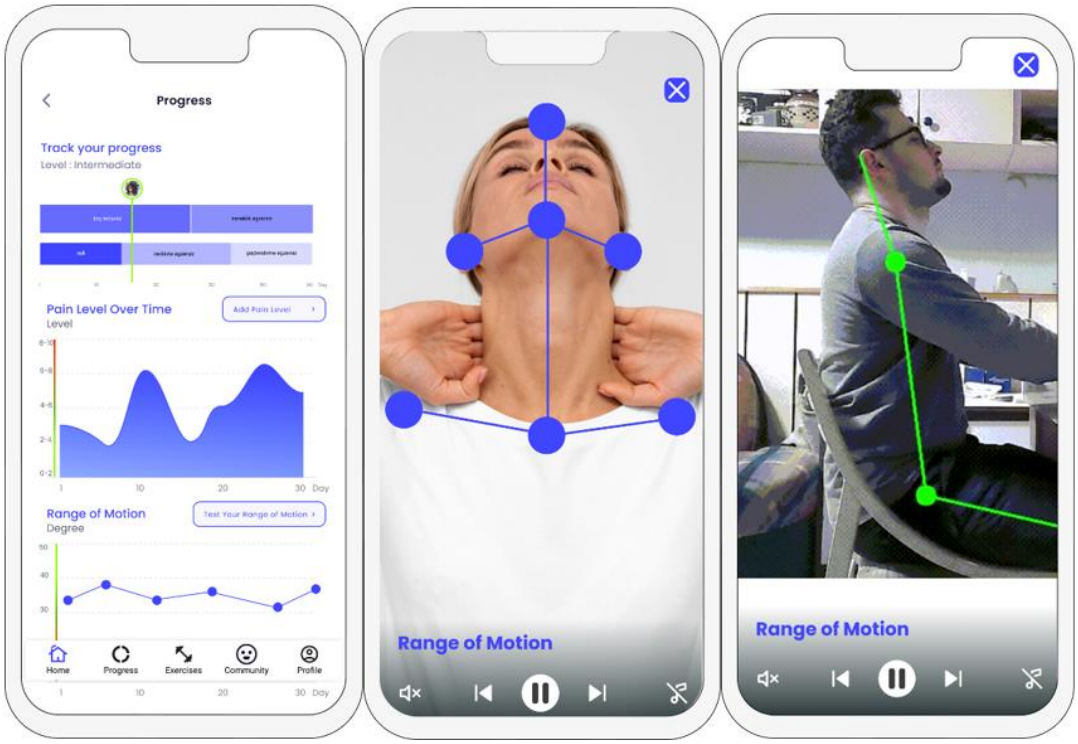


Figure 5.16. a. Range of motion graphic b. AI supported analysis c. An example of AI pose estimation

d. Exercise Count Graphic Bar charts show the efforts and time spent on previous exercises to motivate users. Numerical data, such as bar and line charts, are selected as easy-to-understand representations for users (Figure 5.17).

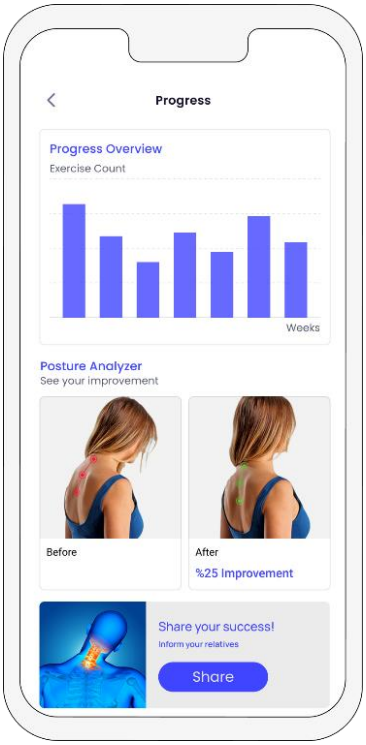


Figure 5.17. Exercise count graphic on progress page

e. Posture Analyzer According to user research, participants complain about posture problems, so improving their posture motivates them. Using human pose estimation technology, visual data is provided to turn this motivation source into a feature (Figure 5.18 a, b, c).

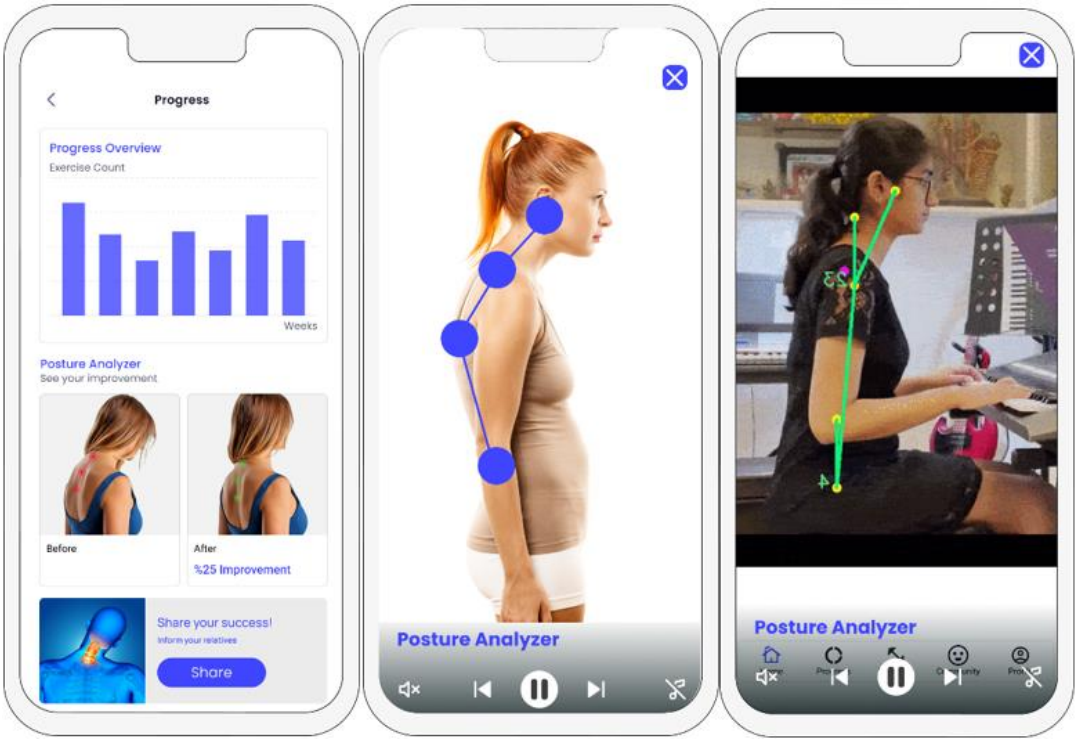


Figure 5.18. a. Posture analyzer before /after photos b. AI supported analysis c. An example of AI pose estimation

f. Share Your Success! According to user research, discussing treatment processes with their social circles and receiving social support motivates users. Therefore, a feature is included where users can share their results and achievements with their close ones (Figure 5.19).

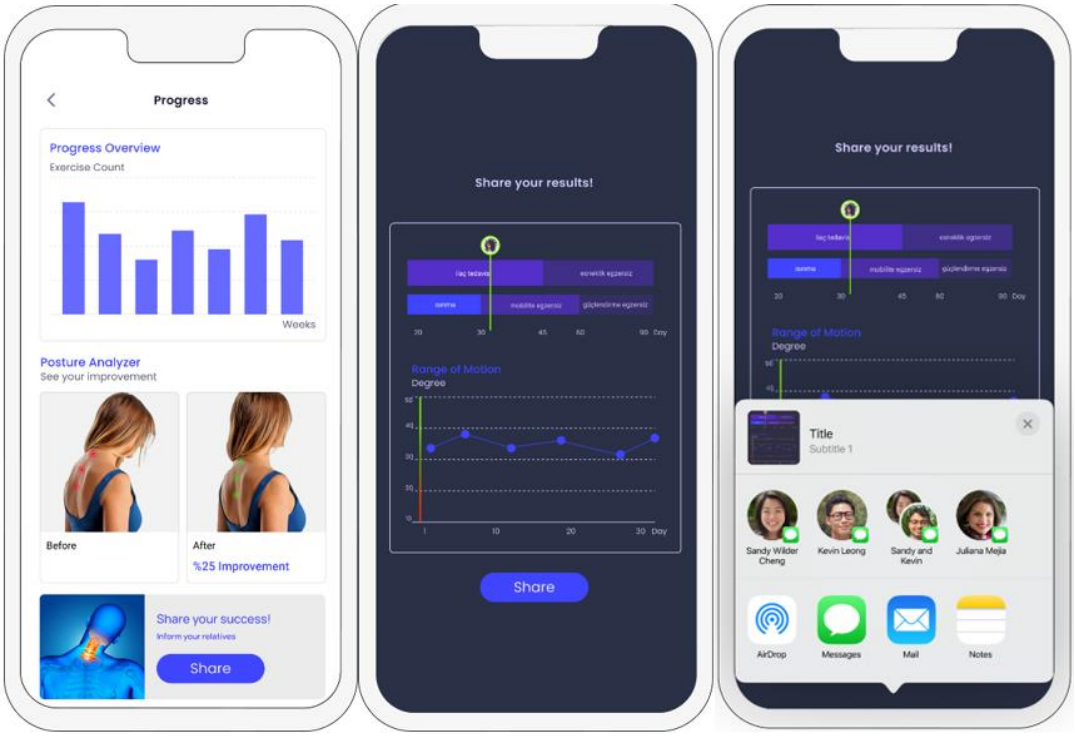


Figure 5.19. Share your success pages

v) Exercises

The Exercises section, located third in the navigation bar, offers users a wide range of exercise plans and group exercises within the application. In this section, users can select exercises suitable for their calendars and plans, increasing their motivation by implementing personal decisions. Exercises section includes, a. Exercise Plans b. Group Exercises

a. Exercise Plans Exercise Plans are grouped with tags according to users' needs, explaining the contents. Exercise Details show the level, duration, and muscle groups targeted by exercises with tags (Figure 5.20).

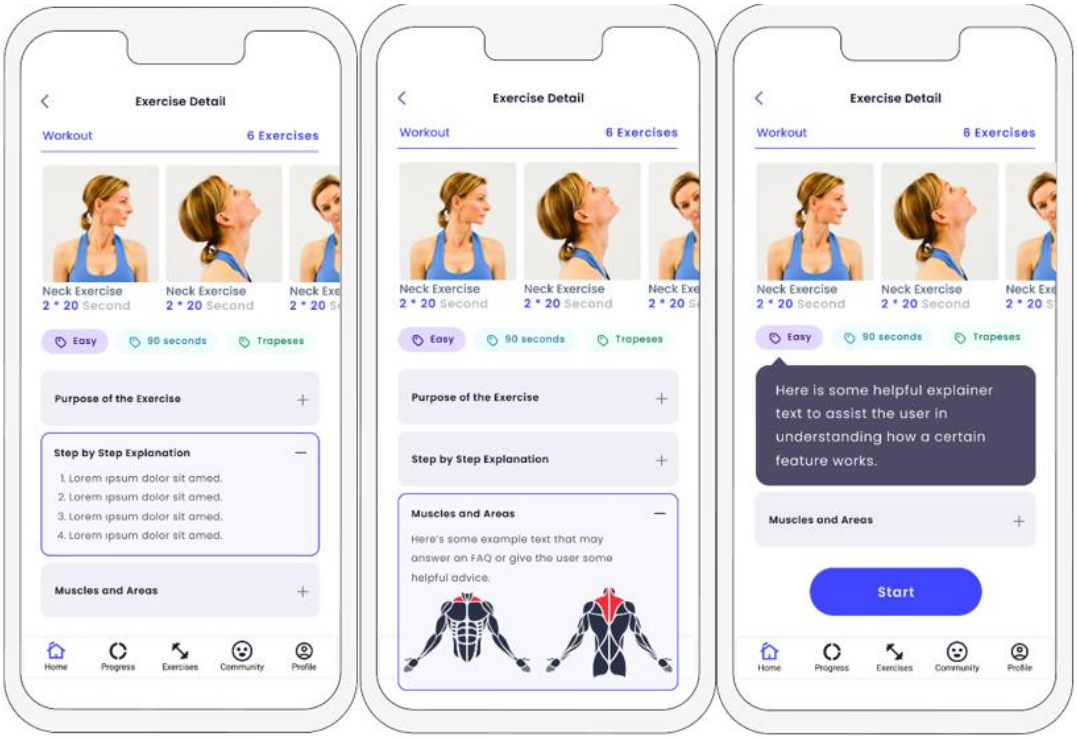


Figure 5.20. Details of Exercise Information

b. Group Exercises To meet the participants' need for social and professional interaction as identified in the user research, users are offered group exercises supervised by doctors. This feature was designed to allow users to register and enter group exercises. Exercising with group friends under the supervision of a doctor aimed to motivate users with both professional and social interaction (Figure 5.21).

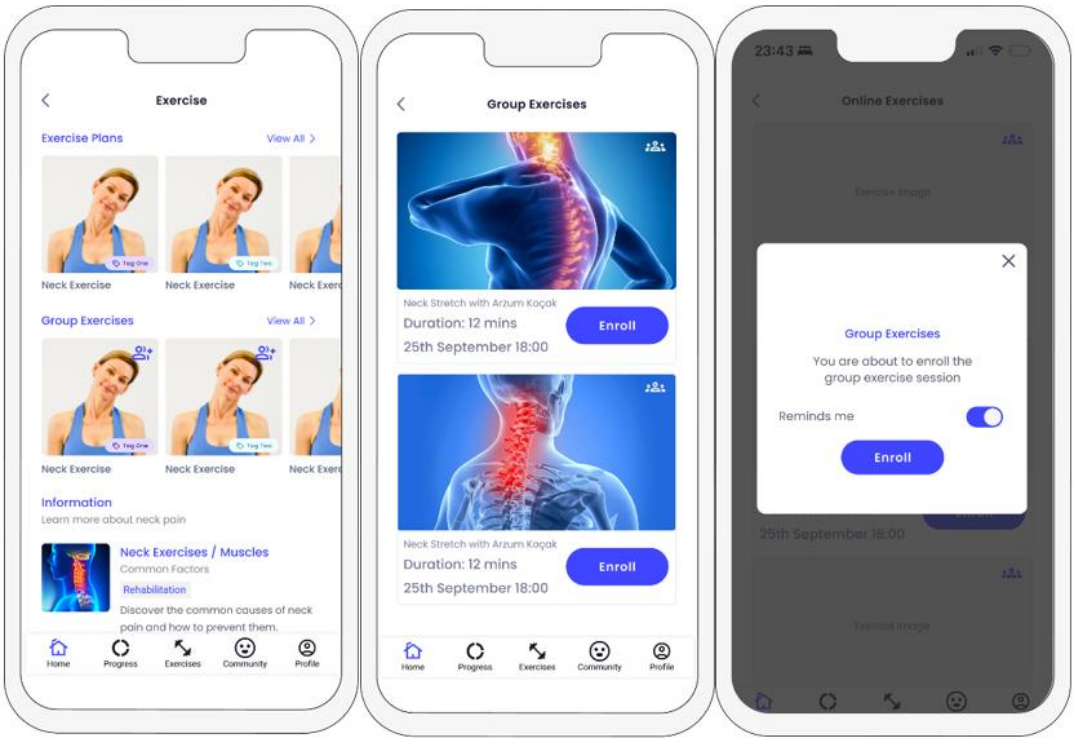


Figure 5.21. Details of Group Exercises

vi) Community

In user research, it was decided to establish a community to meet participants' social needs. However, instead of being a platform for direct communication and spreading misinformation, this community aims to motivate users by sharing stories of patients who have overcome similar conditions. Additionally, a section is added where users can access daily life-integrable recommendations from experts and frequently asked questions (Figure 5.22).

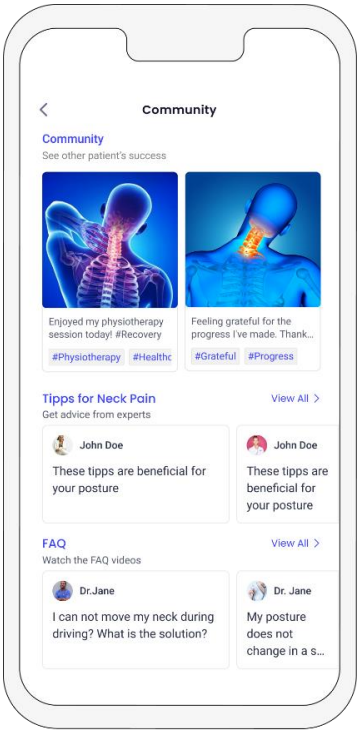


Figure 5.22. Community page

vii) Profile

Two entry methods were followed when logging into the application: entering with email and entering with a patient number. The Profile section is designed differently for these two entry methods. The interface designed for users entering with a patient number includes personal information, medical information, and hospital information. Additionally, there is a chatbot for scheduling appointments, requesting emergency assistance, and answering frequently asked questions. This section addresses users' difficulties regarding hospitals and organizations, as identified in user research. A profile for users to enter via email includes the NDI score and recommendations for doctors and hospitals nearby (Figure 5.23).

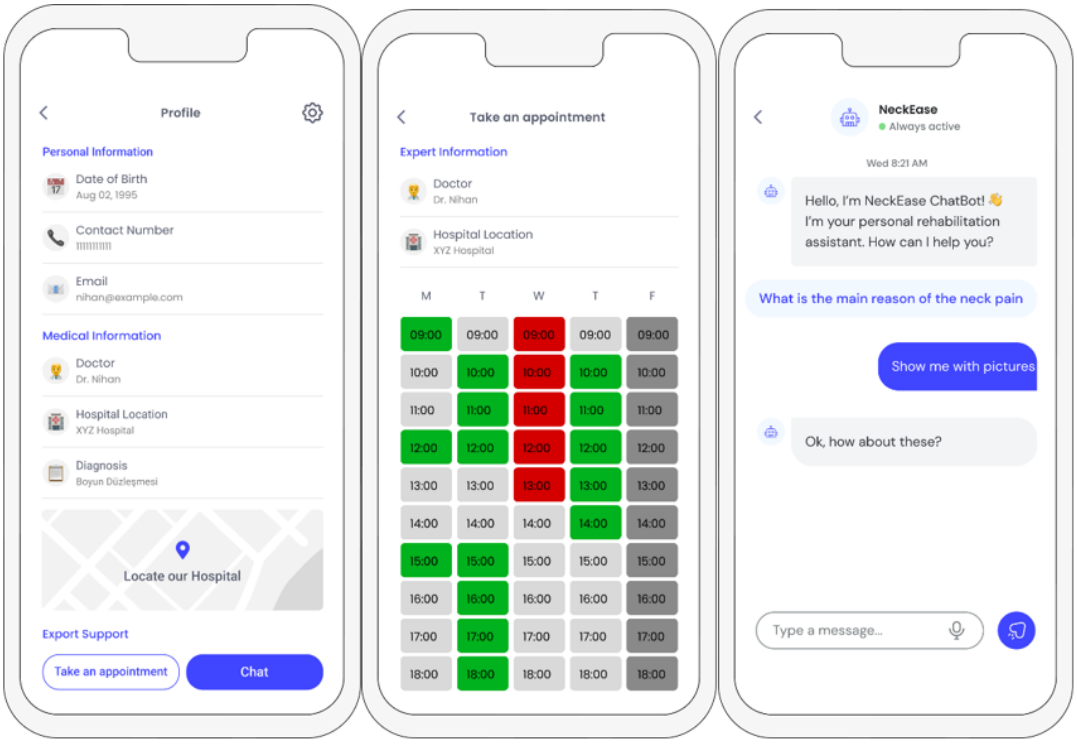


Figure 5.23. Profile page features

viii) Notifications

According to user research, the goal was to design an application that could easily integrate into users' lives. Accordingly, rather than spending much time within the application, the aim was for users to enter the application when needed, follow their exercises and treatments, and return to their daily lives. Therefore, notification contents became important. Calendar and plan notifications, posture correction reminders, reminders for prolonged sitting, and notifications to directly access quick exercises were determined notifications directing users to exercises recommending exercises suitable for their location using GPS assistance (Figure 5.24).

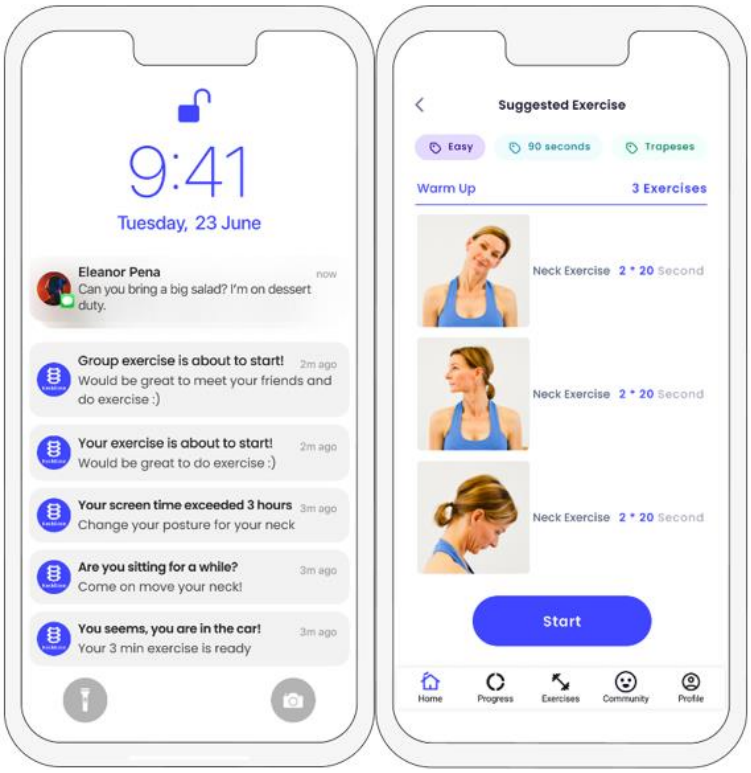


Figure 5.24. Location-based exercise suggestions

5.5 First Impression Survey

The First Impression Survey focused on collecting immediate feedback about users' initial reactions and experiences with the app. This approach aimed to assess aspects such as the ease of navigation of the app's interface and overall feature satisfaction. The results from the survey were critical to understanding the impact of the app's design on users and could guide early improvements. Therefore, following the guided tour of the mobile app, the researcher conducted the first impression survey to understand users' impressions and key features of the mobile app (Appendix E).

5.5.1 Conducting a First Impression Survey of Guided Tour

The survey was conducted immediately after the user's first interaction with the app, ensuring their initial impressions were fresh and unbiased. The survey typically included both qualitative and quantitative questions. For example, users were asked to rate their initial experience, describe their first thoughts, or identify any issues they encountered. The survey was conducted through a one-on-one guided tour, and a survey link sent to the user to gather information. 8 out of 20 participants in patient interviews were included to ensure a comprehensive understanding of different user perspectives.

Participant Selection for the First Impression Survey of Guided Tour

Participants were selected voluntarily from the 20 who participated in the patient interview and were willing to participate in the mobile app guided tour and first impression survey.

First Impression Survey Venue and Equipment

All interviews are conducted via Zoom video conferencing tool (Zoom Video Communications, Inc.). Zoom was selected due of its widespread use, convenience of use, and familiarity with the participants. During Zoom sessions, a mobile application was presented using the Figma Prototype Tool (Figma, Inc.). This presentation is called a Guided Tour.

First Impression Survey Procedure

At this stage of the survey, online meetings with participants were planned. Participants were encouraged to express their opinions throughout the first impression survey. The following procedure was followed in all sessions. First, all participants were informed about the guided tour and first impression survey and their purpose. At the end of the first impression survey, the participants were thanked for their contribution. The session recording ends, and the same procedure is repeated for all participants.

Survey Questions

The questionnaire included questions to obtain the user's similarity during the pilot test. These questions were a 5-point Likert survey to determine whether the user liked the application's features. However, since the designer and the user were talking one-to-one, in the pilot test, the user gave a high number on the scale due to their emotional judgment. For this reason, after the pilot guided tour, the questions were changed according to the features that did not allow the participants to answer with biased responses. The researcher also tried to understand whether the participants would prefer to revisit the mobile application and whether they would recommend it to their relatives. Hence, Likert survey questions analyzed the ratings and scores, providing a measurable understanding of user satisfaction levels. Open-ended responses were evaluated to gather insights into user impressions, expectations, and any specific issues or highlights noted by users.

The first part of the survey includes five questions that aim to understand which features satisfy the participants and which could be developed.

● What are the three (3) best words to describe this mobile application as a first impression in the general impression survey?

● What are the five (5) features that meet your expectations about the motivation-enhancing features in the mobile application shown?

● What are the five (5) features needed to meet your expectations about the motivation-enhancing features in the displayed mobile application?

● At first impression, how can you improve the feature above about this mobile application?

● What would be the first feature you would like to use in this mobile application? Please explain why you want to take this action and what you expect to see after taking this action.

The second part of the survey included the 5 Likert and open-ended questions for understanding, revisiting, and suggesting possibilities after the first impression. Revisiting and suggestions were essential for understanding participants' thoughts about the mobile app in case of continuous usage and suggestions to relatives.

- How unlikely (1) or likely (5) is it to return to this mobile application in the future?
- Does anything make you want to revisit this mobile application? Explain.
- Does anything make you want to avoid revisiting this mobile application? Please explain.
- How unlikely (1) or likely (5) to recommend this mobile app?
- Can this mobile application be integrated into your daily life(1) or not(5)?
- How would you describe this mobile application?
- What changes would you make if you wanted to improve this mobile application?

5.5.2 Results of The First Impression Survey

The results from the First Impression Survey had several implications. Identifying areas where users face confusion or dissatisfaction can lead to immediate design modifications to enhance usability and aesthetics. Understanding what attracts and pleases users informed strategies to increase engagement and retention. The Impression Survey was a valuable tool in the iterative design process. The insights gained can be instrumental in refining the app to meet user expectations better and improve the overall user experience.

Question 1: What are the three (3) best words to describe this mobile application as a first impression in the general impression survey?

The first question showed the survey results in three words that users chose to describe mobile app. Users' responses were varied and emphasized various aspects of the app. Some of the words that stand out are practicality, reliability, informativeness, and innovation. The users state that the app is a time-saving tool that can be accessed anytime. They also emphasize its motivational, solution-oriented, user-friendly, and functional features. These responses draw attention to the app's ease of use and ability to deliver effective results. In short, users describe this mobile app with positive qualities such as practicality, reliability, fun, innovation, and information. This shows that the app comprehensively meets users' needs and provides them with a valuable experience (Figure 5.25).

Figure 5.25. Adjectives of Participants' Description

Question 2: What are the five (5) features that meet your expectations about the motivation-enhancing features in the mobile application shown?

The chart provided listed 25 mobile application features that meet user expectations, and participants were asked to choose 5 of the questions. However, the last six features had the same point in the chart (see Figure 5.26); eight were listed. According to participants' responses in motivation-enhancing features for exercise, the eight features that would likely be most relevant and effective for participants were:

Personal Plan for Exercises This feature, which scored the highest with a value of 6, likely offers personalized workout plans. These plans can be highly motivating because they align with participants' fitness goals and preferences (6 out of 8).

Tracking of the Range of Motion with AI Utilizing artificial intelligence, this feature monitors and analyzes the user's range of motion. These features would also help ensure exercises are performed correctly, enhance safety and effectiveness, and provide feedback for improvement, which is crucial for rehabilitation and skill development. Four participants found this feature satisfactory (4 out of 8).

Reminder Tools for Exercises Scored 3. This feature would help participants stay consistent with their workouts by reminding them when to exercise and reinforcing their routine (3 out of 8).

Offering Exercises Suitable for Location and Condition Also scoring 3, this feature adapts workouts to participants' current environment and physical condition, which can help maintain a high motivation level by making exercises practical and achievable wherever they are. Three participants found this feature satisfactory (3 out of 8).

Access to Expert Knowledge and Instructional Content With a score of 3, having access to expert advice and instructional content can boost participants' confidence in performing exercises correctly and safely, which is motivating and enriching. Three participants found this feature satisfactory (3 out of 8).

Presentation of the Stage in the Treatment Process This feature visually presents the current phase of a user's rehabilitation. Understanding where they are in their treatment journey would help users stay motivated and aware of their progress and forthcoming steps. Three participants found this feature satisfactory (3 out of 8).

Step-by-Step Presentation of the Treatment Process This feature, scoring 3, provided detailed guidance through each step of the workout or treatment plan. This would help the user understand the purpose and benefits of each exercise, thereby enhancing motivation. Three participants found this feature satisfactory (3 out of 8).

Posture Analysis Using AI This feature analyzes posture using AI to identify and correct improper poses during exercises. This was crucial for preventing injuries and ensuring the exercises were effective. Three participants found this feature satisfactory (3 out of 8).

Figure 5.26. Eight (8) features of Mobile App that meet expectations

Question 3: What are the five (5) features that do not meet your expectations about the motivation-enhancing features in the displayed mobile application?

The chart listed 4 of the 25 mobile application features that did not meet user expectations, and participants were asked to choose 5 of the questions. Because only four features did not meet the expectations, participants' answers could not fill the 5-feature list (Figure 5.27).

Allowing the Sharing of Users' Progress and Achievements on Social Media might be because users feel that the sharing functionality could be more seamless and that they need more privacy concerning their health journey (5 out of 8).

Presentation of Processes of Those Who Have Received the Same Treatment and Succeeded This feature showcases the success stories and treatment processes of others in similar situations. It might only meet expectations if the stories are relatable, have depth, and have diversity in the examples presented, which can affect the motivational impact (4 out of 8).

Use of Chatbot for Frequently Asked Questions Using a chatbot for answering common questions might fall short due to issues like the bot not understanding user queries effectively, providing generic or irrelevant responses, or slow interaction times, which could lead to frustration instead of convenience (4 out of 8).

Reminder Tools for Exercises Although featured in the previous list as meeting expectations, it appeared here as needing to meet expectations for some users. This result might come from the reminders needing to be more generic and not user configurable (3 out of 8).

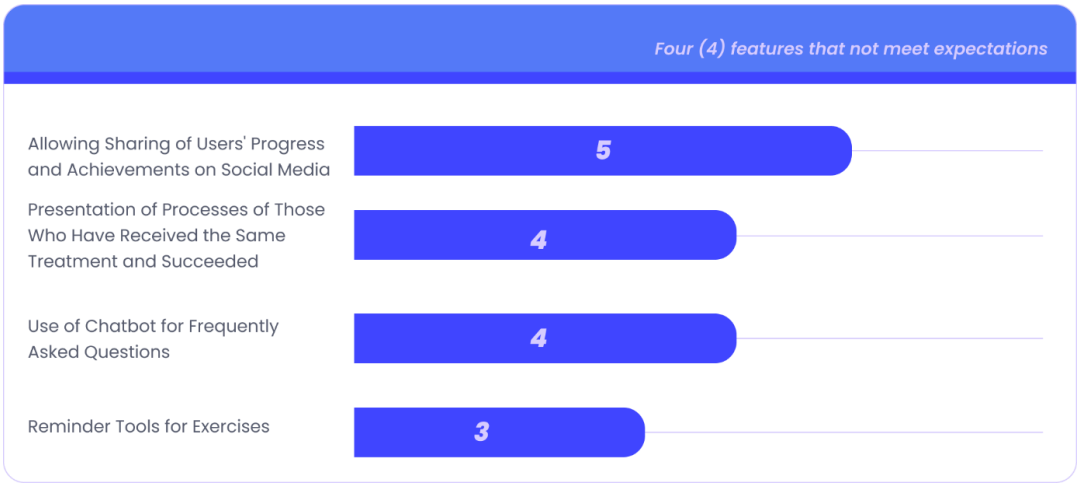


Figure 5.27. Four (4) features of Mobile App that do not meet expectations

Question 4: At first impression, how can you improve the feature above about this mobile application?

Based on the responses from the survey, user feedback was grouped into three main themes. This grouping showed how the feedback received should be focused according to the users' needs and expectations to develop and improve the app.

Reminder and Motivation Mechanisms. Participants demanded additional reminders and motivation tools beyond notifications. Since notifications are easily ignored, small in-app rewards or motivational systems were suggested to distract users from procrastinatory behavior. This could include collecting star points like in games.

App Design and Visual Elements. Various opinions exist on the app's visual design and user interface. Participants suggested making the visual elements and interface more detailed and straightforward so that the app appeals to a broader range of users.

Question 5: Is there anything that makes you want to avoid revisiting this mobile application? Please explain.

The following four features have shown which feature users will gravitate towards as a first choice for how a mobile app should be designed to support users in achieving their health and fitness goals.

Posture Analysis with Artificial Intelligence: Five users (5 /8) indicated that posture analysis using AI would be their first choice as they expect it to help manage the treatment process effectively. As a result of this analysis, personalized treatment planning and motivational milestones are essential. Users would like to use this feature to see how they are doing and track their progress.

"*Posture analysis with AI would be my first choice, and then I would follow the treatment step by step."*

Reminder. One participant would like features that remind them of exercise times and receive appropriate notifications at set exercise times to increase their motivation and be more consistent in achieving their health goals. Participants who wanted to use this feature for the first time aimed to keep their workouts regular and track their progress. A system that reminds them of exercise times can help them stay organized, while progress reports afterward can increase motivation.

"*The first feature I want to use in this mobile app is a reminder of my exercise time."*

Exercise Guidance. One participant stated that exercise guidance helped users create exercise plans that match their health status and goals. This guidance helped them understand which exercises are beneficial for which muscle groups and how exercises can contribute to their health and recovery. One participant commented that seeing how exercise can benefit a muscle group and contribute to recovery would be one of the best in-app experiences.

Personalized Exercise Plans and Pain Reduction. One participant stated that they expected to be offered a personal exercise plan, which would reduce pain levels according to the plan.

As a result of the fifth survey question, participants mostly see their developments with AI technologies. Based on this result, participants who wanted to fulfill the need for competence first wished to satisfy the need for autonomy second.

Question 6-7-8: (6) How unlikely (1) or likely (5) is it to return to this mobile application in the future? **(7)** Does anything make you want to revisit this mobile application? Explain. Moreover, **(8)** Does anything make you want to avoid revisiting this mobile application? Please explain.

These questions aimed to understand why participants wanted to return to the app, so these two questions were presented together.

The feedback is mostly positive, with seven participants rating the likelihood of returning to the app as 5, the highest rating, and only one participant rating the probability as 4, a medium rating. This result shows that participants were generally willing and satisfied to use the app again. No respondent indicated a high likelihood of not returning to the app, i.e., no one gave it a low rating. In addition, the reasons for revisiting were grouped under the following headings.

Usability. The app's overall usability is one of the most essential reasons participants return. An easy-to-use and effective app keeps participants coming back time and time again.

Personal Treatment Opportunity. Participants preferred this application because they could start a specific treatment process supported by expert opinions without the need to go to the hospital. Following the treatment stages and observing the progress showed that it could increase their motivation.

Continuous Control for Recurrent Pain. One participant stated that some conditions were recurrent and, therefore, required regular check-ups, which ensures that users use the app continuously. Regular application use was considered essential for neck health even after healing.

Regular Exercise Follow-up with an Expert. Regular exercise tracking with experts is another reason users use the app repeatedly. This makes users' exercise programs more effective and reliable.

Increased Motivation and Progress Monitoring. The observability of progress and its contribution to motivation encourages users to revisit the app.

Personal Tracking and Feedback. The app's ability to follow a person and provide feedback on the development process makes it sustainable for users.

Time and Space Independence. One participant found the app's ability to provide services anywhere and anytime to be an excellent convenience, and this flexibility caused the participant to prefer the app continuously.

Based on data collected from eight feedback, the situations that may cause users not to want to revisit a mobile app were described. Four of the users who participated in the study gave four different comments. It showed that participants felt receiving constant notifications during peak moments could be annoying and put them off the app. Also, the app's collection of too much information in one place could complicate it and lead to information overload.

Question 9-10: How unlikely (1) or likely (5) to recommend this mobile app? Can this mobile application be integrated into your daily life (1) or not (5)?

All respondents rated the likelihood of recommending the app as 5, the highest score. This indicated that respondents were very satisfied with the app and would not hesitate to recommend it to others. In the 10th question, most respondents (7 out of 8) indicated, with a high score of 5, that the app could be integrated into their daily lives. Only one person found the app integration unlikely and scored it 4. This suggested that the app is practical for the majority and can easily be incorporated into their daily routine.

Question 11: How would you describe this mobile application?

Survey results indicated that participants emphasized the app was "useful," with all participants (8 out of 8) mentioning this trait. The "useful" attribute was also highlighted by six participants, demonstrating the app's practical benefits. Five individuals described the app as "reliable," "functional," "informative," and "innovative"; this underscored that the app gained participants' trust through its solid information delivery, helpful interface, and innovative features. Four participants chose the "high quality" attribute, highlighting the app's overall standard and performance. Three people noted the "unique" quality, indicating that the app distinguished itself from similar products in the market. Lastly, the "user-friendly" description was used by two individuals, suggesting that the app had an easy and understandable user interface. These varied characteristics showcased how participants appreciated the app in different aspects.

Figure 5.28. Adjective summary of the participants' description

Question 12: What changes would you make if you wanted to improve this mobile application?

Based on the responses of 8 survey participants, the application is generally well-thought-out and comprehensive. Participants mentioned that they found the app sufficient and appealing. They also offer several suggestions: adding more motivating elements to the notification section, including medical images and reports within the app, and enhancing it with more visual content. Additionally, there was a recommendation to incorporate a feature for creating characters within the app and the ability to track the development of these characters. According to description, this character would track and reflect the participant's activities and progress within the app. As activities are completed or skipped, these will be represented visually or statistically on the character. This feature could increase motivation and make the app more interactive and fun.

5.5.3 Discussion on the First Impression Survey

Feedback from survey participants provided detailed information on their user experience with the mobile app. The feedback was an essential in improving the mobile app by giving clear indicators of user appreciation and areas for improvement. According to the respondents, they primarily appreciated the features that enabled them to monitor their processes with the support of technology. Secondary satisfaction came from the personalized features, showing a preference for self-monitoring and customization. According to Self Determination Theory (SDT), competence and autonomy are prioritized, while relationality is less of a focus. This suggests that users value the ability to independently manage and understand their health before social interaction or community features. Competency-related features such as self-monitoring capabilities were highly valued when discussing user preferences for a health-focused app. Participants showed a strong preference for taking responsibility for their health management using these tools. In contrast, users often overlooked relationality-related features,

including social interaction. While social interaction remained essential to many digital experiences, personalization, and progress tracking were prioritized as more important elements in health and exercise apps. This suggested a clear preference for functionality that supports personal achievement and personalized health management over community-based features. Furthermore, feedback indicated a desire for these tools to be more responsive to individual user schedules and preferences. Participants indicated that they would recommend the app to friends and relatives and revisit it. This was a strong endorsement of the app's effectiveness and usability. It suggests that users were satisfied with the app and willing to support it in their networks, which indicates its potential for broader acceptance and success.

CHAPTER 6

CONCLUSIONS

6.1 Overview of the Research

The research aims to investigate specific needs and challenges faced by patients receiving home rehabilitation for mechanical neck pain to find ways to increase motivation and engagement. It also seeks to present a comprehensive approach to the design of a digital intervention by examining the foundations of Self Determination Theory (SDT), exploring its applications.

The relationship between chronic neck pain and the significant role of home exercise programs (HEPs) in patient motivation were central to research. The research also delved into the challenges of adherence to HEPs and the critical role of engagement in successful rehabilitation. The research addressed motivation and adherence to home exercise programs for patients struggling with neck pain and sought design solutions to address user engagement issues on mobile applications.

The research, which started with literature research on mechanical neck pain, starting with its definition, causes, and associated problems, continued with treatment methods, especially home-based rehabilitation, and the information sources patients use, such as exercise guides and materials for exercises done outside of clinical settings. The review then addressed the role of motivation in rehabilitation, explained what motivation is, various motivation theories, and the factors contributing to a lack of motivation during home rehab. It explores methods to enhance motivation through positive technology, provided examples and studies that use SDT to help patients stick to their home rehab programs. The review concluded by connecting the treatment of mechanical neck pain with the use of positive technology and SDT to improve motivation in home-based rehabilitation.

Literature review aimed to understand both mechanical neck pain and treatment methods and explore the positive technology and motivation theories that can be used for increasing the patients' engagement to HEPs.

In addition, 7 applications designed for neck pain exercise on the AppStore were evaluated. It was discovered that the apps evaluated in the AppStore, there were major deficiencies, at the same time, according to the psychological needs of Self Determination Theory, the Relatedness features were not sufficient, and the Competence and Autonomy need was more focused on. Users' desire for control over their exercise routines is crucial for motivation. Most mobile applications (6 out of 7) offered autonomy features such as customization and personalization, which allowed users to choose exercises that fit their needs and preferences. This sense of control positively impacted their overall experience. Most mobile applications (6 out of 7) incorporated features to enhance users' sense of skill, mastery, and accomplishment. Most apps (5 out of 7) lacked features promoting relatedness. To address this, integrating social elements or professional guidance could enhance motivation by fostering a sense of connection and support.

After getting information from literature, expert consultation was set with experts. Expert consultations aimed to understand the treatment of mechanical neck pain and gather experts' opinions on home-based rehabilitation. To achieve this, consultation meetings were held with physiotherapy doctors and physiotherapists. During these meetings, 10 questions were asked to the experts to clarify patients' motivations in the home rehabilitation process. These questions covered common disease diagnoses, treatment processes, the home rehabilitation process, and tracking of the treatment progress. Additionally, the meetings explored practices in both public and private hospitals and examined factors influencing patient care.

The data from the expert consultation prepared the ground for the questions that could be asked to the users in the user research and the user research was designed on the information about the treatment and post-treatment processes learnt from the

experts. To understand motivation during the home rehabilitation period, the research first gathered warm-up questions, demographic information, and occupational information from participants. Then, 36 questions were asked to patients, organized under three main headings: experiences before treatment, experiences during the examination, and experiences during home-based rehabilitation. According to responses of participants 6 motivation source obtained and used for generating design recommendations for mobile applications for neck pain: Pain Reduction, Professional Interaction, Personalization, Knowledge Competence, Social Interaction, Progress Monitoring and Goal Achievement.

The results highlighted the importance of pain reduction, professional interaction, personalization, knowledge competence, social support, and progress monitoring and goal achievement in motivating patients during home-based rehabilitation. Thanks to defining these themes as motivation sources, 25 features recommended for mobile applications. After determining the design recommendations according to the information obtained from the users and the information obtained from previous studies and evaluation of mobile apps, a mobile application was designed according to the insights obtained from all of research methods. This mobile application was adapted to the application features to increase motivation and participation among patients receiving home rehabilitation for mechanical neck pain, and these 25 features were included in the application. In conclusion, the findings of this research can provide valuable insights into the use of mobile applications to support patients with mechanical neck pain and can be an example for the development of not only mobile applications also future digital health interventions in home-based rehabilitation. After the mobile application was designed and prototyped, the features and navigation of the application were introduced to the participants with a guided tour. After this introduction, a first impression survey was conducted. According to the results of this survey, automation and competence features were the features that the participants stated, and relatedness features were the features that they not preferred.

6.2 Revisiting Research Questions

The research aimed to increase motivation and engagement among patients who receive home rehabilitation for mechanical neck pain. It investigated the specific needs and challenges patients face and seeks to design a digital intervention based on the principles of SDT. The study's objectives are:

To examine the primary information sources from which patients acquire information during home-based rehabilitation. To investigate how the three basic needs from SDT (autonomy, competence, and relatedness) can guide the researchers and enhance patients' motivation and be integrated into the design process of a mobile digital health app for mechanical neck pain. To present the integration of a digital health application into home-based rehabilitation. The research questions were created with the objectives mentioned above. The main question and its sub-questions are listed below:

- **What specific needs, challenges, and expectations do patients with mechanical neck pain encounter during treatment, especially in home-based rehabilitation?**

Patients with mechanical neck pain encountered significant challenges during rehabilitation, particularly regarding their daily activities. According to literature research and patient interviews (refer to 2.1.2 and see 4.2.2.2) these challenges primarily revolved around mobility limitations, reduced range of motion, and a pervasive lack of comfort, which collectively hamper their ability to perform routine tasks. Neck pain significantly impacted various aspects of daily life for the participants, affecting personal care activities such as washing and dressing, making routine tasks challenging and diminishing overall quality of life. It posed challenges in lifting activities, whether dealing with heavy weights or everyday objects, leading to discomfort and limited mobility. Reading was also affected, as neck pain reduced reading duration and hindered concentration. Cervical discomfort often impacted focus, making it difficult to

maintain attention. Work-related tasks and job performance suffered, with neck pain leading to decreased productivity and potential absenteeism. Driving comfortably and safely was challenging due to the discomfort, affecting focus and execution of driving maneuvers. Neck pain disrupted sleep quality, making it hard to find a comfortable position and reducing sleep duration. Recreational activities, including sports, hobbies, and other leisure pursuits, were also limited, further affecting an individual's ability to enjoy life fully (see 2.1.2). In addition, according to participants of patient interview, restricted mobility led to difficulties in moving their necks and challenges with activities that required turning or tilting the head, such as driving a car or looking at a computer screen. Participants reported that a reduced range of motion made it difficult to lie down, stretch, or engage in physical activities without discomfort or pain. The lack of comfort indicated a constant struggle to find positions or postures that did not worsen their neck pain, affecting sleep, work, and overall quality of life. One participant shared, “I woke up one day, I was going to go to a presentation, I went to the presentation, but I drove the car crying, I had neck pain,” (P18). Another mentioned, “It even changes the way I talk to people. I cannot look sideways and talk,” (P01). Additionally, a participant noted: “I suffered a lot of neck pain while writing a thesis.” (P07)

In addition, patients with mechanical neck pain had specific needs and expectations during the home-based rehabilitation, which could be categorized into several key areas: environmental factors, instructional materials, motivation and engagement.

Firstly, the home environment played a crucial role in the rehabilitation process, with patients appreciating the privacy and convenience it offered for exercise. However, challenges such as the lack of professional supervision and the need for a motivating atmosphere could hinder their ability to adhere to exercise routines. This underscored the importance of creating a supportive and conducive home environment for rehabilitation, where patients feel both comfortable and motivated to engage in their prescribed exercises (see 4.2.4.1).

Instructional materials were another critical aspect of home-based rehabilitation for patients with mechanical neck pain. The research explored participants' experiences with instructional materials used during home-based rehabilitation for neck pain, including brochures and online resources recommended by healthcare professionals. Most participants received printed exercise programs, while a few were given only verbal instructions. Participants emphasized the need for a balance between visual aids and clear, step-by-step written instructions, with video resources highly valued for accurately demonstrating exercises. Personalized exercise programs tailored to individual diagnoses and needs were considered more effective and motivating. Additionally, some participants relied on personal networks, such as friends and family, for extra exercise suggestions, although this approach was seen as unreliable and potentially harmful.

Online instructional materials, including websites, digital brochures, and educational videos, were frequently used by participants seeking additional information. However, concerns about the reliability of online sources, the risk of internet fraud, and the impersonal nature of general information were significant issues. Participants tended to trust information from hospital-affiliated websites and sought assistance in identifying accurate and reliable sources. Social media and mobile apps were also utilized by some participants, with these tools providing structured exercise programs, visual demonstrations, and reminders, which helped support their rehabilitation process more systematically. Overall, the research highlighted the importance of reliable, personalized, and clearly presented instructional materials in enhancing the home-based rehabilitation experience for neck pain patients.

Motivation and engagement in home exercises were influenced by several factors, including pain reduction, professional interaction, and Knowledge Competence. It was explored their adherence to home exercise programs and the factors influencing it, divided into two main areas: challenges in adhering to home-based rehabilitation and motivation sources for adhering to home-based exercises. Participants faced challenges such as time management, need for social and

professional support, and fluctuating pain and intensity. Busy schedules and demanding workloads made it difficult to find time for exercise (9 out of 20). Social and professional support was often necessary for motivation, with many participants preferring to exercise with a friend or trainer (15 out of 20). Tracking progress and maintaining communication with healthcare professionals were also challenging, leading to concerns about doing exercises correctly (11 out of 20). Pain fluctuation affected regular exercise, with decreased pain leading to decreased motivation (6 out of 20).

According to literature research, for individuals with musculoskeletal pain, the absence of positive feedback from physiotherapists significantly impacted their adherence to home exercise programs. When physiotherapists and caregivers supervised exercises and provided appropriate feedback, patients were more likely to stick to their routines and benefit from them. However, having too many exercises in a program often led to a lack of motivation. Self-motivation played a crucial role in adherence, as individuals with higher self-motivation were more consistent in their exercise routines. Studies showed that patients with greater self-efficacy, or belief in their ability to succeed, were more likely to adhere to outpatient physical therapy programs. Additionally, past behavior was a strong predictor of current adherence; patients who had previously adhered well to exercise routines were likely to do so again. Patients who were physically active before starting home-based exercises were more likely to maintain their exercise routines. Common barriers included difficulty fitting exercise into daily life, forgetting to exercise, and not finding the time, all of which hindered adherence. Worsening pain during exercise also discouraged patients from continuing, as they were less likely to persist with activities that increased their discomfort. Furthermore, high levels of helplessness, depression, and anxiety negatively affected adherence to treatment, with studies confirming that depression could significantly reduce patients' commitment to home-based exercise. Addressing these psychological barriers was essential for improving adherence rates and ensuring the effectiveness of home exercise programs.

- **By which ways do patients primarily acquiring information while in the home-based exercise stage?**

During the home-based exercise stage for patients with mechanical neck pain, acquiring information effectively was crucial to ensure the success of their rehabilitation. Primarily, these patients received detailed guidance and exercise plans directly from healthcare professionals, such as physical therapists or doctors. This information often came in the form of printed brochures or verbal instructions during examinations. These resources were instrumental in guiding patients through their exercises, offering crucial details on execution techniques, frequency, and precautions to avoid further injury. However, there was a notable demand for more interactive and detailed materials, such as video demonstrations, which can significantly enhance understanding and adherence to prescribed exercise routines.

In addition to professional guidance, the internet served as a significant source of supplementary information for patients engaged in home-based exercises. Online platforms provided a wealth of resources, including instructional videos, forums for community support, and articles on neck pain management. Patients were increasingly turning to these digital resources for additional insights and alternative exercises that can be incorporated into their rehabilitation programs. Nonetheless, the challenge of discerning reliable and accurate information online remained a concern, highlighting the need for healthcare providers to recommend trusted websites and online tools to their patients.

Personal networks, including family, friends, and acquaintances who have undergone similar experiences, also played a vital role in the information-gathering process for patients. These personal connections offered not only practical advice and exercise recommendations but also emotional support and motivation, which are invaluable during the recovery journey. Additionally, a smaller subset of patients leveraged digital applications and platforms designed specifically for rehabilitation purposes. These tools offered personalized exercise routines, tracking functionalities, and educational content, catering to the modern patient's preference

for digital and accessible health management solutions. Together, these channels of information acquisition underscore the multifaceted approach patients adopted during home-based rehabilitation, blending professional advice, digital innovation, and personal support to navigate their recovery effectively.

- **How do patients have opinion about the strengths and weaknesses of information source used by patients (e.g. HEP brochures, videos, etc.)?**

According to participants' opinions on the strengths and weaknesses of various information sources for HEPs highlighted the diverse needs and preferences individuals have when managing mechanical neck pain at home (see 4.2.4.2).

HEP brochures, often provided by healthcare professionals, were valued for their direct connection to the patient's specific treatment plan and easy to access. The strengths of these brochures lied in their accessibility and ease of reference, allowing patients to quickly remind themselves of the exercises they need to perform. However, patients frequently cited weaknesses such as the lack of dynamic instruction and insufficient detail in these materials. Static images and text might not fully convey the correct techniques, leading to potential misunderstandings or the inability to perform exercises effectively. Patients also expressed a desire for more personalized content that considers their unique conditions and recovery stages.

Videos, whether accessed online or provided by healthcare professionals, were highly regarded for their ability to demonstrate exercises in a dynamic and visually engaging manner. The strength of video instruction lied in its capacity to show movement in real time, offering a clearer understanding of exercise techniques and pacing. Videos could also be paused and replayed, providing a level of interactivity that brochures cannot. However, weaknesses included the variability in the quality and reliability of online video content, with patients expressing concerns over finding videos that accurately match their rehabilitation needs. Additionally, there

was the challenge of ensuring that the exercises shown are appropriate for the viewer's specific health condition and rehabilitation stage.

Digital platforms and applications represented a growing source of information for home-based exercises, praised for their convenience and the ability to offer customized exercise programs. These tools could track progress, send reminders, and provide a broad range of exercises suited to different levels of ability. The primary strength of digital platforms was their interactivity and personalization, enhancing patient engagement and adherence. Yet, weaknesses included the potential cost of subscription services, the need for internet access and technological literacy, and concerns about the generalization of advice without the oversight of a healthcare professional.

- **What are the primary motivation sources for engaging and adhering to home-based rehabilitation?**

According to patient interview results, participants identified six main sources of motivation:

Pain Reduction. A large percentage, 18 out of 20, expressed a desire to get rid of their pain and alleviate their discomfort. Therefore, relieving pain emerged as their most significant source of motivation. Participants should have been reminded to start exercising before they felt pain. The most frequently stated reason participants began their exercise routines was the onset of pain. Participants who did not use alarms or reminders said they started exercising only when they felt pain (6 out of 20).

Professional Interaction. The involvement and empathy of doctors were crucial, with participants seeking regular feedback and progress updates (18 out of 20). Professional support and effective communication between healthcare providers and patients play a pivotal role in motivation. Regular check-ins, whether through in-person visits, telehealth consultations, or digital communication platforms, could provide patients with the encouragement and guidance they need to continue their

exercises. These interactions offered opportunities for patients to ask questions, report challenges, and receive adjustments to their exercise programs. The knowledge that a professional was overseeing their progress and available to offer support can significantly enhance a patient's commitment to their rehabilitation process. This external motivation complemented the patient's intrinsic motivation by providing a sense of accountability and validation.

Personalization. Tailored exercise programs were seen as more effective and motivating, with participants stressing the need for individualized routines based on their specific conditions and goals (8 out of 20). Personalization of the exercise program was critical factor in maintaining patient motivation. When exercises were tailored to the individual's specific condition, capabilities, and stage of recovery, patients were more likely to perceive them as both doable and beneficial. This customization should have extended beyond the exercises themselves to include the scheduling and integration of the regimen into the patient's daily life, thereby reducing barriers to adherence. Personalization fostered a sense of ownership and relevance, encouraging patients to stay engaged with their exercises. Additionally, providing options for scaling exercises up or down allowed patients to adjust their activity based on their pain levels and physical condition on any given day, which could help maintain consistency.

Knowledge Competence. Detailed information about exercises and the treatment process increased motivation by alleviating fears and satisfying curiosity (16 out of 20). Although participants were asked about information sources and motivation under separate headings during the interviews, it was found that obtaining sufficient information had a direct positive impact on their motivation (16 out of 20 participants). To increase motivation, providing resources that detail how specific exercises benefit muscle groups and health conditions was found to be effective (12 out of 20 participants). Detailed information about the treatment process to allay fears and satisfy curiosity also motivated participants. Participants mentioned that they could have been further motivated by medical advice and educational information that would create body awareness (8 out of 20 participants).

Social Interaction. Support from family, friends, and communities played a significant role in motivation, with participants finding it easier to exercise with others (15 out of 20). Social support from family, friends, and peer groups acts as a powerful motivational force. Encouragement from loved ones and the sharing of experiences and tips with peers who are undergoing similar rehabilitation processes could provide both emotional and practical support. Social media platforms and online forums offer spaces where patients could connect, share their progress, and celebrate achievements, creating a sense of community around their rehabilitation journey. This social reinforcement not only boosted morale but also encouraged consistency and adherence to exercise programs through a shared experience of recovery.

Progress Monitoring and Goal Achievement. Participants emphasized the importance of ensuring that the treatment process remained appropriate to their evolving needs. They highlighted the necessity of using visuals and texts to show progress and explain health status at each exercise step. Notable and tangible changes, especially physical improvement or increased muscle strength were identified as key motivators. Participants reported feeling motivated when they experienced positive sensations or observed progress during their exercises. Additionally, they expressed a desire to receive information about treatment follow-up and recovery processes (6 out of 20 participants).

In addition, according to literature research, leveraging technology and digital tools could introduce an element of engagement and novelty that sustains motivation over time. Applications that track progress, provide reminders, and offer virtual rewards for consistency and milestones tap into gamification strategies that make the rehabilitation process more interactive and rewarding. Video demonstrations, virtual reality (VR) exercises, and online workshops could add variety and depth to the home exercise experience, making it more appealing and less monotonous. These technological solutions could cater to both the informational needs of patients, by demonstrating proper techniques, and their motivational needs, by making the process of rehabilitation more engaging and less isolating.

- **How can a mobile health app be incorporated into home-based rehabilitation to support patients with mechanical neck pain?**

Based on the analysis of participants' responses, the identified needs and expectations for app design were grouped under five main headings: Personalization, Progress Monitoring and Goal Achievement, Professional Interaction, Knowledge Competence, and Social Interaction. The features and content under these headings were designed to meet participants' needs and motivations for exercise.

Personalization

Personalization allowed users to set up their profiles with personal health data, modify the app's appearance, and choose content relevant to their diagnosis and interests, respecting and adapting to individual differences. This individualized approach empowered users, making them feel that the app served their specific needs rather than presenting a one-size-fits-all solution. Features included user profiles that allow access to personal health data and medical information, satisfying the need for autonomy. A customizable interface enabled users to adjust the app's appearance and features to their preferences. Adaptive content and exercises tailored to individual diagnoses and preferences further meet the need for autonomy. Examples included presenting exercises in easy, medium, and hard levels and tracking pain levels to offer suitable exercises. Location-based services, adapted exercises to the user's current location and situation, fulfilling the need for autonomy. Additionally, scheduling tools like calendars and personalized reminders helped integrate exercise routines into users' daily lives.

Progress Tracking Tools

Progress tracking tools enabled users to monitor their progress, showing them that they are advancing and succeeding, which meet their competence needs. This visual representation of progress and success could encourage continuous exercise participation. Providing users with positive feedback about their stage in the

process and their progress meet their need for competence. Progress tracking features included presenting the treatment process step by step, showing which stage of the treatment they are in, and optionally presenting photos of their posture before and after.

Professional Interaction

Access to expert knowledge, Q&A sections, and tutorials through the app enhanced the user's sense of competence. Users gained knowledge, skills, and confidence in managing their condition or performing tasks, aligning with the SDT principle of competence. Features supporting professional interaction included providing direct access to professional knowledge, which gives users the necessary information to continue the process, thus supporting their competence needs. Q&A sections and tips from experts on neck pain provided necessary information about symptoms and treatments, increasing users' awareness and helping them develop knowledge. Knowing the source of information also enhanced their sense of trust.

Knowledge Competence

Access to reliable information made users more likely to feel confident in their actions, a crucial aspect of feeling competent. Users were more effective when they understand what they are doing and why. Knowledge competence features included comprehensive content that provides users with adequate information about their condition and the process they will undergo, drawn from reliable sources. Information about the causes of neck pain, the treatment process, and what to watch out for during the process could be presented. Tutorials that show examples of exercises through video demonstrations and prepare tutorials educated users and meet their competence needs. Features included showing and explaining exercises included in the personal plan beforehand, indicating the difficulty level, duration, and muscle groups targeted by the exercises, and presenting exercises with information on duration, repetitions, and sets.

Social Interaction

Social interaction features in the app, such as shared goals with families and group exercises, facilitated connections between users, allowing them to feel part of a community and enhancing their sense of belonging and emotional connection with others. Shared goals and progress features allowed users to share their progress and successes within the app with friends and family on different social media platforms, meeting their need for social interaction. Group exercises connected users through shared experiences with similar difficulties or pain levels. Features included the opportunity to participate in group exercises led by experts and the opportunity to do group exercises online with participants at similar levels.

- **How might the design of a mobile health app for mechanical neck pain be designed by the three basic psychological needs of Self Determination Theory while also serving to motivate patients?**

SDT provided a framework for understanding motivation, emphasizing the importance of fulfilling three basic psychological needs: autonomy, competence, and relatedness. When designing a digital health application for mechanical neck pain, leveraging SDT involved creating features that support these needs, designer can follow the needs and use them as theoretical background. The design recommendations based on SDT highlighted the importance of a user-centered approach in the development of digital health applications. This alignment with SDT's principles ensured that the app not only meet the users' psychological health needs but also supported designers to take guide, making it a powerful tool in the design of mobile app.

In that case, autonomy was addressed by allowing users to personalize their experience within the app, such as setting up profiles with personal health data, customizing the app’s interface, and choosing exercises that fit their specific conditions and preferences. This level of personalization and control made users feel empowered and more likely to engage with the app, as it aligns with their individual health goals and lifestyle preferences. To satisfy the competence need,

the app could include features like progress tracking tools and positive feedback mechanisms that provide users with tangible evidence of their progress and successes. Access to professional knowledge through Q&A sections, tips from experts, and comprehensive content on neck pain management could further enhance users' feeling of being skilled and effective in managing their condition. These features collectively contributed to a user's sense of competence, reinforcing their motivation to continue using the app and adhere to their exercise regimen by making them felt capable and informed. Relatedness, the third core need, focused on creating a sense of connection and belonging among users. While direct user-to-user communication might pose risks of information pollution, incorporating social interaction features such as shared goals, progress sharing capabilities with friends and family, and opportunities for group exercises could foster a supportive community atmosphere. These aspects of the app could enhance users' motivation by making them feel part of a collective journey towards recovery, offering emotional support with others who are facing similar challenges.

Personalization and Autonomy. Digital health applications could support the personalization of treatment plans by allowing users to input their personal health data, set preferences, and choose exercises that cater to their specific condition and recovery stage. This personalization enhanced autonomy, enabling patients to have control over their rehabilitation process. Features like customizable interfaces and adaptive content further aligned with the patient's need for autonomy, ensuring that the app experience feels personal and relevant. By incorporating scheduling tools and reminders, these applications could assist patients in integrating their exercise routines seamlessly into their daily lives, promoting consistency and adherence. Utilizing the flexibility of digital platforms, health applications could offer interactive and adaptive content that responds to the user's current pain level, physical capabilities, and location. This adaptability ensured that exercises are always appropriate and achievable, minimizing the risk of injury or discouragement. For example, an app could suggest specific exercises that are ideal

for the office if it detects that the user is at their place of work, thereby enhancing the practicality and relevance of the recommended activities.

Progress Tracking and Competence. To address the need for competence, digital health applications could include progress tracking tools that provide visual feedback on the patient's advancements. This feature helped patients recognize their improvements, boosting their motivation and confidence in their ability to manage their condition. Positive feedback mechanisms, access to professional advice, and comprehensive educational content empowered patients with the knowledge and skills needed for effective self-management. Through detailed tutorials and expert tips, patients could enhance their competence in performing exercises correctly and understanding the rationale behind each activity. Digital health applications could serve as a bridge between patients and healthcare professionals, facilitating better communication and continuity of care. Features such as the ability to share progress reports with therapists, receive personalized feedback, and access Q&A sections with experts could enhance the therapeutic relationship. This integration ensured that the home exercise stage was closely monitored and aligned with the overall treatment plan, providing a more cohesive and effective rehabilitation experience.

Social Support and Relatedness. Integrating social interaction features into digital health applications could fulfill the need for relatedness among patients. While direct communication between users might be limited to prevent misinformation, the apps could offer features such as shared goals, the ability to share progress with friends and family, and opportunities for participating in group exercises virtually. These features helped build a sense of community and support, making patients feel connected and supported by others going through similar experiences.

6.3 Additional Findings

According to patient interview results, one main additional finding was presented, this result was not the main aim of the research.

According to participants' opinions and literature, creating body awareness was deemed crucial by participants, who believed that education aimed at increasing body awareness could lead to better health outcomes. Participants noted that a lack of knowledge about the body hindered their ability to effectively manage their treatment, emphasizing the need for comprehensive patient education. The importance of physical education and body awareness in health management is supported by literature, which suggests that inadequate knowledge can prevent individuals from adhering to treatment protocols and achieving optimal health. Participants in this study reported that their lack of physical education and body awareness negatively impacted their health, as they were often unaware of how to perform exercises correctly or understand the benefits of their treatment. Research has shown that patient education, particularly in creating body awareness, can enhance engagement in rehabilitation programs and lead to better health results.

6.4 Limitations of the Study

This research focused on the home-based rehabilitation experiences of patients aged 18 years and older with mechanical neck problems. Participants were not selected according to pain levels to comprehensively capture patients' experiences across all pain levels. However, this approach may miss certain insights into different pain intensities. The study included only patients who underwent a home exercise program for mechanical neck pain and received services from private or public healthcare institutions in Turkey; this may not reflect the experiences of patients in different healthcare systems or regions. Since the designed mobile application was only shown to the participants and their first impressions were asked, secondary comments and post-use opinions could not be obtained.

6.5 Suggestions for Future Studies

Future studies can consider broadening the scope of the participant pool to include individuals from a variety of cultural and demographic backgrounds. This expansion would enable a more detailed analysis of how cultural and demographic factors influence the effectiveness of home-based rehabilitation programs, allowing for the development of more culturally sensitive and demographically appropriate interventions. Further research should also investigate the effectiveness of various motivation theories tailored to individual preferences in home-based rehabilitation. It is essential to explore how different motivational techniques such as gamification elements can impact patient engagement and adherence to prescribed exercises. Additionally, future studies may explore the role of healthcare professionals and caregivers, in enhancing adherence to home-based rehabilitation programs and integrate their experiences to digital interventions. This could include examining the impact of regular follow-ups by healthcare providers, the support roles of caregivers in maintaining exercise routines. Understanding these dynamics could offer new avenues for developing multi-faceted intervention strategies that leverage professional guidance.

REFERENCES

Akinci, A. C., & Olgun, N. (2011). The Effectiveness of Nurse-Led, Home-Based Pulmonary Rehabilitation in Patients with COPD in Turkey. Rehabilitation Nursing, 36(4), 159–165. https://doi.org/10.1002/j.2048-7940.2011.tb00084.x

Aldukhayel, A., Almeathem, F. K., Aldughayyim, A. A., Almeshal, R. A., Almeshal, E. A., Alsaud, J. S., & Albaltan, R. I. (2021). Musculoskeletal pain among school teachers in Qassim, Saudi Arabia: prevalence, pattern, and its risk factors. Curēus. https://doi.org/10.7759/cureus.17510

Alexandre, N. M. C., Nordin, M., Hiebert, R., & Campello, M. (2002). Predictors of compliance with short-term treatment among patients with back pain. Revista Panamericana De Salud Pública, 12(2), 86–95. https://doi.org/10.1590/s1020-49892002000800003

Argent, R., Daly, A., & Caulfield, B. (2018). Patient involvement with Home-Based Exercise Programs: Can connected health interventions influence adherence? Jmir Mhealth and Uhealth, 6(3), e47. https://doi.org/10.2196/mhealth.8518

Azboy, Y. (2020). Effectiveness of video based home exercise program on pain, kinesiophobia, quality of life, physical activity and depression level in neck pain associated with cervical disc herniation [Unpublished Master Thesis]. Istanbul Aydın University / Graduate School of Education / Department of Physiotherapy and Rehabilitation / Department of Physiotherapy and Rehabilitation.

Bachmann, C., Oesch, P., & Bachmann, S. (2017). Recommendations for Improving Adherence to Home-Based Exercise: A Systematic Review. Physikalische Medizin Rehabilitationsmedizin Kurortmedizin, 28(01), 20–31. https://doi.org/10.1055/s-0043-120527

Bassett, S. F., & Phty, D. (2003). The assessment of patient adherence to physiotherapy rehabilitation. New Zealand Society of Physiotherapists. http://physiotherapy.org.nz/assets/Professional-dev/Journal/2003-July/July03commentary.pdf

Bassett, S., & Phty, D. (2003). The assessment of patient adherence to physiotherapy rehabilitation. Journal of Physiotherapy. http://physiotherapy.org.nz/assets/Professional-dev/Journal/2003-July/July03commentary.pdf

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. Psychological Bulletin, 117(3), 497–529. https://doi.org/10.1037/0033-2909.117.3.497

Bhattacharjya, S., Linares, I., Langan, J., Xu, W., Subryan, H., & Cavuoto, L. A. (2022). Engaging in a home-based exercise program: A mixed-methods approach to identify motivators and barriers for individuals with stroke. Assistive Technology. https://doi.org/10.1080/10400435.2022.2151663

Bizzarini, E., Chittaro, L., Frezza, M., Polo, M., Malisan, C., Menosso, R., & Zampa, A. (2022). A mobile app for home-based exercise in spinal cord injured persons: Proposal and pilot study. Digital Health, 8, 205520762110707. https://doi.org/10.1177/20552076211070724

Blotnicky, K. A., Mann, L. L., & Joy, P. R. (2015). AN ASSESSMENT OF UNIVERSITY STUDENTS' HEALTHY EATING BEHAVIORS WITH THE EXPECTANCY THEORY. ASBBS eJournal, 11(1).

Bolton, J. R., & Breen, A. (1999). The Bournemouth Questionnaire: A short-form comprehensive outcome measure. I. Psychometric properties in back pain patients. Journal of Manipulative and Physiological Therapeutics, 22(8), 503–510. https://doi.org/10.1016/s0161-4754(99)70001-1

Boswell, M. V., Shah, R. V., Everett, C. R., Sehgal, N., Mackenzie-Brown, A. M., Abdi, S., Bowman, R. C., Deer, T. R., Datta, S., Colson, J., Spillane, W., Smith, H. S., Lucas, L. F., Burton, A. W., Chopra, P., Staats, P. S., Wasserman, R. A., & Manchikanti, L. (2005). Interventional Techniques in the Management of Chronic Spinal Pain: Evidence-Based Practice Guidelines. Pain Physician, 1;8(1;1), 1–47. https://doi.org/10.36076/ppj.2006/9/1

Carmeli, E., Sheklow, S. L., & Coleman, R. (2006). A comparative study of organized class-based exercise programs versus individual home-based exercise programs for elderly patients following hip surgery. Disability and Rehabilitation, 28(16), 997–1005. https://doi.org/10.1080/09638280500476154

Chasanidou, D. (2018a). Design for Motivation: Evaluation of a design tool. Multimodal Technologies and Interaction, 2(1), 6. https://doi.org/10.3390/mti2010006

Chauhan, P., Attrey, P., & Singh, A. K. (2021a). Effect of Post Isometric Relaxation with Deep Neck Flexor Exercise in Subacute Mechanical Neck Pain. International Journal of Health Sciences and Research, 11(10), 46–59. https://doi.org/10.52403/ijhsr.20211008

Choi, J., Choi, K., Reddy, L. F., & Fiszdon, J. M. (2014). Measuring motivation in schizophrenia: Is a general state of motivation necessary for task-specific motivation? Schizophrenia Research, 153(1–3), 209–213. https://doi.org/10.1016/j.schres.2014.01.027

Chua, S. K., Abdul Muthalib, N. F., Md Shukri, N. S., & Zahari, Z. (2021). Effects of Home Exercise Program on Pain and Neck Functions in Individuals With Non- Specific Neck Pain. Malaysian Journal of Medicine and Health Sciences.

Chung, B. P. H., Chiang, W. K. H., Lau, H., Lau, T. F. O., Lai, C. W. K., Sit, C. S. Y., Chan, K. Y., Yeung, C. Y., Lo, T. M., Hui, E., & Lee, J. S. W. (2020). Pilot study on comparisons between the effectiveness of mobile video-guided and paper-based home exercise programs on improving exercise adherence, self-efficacy for exercise and functional outcomes of patients with stroke with 3-month follow-up: A single-blind randomized controlled trial. Hong Kong Physiotherapy Journal, 40(01), 63–73. https://doi.org/10.1142/s1013702520500079

Cieza, A., Causey, K., Kamenov, K., Hanson, S. W., Chatterji, S., & Vos, T. (2020). Global estimates of the need for rehabilitation based on the Global Burden of Disease study 2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet, 396(10267), 2006–2017. https://doi.org/10.1016/s0140-6736(20)32340-0

Colombo, R., Pisano, F., Mazzone, A., Delconte, C., Micera, S., Carrozza, M. C., Dario, P., & Minuco, G. (2007). Design strategies to improve patient motivation during robot-aided rehabilitation. Journal of Neuroengineering and Rehabilitation, 4(1). https://doi.org/10.1186/1743-0003-4-3

Cridland, E. K., Phillipson, L., Brennan-Horley, C., & Swaffer, K. (2016). Reflections and recommendations for conducting In-Depth Interviews with people with Dementia. *Qualitative Health Research*, *26*(13), 1774–1786. https://doi.org/10.1177/1049732316637065

Croft, P., Papageorgiou, A. C., Ferry, S., Thomas, E., Jayson, M. I. V., & Silman, A. J. (1995). Psychologic distress and low back pain. Spine, 20(24), 2731–2737. https://doi.org/10.1097/00007632-199512150-00015

Davies, L., LeClair, K., Bagley, P., Blunt, H., Hinton, L., Ryan, S., … & Ziébland, S. (2020). Face-to-face compared with online collected accounts of health and illness experiences: a scoping review. Qualitative Health Research, 30(13), 2092-2102. https://doi.org/10.1177/1049732320935835

Dean, S., Smith, J. A., Payne, S., & Weinman, J. (2005). Managing time: An interpretative phenomenological analysis of patients' and physiotherapists' perceptions of adherence to therapeutic exercise for low back pain. Disability and Rehabilitation, 27(11), 625–636. https://doi.org/10.1080/0963820500030449

Dearnley, C. (2005). A reflection on the use of semi-structured interviews. *Nurse Researcher*, *13*(1), 19–28. https://doi.org/10.7748/nr2005.07.13.1.19.c5997

Deci, E. L., & Ryan, R. M. (1985). Intrinsic Motivation and Self-Determination in human behavior. In Springer eBooks. https://doi.org/10.1007/978-1-4899-2271-7

Desmet, P., & Fokkinga, S. (2020). Beyond Maslow's Pyramid: Introducing a typology of thirteen fundamental needs for Human-Centered Design. Multimodal Technologies and Interaction, 4(3), 38. https://doi.org/10.3390/mti4030038

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness. Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments. https://doi.org/10.1145/2181037.2181040

DiCicco-Bloom, B., & Crabtree, B. F. (2006). The qualitative research interview. Medical Education, 40(4), 314–321. https://doi.org/10.1111/j.1365-2929.2006.02418.x

Dunn, J., Runge, R., & Snyder, M. (2018). Wearables and the medical revolution. Personalized Medicine, 15(5), 429–448. https://doi.org/10.2217/pme-2018-0044

Dusunceli, Y., Öztürk, C., Atamaz, F., Hepgüler, S., & Durmaz, B. (2009). Efficacy of neck stabilization exercises for neck pain: A randomized

controlled study. Journal of Rehabilitation Medicine, 41(8), 626–631. https://doi.org/10.2340/16501977-0392

E, N., Dowle, P., & Ks, A. H. (2018). Effectiveness of pilates as an adjunct to conventional therapy in chronic mechanical neck pain: a randomized controlled trial. Journal of Novel Physiotherapies, 08(01). https://doi.org/10.4172/2165-7025.1000381

Eckard, T. G., Lopez, J., Kaus, A. L., & Aden, J. K. (2015). Home Exercise program Compliance of service members in the deployed environment: an observational cohort study. Military Medicine, 180(2), 186–191. https://doi.org/10.7205/milmed-d-14-00306

Effects of home exercise program on pain and neck functions in individuals with non- specific neck pain. (2021). Malaysian Journal of Medicine and Health Sciences (eISSN 2636-9346), 17, 60–67. https://medic.upm.edu.my/upload/dokumen/2021061417084009_2020_1129.pdf

Emmerson, K. B., Harding, K. E., & Taylor, N. F. (2016). Home exercise programmes supported by video and automated reminders compared with standard paper-based home exercise programmes in patients with stroke: a randomized controlled trial. Clinical Rehabilitation, 31(8), 1068–1077. https://doi.org/10.1177/0269215516680856

Escolar-Reina, P., Medina-Mirapeix, F., Gascón-Cánovas, J. J., Montilla-Herrador, J., Jimeno-Serrano, F. J., De Oliveira Sousa, S. L., Del Baño-Aledo, M. E., & Lomas-Vega, R. (2010). How do care-provider and home exercise program characteristics affect patient adherence in chronic neck and back pain: a qualitative study. BMC Health Services Research, 10(1). https://doi.org/10.1186/1472-6963-10-60

Essery, R., Geraghty, A. W. A., Kirby, S., & Yardley, L. (2016). Predictors of adherence to home-based physical therapies: a systematic review.

Disability and Rehabilitation, 39(6), 519–534. https://doi.org/10.3109/09638288.2016.1153160

Fan, T., Wang, X., Song, X., Zhao, G., & Zhang, Z. (2023). Research Status and Emerging Trends in Virtual Reality Rehabilitation: Bibliometric and Knowledge Graph study. JMIR Serious Games, 11, e41091. https://doi.org/10.2196/41091

Farahbakhsh, F., Akbari-Fakhrabadi, M., Shariat, A., Cleland, J. A., Farahbakhsh, F., Seif-Barghi, T., Mansournia, M. A., Rostami, M., & Kordi, R. (2018). Neck pain and low back pain in relation to functional disability in different sport activities. Journal of Exercise Rehabilitation, 14(3), 509–515. https://doi.org/10.12965/jer.1836220.110

Fernández-De-Las-Peñas, C., Cleland, J., & Dommerholt, J. (2015). Manual therapy for musculoskeletal pain syndromes: an evidence- and clinical-informed approach. Elsevier Health Sciences.

Fogg, B. (2009). A behavior model for persuasive design. PersPersuasive '09: Proceedings of the 4th International Conference on Persuasive Technology. https://doi.org/10.1145/1541948.1541999

Fu, Q., & Levine, B. D. (2018). Exercise and non-pharmacological treatment of POTS. Autonomic Neuroscience (Print)/Autonomic Neuroscience, 215, 20–27. https://doi.org/10.1016/j.autneu.2018.07.001

Funao, H., Tsujikawa, M., Momosaki, R., & Shimaoka, M. (2021). Virtual reality applied to home-visit rehabilitation for hemiplegic shoulder pain in a stroke patient: a case report. Journal of Rural Medicine, 16(3), 174–178. https://doi.org/10.2185/jrm.2021-003

Ganesh, G. S., Mohanty, P., Pattnaik, M., & Mishra, C. (2014). Effectiveness of mobilization therapy and exercises in mechanical neck pain. Physiotherapy Theory and Practice, 31(2), 99–106. https://doi.org/10.3109/09593985.2014.963904

Gao, Z., Lee, A. M., & Harrison, L. (2008). Understanding Students' motivation in sport and Physical Education: From the Expectancy-Value Model and Self-Efficacy Theory Perspectives. Quest, 60(2), 236–254. https://doi.org/10.1080/00336297.2008.10483579

Gassert, R., & Dietz, V. (2018). Rehabilitation robots for the treatment of sensorimotor deficits: a neurophysiological perspective. Journal of Neuroengineering and Rehabilitation, 15(1). https://doi.org/10.1186/s12984-018-0383-x

Goršič, M., Cikajlo, I., Goljar, N., & Novak, D. (2017). A multisession evaluation of an adaptive competitive arm rehabilitation game. Journal of Neuroengineering and Rehabilitation, 14(1). https://doi.org/10.1186/s12984-017-0336-9

Goršič, M., Cikajlo, I., & Novak, D. (2017). Competitive and cooperative arm rehabilitation games played by a patient and unimpaired person: effects on motivation and exercise intensity. Journal of Neuroengineering and Rehabilitation, 14(1). https://doi.org/10.1186/s12984-017-0231-4

Griffiths, C., Ryan, P., & Foster, J. (2011). Thematic analysis of antonovsky's sense of coherence theory. Scandinavian Journal of Psychology, 52(2), 168-173. https://doi.org/10.1111/j.1467-9450.2010.00838.x

Grimby-Ekman, A., Andersson, E., & Hagberg, M. (2009). Analyzing musculoskeletal neck pain, measured as present pain and periods of pain, with three different regression models: a cohort study. BMC Musculoskeletal Disorders, 10(1). https://doi.org/10.1186/1471-2474-10-73

Gross, A., Forget, M., St George, K., Fraser, M. M., Graham, N., Perry, L., ... & Burnie, S. J. (2007). Patient education for neck pain. Cochrane Database of Systematic Reviews, (3).

Gross, A., Forget, M., St George, K., Fraser, M. M., Graham, N., Perry, L., Burnie, S. J., Goldsmith, C. H., Haines, T., & Brunarski, D. (2012). Patient education for neck pain. Cochrane Library. https://doi.org/10.1002/14651858.cd005106.pub4

Gross, A., Kay, T. M., Paquin, J., Blanchette, S., Lalonde, P., Christie, T., Dupont, G., Graham, N., Burnie, S. J., Gelley, G., Goldsmith, C. H., Forget, M., Hoving, J. L., Brønfort, G., & Santaguida, P. L. (2015). Exercises for mechanical neck disorders. Cochrane Library, 2015(1). https://doi.org/10.1002/14651858.cd004250.pub5

Gross, A., Miller, J., D'Sylva, J., Burnie, S. J., Goldsmith, C. H., Graham, N., Haines, T., Brønfort, G., & Hoving, J. L. (2010). Manipulation or mobilisation for neck pain: A Cochrane Review. Manual Therapy, 15(4), 315–333. https://doi.org/10.1016/j.math.2010.04.002

Gull, M., Khalil, W., Jaffar, M., Ara, J., Mustansar, A., & Laique, T. (2021). Prevalence of Mechanical Neck Pain among University Students: An Observational Study. Pakistan Journal of Medical & Health Sciences, 15(6), 1963–1965. https://doi.org/10.53350/pjmhs211561963

Hains, F., Waalen, J. K., & Mior, S. (1998). Psychometric properties of the neck disability index. PubMed, 21(2), 75–80. https://pubmed.ncbi.nlm.nih.gov/9502061

Henry, K., Rosemond, C., & Eckert, L. B. (1999). Effect of number of home exercises on compliance and performance in adults over 65 years of age. Physical Therapy, 79(3), 270–277. https://doi.org/10.1093/ptj/79.3.270

HEP2go - Online Home Exercise Program - Rehab - Physical Therapy, Occupational Therapy, Physical therapist, Occupational Therapist, Therapeutic Exercises, HEP. (n.d.). https://www.hep2go.com/

Hjelle, K. M., Tuntland, H., Førland, O., & Alvsvåg, H. (2016). Driving forces for home-based reablement; a qualitative study of older adults' experiences.

Health & Social Care in the Community, 25(5), 1581–1589. https://doi.org/10.1111/hsc.12324

Houle, M., Lessard, A., Marineau-Bélanger, É., Lardon, A., Marchand, A., Descarreaux, M., & Abboud, J. (2021). Factors associated with headache and neck pain among telecommuters – a five days follow-up. BMC Public Health, 21(1). https://doi.org/10.1186/s12889-021-11144-6

Hoving, J. L., De Vet, H. C., Twisk, J. W., Devillé, W. L., Van Der Windt, D., Koes, B. W., & Bouter, L. M. (2004). Prognostic factors for neck pain in general practice. Pain, 110(3), 639–645. https://doi.org/10.1016/j.pain.2004.05.002

Igolnikov, I., Gallagher, R. M., & Hainline, B. (2018). Sport-related injury and pain classification. In Handbook of Clinical Neurology (pp. 423–430). https://doi.org/10.1016/b978-0-444-63954-7.00039-2

Iversen, M. D., Fossel, A. H., & Katz, J. N. (2003a). Enhancing function in older adults with chronic low back pain: a pilot study of endurance training11No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit upon the author(s) or upon any organization with which the author(s) is/are associated. Archives of Physical Medicine and Rehabilitation, 84(9), 1324–1331. https://doi.org/10.1016/s0003-9993(03)00198-9

Jack, K., McLean, S., Moffett, J. K., & Gardiner, E. (2010). Barriers to treatment adherence in physiotherapy outpatient clinics: A systematic review. Manual Therapy, 15(3), 220–228. https://doi.org/10.1016/j.math.2009.12.004

Jackson, C. P., & Brown, M. D. (1983). Is There a Role for Exercise in the Treatment of Patients with Low Back Pain? Clinical Orthopaedics and Related Research, 179(NA;), 39???45. https://doi.org/10.1097/00003086-198310000-00007

Jahre, H., Grotle, M., Småstuen, M., Guddal, M. H., Smedbråten, K., Richardsen, K. R., Stensland, S., Storheim, K., & Øiestad, B. E. (2021). Risk factors and risk profiles for neck pain in young adults: Prospective analyses from adolescence to young adulthood—The North-Trøndelag Health Study. PloS One, 16(8), e0256006. https://doi.org/10.1371/journal.pone.0256006

Jahre, H., Grotle, M., Smedbråten, K., Dunn, K. M., & Øiestad, B. E. (2020). Risk factors for non-specific neck pain in young adults. A systematic review. BMC Musculoskeletal Disorders, 21(1). https://doi.org/10.1186/s12891-020-03379-y

Jeong, Y. H., Healy, L. C., & McEwan, D. (2021). The application of Goal Setting Theory to goal setting interventions in sport: a systematic review. International Review of Sport and Exercise Psychology, 1–26. https://doi.org/10.1080/1750984x.2021.1901298

Johansson, A., Bravell, M. E., Karlsson, A. B., & Fristedt, S. (2021). Valuable aspects of home rehabilitation in Sweden: Experiences from older adults. Health Science Reports, 4(1). https://doi.org/10.1002/hsr2.249

Johnson, N., Keating, S., & George, J. (2012). Exercise and the liver: Implications for therapy in fatty liver Disorders. Seminars in Liver Disease, 32(01), 065–079. https://doi.org/10.1055/s-0032-1306427

Johnson, R. W., Williams, S. A., Gucciardi, D. F., Bear, N., & Gibson, N. (2020). Can an online exercise prescription tool improve adherence to home exercise programmes in children with cerebral palsy and other neurodevelopmental disabilities? A randomised controlled trial. BMJ Open, 10(12), e040108. https://doi.org/10.1136/bmjopen-2020-040108

Jun, D., Johnston, V., McPhail, S. M., & O'Leary, S. (2020). A longitudinal evaluation of risk factors and interactions for the development of nonspecific neck pain in office workers in two cultures. Human Factors, 63(4), 663–683. https://doi.org/10.1177/0018720820904231

Kazeminasab, S., Nejadghaderi, S. A., Amiri, P., Pourfathi, H., Araj-Khodaei, M., Sullman, M. J., Kolahi, A., & Safiri, S. (2022). Neck pain: global epidemiology, trends and risk factors. BMC Musculoskeletal Disorders, 23(1). https://doi.org/10.1186/s12891-021-04957-4

Khired, Z. (2022a). The prevalence of and factors associated with neck pain among Jazan adult population. Curēus. https://doi.org/10.7759/cureus.28008

Kim, R., Wiest, C., Clark, K., Cook, C., & Horn, M. E. (2018). Identifying risk factors for first-episode neck pain: A systematic review. Musculoskeletal Science and Practice, 33, 77–83. https://doi.org/10.1016/j.msksp.2017.11.007

Kong, Y. S., Kim, Y. M., & Shim, J. (2017). The effect of modified cervical exercise on smartphone users with forward head posture. Journal of Physical Therapy Science, 29(2), 328–331. https://doi.org/10.1589/jpts.29.328

Korhonen, T. (2003). Work related and individual predictors for incident neck pain among office employees working with video display units. Occupational and Environmental Medicine, 60(7), 475–482. https://doi.org/10.1136/oem.60.7.475

Kuroda, Y., Young, M., Shoman, H., Punnoose, A., Norrish, A. R., & Khanduja, V. (2020). Advanced rehabilitation technology in orthopaedics—a narrative review. International Orthopaedics, 45(8), 1933–1940. https://doi.org/10.1007/s00264-020-04814-4

Lambert, T. E., Harvey, L. A., Avdalis, C., Chen, L. W., Jeyalingam, S., Pratt, C. A., Tatum, H. J., Bowden, J. L., & Lucas, B. R. (2017). An app with remote support achieves better adherence to home exercise programs than paper handouts in people with musculoskeletal conditions: a randomised trial. Journal of Physiotherapy, 63(3), 161–167. https://doi.org/10.1016/j.jphys.2017.05.015

Lawler, E. E. (1972). Pay and Organizational Effectiveness: A Psychological View. ILR Review, 25(3), 451. https://doi.org/10.2307/2521335

Lee, H. (2016). Neck Pain and Functioning in Daily Activities Associated with Smartphone Usage. The Journal of Korean Physical Therapy, 28(3), 183–188. https://doi.org/10.18857/jkpt.2016.28.3.183

Lee, H., & Lee, S. (2021). Analysis of Home-Based Rehabilitation Awareness, Needs and Preferred Components of Elderly Patients with Hip Fracture Surgery in South Korea. International Journal of Environmental Research and Public Health/International Journal of Environmental Research and Public Health, 18(14), 7632. https://doi.org/10.3390/ijerph18147632

Lee, M., Kim, M., Oh, S., Choi, Y. J., Lee, D., Lee, S., & Yoon, B. C. (2017). A Self Determination Theory-based self-myofascial release program in older adults with myofascial trigger points in the neck and back: A pilot study. Physiotherapy Theory and Practice, 33(9), 681–694. https://doi.org/10.1080/09593985.2017.1345024

Lin, Y., Hsu, W., Hsieh, L., Chang, K., Kuo, Y., & Hsieh, T. (2021). The effect of giving verbal feedback during neck stabilisation exercise as an addition to physical therapy in patients with chronic neck pain: A randomised controlled trial. Clinical Rehabilitation, 36(2), 230–239. https://doi.org/10.1177/02692155211044138

Locke, E. A., & Latham, G. P. (1990). *A theory of goal setting & task performance*.

Malińska, M., Bugajska, J., & Bartuzi, P. (2021). Occupational and non-occupational risk factors for neck and lower back pain among computer workers: a cross-sectional study. International Journal of Occupational Safety and Ergonomics, 27(4), 1108–1115. https://doi.org/10.1080/10803548.2021.1899650

Markopoulos, P., Shen, X., Wang, Q., & Timmermans, A. (2020). NECKio: Motivating neck Exercises in Computer Workers. Sensors, 20(17), 4928. https://doi.org/10.3390/s20174928

Maslow, A. H. (1997). Motivation and personality. In SAGE Publications Ltd eBooks (pp. 110–133). https://doi.org/10.4135/9781446221815.n7

Masmoudi, M., Zenati, N., Izountar, Y., Benbelkacem, S., Haicheur, W., Guerroudji, M. A., Oulefki, A., & Hamitouche, C. (2024). Assessing the effectiveness of virtual reality serious games in post-stroke rehabilitation: a novel evaluation method. Multimedia Tools and Applications, 83(12), 36175–36202. https://doi.org/10.1007/s11042-023-17980-5

Mawson, A. R., Ray, B. D., Bhuiyan, A. R., & Jacob, B. (2017). Pilot comparative study on the health of vaccinated and unvaccinated 6- to 12- year old U.S. children. Journal of Translational Science, 3(3). https://doi.org/10.15761/jts.1000186

Medina-Mirapeix, F., Escolar-Reina, P., Gascón-Cánovas, J. J., Montilla-Herrador, J., Jimeno-Serrano, F. J., & Collins, S. M. (2009a). Predictive factors of adherence to frequency and duration components in home exercise programs for neck and low back pain: an observational study. BMC Musculoskeletal Disorders, 10(1). https://doi.org/10.1186/1471-2474-10-155

Melles, M., Albayrak, A., & Goossens, R. (2020). Innovating health care: key characteristics of human-centered design. International Journal for Quality in Health Care, 33(Supplement_1), 37–44. https://doi.org/10.1093/intqhc/mzaa127

Merskey, H. (1994). Classification of chronic pain: Descriptions of chronic pain syndromes and definitions of pain terms. http://ci.nii.ac.jp/ncid/BA25713890

Minor, M. A., & Brown, J. D. (1993). Exercise Maintenance of Persons with Arthritis after Participation in a Class Experience. Health Education Quarterly, 20(1), 83–95. https://doi.org/10.1177/109019819302000108

Moffett, J., & McLean, S. (2005). The role of physiotherapy in the management of non-specific back pain and neck pain. Rheumatology, 45(4), 371–378. https://doi.org/10.1093/rheumatology/kei242

Momenzadeh, S., Zali, A., Razzaghi, Z., Momenzadeh, F., Mirkheshti, A., Sayadi, S., Teymourian, H., & Momenzadeh, R. (2022). Efficacy of Low-Level laser therapy for the treatment of nonspecific chronic neck pain: LowLevel Laser therapy vs. Sham Laser: Low-Level Laser therapy for nonspecific chronic neck pain. Journal of Lasers in Medical Sciences, 13.

Moom, R. K., Sing, L. P., & Moom, N. (2015). Prevalence of Musculoskeletal Disorder among Computer Bank Office Employees in Punjab (India): A Case Study. Procedia Manufacturing, 3, 6624–6631. https://doi.org/10.1016/j.promfg.2015.11.002

Morville, P., & Rosenfeld, L. (2006). Information architecture for the world wide web: Designing Large-Scale Web Sites. “O’Reilly Media, Inc.”

Mosa, A. S. M., Yoo, I., & Sheets, L. (2012). A Systematic review of healthcare applications for smartphones. BMC Medical Informatics and Decision Making, 12(1). https://doi.org/10.1186/1472-6947-12-67

Needs before wants in user experiences – Maslow and the hierarchy of needs. (2016, July 16). Interaction Design Foundation - IxDF. https://www.interaction-design.org/literature/article/needs-before-wants-in-user-experiences-maslow-and-the-hierarchy-of-needs

Nikander, R., Mälkiä, E., Parkkari, J., Heinonen, A., Starck, H., & Ylinen, J. (2006). Dose-Response relationship of specific training to reduce chronic neck pain and disability. Medicine and Science in Sports and Exercise, 38(12), 2068–2074. https://doi.org/10.1249/01.mss.0000229105.16274.4b

Nso, N., Nassar, M., Mbome, Y., Emmanuel, K. E., Ngonge, A. L., Badejoko, S., Akbar, S., Landry, I., Alfishawy, M., Munira, M., & Rizzo, V. (2022). Comparative Assessment of the Long-Term Efficacy of Home-Based versus Center-Based Cardiac Rehabilitation. Curēus. https://doi.org/10.7759/cureus.23485

Okezue, O. C., Nwafor, G. C., Ezeukwu, O. A., John, J. N., & Uchenwoke, C. I. (2019). Adherence to Home Exercise Programmes and its Associated Factors among Patients Receiving Physiotherapy. Clinical Health Promotion - Research and Best Practice for Patients, Staff and Community, 9(1), 7–14. https://doi.org/10.29102/clinhp.19003

Onaade, O., Maples, J. M., Rand, B., Fortner, K. B., Zite, N. B., & Ehrlich, S. F. (2021). Physical activity for blood glucose control in gestational diabetes mellitus: rationale and recommendations for translational behavioral interventions. Clinical Diabetes and Endocrinology, 7(1). https://doi.org/10.1186/s40842-021-00120-z

Özel Aslıyüce, Y. (2018). Neck bournemouth questionnaire: turkish version, validity and reliability study [Unpublished Master Thesis]. Hacettepe University / Institute of Health Sciences / Department of Physical Therapy and Rehabilitation / Division of Physical Therapy and Rehabilitation.

Ozgur, A. G., Wessel, M. J., Johal, W., Sharma, K., Özgür, A., Vuadens, P., Mondada, F., Hummel, F. C., & Dillenbourg, P. (2018). Iterative Design of an Upper Limb Rehabilitation Game with Tangible Robots. HRI ’18: Proceedings of the 2018 ACM/IEEE International Conference on Human-Robot Interaction. https://doi.org/10.1145/3171221.3171262

Özlü, Ö. (2017). The effect of mulligan mobilization technique application in addition to classical therapies on pain and joint range of motion people with neck pain [Unpublished Master Thesis]. Istanbul Medipol University Institute of Health Sciences, Istanbul, Turkey.

Piron, L., Turolla, A., Tonin, P., Piccione, F., Lain, L., & Dam, M. (2008). Satisfaction with care in post-stroke patients undergoing a telerehabilitation programme at home. Journal of Telemedicine and Telecare, 14(5), 257–260. https://doi.org/10.1258/jtt.2008.080304

Pocock, T., Smith, M., & Wiles, J. (2021). Recommendations for virtual qualitative health research during a pandemic. Qualitative Health Research, 31(13), 2403-2413. https://doi.org/10.1177/10497323211036891

Positive computing: technology for wellbeing and human potential. (2015). Choice Reviews Online, 52(10), 52–5380. https://doi.org/10.5860/choice.189530

Poulsen, A. G., Gravesen, J. D., Madsen, M. N., Mikkelsen, L. R., Bandholm, T., & Rossen, C. B. (2022). Patient perspectives on home-based rehabilitation exercise and general physical activity after total hip arthroplasty: A qualitative study (PHETHAS-2). F1000Research, 10, 382. https://doi.org/10.12688/f1000research.51684.4

Radwan, A., Ashton, N. J., Gates, T., Kilmer, A., & VanFleet, M. (2021). Effect of different pillow designs on promoting sleep comfort, quality, & spinal alignment: A systematic review. European Journal of Integrative Medicine, 42, 101269. https://doi.org/10.1016/j.eujim.2020.101269

Rahman, R., Hudson, J., Thøgersen-Ntoumani, C., & Doust, J. H. (2015). Motivational processes and well-being in cardiac rehabilitation: a Self Determination Theory perspective. Psychology, Health & Medicine, 20(5), 518–529. https://doi.org/10.1080/13548506.2015.1017509

Rezaei, M., Sharifi, A., Vaccaro, A., & Rahimi-Movaghar, V. (2019). Home-based rehabilitation programs: Promising field to maximize function of patients with traumatic spinal cord injury. Asian Journal of Neurosurgery, 14(03), 634–640. https://doi.org/10.4103/ajns.ajns_86_17

Rhim, H. C., Lee, J. H., Lee, S. J., Jeon, J. S., Kim, G., Lee, K. Y., & Jang, K. (2020). Supervised Rehabilitation May Lead to Better Outcome than

Home-Based Rehabilitation Up to 1 Year after Anterior Cruciate Ligament Reconstruction. Medicina, 57(1), 19. https://doi.org/10.3390/medicina57010019

Riccò, M., Cattani, S., Gualerzi, G., & Signorelli, C. (2016). Work with visual display units and musculoskeletal disorders: A cross-sectional study. Medycyna Pracy, 67(6), 707–719. https://doi.org/10.13075/mp.5893.00471

Rinonapoli, G., Ceccarini, P., Manfreda, F., Talesa, G. R., Simonetti, S., & Caraffa, A. (2023). Shoulder and Neck Pain in Swimmers: Front Crawl Stroke Analysis, Correlation with the Symptomatology in 61 Masters Athletes and Short Literature Review. Healthcare, 11(19), 2638. https://doi.org/10.3390/healthcare11192638

Riva, G., Baños, R. M., Botella, C., Wiederhold, B. K., & Gaggioli, A. (2012). Positive technology: Using interactive technologies to promote positive functioning. Cyberpsychology, Behavior and Social Networking, 15(2), 69–77. https://doi.org/10.1089/cyber.2011.0139

Russell, K. L., & Bray, S. R. (2009). Self-determined motivation predicts independent, home-based exercise following cardiac rehabilitation. Rehabilitation Psychology, 54(2), 150–156. https://doi.org/10.1037/a0015595

Ryan, R. M., & Deci, E. L. (2000a). Intrinsic and Extrinsic Motivations: classic definitions and new directions. Contemporary Educational Psychology, 25(1), 54–67. https://doi.org/10.1006/ceps.1999.1020

Ryan, R. M., & Deci, E. L. (2000b). Self Determination Theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55(1), 68–78. https://doi.org/10.1037/0003-066x.55.1.68

Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The Motivational Pull of Video Games: A Self Determination Theory Approach. Motivation and Emotion, 30(4), 344–360. https://doi.org/10.1007/s11031-006-9051-8

Sabaté, E. (2003). Adherence to long-term therapies: Evidence for Action. World Health Organization.

Sæbu, M., Sørensen, M., & Halvari, H. (2013). Motivation for physical activity in young adults with physical disabilities during a rehabilitation stay: a longitudinal test of Self Determination Theory. Journal of Applied Social Psychology, 43(3), 612–625. https://doi.org/10.1111/j.1559-1816.2013.01042.x

Safiri, S., Kolahi, A., Hoy, D., Buchbinder, R., Mansournia, M. A., Bettampadi, D., Ashrafi-Asgarabad, A., Almasi-Hashiani, A., Smith, E., Sepidarkish, M., Cross, M., Qorbani, M., Moradi-Lakeh, M., Woolf, A. D., March, L., Collins, G., & Ferreira, M. L. (2020). Global, regional, and national burden of neck pain in the general population, 1990-2017: systematic analysis of the Global Burden of Disease Study 2017. BMJ, m791. https://doi.org/10.1136/bmj.m791

Schneiders, A. G., Zusman, M., & Singer, K. (1998). Exercise therapy compliance in acute low back pain patients. Manual Therapy, 3(3), 147–152. https://doi.org/10.1016/s1356-689x(98)80005-2

Seligman, M. E. P., & Csikszentmihalyi, M. (2000). Positive psychology: An introduction. American Psychologist/□the □American Psychologist, 55(1), 5–14. https://doi.org/10.1037/0003-066x.55.1.5

Şener, B., Umulu, S., & Yılmaz, A. O. (2022). DIGITAL HEALTH INTERVENTIONS FOR PROMOTING SLEEP WELLBEING: A DESIGN APPROACH USING SELF DETERMİNATİON THEORY. DS 117: Proceedings of the 24th International Conference on Engineering and Product Design Education (E&Amp;PDE 2022), London South Bank

University in London, UK. 8th - 9th September 2022. https://doi.org/10.35199/epde.2022.55

Shim, G. Y., Kim, E. H., Baek, Y. J., Chang, W. K., Kim, B. R., Oh, J. H., Lee, J. I., Hwang, J. H., & Lim, J. (2023). A randomized controlled trial of postoperative rehabilitation using digital healthcare system after rotator cuff repair. Npj Digital Medicine, 6(1). https://doi.org/10.1038/s41746-023-00842-7

Siemonsma, P., Döpp, C., Alpay, L., Tak, E., Van Meeteren, N., & Chorus, A. (2014). Determinants influencing the implementation of home-based stroke rehabilitation: a systematic review. Disability and Rehabilitation, 36(24), 2019–2030. https://doi.org/10.3109/09638288.2014.885091

Sim, J., Lacey, R. J., & Lewis, M. (2006). The impact of workplace risk factors on the occurrence of neck and upper limb pain: a general population study. BMC Public Health, 6(1). https://doi.org/10.1186/1471-2458-6-234

Simonse, L., Albayrak, A., & Starre, S. (2019). Patient journey method for integrated service design. Design for Health, 3(1), 82–97. https://doi.org/10.1080/24735132.2019.1582741

Sketching user experiences. (2007). In Elsevier eBooks. https://doi.org/10.1016/b978-0-12-374037-3.x5043-3

Sluijs, E. M., Kok, G. J., & Van Der Zee, J. (1993). Correlates of exercise compliance in physical therapy. Physical Therapy, 73(11), 771–782. https://doi.org/10.1093/ptj/73.11.771

Son, K. M., Cho, N. H., Lim, S. H., & Kim, H. A. (2013). Prevalence and risk factor of neck pain in elderly Korean community residents. Journal of Korean Medical Science/Journal of Korean Medical Science, 28(5), 680. https://doi.org/10.3346/jkms.2013.28.5.680

Spindler, H., Dyrvig, A., Schacksen, C. S., Anthonimuthu, D., Frost, L., Gade, J. D., Kronborg, S. H., Mahboubi, K., Refsgaard, J., Dinesen, B., Hollingdal, M., & Kayser, L. (2022). Increased motivation for and use of digital services in heart failure patients participating in a telerehabilitation program: a randomized controlled trial. mHealth, 8, 25. https://doi.org/10.21037/mhealth-21-56

Steihaug, S., Lippestad, J., & Werner, A. (2016). Between ideals and reality in home-based rehabilitation. Scandinavian Journal of Primary Health Care, 34(1), 46–54. https://doi.org/10.3109/02813432.2015.1132888

Swanson, V. A., Johnson, C., Zondervan, D. K., Bayus, N., McCoy, P., Ng, Y. F. J., Bs, J. S., Reinkensmeyer, D. J., & Shaw, S. (2023). Optimized home rehabilitation technology reduces upper extremity impairment compared to a conventional home exercise program: a randomized, controlled, Single-Blind trial in subacute stroke. Neurorehabilitation and Neural Repair, 37(1), 53–65. https://doi.org/10.1177/15459683221146995

Tan, J., & Nordin, M. (1992). Role of physical therapy in the treatment of cervical disk disease. Orthopedic Clinics of North America, 23(3), 435–449. https://doi.org/10.1016/s0030-5898(20)31756-9

Tariq, F., Kashif, M., Mehmood, A., & Quraishi, A. (2020). Prevalence of Neck Pain and its effects on Activities of Daily Living among dentists working in Faisalabad. Rehman Journal of Health Sciences, 2(1), 10–13. https://doi.org/10.52442/rjhs.v2i1.28

Thielke, S., Harniss, M., Thompson, H. J., Patel, S., Demiris, G., & Johnson, K. (2011). Maslow's hierarchy of human needs and the adoption of Health-Related Technologies for Older adults. Ageing International, 37(4), 470–488. https://doi.org/10.1007/s12126-011-9121-4

Thoomes, E., Scholten-Peeters, G. G. M., Koes, B. W., Falla, D., & Verhagen, A. (2013). The effectiveness of conservative treatment for patients with

cervical radiculopathy. The Clinical Journal of Pain, 29(12), 1073–1086. https://doi.org/10.1097/ajp.0b013e31828441fb

Thorup, C. B., Grønkjær, M., Spindler, H., Andreasen, J. J., Hansen, J., Dinesen, B. I., Nielsen, G., & Sørensen, E. E. (2016). Pedometer use and self-determined motivation for walking in a cardiac telerehabilitation program: a qualitative study. BMC Sports Science, Medicine & Rehabilitation, 8(1). https://doi.org/10.1186/s13102-016-0048-7

Tirgil, A., Gurol-Urganci, I., & Atun, R. (2018). Early experience of universal health coverage in Turkey on access to health services for the poor: regression kink design analysis. Journal of Global Health, 8(2). https://doi.org/10.7189/jogh.08.020412

TÜİK Kurumsal. (2019). https://data.TÜİK.gov.tr/Bulten/Index?p=Turkiye-Saglik-Arastirmasi-2019-33661

TÜİK Kurumsal. (2022). https://data.TÜİK.gov.tr/Bulten/Index?p=Turkiye-Saglik-Arastirmasi-2022

Turk, D. C., & Rudy, T. E. (1991). Neglected topics in the treatment of chronic pain patients — relapse, noncompliance, and adherence enhancement. Pain, 44(1), 5–28. https://doi.org/10.1016/0304-3959(91)90142-k

Urdan, T. (2023). Understanding motivation. In Oxford University Press eBooks (pp. 251–258). https://doi.org/10.1093/oso/9780197662359.003.0043

Van Egmond, M. A., Engelbert, R. H. H., Klinkenbijl, J. H. G., Van Berge Henegouwen, M. I., & Van Der Schaaf, M. (2020). Physiotherapy with telerehabilitation in patients with complicated postoperative recovery after esophageal cancer surgery: Feasibility study. JMIR. Journal of Medical Internet Research/Journal of Medical Internet Research, 22(6), e16056. https://doi.org/10.2196/16056

Vélez-Guerrero, M. A., Callejas-Cuervo, M., & Mazzoleni, S. (2021). Artificial Intelligence-Based Wearable Robotic Exoskeletons for Upper Limb Rehabilitation: A review. Sensors, 21(6), 2146. https://doi.org/10.3390/s21062146

Voigt, C. D., Foncerrada, G., Peña, R., Guillory, A. N., Andersen, C. R., Crandall, C. G., Wolf, S. E., Herndon, D. N., & Suman, O. E. (2020). Effects of Community-Based Exercise in Adults with Severe Burns: a randomized controlled trial. Archives of Physical Medicine and Rehabilitation, 101(1), S36–S41. https://doi.org/10.1016/j.apmr.2017.12.022

Von Koch, L., Wottrich, A. W., & Holmqvist, L. W. (1998). Rehabilitation in the home versus the hospital: The importance of context. Disability and Rehabilitation, 20(10), 367–372. https://doi.org/10.3109/09638289809166095

Von Korff, M., & Simon, G. E. (1996). The relationship between pain and depression. British Journal of Psychiatry, 168(S30), 101–108. https://doi.org/10.1192/s0007125000298474

Vroom, V. H. (1964). Work and motivation. http://ci.nii.ac.jp/ncid/BA04836203

Webster, D., & Celik, O. (2014). Systematic review of Kinect applications in elderly care and stroke rehabilitation. Journal of Neuroengineering and Rehabilitation, 11(1), 108. https://doi.org/10.1186/1743-0003-11-108

Wolin, K. Y., Schwartz, A. L., Matthews, C. E., Courneya, K. S., & Schmitz, K. H. (2012). Implementing the exercise guidelines for cancer survivors. ˜the œJournal of Supportive Oncology/˜the œJournal of Supportive Oncology., 10(5), 171–177. https://doi.org/10.1016/j.suponc.2012.02.001

World Health Organization: WHO. (2022, July 14). Musculoskeletal health. https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions

Wu, D., Zhu, X., & Zhang, S. (2018). Effect of home-based rehabilitation for hip fracture: A meta-analysis of randomized controlled trials. Journal of Rehabilitation Medicine, 50(6), 481–486. https://doi.org/10.2340/16501977-2328

Xie, Y., Jun, D., Thomas, L., Coombes, B. K., & Johnston, V. (2020). Comparing central Pain processing in Individuals with Non-Traumatic Neck Pain and Healthy Individuals: A Systematic Review and Meta-Analysis. ˜the œJournal of Pain/Journal of Pain, 21(11–12), 1101–1124. https://doi.org/10.1016/j.jpain.2020.02.007

Yargın, G. T., Süner, S., & Günay, A. (2018). Modelling user experience: Integrating user experience research into design education. International Conferences Interfaces and Human, 26–34. https://acikerisim.tedu.edu.tr/xmlui/handle/20.500.12485/569

Yeung, A. W. K., Tosevska, A., Klager, E., Eibensteiner, F., Laxar, D., Stoyanov, J., Glisic, M., Zeiner, S., Kulnik, S. T., Crutzen, R., Kimberger, O., Kletecka-Pulker, M., Atanasov, A. G., & Willschke, H. (2021). Virtual and Augmented reality applications in Medicine: Analysis of the scientific literature. JMIR. Journal of Medical Internet Research/Journal of Medical Internet Research, 23(2), e25499. https://doi.org/10.2196/25499

Ylinen, J. (2007). Physical exercises and functional rehabilitation for the management of chronic neck pain. PubMed, 43(1), 119–132. https://pubmed.ncbi.nlm.nih.gov/17369784

Yoshida, B., Mesregah, M. K., Ortega, B., Wang, J. C., & Buser, Z. (2023). Cervical spinal pain. In Springer eBooks (pp. 275–282). https://doi.org/10.1007/978-3-031-20987-1_32

Zhang, F., Zhu, X., & Ye, M. (2019). Fast Human Pose Estimation. Conference on Computer Vision and Pattern Recognition. https://doi.org/10.1109/cvpr.2019.00363

Zhang, S., Liang, C., Zhang, J., Yang, X., & Meng, X. (2020). The role and effectiveness of self-management in a home-based cardiac rehabilitation program. Medicine, 99(31), e20972. https://doi.org/10.1097/md.0000000000020972

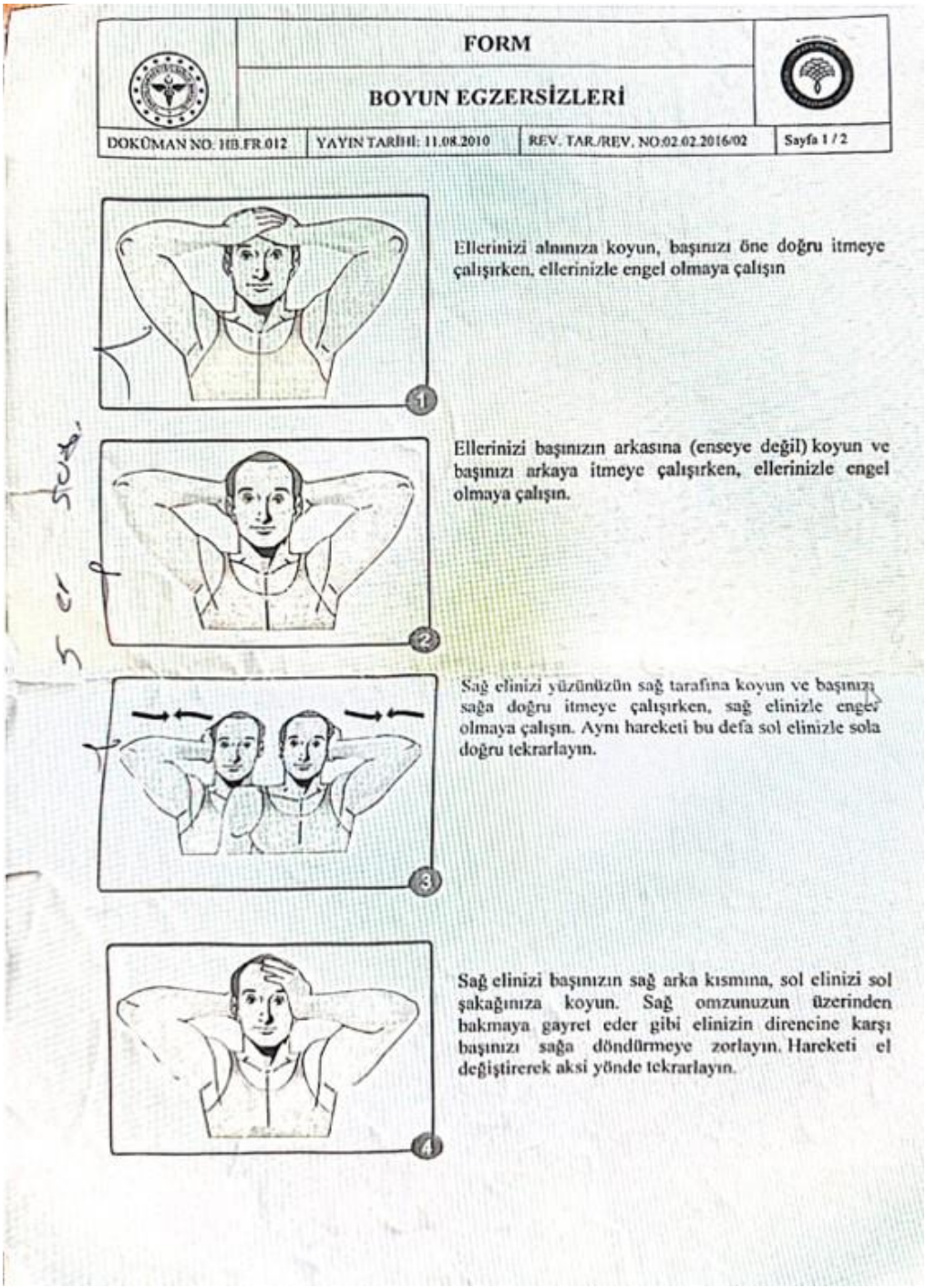
Zhao, Z., Lan, S., & Zhang, S. (2020). Human Pose Estimation based Speed Detection System for Running on Treadmill. IEEE. https://doi.org/10.1109/iccst50977.2020.00108

Zheng, B., Zheng, L., Li, M., Lin, J., Zhu, Y., Jin, L., You, R., Gao, Y., Liu, X., & Wang, S. (2022). Sex differences in factors associated with neck pain among undergraduate healthcare students: a cross-sectional survey. BMC Musculoskeletal Disorders, 23(1). https://doi.org/10.1186/s12891-022-05782-z

Zhong, B., Niu, W., Broadbent, E., McDaid, A., Lee, T. M. C., & Zhang, M. (2019). Bringing psychological Strategies to Robot-Assisted Physiotherapy for enhanced treatment efficacy. Frontiers in Neuroscience, 13. https://doi.org/10.3389/fnins.2019.00984

APPENDICES

A. An example of Home Exercise Program



FORM

BOYUN EGZERSİZLERİ

DOKÜMAN NO: HB.FR.012	YAYIN TARİHİ: 11.08.2010	REV. TAR./REV. NO:02.02.2016/02	Sayfa 1 / 2

1

Ellerinizi alnınıza koyun, başınızı öne doğru itmeye çalışırken, ellerinizle engel olmaya çalışın

2

Ellerinizi başınızın arkasına (enseye değil) koyun ve başınızı arkaya itmeye çalışırken, ellerinizle engel olmaya çalışın.

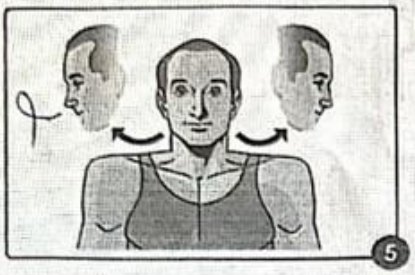
3

Sağ elinizi yüzünüzün sağ tarafına koyun ve başınızı sağa doğru itmeye çalışırken, sağ elinizle engel olmaya çalışın. Aynı hareketi bu defa sol elinizle sola doğru tekrarlayın.

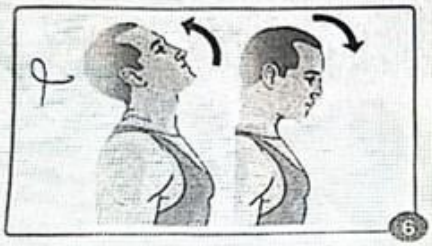
4

Sağ elinizi başınızın sağ arka kısmına, sol elinizi sol şakağınıza koyun. Sağ omzunuzun üzerinden bakmaya gayret eder gibi elinizin direncine karşı başınızı sağa döndürmeye zorlayın. Hareketi el değiştirerek aksi yönde tekrarlayın.

	FORM		
	BOYUN EGZERSİZLERİ		
DOKÜMAN NO: HB.FR.012	YAYIN TARİHİ: 11.08.2010	REV. TAR./REV. NO:02.02.2016/02	Sayfa 2 / 2



Başınızı yavaşça sağa döndürün ve üç saniye böyle durun. Başınızı öne döndürün. Dinlenin. Hareketi aksi yönde tekrarlayın.



Aşırı zorlanmaya sebep olmadan, başınızı çeneniz göğsünüze değecek kadar öne eğmeye çalışın. Dinlenin. Başınızı yavaşça arkaya bükün ve tekrar dinlenin.

Günde 2 x 10 tekrar

En az 3 ay

Başınızı saat yönünde mümkün olduğu kadar geniş ve tam bir çember çizecek şekilde (Yukarı - Sola, Aşağı- Sağa) döndürün. Aynı hareketi, saatin aksi yönünde tekrarlayın. Dinlenin.

Sağ elinizi başınızın sağ arka kısmına, sol elinizi sol şakağınıza koyun. Sağ omzunuzun üzerinden bakmaya gayret eder gibi elinizin direncine karşı başınızı sağa döndürmeye zorlayın. Hareketi el değiştirerek aksi yönde tekrarlayın.

B. Consultation Expert Meeting Questions

- Hastaneye en çok hangi rahatsızlık/rahatsızlıklar için başvuruluyor?
- Başvurulan rahatsızlıkların hangileri ameliyata ihtiyaç duymuyor? Ameliyat için ne gibi özellikler olması gerekiyor?
- Ameliyata ihtiyaç duyulmayan rahatsızlıklar için nasıl bir tedavi planlanıyor? Tedavi nasıl sürdürülüyor? Ne tür yöntemler kullanıyorsunuz?
- Eve egzersiz vermek için rahatsızlığın belli bir özelliği olması gerekiyor mu? Açıklayabilir misiniz? Bu özellikler neye göre belirleniyor?
- Evde yapılan egzersizler hangi özelliklere göre belirleniyor?
- Eve verilen egzersizlerde hasta takibi nasıl yapılıyor? Belli yöntemler var mı? Bu yöntemlerden örnek verebilir misiniz?
- Eve verilen egzersizlerde doktorların hastalardan beklentileri nelerdir? Bu beklentiler nasıl karşılanabilir?
- Eve verilen egzersizler hakkında en çok sorulan sorular nelerdir?
- Hasta takibinde hastanın ve doktorun rolleri nelerdir?
- Hasta takibinin planlanmasında kullanılan yöntemler nelerdir?
- Hasta takibinde belirli bir süre var mıdır? Bu süre neye göre belirlenmektedir?

C. Patient Interview Questions

Merhaba, çalışmama hoş geldiniz. Nasılsınız? Size biraz kendimden bahsetmek isterim. Ben Orta Doğu Teknik Üniversitesi, Endüstriyel Tasarım Bölümünde Yüksek Lisans yapmaktayım. Yüksek lisans tez araştırması kapsamında boyun ağrılarından dolayı hastaneye başvurup, evde egzersiz yapmak durumda olan kişileri anlamak üzerine bir çalışma yürütmekteyim. Bu yüzden sizinle bir mülakat yapmak isterim.

Bugün konumuz boyun ağrıları için fizyoterapi sürecinin ev egzersizi aşaması hakkında olacak. Bilindiği üzere boyun ağrılarının son dönemlerde artışından dolayı tedavi sayısı da ev egzersizi programları da artıyor. Bu süreçte de herkes kendi deneyimini farklı şekillerde yaşıyor ve benim amacım, sizin deneyimlerinizi de öğrenerek bu konuda daha sağlıklı, iletişimi kolaylaştıran ve bilgi iletimini kolaylaştıran ve sizleri motive edecek dijital bir ortamın nasıl olması gerektiğini en iyi şekilde anlamak. Sizin deneyiminiz benim için çok değerli. Bu sebeple benimle ile görüşlerinizi paylaşırsanız çok sevinirim.

Daha önce de belirttiğim gibi size birkaç soru soracağım. Sizin vereceğiniz cevapları ve kimliğinizi kimseyle paylaşmayacağımı size hatırlatmak isterim. Bu bilgileri yazacağım yüksek lisans tez çalışmalarında kullanmayı planlıyorum. Bu tez çalışmalarında isminiz asla yer almayacak, bilgileri sizin verdiğini kimse bilmeyecek. Şimdi yapacağım soru-cevap çalışmasının yaklaşık olarak yarım saat süreceğini düşünmekteyim. Aktiviteler sırasında eğer cevaplamak istemediğiniz bir soru olursa, istediğiniz zaman o soruyu cevaplamadan geçebilirsiniz. Ayrıca istediğiniz zaman çalışmamı bırakabilirsiniz Benzer şekilde mola vermek isterseniz de bana söyleyebilirsiniz. Daha sonrasında da önemli noktaları tekrar incelemem gerekeceği ve not almam zor olacağı için görüşme sırasında izniniz olursa ses ve görüntü kaydı alacağım. Bu kayıtları sadece kendi değerlendirme aşamalarında kullanacağım, fotoğraf gerekli olursa yüzünüz görünmeyecek şekilde çalışma ortamının görüntülerini kullanacağım ve tez çalışmam dışında bir yerde paylaşmayacağım.

Bunlar sizin için uygun mu?

Uygunsa, başlayabiliriz.

ÇALIŞMA
MÜLAKAT – SORU/CEVAP

1.KISIM - ***Boyun ağrısı çekme ve doktora danışma süreci***

1.1 Boyun ağrısı çektiğiniz dönemlerdeki deneyimlerinizden kısaca bahseder misiniz? **1.1.1** Eğer şunu yapmasaydım boynum ağrımazdı dediğiniz bir durum,davranış var mı?

1.1.2 Mesleğiniz nedir? Ağrı konusunda bir etkisi olduğunu düşünüyor musunuz? Neden?

1.2 Yaklaşık ne kadar süre boyun ağrısı çektiniz? Doktora başvurmaya ne zaman karar verdiniz?

1.2.1 Doktora gitmeyi ertelediğinizden bahsettiniz, acaba erteleme sebepleriniz nelerdir? Örneklendirebilir misiniz?

1.3 Tedaviye başlama sürecinizden bahseder misiniz? Bu soruda hastane kayıt, ilk izlenim, iletişim, ilgi-alaka gibi etkenleri düşünebilirsiniz.

1.3.1 Tedaviye başlangıç süreci ile ilgili deneyimlerinizin yanında beklentileriniz nelerdir? Tecbüreniz ile ilgili aklınıza gelen önerilerinizi de paylaşabilirsiniz.

2.KISIM - ***Ev Egzersizi Süreci***
Bu aşamada sağlık kurumu içindeki tedavileriniz dışında, eve ödev verilen egzersizler hakkında da konuşacağımızı hatırlatmak isterim.
2.1 Egzersiz Süreci (Hastane-Ev)

2.1.1 Muayeneden sonra ev egzersizi tedavi sürecindeki tecrübelerinizden bahsedebilir misiniz?

2.1.1.1 Ev egzersizi sürecinde kendinizi ev ortamı, dış etkenler konularında nasıl hissediyorsunuz?

Egzersizler için hatırlatmalar oluyor mu? Siz ne tür yöntemler kullanıyorsunuz?

2.1.1.2 Hastanede aldığınız egzersizler ve ev egzersizi olarak düşündüğümüzde olumlu ve olumsuz yönlerini anlatabilir misiniz? Tecrübelerinizi paylaşabilir misiniz?

2.2 Bilgi Edinme

Bilgi edinme aşamasında sorularımız materyal ve içerikler üzerine olacaktır.

2.2.1 Ev egzersizi aşamasında size uzman tarafından verilen bilgiler nelerdir?

Önerilen bilgi kaynakları, internet siteleri, kağıt broşürler veya benzer kaynaklar hakkında bilgi edindiniz mi? Bu materyaller ve içerikleri hakkında görüşlerinizi iletebilir misiniz?

2.2.2 Bu materyaller ve içerikleri ile ilgili önerileriniz varsa söyleyebilirsiniz.

Uzmanların önerdiği bilgi kaynakları dışında sizin kullandığınız farklı yöntemler, danıştığınız kişiler, bilgi edindiğiniz kaynaklar var mı? Örneklendirebilir misiniz? Bu yöntemleri seçmenizin sebebi nedir? Nelere dikkat edersiniz?

2.2.3 Tedavi sürecinde ev egzersizi kağıdı/broşürü aldınız mı? Bu broşürler hakkındaki düşünceleriniz nelerdir?

Bu aşamada, size 3 Farklı ev egzersizi programı göstereceğim. Bu programlarda gördüğünüz eksiklikleri, kullanırken yaşadığınız problemleri ve süreçteki olumlu veya olumsuz tecrübelerinizi öğrenmek isterim. Tecrübeleriniz ile birlikte önerilerinizi de dinlemeye hazırım.

-Fotoğraflar çizimler görseller hakkında ne düşünüyorsunuz?

-İçerikler yazılar hakkında ne düşünüyorsunuz?

- Video içerikler hakkında ne düşünüyorsunuz?

Sağlık Bakanlığı Örneği

	T.C. SAĞLIK BAKANLIĞI İlker Çelikcan Fizik Tedavi ve Rehabilitasyon Hastanesi BOYUN EGZERSİZLERİ BİLGİLENDİRME FORMU			
Kodu: HB.FR.70	Yayın Tarihi: 06.03.2019	Revizyon No: 00	Revizyon Tarihi: -	Sayfa No: 1 / 2

Her egzersizi ..... defa yapınız. Her egzersizde ..... 'e kadar sayınız.
Egzersizleri günde ..... kez yapınız.

Ellerinizi alnınıza koyun. Başınızı öne doğru itmeye çalışırken, ellerinizle engel olmaya çalışın. 5'e kadar sayıp gevşeyin.

Ellerinizi başınızın arkasında kenetleyin. Başınızı arkaya doğru itmeye çalışırken ellerinizle engel olmaya çalışın. 5'e kadar sayıp gevşeyin.

Sağ elinizi başınızın sağ tarafına koyun. Başınızı sağa doğru itmeye çalışırken sağ elinizle engel olun. 5'e kadar sayıp gevşeyin. Aynı hareketi bu sefer sol elinizle sola doğru tekrarlayın.

Aşırı zorlamadan başınızı çeneniz göğsünüze değecek kadar öne eğmeye çalışın. 5'e kadar sayıp başınızı nötral (orta) pozisyona getirip dinlenin. Sonra başınızı arkaya bükün. 5'e kadar sayıp tekrar nötral (orta) pozisyona gelin.

Başınızı yavaşça kulağınız omzunuza değecek kadar sağa eğmeye çalışın. 5'e kadar sayıp nötral (orta) pozisyona gelin. Sonra hareketi aksi yönde tekrarlayın.

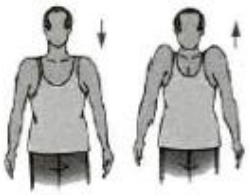
Başınızı yavaşça sağa döndürün. 5'e kadar sayın. Nötral (orta) pozisyona gelin, sonra başınızı sola döndürün. 5' e kadar sayın, dinlenin.

Alnınızı yere koyarak yüzüstü uzanın. Ellerinizi şekildeki gibi başınızın yanında olsun. Başınız ve gövdeniz yerden kalkmadan ön kol ve dirseklerinizi, kürek kemiklerinizi birbirine yaklaştırarak kaldırın. 10'a kadar sayıp gevşeyin.

Her egzersizi ..... defa yapınız. Her egzersizde ..... 'e kadar sayınız.
Egzersizleri günde ..... kez yapınız.

Alnınızı yere koyarak yüzüstü yatın. Elleriniz kalçanızın üzerine kenetli, başınız ve gövdeniz kalkmadan, kollarınızı kenetli olarak yukarı kaldırın. 10'a kadar sayıp gevşeyin.

Ayakta veya otururak omuzlarınızı yukarı, kulaklarınıza doğru kaldırın. 5'e kadar sayıp gevşeyin.



Ayakta veya otururak omuzları yukarı kaldırın ve geriye doğru döndürün. 5'e kadar sayıp gevşeyin.

Ellerinizi göğüs hizasında birleştirip birbirine doğru iterek 5'e kadar sayıp gevşeyin.

Ellerinizi göğüs hizasında birleştirip birbirinden ayırmaya çalışın. 5'e kadar sayıp gevşeyin.

Ayakta kollarınızı 90 derece açı oluşturacak şekilde duvara dayayın. Öne doğru esneyip kürek kemiklerinizi birbirine yaklaştırın. 5'e kadar sayıp gevşeyin.

Fizyoo.com Örneği

BOYUN EGZERSİZLERİ

Aşağıda tarif edilen egzersizlerin her birini günde ..... kez ..... defa yapınız.

Başlangıç Pozisyonu (Nötral Pozisyon)

Boyun egzersizleri esnasında boynun düzgün pozisyonda tutulması önemlidir. Bu nedenle önce nötral pozisyon denilen pozisyon oluşturulur. Bu amaçla baş, boyun düz hale gelene kadar arkaya çekilir, bu sırada yüz tam karşıya bakmalıdır. Egzersizler bu pozisyon korunarak yapılır.

Kas Güçlendirme Egzersizleri

a. Başı öne eğmeye direnç
Eller alna konur. Baş öne doğru itilmeye çalışılırken eller ile direnç verilerek engellenir. 10'a kadar sayılır ve bırakılır.

b. Başı arkaya eğmeye direnç
Eller başın arkasına konur. Baş arkaya doğru itilmeye çalışılırken eller ile direnç verilerek engellenir. 10'a kadar sayılır ve bırakılır.

c. Başı yana eğmeye direnç
Sağ el, başın sağ tarafına konur. Baş sağa doğru itilmeye çalışılırken sağ el ile direnç verilerek engellenir. 10'a kadar sayılır ve bırakılır. Aynı hareket sol el ile sola doğru tekrarlanır.

d. Başı döndürmeye direnç
Sağ el, başın arka kısmına, sol el şakağa konur. Sağ omzun üzerinden bakmaya gayret eder gibi elin direncine karşı baş sağa dönmeye zorlanır. Bu durumda 10'a kadar sayılır ve bırakılır. Hareket el değiştirerek aksi yönde tekrarlanır.

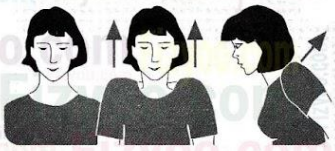
e. Omuz kavşağını güçlendirme
Eller göğüs hizasında, burun hizasında ve baş üstünde birleştirilip, birbirine doğru itilir veya çekilir. Her hareket sırasında 10'a kadar sayılır.

Boyun Hareket Açıklığını Korumaya Yönelik Egzersizler

a. Baş yavaşça sağa döndürülür ve 3'e kadar sayılır. Daha sonra başlangıç pozisyonuna getirilerek dinlenilir. Aynı hareket aksi yönde yapılır.

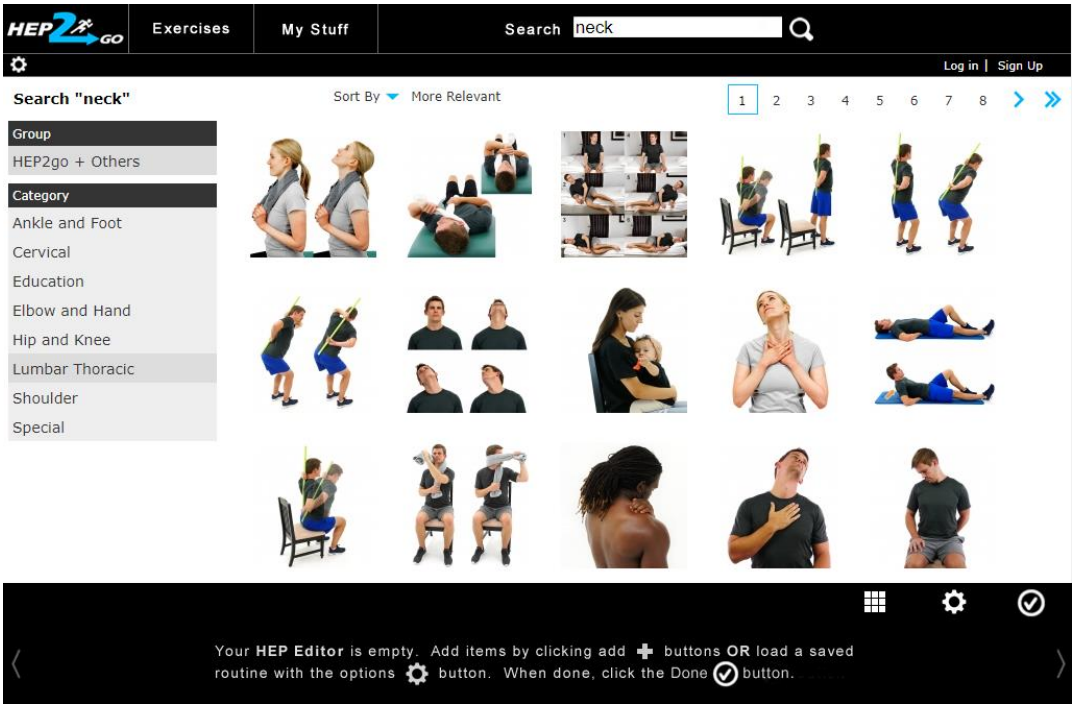
b. Aşırı zorlamaya sebep olmadan; baş, çene göğüse değecek kadar öne eğmeye çalışılır. Daha sonra başlangıç pozisyonuna getirilerek dinlenilir. Baş yavaşça arkaya bükülür. Tekrar başlangıç pozisyonuna getirilerek dinlenilir.

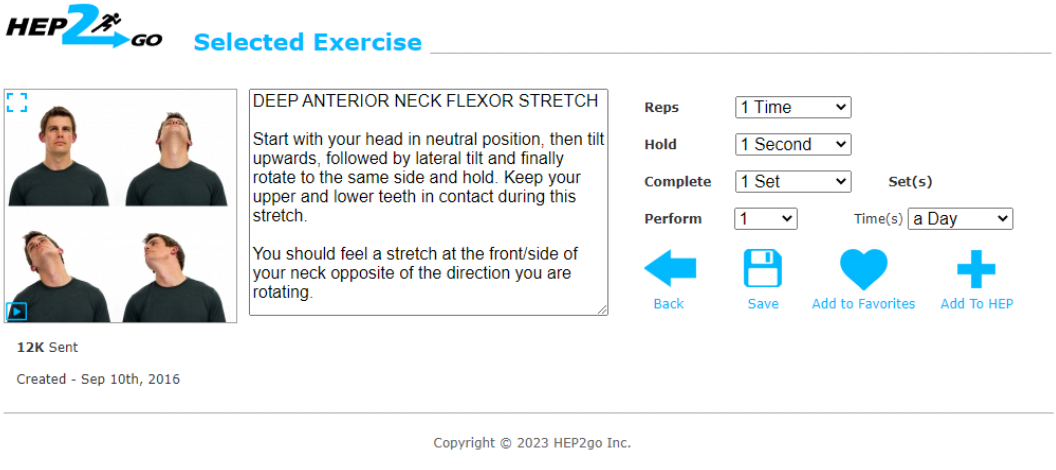
c. Baş yavaşça kulak omuza değecek kadar sağa eğmeye çalışılır. Daha sonra başlangıç pozisyonuna getirilerek dinlenilir. Hareket aksi yönde tekrarlanır. Tekrar başlangıç pozisyonuna getirilerek dinlenilir.

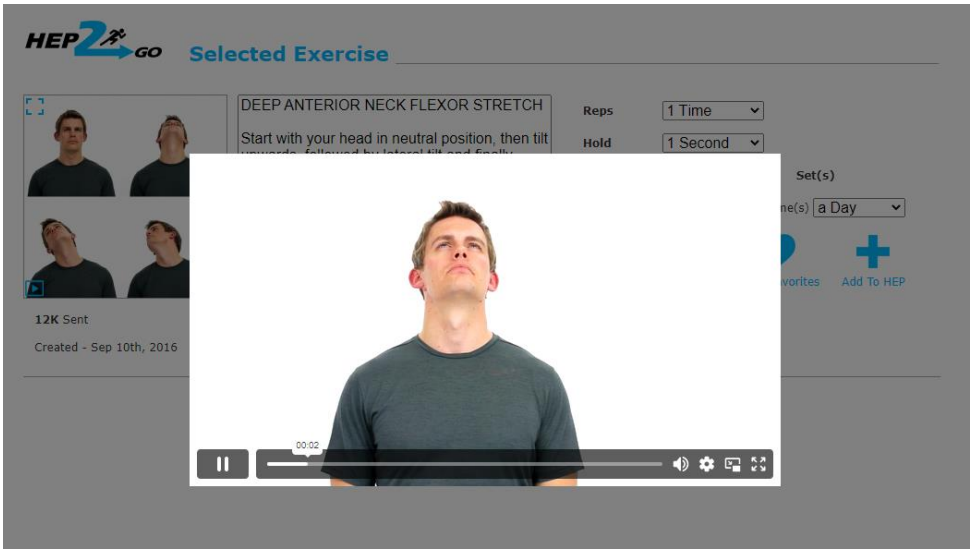


d. Omuzları arkada birleştirme
Her iki omuz yukarı doğru kaldırılarak arkada birleştirilir.

Hep2go Site Örneği (Siteden Online Gösterilecek) - Renkli görsel/ Açıklamalı / Videolu Görsel







2.3 Motivasyon

Egzersiz programlarını inceledikten sonra bir diğer konumuz motivasyon.

Bu aşamaya kadar bana yardım ettiğiniz için teşekkür ederim.

2.3.1 Evde egzersiz sürecindeki egzersize başlama ve devamını getirme deneyimlerinizden bahsedebilir misiniz?

Motivasyonunuzu nasıl sağlıyorsunuz? Yöntemlerinizden bahseder misiniz?

Motive olmakta zorlanıyor musunuz ?

2.3.2 Ev egzersizi sürecinde egzersizlerinizi ertelediğiniz, yapmadığınız durumlar oluyor mu? Oluyorsa sebepleri nedir/nelerdir bahsedebilir misiniz?

2.3.4 Bu süreçte egzersize başlama ve devamını getirme konularında size iyi gelen kendinizi iyi hissettiren dış etkenler nelerdir. Örneklendirebilir misiniz? (aile,arkadaş vs)

2.3.5 Ev egzersizi sürecinde doktor veya fizyoterapistiniz ile iletişiminiz devam ediyor muydu? Doktorunuzla iletişimde kalmaya devam etmek motivasyonunu ne şekilde etkilerdi? Açıklayabilir misiniz?

3.KISIM ***Dijital Ortam Öneri/ Tahminleri***

3.1 Hangi dijital ortamları sıklıkla kullanıyorsunuz. Egzersiz için daha önce kullandığınız dijital ürünler nelerdir? (TV, tablet, telefon, saat vb.)

3.2 Ev egzersizi sürecinde bilgi edinme ve motivasyon amacıyla kullandığınız materyalleri düşündüğümüzde, bu materyallerin içeriklerinin ve uygulamalarının bir dijital ortam içerisinde bulunması hakkında düşünceleriniz nelerdir?

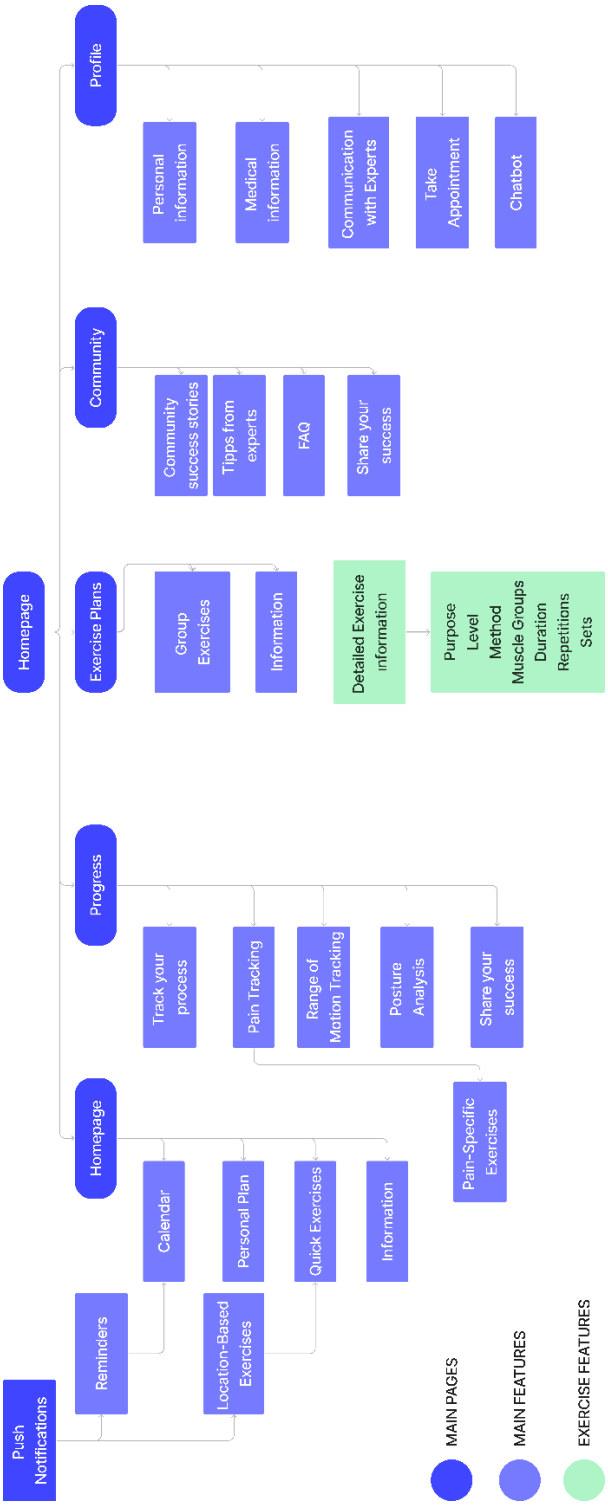
3.3 Bu dijital ortamda doktorunuz ile iletişim sağlanabilmesi, sizin durumunuzu ve egzersizleri kontrol edebilmesi hakkında ne düşünürdünüz?

3.4 Bir dijital ortamda bulunmasını istediğiniz konuşmalarımızdan sonra aklınıza gelen önerileriniz var mıdır? Örneklendirebilir misiniz?

3.5 ‘‘Egzersizlerin sonunda somut başarılar elde ettim‘‘ cümlesini söylemiş olsaydınız aklınıza gelen somut başarılar neler olurdu? Örnekleyebilir misiniz? **Ağrının azalması, egzersiz sayısı, tekrar sayısı,oyun puanı gibi örnekler verebilirim.**

Çalışmamızın sonuna geldik. Sizinle bu çalışmayı gerçekleştirmek benim için gerçekten çok keyifliydi. Umarım siz de keyif almışsındır. Çok teşekkür ederim.

D. Information Architecture for Mobile App Design



E. First Impression Survey Questions

Rehberli Gösterim Anketi

Merhaba,

Bu anket, ODTÜ Endüstriyel Tasarım Bölümü'nde yürütmekte olduğum yüksek lisans çalışmam kapsamında, 18 yaş üzeri mekanik **boyun problemi olan hastaların evde egzersiz aşaması** deneyimlerini iyileştirmek için geliştirdiğim mobil uygulama odaklanmaktadır.

Anketin amacı, mobil uygulamada size gösterdiğim içerik ve genel tasarım özelliklerinin günlük yaşamınıza entegre edilebilirliğini ve beklentilerinizi ne ölçüde karşıladığını anlamak, eklenmesini/geliştirilmesini düşündüğünüz özelliklere yönelik önerilerinizi almaktır.

Beni bu konuda destekleyip çalışmama katılırsanız sevinirim.

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* Zorunlu soruyu belirtir

Mobil Uygulama Özellik Anketi

Motivasyon arttırmaya yönelik özelliklere yönelik düşüncelerinizi anlamaya yönelik bir bölümdür.

1. Genel gösterim anketinde ilk izlenim olarak bu mobil uygulamayı anlatacak en iyi * üç (3) kelime nedir?

2. Gösterimi yapılan mobil uygulamada motivasyon arttıcı özellikler hakkında **beklentinizi karşılayan** beş (5) özellik nedir? *

Uygun olanların tümünü işaretleyin.

- [ ] Egzersizler için hatırlatma araçları kullanılması
- [ ] Konumunuza ve durumunuza göre uyarlanan egzersizler sunulması
- [ ] Egzersizler için takvim, planlama araçları kullanılması
- [ ] Egzersizler için kişisel plan sunulması
- [ ] Egzersizlerin süre,tekrar,set bilgileri ile sunulması
- [ ] Egzersizlerin amacı, yapılışı ve çalıştırdığı kas bilgisinin sunulması
- [ ] Egzersizlerin kolay,orta,zor olarak seviyelere göre sunulması
- [ ] Gün içinde kısa süreli egzersizler (2-3 dk) sunulması
- [ ] Süreç ve rahatsızlık hakkında kaynağı bilinen bilgiler sağlamak
- [ ] Uzman bilgisine erişim ve öğretici içerikler sunulması
- [ ] Tedavi sürecinde hangi aşamada bulunduğunuzun sunulması
- [ ] Tedavi sürecinin aşama aşama sunulması
- [ ] Ağrı düzeyinizin takip edilmesi özelliği
- [ ] Ağrı düzeyinize uygun egzersizlerin sunulması
- [ ] Yapay zeka ile hareket kabiliyetinizin takip edilmesi
- [ ] Yapay zeka ile postür analizi yapılması
- [ ] Postürünüzün öncesi-sonrası şeklinde fotoğrafla sunulması
- [ ] Kullanıcıların ilerlemelerini ve başarılarını sosyal medya araçları sayesinde yakınları ile paylaşmalarına izin verme
- [ ] İstek doğrultusunda uzman eşliğinde yapılan grup egzersizlerine katılım imkanı
- [ ] Aynı tedaviyi almış ve başarılı olmuş kişilerin süreçlerinin sunulması
- [ ] Kişisel sağlık verileri ve doktor/hastane bilgilerinin sunulması
- [ ] Uzmanlar ile randevular sayesinde iletişime geçebilme özelliği
- [ ] Sohbet robotu ile sıkça sorulan sorulara yanıt bulmak
- [ ] Uzmanlar tarafından süreç/istatistik sayfasındaki bilgilerinizin takip edilmesi
- [ ] Uygulamanın görsel elementlerinin isteğe göre ayarlanabilmesi

3. Gösterimi yapılan mobil uygulamada motivasyon arttıcı özellikler hakkında **beklentinizi karşılamayan** beş (5) özellik nedir? *

Uygun olanların tümünü işaretleyin.

- [ ] Egzersizler için hatırlatma araçları kullanılması
- [ ] Konumunuza ve durumunuza göre uyarlanan egzersizler sunulması
- [ ] Egzersizler için takvim, planlama araçları kullanılması
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- [ ] Egzersizlerin süre,tekrar,set bilgileri ile sunulması
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- [ ] Tedavi sürecinin aşama aşama sunulması
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- [ ] Ağrı düzeyinize uygun egzersizlerin sunulması
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- [ ] Kişisel sağlık verileri ve doktor/hastane bilgilerinin sunulması
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- [ ] Uzmanlar tarafından süreç/istatistik sayfasındaki bilgilerinizin takip edilmesi
- [ ] Uygulamanın görsel elementlerinin isteğe göre ayarlanabilmesi

4. İlk bakışta, bu mobil uygulama hakkında yukarıdaki hangi özelliği nasıl geliştirebilirsiniz? *

_____

5. Bu mobil uygulamada yapacağınız ilk kullanmak istediğiniz özellik hangisi olurdu? Lütfen bu aksiyonu neden almak istediğinizi ve bu aksiyonu aldıktan sonra ne görmeyi beklediğinizi açıklayın. *

Mobil Uygulama Derecelendirme

Motivasyon arttırmaya yönelik özelliklerle tasarlanmış olan uygulamaya yönelik derecelendirme düşüncülerinizi almak için oluşturulmuş bir bölümdür.

6. Gelecekte bu mobil uygulamaya *geri dönmek* ne kadar olası değil (1) ya da olası (5) ? *

Yalnızca bir şıkkı işaretleyin.

	1	2	3	4	5	
Olas	◯	◯	◯	◯	◯	Olası

7. Bu mobil uygulamayı tekrar ziyaret etmek istemenize sebep olan bir şey var mı? Açıklayınız. *

8. Bu mobil uygulamayı tekrar ziyaret etmek istememenize sebep olan bir şey var mı? Açıklayınız. *

9. Bu mobil uygulamayı *tavsiye etmek* ne kadar olası değil (1) ya da olası (5)? *

Yalnızca bir şıkkı işaretleyin.

	1	2	3	4	5	
Olas	◯	◯	◯	◯	◯	Olası

10. Bu mobil uygulama günlük yaşamınıza entegre edilebilir mi edilemez(1) ya da edilebilir(5)? *

Yalnızca bir şıkkı işaretleyin.

	1	2	3	4	5	
Ente	◯	◯	◯	◯	◯	Entegre Edilebilir

11. Bu mobil uygulamayı nasıl tanımlarsınız? *

Uygun olanların tümünü işaretleyin.

- [ ] Kullanışlı
- [ ] Sade
- [ ] Karmaşık
- [ ] Güvenilir
- [ ] Kaliteli
- [ ] Benzersiz
- [ ] Yararlı
- [ ] Yenilikçi
- [ ] İşlevsel
- [ ] Kullanıcı dostu
- [ ] Bilgilendirici
- [ ] Hiçbiri
- [ ] Diğer: _____

12. Bu mobil uygulamayı geliştirmek isteseydiniz, yapacağınız değişiklikler ne olurdu? *

_____