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Is Technology Friend or Foe

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CHAPTER I

Current Approaches for Rheumatoid Arthritis Foot Orthoses

Ö.F. ÖZÇELEP[1]
A.TURHAN[2]

Introduction

Rheumatoid arthritis (RA) is an inflammatory disease that causes symmetrical involvement in peripheral joints, especially in the hands and feet, and proximally in the cervical and lumbar regions. The prevalence of RA in developed countries is between 0.5-1%, and women are affected twice as often as men. One of the typical problems of RA patients is foot and ankle involvement. Foot and ankle involvement is present in approximately 16% of patients at diagnosis and in 90–100% of individuals ten years after initial diagnosis. It is very important to recognize the causes of ankle

[1] Öğretim Görevlisi, Kırşehir Ahi Evran Üniversitesi, Fizik Tedavi ve Rehabilitasyon Yüksekokulu
[2] Öğretim Görevlisi Doktor, Kırşehir Ahi Evran Üniversitesi, Fizik Tedavi ve Rehabilitasyon Yüksekokulu

diseases, start treatment as soon as possible and adopt preventive rehabilitation approaches. Understanding the nature of RA and determining how it affects individuals' functional status can help healthcare professionals create treatment plans and alleviate symptoms. Foot involvement is common in 80% of RA patients at some stage throughout the disease's progression. This involvement can progress very quickly and leave the person severely disabled, making walking difficult in 75% of cases, and sometimes causing significant functional limitation. Foot orthoses are a component of conservative treatment when it comes to treating joint and soft tissue discomfort, deformity, and joint instability in patients with RA. Orthotic treatment options have been proven to minimize plantar pressure and enhance walking speed in rheumatoid arthritis, gout, and 1st metatarsophalangeal joint osteoarthritis. Future studies should focus on the interplay between FO design, pain management, and evolving biomechanics. This can be achieved by conducting in-depth studies of evolving biomechanics using computational modeling techniques, as well as more comprehensive description of changes in patients' pain in terms of both location and severity. This makes it easier to decide which FO design is best for a particular set of pain types and locations. Understanding this connection may help increase the effectiveness of FO use in RA patients.

Definition of Rheumatoid Arthritis

Rheumatoid arthritis (RA) is a systemic, inflammatory diseases characterized by symmetrical peripheral joint involvement.(Emery, 2015) Symptoms include pain, stiffness, and general fatigue, with flares and remissions.(Bray, 2016) Despite recent major breakthroughs in medical therapy, RA is a chronic disease with mild to severe hinders in mobility and involvement in regular daily activities. Joint mobility, muscular function, and strength are frequently compromised in terms of physically structure and function. Activity constraints, such as difficulties walking or handling items, may limit involvement in personal care, domestic tasks, job, social connections, and leisure activities. (Rosso et.

al.,2013) The resources accessible, as well as how a person responds to their condition and the obstacles it poses (personal features), impact perceived health, as does the surroundings, such as accessibility to the physical or constructed environment or assistance offered by institutional regulations.(Dziedzic & Hammond, 2010) Loss of core strength, for example, occurs early in RA and affects more than one-third of patients, depending on disease severity, age of start, and employment demands.(Burton et al., 2006) RA has a substantial physical, psychological, and economic effect. Rehabilitation services are critical for preserving, restoring, and increasing patient function, as well as for improving quality of life.(Dziedzic & Hammond, 2010)

Prevalence and Incidence

In Western nations, RA affects 0.5-1% of the population, and women are affected twice as often as males.(Myasoedova et al., 2010) There is a genetic predisposition, which is substantiated by higher incidence among indigenous groups in North America (up to 7%) and lower rates in China, Japan, and rural Africa.(Safiri et al., 2019) The incidence varies but is normally near to 40 per 100,000, however it has reduced in recent decades, most likely due to increasing oral contraceptive usage, dietary impacts, and cohort effects. However, according to a 2010 cohort research, the incidence of RA in women is rising following four decades of reduction.(Myasoedova et al., 2010) A 2021 systematic review reports a wide range of point and period prevalence based on population and data collection method, with the mean point and period prevalence of RA being 51 per 10,000 and 56 per 10,000, respectively. Urban and rural prevalence may be higher due to poor case findings in areas with fewer health services or differences in the risk environment.(Almutairi et al., 2021)

Although numbers on the prevalence of RA vary widely depending on the research and location, a study in France that described the causes of death and recommended therapies showed the prevalence of RA to be 0.47-0.66% in women and 0.28% in

males.(Vegas et al., 2022) It has been reported that mortality rates in RA are higher than in the general population. It has been stated that recently developed effective treatments can reduce disease activity and excess risk of death.(Dadoun et al., 2013)

Pathophysiology

RA is an example of autoimmune illness characterized by unusual antibody and T-cell responses to an autoantigen.(Alivernini et al., 2019) As a result, an extensive inflammatory process occurs, resulting in a variety of extra-articular characteristics in synovial cells lining joint capsules and other bodily tissues.(Emery, 2015)

A healthy joint has a thin synovial membrane that covers the joint capsule. Synovial fluid, which lubricates and nourishes joint cartilage, is produced by these cells. Early RA is distinguished by lymphocyte infiltration of the joint capsule, which induces the synovial lining to proliferate and increase synovial fluid production. Swollen, hotter red, and painful joints are the symptoms. Prolonged inflammation stresses the surrounding ligaments and tendons, resulting in laxity and joint instability. As a result, treatments focuses on decreasing the inflammatory response. The pannus forms in later phases, and the synovium proliferates with fibroblasts, macrophages, T cells, and blood vessels. The pannus infiltrates and erodes the articular cartilage, exposing the bone. Bone resorption and remodeling may occur in advanced illness, where cartilage damage is unavoidable. The most common treatment for advanced illness is joint replacement. Synovitis does not just affect the joint capsules. Tendon sheaths may also be altered in the same way. RA is considered to be "active" or "worsened" when joints become inflamed and laboratory indications of disease activity, such as erythrocyte sedimentation rate (ESR), rise. When inflammation is modest, RA is considered to be 'in remission' or 'managed'. (Bray, 2016)

Extra-articular manifestations of RA include a variety of inflammatory processes, including cutaneous changes such as

vasculitis (inflammation of small blood vessels) and rheumatoid nodules (nodes of fibrosis in subcutaneous tissue, usually near the elbow); inflammation of eye tissues (scleritis, uveitis); heart disease (myocarditis, pericarditis, and effusions); lung and pleural disease; kidney disease.(Alivernini et al., 2019)

Risk factors

Genetic Risk Factors

Currently, more than 100 genetic risk factors for RA have been identified and replicated. Most of these risk factors have moderate minor allele frequencies. This suggests that risk alleles are not uncommon, but rather ubiquitous in the population. In comparison to the prevalence of these risk factors, the chances are rather low (ranging from 1.1 to 1.3). This implies that having a single risk factor does not significantly enhance the probability of RA. Surprisingly, several of the discovered genes are found on the same route. For example, HLA class II histocompatibility antigen DRB1-9 beta chain (HLA-DRB1), protein tyrosine phosphatase non-receptor type 22 (PTPN22), signal transducer and activator of transcription 4 (STAT4), cluster of differentiation 40 (CD40), cytotoxic T -lymphocyte antigen 4 (CTLA4), interleukin (IL)2, IL21, and protein kinase C theta type (PRKCQ) are all involved in T cell activation, whereas CD40, CTLA4, IL 2, IL21, PRKCQ, PTPN22, STAT4, tumor necrosis factor alpha -induced protein 3 (TNFAIP3) and tumor necrosis factor receptor-associated factor 1 (TRAF1) are involved in cell cycle regulation.(Emery, 2015)

Environmental Risk Factors

Table 1 summarizes the environmental risk factors for RA. Given a heritability of 66%, environmental influences can explain up to 34% of the variation. Smoking is the only environmental factor that has been widely cited as a risk factor, particularly in those who have HLA-DRB1 shared epitope alleles.(Linn-Rasker & al., 2006)

Table 1: Enviromental Risk Factors

Risk Factor	Level of Evidence
Environment	
Air pollution→	**Insufficient** -Increases the risk of RA. (Hart & al., 2009)
Infections→	**Insufficient** -There is indirect evidence with findings of increased RA onset rates during winter. (Schlesinger & Schlesinger, 2005; Symmons, 2003) -Several bacteria have been linked to higher antibody titers in RA patients compared to controls, but no one pathogen appears to be the cause of RA.(Loyola-Rodriguez & al., 2010; Söderlund & al., 1997)
Life style	
Smoking→	**High Level of Evidence** - This is the only well-known environmental component associated with RA.(Linn-Rasker & al., 2006) -Predisposition in HLA-DRB1 shared epitope-positive individuals to develop ACPA-positive RA(Klareskog & al., 2006)
Coffee→	**Insufficient**
Alcohol→	- There have been both good and negative consequences documented. **Insufficient** -It is unclear whether alcohol is truly protective; RA patients report drinking less alcohol.(Maxwell & al., 2010)
Hormonal	
Parity→	**Insufficient**
Hormone replacement therapy/ oral contraceptives→	Some studies have found that women who have given birth had a decreased chance of developing RA. (Jorgensen & al., 1996; Pikwer & al., 2009) **Insufficient** Some studies have reported a reduced risk of RA. (Doran & al., 2004; Jorgensen & al., 1996)
Breast-feeding→	**Insufficient** Following a prolonged period of breastfeeding, women have shown a reduction in their risk of developing RA. (Doran & al., 2004; Karlson & al., 2004)

Clinical Appearance of Ankle RA

Foot and ankle involvement is a typical condition in people with rheumatoid arthritis (RA). (Stolt & al., 2017a) Foot and ankle involvement is found in 16% of patients at the time of diagnosis (Jaakkola & Mann, 2004) and in 90-100% of patients ten years after the first diagnosis. (Borman & al., 2012) The most prevalent foot problems in RA patients include MTP joint dislocation, toe abnormalities such as hallux valgus, claw and hammer toes, and hindfoot valgus with a collapse in longitudinal arch support.(Borman & al., 2012; Stolt & al., 2017b) Pain and callus development, ulceration, and elevated local plantar pressures beneath the foot are all consequences of structural foot abnormalities. (Stolt & al., 2017b; Weijers & al., 2003)

Plantar pressure under the metatarsal heads increases by a factor of two to three in RA compared to healthy individuals(Otter & al., 2004; van der Leeden & al., 2006) Additionally, the medial longitudinal arch collapse results in a delayed force transfer from the hindfoot to the forefoot(Turner & al., 2006). These load and pressure distribution changes are reported to be associated with pain and forefoot deformities.(Carroll & al., 2015; Turner & al., 2006) However, Schmiegel & al. demonstrated that changes in plantar pressure distribution may be detected in the early phases of rheumatoid arthritis development. (Schmiegel & al., 2008) As a result, early therapies such as foot insoles are indicated for RA patients who are in the early stages of the illness and are not suffering discomfort or deformity.(Tenten-Diepenmaat, van der Leeden, Vliet Vlieland, Dekker, & al., 2018; Turner & al., 2006)

Foot Orthosis Applications

Identifying ankle disorders is crucial in order to start therapy as soon as feasible in order to minimize worsening. Assessing the features of joint inflammation and its influence on RA patients' functional status would help physicians to tailor therapeutic approaches and reduce symptoms.(Abdelzaher & al., 2022)

Rheumatic disease rehabilitation can be difficult since patients often have comorbidities that must be addressed. Those particular variables must be factored into goal planning. In addition to the medical therapies discussed before, rehabilitation treatments should include patient education, functional mobility improvement or maintenance, determining the need for orthoses and durable medical devices, suitable physical modalities, and exercise.(Hsieh & al., 2021)

Several studies have discovered that foot involvement is widespread in RA patients, with an estimated 80% involvement along the course of the disease. (Ali Khan &. al., 2021) This disability can be quickly debilitating, impeding walking in three-quarters of instances and occasionally resulting in a significant functional handicap. Pain and biomechanical anomalies are caused by the deformations, which increase the deformations, creating a vicious spiral.(Fazaa & al., 2022) FO are the first line of conservative treatment for persons with RA and foot pain, with the goal of addressing joint and soft-tissue pain, deformity, and joint instability. FO is a medical device that is worn inside the shoe to support, prevent, align, and cure lower extremity, foot abnormalities, and malalignment.(Simonsen, Næsborg-Andersen, & al., 2022) Key footwear characteristics included cushioning and a wide toe box for rheumatoid arthritis; cushioning, midsole stability and a rocker-sole for gout; and a rocker-sole for 1st metatarsophalangeal joint osteoarthritis. Footwear interventions were associated with reductions in foot pain, impairment and disability for people with rheumatoid arthritis.(Frecklington & al., 2018) Although the usage of orthoses appears to improve foot pain, this meta-analysis found no statistically significant differences in long- and short-term pain reduction and/or reduced disability between the control and intervention groups.(Gijon-Nogueron & al., 2018) However, Aria et al. reported that using custom-made FO reduced forefoot discomfort in rheumatoid arthritis, hallux abductus valgus, and secondary metatarsalgia by increasing sole pressures.(Arias-Martín & al., 2018) Linberg et al. also provided each subject with a 4mm thin

individually designed insole of a flexible plastic substance with synthetic textile material on the top side in their study. Walkinginduced forefoot soreness was immediately clinically significant when thin, easily adaptable insoles were used. After a year, the majority of the patients were still wearing the insoles.(Linberg & Mengshoel, 2018) Another study also found that custom FO significantly reduced participants' foot pain compared to placebo orthoses, but did not have a positive effect on disability, foot functionality, and quality of life compared to cushioning alone.(Reina-Bueno & al., 2019) Pain relief is plausibly attributed to changes in ankle joint moments when custom-made FO is used. (Simonsen, Næsborg-Andersen, & al., 2022)

Footwears have been proven to lower plantar pressure in people with rheumatoid arthritis, gout, and 1st metatarsophalangeal joint osteoarthritis, as well as enhance walking speed in those with rheumatoid arthritis and gout. (Frecklington & al., 2018) FO are tailored to the plantar foot shape and personalized by targeting optimal restoration of normal arch height. When produced, it showed a relieving effect on ankle/foot pain along with changes in ankle joint moments in people with RA. Changes in foot pressure distribution, joint moments, and angles are most evident in custom-made FO compared to prefabricated FO, and patients with foot disorders have better results in changing gait mechanics with an individualized FO. (Simonsen, Hirata, & al., 2022)

It has been stated that therapeutic shoes may be effective in RA patients, although they have weak evidence. (Tenten-Diepenmaat, van der Leeden, Vliet Vlieland, Roorda, & al., 2018) For example, FO made of soft materials have lower forefoot plantar pressure compared to FO made of semi-rigid materials. (Tenten-Diepenmaat & al., 2019)In addition, it has been stated that the use of a off the shelf insole with an individually modified metatarsal pad and medial longitudinal arch support can change the plantar pressure of rheumatoid arthritis patients after a month of follow-up. (Partovifar & al., 2021) A study also showed that FO improves foot

function and balance in patients with rheumatoid arthritis. (Gaino & al., 2021)

Discussion for Future Studies

The intersection between FO design, pain management, and shifting biomechanics should be the subject of future study. This may be accomplished by conducting extensive investigations of altering biomechanics using computer modeling methodologies, as well as providing a more complete description of changes in patient pain in terms of both location and severity. This assists in determining which FO design is most suited for various types of regions of discomfort. Insights regarding this link may help to improve FO therapy for RA patients.(Simonsen, Næsborg-Andersen, & al., 2022) Studies examining the effect of prefabricated insoles in men with RA and comparing the effect of insoles between male and female populations are needed. (Partovifar & al., 2021) To explore the comparative cost-effectiveness of different forms of FO in the treatment of rheumatoid arthritis-related foot issues, definitive, high-quality RCTs with appropriate sample numbers and long-term follow-up are required.(Tenten-Diepenmaat & al., 2019)

Cultural validation studies may also be the subject of future studies to increase the feasibility of existing tools at the international level. It has been stated that it would be useful to know the basic features of aesthetically sound shoes according to RA patients, and this can only be researched through interviews with RA patients.(Stolt & al., 2017a) In addition, in the future, care guides or recommendations will be made to determine how healthcare professionals should perform foot health assessments and how they care for the patient. It would be useful to include specific information about when to refer a podiatrist. These care guides may even include modern information sources such as evidence-based websites with short video clips to direct the patient to appropriate personalized foot care.(Laitinen & al., 2022)

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CHAPTER II

Integrating ChatGPT in Health Sciences Education: Exploring Opportunities and Challenges

Sedat YİĞİT[1]
Soner BERŞE[2]

Introduction

The rapid technological progression has induced significant shifts across various sectors, with education being a prime example. As educators strive to enrich learners' academic journey and promote their active participation, the incorporation of technology into all academic disciplines has become increasingly prevalent. Technological tools provide students with customised learning paths, engaging and vibrant educational content, motivation for their academic pursuits, and alternative learning opportunities (Elvan & Mutlubaş, 2020).

[1] Assistant Professor, Gaziantep University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation
[2] Lecturer, Gaziantep University, Faculty of Health Sciences, Department of Nursing

Despite initial debates about the implementation of remote education technology, this form of education has grown in acceptance over time. Learners now have the ability to conveniently access assignments, lecture materials, study resources, and even online assessments. However, each novel technological development rekindles fresh discussions about its role and implications for education. One such notable development is the AI (Artificial intelligence) enabled chatbot, ChatGPT. Its advent in the education sector has sparked mixed reactions from educators. While some endorse ChatGPT as an enhancer of the learning experience, critics argue about potential risks to educational integrity and the traditional role of teachers. There's a prominent concern that students may uncritically use content produced by the chatbot without appropriate referencing (García-Peñalvo, 2023). Despite the concerns, AI technologies have the potential to optimise tasks, expedite processes, and unveil new opportunities across various domains.

ChatGPT's prowess in natural language processing widens its application scope in applied sciences, such as healthcare. In the field of healthcare, ChatGPT can play a crucial role in enhancing patient communication, assisting health education, and providing reliable information (Alkhaqani, 2023; Scerri & Morin, 2023). However, it is important to acknowledge that the current body of literature on the role of ChatGPT in education, and specifically in healthcare education, is somewhat limited. Therefore, it's crucial to encourage further research to thoroughly understand its potential advantages and challenges, to ensure we optimally leverage AI advancements like ChatGPT in the evolving educational landscape.

ChatGPT and Health Sciences Education

The application of ChatGPT, a language processing technology empowered by artificial intelligence, may bring about various benefits in health education. It can facilitate the customization of educational content and evaluation tools to accommodate the distinctive needs and learning styles of different

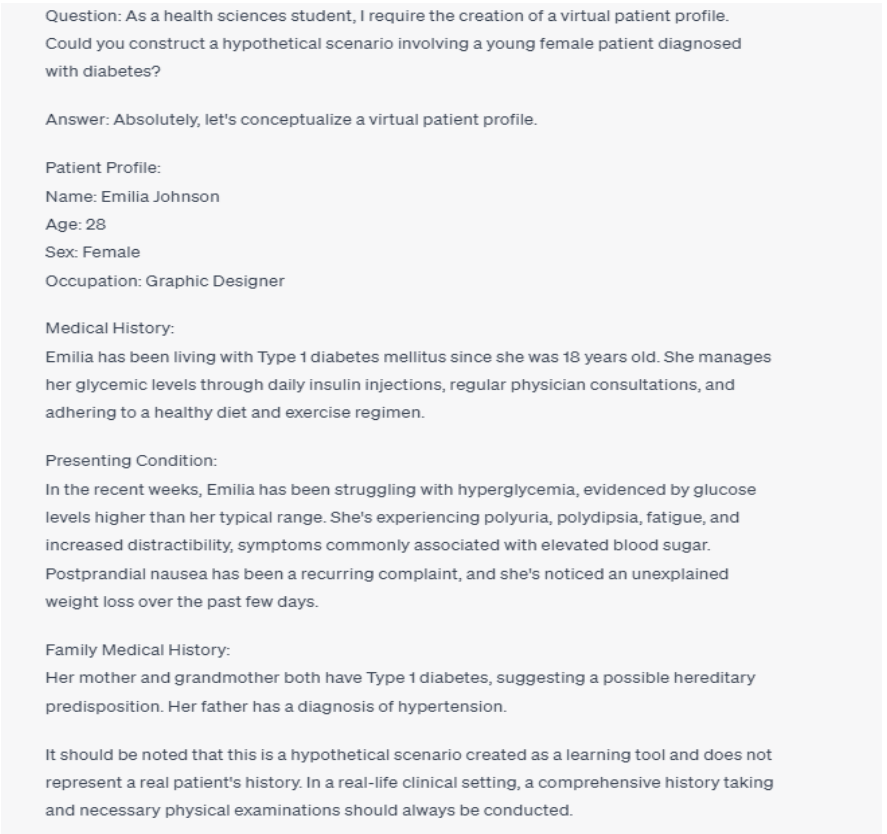
students. This scenario could foster a comprehensive learning experience by assisting in the improvement of intended learning outcomes (Bhutoria, 2022).

Personalized learning is reported to enhance the engagement of students in the health field and enrich their learning outcomes (Rojanasarot & et al., 2018). Additionally, AI-based technologies can assist in bolstering clinical reasoning skills by creating realistic case scenarios that provide instantaneous feedback on diagnosis and treatment decisions (Grunhut, Wyatt & Marques, 2021). This situation can minimize the risk of harming actual patients by allowing health education students to practice their clinical skills in a safe and controlled environment via simulation (Datta, Upadhyay & Jaideep, 2012). Furthermore, ChatGPT enables the reinforcement of complex medical concepts through interactive explanations and demonstrations, thus simplifying the learning of medical terminology (Sapci & Sapci, 2020).

ChatGPT has the potential to profoundly change health and other applied sciences, similar to previous technologies (Archibald & Clark, 2023). Although ChatGPT has the potential to revolutionize health education and research in particular, due to its ability to optimize processes and assist in clinical decision-making, its impact on health education and research remains a significant topic of debate. Therefore, ChatGPT should be used carefully and responsibly in applied fields such as health (Alkhaqani, 2023).

ChatGPT can save time for healthcare professionals in tasks such as monitoring patient information. In addition, it can assist in providing general information, creating clinical notes, communicating with patients and their families, and determining appropriate treatment options. However, it is important to remember that the answers provided by the chatbot may be incorrect or outdated, and the technology is still evolving and may not possess the desired level of accuracy, up-to-date information, or sensitivity (Salvagno, Taccone & Gerli, 2023).

ChatGPT can also provide linguistic support to students studying in the health field. Students may struggle to understand texts written in medical language. Texts written in this professional language can be transformed into simpler and more comprehensible texts using ChatGPT. Similarly, complex instructions can be simplified easily (Scerri & Morin, 2023). In addition, ChatGPT can help students communicate with foreign patients during practical training and easily explain complex medical instructions to patients. ChatGPT can also offer students the opportunity to practice learning medical terminology.



Question: As a health sciences student, I require the creation of a virtual patient profile. Could you construct a hypothetical scenario involving a young female patient diagnosed with diabetes?

Answer: Absolutely, let's conceptualize a virtual patient profile.

Patient Profile:
Name: Emilia Johnson
Age: 28
Sex: Female
Occupation: Graphic Designer

Medical History:
Emilia has been living with Type 1 diabetes mellitus since she was 18 years old. She manages her glycemic levels through daily insulin injections, regular physician consultations, and adhering to a healthy diet and exercise regimen.

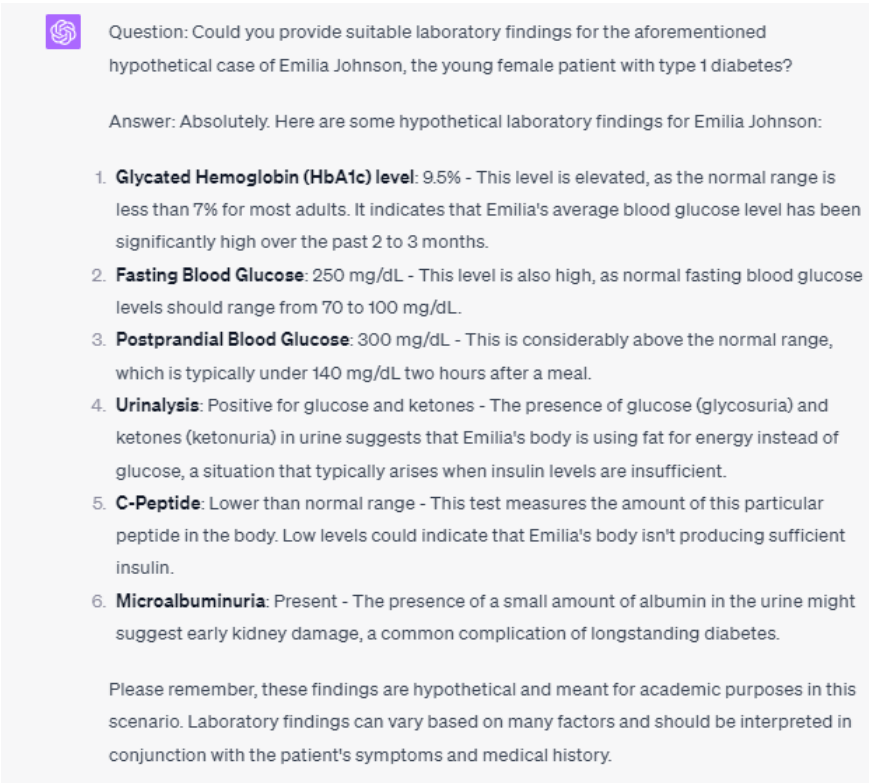
Presenting Condition:
In the recent weeks, Emilia has been struggling with hyperglycemia, evidenced by glucose levels higher than her typical range. She's experiencing polyuria, polydipsia, fatigue, and increased distractibility, symptoms commonly associated with elevated blood sugar. Postprandial nausea has been a recurring complaint, and she's noticed an unexplained weight loss over the past few days.

Family Medical History:
Her mother and grandmother both have Type 1 diabetes, suggesting a possible hereditary predisposition. Her father has a diagnosis of hypertension.

It should be noted that this is a hypothetical scenario created as a learning tool and does not represent a real patient's history. In a real-life clinical setting, a comprehensive history taking and necessary physical examinations should always be conducted.

Figure 1. ChatGPT creating a virtual patient. (Source: OpenAI, https://chat.openai.com/)

ChatGPT can provide students with an interactive learning experience. In figure 1, ChatGPT has been asked to create a virtual patient with the desired patient information, allowing health students to practice on their own and simulate real-world patient scenarios. ChatGPT has created the virtual patient and presented their medical history. ChatGPT, by sharing the physical characteristics, laboratory results, and diagnosis of the virtual patient it created, is able to provide students with a detailed scenario for them to practice (Figure 2). ChatGPT not only creates a detailed patient scenario but also provides information about the treatment plan for students (OpenAI, 2023).



Question: Could you provide suitable laboratory findings for the aforementioned hypothetical case of Emilia Johnson, the young female patient with type 1 diabetes?

Answer: Absolutely. Here are some hypothetical laboratory findings for Emilia Johnson:

1. **Glycated Hemoglobin (HbA1c) level**: 9.5% - This level is elevated, as the normal range is less than 7% for most adults. It indicates that Emilia's average blood glucose level has been significantly high over the past 2 to 3 months.
2. **Fasting Blood Glucose**: 250 mg/dL - This level is also high, as normal fasting blood glucose levels should range from 70 to 100 mg/dL.
3. **Postprandial Blood Glucose**: 300 mg/dL - This is considerably above the normal range, which is typically under 140 mg/dL two hours after a meal.
4. **Urinalysis**: Positive for glucose and ketones - The presence of glucose (glycosuria) and ketones (ketonuria) in urine suggests that Emilia's body is using fat for energy instead of glucose, a situation that typically arises when insulin levels are insufficient.
5. **C-Peptide**: Lower than normal range - This test measures the amount of this particular peptide in the body. Low levels could indicate that Emilia's body isn't producing sufficient insulin.
6. **Microalbuminuria**: Present - The presence of a small amount of albumin in the urine might suggest early kidney damage, a common complication of longstanding diabetes.

Please remember, these findings are hypothetical and meant for academic purposes in this scenario. Laboratory findings can vary based on many factors and should be interpreted in conjunction with the patient's symptoms and medical history.

Figure 2: Simulated Laboratory Findings for an Educational Case Study A Hypothetical Representation of a Type 1 Diabetic Patient.

Challenges and concerns often arise regarding the use of ChatGPT in health education. As with any new technology, there are limitations that need to be examined to ensure the benefits of this innovation outweigh potential risks (Sallam, 2023). One of the most significant limitations is the risk of violating data privacy (Mijwil, Aljanabi & Ali, 2023). Health education involves the use of important patient information. Strict regulation is required to prevent the potential harmful consequences of neglecting data privacy in AI-supported technology programs (Gerke, Minssen & Cohen, 2020). Therefore, the application of ChatGPT in health education needs to be examined considering possible serious issues that could lead to legal liability problems for patients and healthcare professionals (Sallam, 2023).

Another significant limitation is the potential for ChatGPT to present erroneous, biased, and inappropriate information across various health education disciplines (Tlili & et al., 2023). This situation could affect the quality of education, leading to a decrease in the quality of healthcare services (Marcelin & et al., 2019). It is important to consider ChatGPT's impartiality and its ability to generate information for the integrity of health education (Guidance, 2021). Additionally, ChatGPT could affect the development of critical thinking and communication skills, which are crucial for students learning in the health field (Cotton, Cotton & Shipway, 2023). In light of this information, all stakeholders involved in health education must strike a good balance between AI-based programs and traditional teaching methods (Eysenbach 2023).

Conclusion

It can be concluded that technologies providing students with the opportunity to practice on real-world scenarios can reinforce their theoretical knowledge and improve their practical skills. Chatbots like ChatGPT could better prepare students for their professions. It can be said that technologies like ChatGPT can help students reinforce their theoretical knowledge and improve their practical skills. The opportunity for students to practice on real-

world scenarios provided by chatbots can better prepare them for their professions.

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CHAPTER II

Digital Dependence and Physical Activity: Exploring the Interplay of Technology Addiction and Exercise

Abdurrahim YILDIZ[1]
Ümit ERKUT[2]

Introduction

Nowadays social media use, online shopping, online gaming, Internet pornography viewing, and other online behaviors are routine framed as addictions that are new and uniquely dangerous. Smartphones have been described in the news media as 'today's hypodermic needle' (Waters, 2021) and screens have been cast as ‘digital heroin’ and ‘electronic cocaine’ (Kardaras, 2016). When compared to substance addiction, technology addiction does not lead to traumatic situations, but it causes psychological changes, disconnection from social life, damage to social life and symptoms

[1] Asisstant Prof., Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Sakarya University of Applied Sciences, Sakarya, Türkiye
[2] Asisstant Prof., Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Rumeli University, Istanbul, Türkiye.

of depression. In technology addiction, the person has difficulty in coping with the consequences when he/she is deprived of what he/she is addicted to. The symptoms of technology addiction are mental changes, affecting social life and depression symptoms, and the individual uses any technological product that he/she is addicted to excessively, experiences its deprivation when he/she cannot reach it and has to struggle with the negative effects of this situation (Karayel & Hümeyra, 2019).

The Importance of Physical Activity

Physical activity is recognized as a protective factor in the promotion of prevention and treatment of non-communicable diseases such as non-communicable type-2 diabetes, breast and colon cancer and cardiovascular diseases. The activity also has other benefits for mental health, postpones the onset of dementia and can maintain a general well-being and healthy weight. They are defined as any movement of the body that is produced by skeletal muscles, involves exertion of energy and can be performed at various intensities leisure time, during work, transportation, household chores, while performing exercise or participating in sports activities. At the lower end of the frequency range, sedentary behavior is described as any awake behavior performed in a sitting, lying or reclining position with reduced energy effort. Recent evidence shows that high levels of inactivity are associated with type 2 diabetes and cardiovascular disease, as well as cancer, cardiovascular disease and mortality from all causes (Bull et al., 2020).

Rationale for Studying the Interplay

Adolescent technological addictions have increased to disturbing levels in the past few years. Due to fast advances in modern technology and increasing access to digital devices, young people are becoming progressively more dependent on electronic media in different areas of daily life. Psychological dependencies cover a range of troubling behaviors, including overuse of the

internet, addiction to online gaming, and obsessive participation in compulsive social media. This addictive behavior may lead to harmful consequences such as failure in academics, disrupted social interactions and deteriorating mental health (Suprayitno, Sunarno, Saputra, & Riza, 2023). Developments in computer and internet technology, in particular, have enabled individuals in various parts of the world to establish more intensive communication with various parts of the world and to access the information they need very quickly (Chayko, 2008). Nevertheless, developments in this field have resulted in the emergence of other problem areas. Although social media addiction first emerged as addiction to computers and games, recently, with the development of various social networking tools, addiction to social media has been added to other types of addiction (Griffiths, 2005; He, Turel, Brevers, & Bechara, 2017; Oberst, Wegmann, Stodt, Brand, & Chamarro, 2017). Children's use of technological devices has increased. It has also been observed that addiction to technology has increased. Addiction is when an individual loses control over an object or behavior and cannot do without it. Technology addiction is the unconscious and uncontrolled use of technological tools and the inability to live without technological devices. Recently, there have been studies on behavioral addiction in individuals with technological addictions like internet addiction, digital gaming addiction, social media addiction and smartphone addiction. According to research, individuals with internet addiction, social network addiction, digital gaming addiction and mobile smartphone addiction have similar signs and symptoms to those with other forms of chemical or emotional addiction (Griffiths, 2005; Younes et al., 2016).

The Digital Age and Sedentary Behavior

The Pervasiveness of Digital Devices

Since the coining of the term "non-formal learning" by Pontefract (Pontefract, 2016), it defines the key aspects of learning enriched by formal, non-formal and communal experiences. All of

the learning becomes increasingly collaboration, interconnected, continuous, conversational, dialogical, more community-based and communicative. The formal context includes different learning activities such as classroom, game-based, virtual classroom, e-learning, forums, and conferences; the informal context includes web conferencing, mentoring, workshops, webinars, case studies, podcasts; the social concept refers to learning through social networking tools such as blogs, wikis, micro blogs, tagging, friendship, user-generated messaging platforms and content. While the non-formal learning model has been applied and studied in the organizational context for employees, it is commonly utilized for e-learning to motivate learners across other learning and training contexts. Accelerate learning activities for students across all channels and platforms to structure content and context around emerging paradigm approaches of the next learning paradigm. The accessibility of content anytime and anywhere leads to changes in e-learning and social learning. Hence, the advancement and use of progress and technology of social learning contexts and environments is enabling and facilitating better content distribution among different user segments and types of individuals. The recent point about the use of cell phones has enormous implications for the sharing of ideas, discussions and the dissemination of other social information. The technology available today (mobile non-formal learning technologies, apps and pervasive computing, etc.) can increase the accessibility and use of resources and interaction between peers to achieve innovative practices and programmes.

Increasing digital interdependence profoundly altered essential human engagement and created a new and expansive environment for access to information, digital learning and connectivity at our fingertips. The exponential growth and all-consuming nature of technology, from the first evolution of the world wide web to the versatile computing tools which are the palm of our hands, has been a fascinating development. (Cladis, 2018). What is the average number of times a day people interact with their phones? The research shows that on average, people tap, click and

swipe 2,617 times per day. Among the heaviest adopters (top 10%), average interactions more than doubled to 5,427 taps per day. That averages out to close to 1 million touches per year; 2 million for the less shy among us. On a typical phone, the mean phone screen duration is 2.42 hours for the moderate user and 3.75 hours for the severe consumer. Michael Winnick and Robert Zolna. https://dscout.com/people-nerds/mobile-touches.

Impacts of Sedentary Lifestyle and Screen Time on Physical Health

Sedentary behaviors are described as behaviors performed while awake, for example sitting or bending, at an exertion of 1.5 metabolic equivalent tasks (METs) or below. This definition, proposed by the Sedentary Behaviors Research Network, is the most commonly used definition of sedentary behaviors at present (Tremblay et al., 2017). Sedentary lifestyles contribute to every mortality cause, double the risk of diabetes and obesity, cardiovascular disease, and increase the risk of high blood pressure, colon cancer, lipid disorders, osteoporosis, anxiety and depression. The World Health Organization estimates that between 60% and 85% of populations in both industrialized and developing economies are leading sedentary lifestyles, indicating that this is one of the most significant but under-addressed public health challenges of today. It is estimated that around two-thirds of children are also not active enough, with serious implications for children's future health ("Physical inactivity a leading cause of disease and disability, warns WHO," 2002).

Screen-dependent sedentary time has many negative health impacts. Duration of total daily inactivity and television exposure have been associated with an excess risk of mortality from all causes (Katzmarzyk et al., 2019). Looking at mortality rates of people who sat for less than 10 hours and less than 5 hours a day, one study found that time spent sitting was associated significantly with all-cause mortality (Rillamas-Sun et al., 2018). According to a study examining the association between time spent watching television

and overall rates of all-cause mortality, those who spend 6 or more hours a day watching television have twice the risk of dying from all causes compared to those who watch less than 2 hours of television (Hamer, Yates, & Demakakos, 2017). People who spent longer than 4 hours a day watching television were 1.5 times likelier to die from all causes than people who spent less than 2 hours a day watching television (Imran et al., 2018).

Understanding Technology Addiction

It begins with H. G. Wells' 1894 fictional story about an electric power plant worker dependent on a powerful electric machine. In 1956, Horton and Wohl explored the psychological impact of mass media, suggesting that vulnerable individuals might develop problematic para-social relationships with characters. The term "computerniks" was coined in 1968 by Block and Ginsburg to describe those emotionally or sexually attached to computers. The scientific inquiry into technological addiction began in the late 1970s. Leary (1975) used the term "technological addiction" to describe people's obsession with inventing and using various technologies. Weizenbaum (1976) introduced the concept of a "pathologically compulsive programmer," likening it to compulsive gambling. Thimbleby (1979) suggested that the addictive nature of PCs leads to obsessive compulsive programmers. Zimbardo (1980) reported on the negative experiences of computer dependents at Stanford University. Frude (1983) compared computer addicts with alcoholics, noting their deep love for machines and social withdrawal. In the 1980s, research focused on the negative effects of playing video game addictions. Ross et al. (1982) reported evidence of obsessive video game involvement and Loftus and Loftus (1983) proposed measures to recognize addicts to video games. Several researchers have emphasized the benefits of information technologies as educational devices and as contributors to children's learning and growth. In the 1980s, there were bans on video games in various countries due to concerns about violence and mental problems, leading to what the authors describe as a "moral panic"

surrounding video game. The research expanded beyond video games to include the concept of "computer mania" and discussions on "compulsive technology" and "technophilia." The 1990s saw increased public attention to video game addiction, and scholars like Mark D. Griffiths began rigorous research, defining and empirically demonstrating the existence of technological addictions. With the rise of the Web, interest has turned to Internet Addictive Disorder and Kimberly S. Young has provided strong empirical evidence for this phenomenon. In the beginning of the 2000s, it was a surge of interests technology addiction, leading to the development of models and measurement instruments. While mainstream information systems journals were initially slow to publish on technology addiction, major papers began to appear in these journals around 2011. The topic of technology addiction entered mainstream research in the information systems field, and academic conferences started featuring dedicated tracks on the topic. In the early 2010s, neuroscience studies comparing technology-related and substance addictions gained prominence. Identification of Gaming Disorder by the International Classification of Diseases 11th Revision and the Diagnostic and Statistical Manual of Mental Disorders-5's call to examine Internet Gaming Disorder have further fueled medical and psychiatric research and indicate that technological addiction investigations will continue in the field of information systems (Serenko & Turel, 2021).

Digital addiction prevalence of various different forms of digital addiction subtypes between 0.5% and 84%, with large disparities in diagnostic tools, digital media subtypes and methodological quality, and biases due to small single population, sample size, invalid screening methods and non-random sampling (Alhassan et al., 2018; Feng, Ramo, Chan, & Bourgeois, 2017). These seem to be the key figures you might need to 'get a handle' on the 'state of digital' today: Worldwide population: 7.91 billion as of January 2022, growing at an estimated rate of 1.0 percentage point per year to reach 8 billion by mid-2023. More than over half of the world's inhabitants (57.0 percent) live in metropolitan areas

(https://wearesocial.com/uk/blog/2022/01/digital-2022-another-year-of-bumper-growth-2/). Today, slightly more than 2/3 of the world's population (67.1 %) uses a smartphone, and the global number of individual users will increase to 5.31 billion by the beginning of 2022. At this time last year, with 95 million new cell phone users, the global total was up 1.8 percent year-on-year. Global internet users are estimated to reach 4.95 billion by early 2022, while internet penetration currently stands at 62.5 percent of the world's current population. Though the data shows that internet users have increased by 192 million (+4.0 %) in the last year, continuing restrictions on surveys and reports due to COVID-19 suggest that actual growth trends may be much higher than these data indicate. Globally, there are 4.62 billion social media accounts as of January 2022. That's 58.4 percent of the global population, but it's important to realize that social media "users" may not necessarily indicate unique persons. In the last 12 months, more than 10 percent increase in global social media users, 424 million people start their digital journey on social media in 2021 [23].

Physical Activity and Its Benefits

WHO defines physical activity as meaning any movement of the body that is generated by muscles of the skeleton and requires the use of energy. It includes any movement, defined as leisure time, including transportation to and from a place or as just part of a participant's work. Physical activity at both mild and severe intensity improves physical health (Organization, 2022). Common types of ways to be active include sports, cycling, walking, wheeling, active recreation, and can be enjoyed by anyone of any skill level. Physical activity on a regular basis provides significant health advantages. Even a little physical activity is preferable to nothing at all. Humans can reach suggested activity rates easily by getting more active in comparatively simple ways throughout the day.

Regular physical activity can bring many benefits. These benefits can be summarized as follows (Organization, 2019):

- Increase muscular structure
- Increase cardiorespiratory fitness.
- Improves functional and bone health.
- Decreases the risk of diabetes, hypertension, depression, coronary heart disease, stroke and various types of cancer.
- Decrease helps to promote the development of a healthy body weight and the risk of falls

Physical activity improves in children and adolescents:

- Physical fitness and bone health
- Cardiometabolic health
- Develop cognitive function
- Mental and physiological health
- Regulate adipose tissue

Higher levels of physical activity improve in adults and older adults:

- Reduce risk of mortality
- Occurrence hypertension
- Incident site-specific cancers
- Prevents of falls
- Incident type-2 diabetes
- Reduced symptoms of depression and anxiety
- Develop cognitive health
- Increase quality of sleep
- Improve healthy adipose tissue

Physical activity for postpartum and pregnant women provides the following maternal and fetal health benefits and reduces these parameters:

- Pre-eclampsia
- Excessive gestational weight gain
- Gestational hypertension
- Reduction in the risk of gestational diabetes
- Complications of childbirth
- Postpartum depression
- Neonatal complications
- Physical activity has no negative effect on birth weight or risk of stillbirth.

Recommendations and Guidelines

WHO guidance and recommendations provide details on what level of physical activity is necessary for maintaining optimum health for specific population groups and for various age groups (Organization, 2019).

WHO recommends the following:

Children under 5 and Infants (under 1 year) need to be physically active a few times a day in a 24-hour day in a range of ways, especially interactive floor games; more is always better. For children who are not yet mobile, this includes at least 30 minutes at intervals throughout the day in the prone position while awake; limited to no more than 1 hour at a time (for example, strapped to the back of a highchair, stroller or caregiver); screen time is not recommended. While they are still, it is recommended that a caregiver tells a story or reads a book. They should also have 14-17 hours of quality sleep for babies aged 0-3 months or 12-16 hours for babies aged 4-11 months, including naps (Organization, 2019).

Children aged 1-2 years should spend at least 180 minutes in a 24-hour day in a variety of physical activities of all intensities, including moderate to vigorous intensity physical activity; even more is better. They should not be immobilized or seated for more than 1 hour at a time. For 1-year-olds, sedentary screen time (such as watching videos or television, playing computer games) is not suggested. For 2-year-olds, inactive screen time should be no more than 1 hour; less is better. When sedentary, reading books and storytelling with a caregiver is encouraged; and obtain 11-14 hours of quality sleep, including regular bed and wake times and naps(Organization, 2019).

Children aged 3-4 years should do at least 180 minutes of varied physical activity in a 24-hour day, at any intensity spread throughout the day. At least 60 minutes of these activities should be moderate to vigorous intensity physical activity. Increasing the duration will provide additional benefits. Sedentary screen time should be no more than 1 hour; less is better. When sedentary, engage in and encourage reading and storytelling with a caregiver; and Regular bedtime and wake-up times should be 10-13 hours, including naps (Organization, 2019).

Children and adolescents aged 5-17 years should engage in physical activity of moderate to vigorous intensity, mostly aerobic, for at least 60 minutes on average per day during the week. They should include activities that strengthen muscles and bones, as well as vigorous-intensity aerobic activities at least 3 days a week. Limit sedentary time, especially screen time for entertainment (Organization, 2019).

Adults aged 18-64 years should engage in at least 150-300 minutes of moderately intense aerobic exercise or at least 75-150 minutes of vigorous intensity aerobic exercise or an equivalently high combination of moderate- and vigorous-intensity activity during the week. Furthermore, participants should do moderate or higher intensity muscle-strengthening activities involving all major muscle groups 2 or more days a week, as these have additional health

benefits. For additional health benefits, they can increase moderate intensity aerobic physical activity to more than 300 minutes or intensity aerobic physical activity to more than 150 minutes, or an equivalent combination of moderate and vigorous intensity activity during the week. They need to limit sedentary time. Replacing time sedentary with physical activity of any intensity offers health benefits (including light intensity) and all adults and older people could aim to do more than the suggested levels of moderate to vigorous intensity physical activity to help decrease the harmful health impacts of high amounts of inactive behaviour (Organization, 2019).

As for adults aged 65 years and older; as an integral part of their daily physical activity, older adults should engage in a variety of multicomponent physical activities emphasizing moderate or higher intensity functional balance and strength training 3 or over days per week to increase their functional capacity and reduce falls (Organization, 2019).

Global Physical Activity Levels

Approximately a fourth of the global adult population (1.4 billion adults) is not enough active. Globally, 1 in 3 women and 1 in 4 men does not get sufficient levels of physical activity to stay healthy. In high-income countries, the level of inactivity is twice as high as in lower income countries. Since 2001, no improvement in global physical activity levels has been observed. Between 2001 and 2016, inadequate action expanded by 5% in higher-income regions (from 31.6% to 36.8%). Increasing degrees of reduced physical activity have adverse impacts on healthcare systems, economic development, the health of the environment, quality of life and community well-being. Worldwide, 28% of adults aged 18 years and older were not sufficiently active in 2016 (23% of men and 32% of women). These people were not meeting current global guidelines of at least 150 minutes of moderately intense or 75 minutes of vigorously intense intensity physical activity each week. Approximately 26% of men and 35% of women in high-income

countries are not sufficiently physically active, compared to 12% of men and 24% of women in low-income regions. The decrease in levels of physical activity is caused in part by inactivity in free time and inactive behaviors at home and at work. Similarly, the growing use of "passive" modes of transportation contributes to insufficient physical activity. In 2016, worldwide, 81% of adolescents aged 11-17 years were not sufficiently physically active. Teenage girls are significantly less physically active than teenage boys, with 78% compared to 85% not achieving the WHO recommendation of at a minimum of 60 minutes of moderate to vigorous intensity physical activity daily (Organization, 2019).

Ding et al. (Ding et al., 2020) created a physical activity graph as a result of decades of evidence generation, synthesis and updating of existing physical activity guidelines. With this figure, it is possible to easily determine the context, target population and type of physical activity. We can also see the change in physical activity intensity, frequency, duration, and volume over the years.

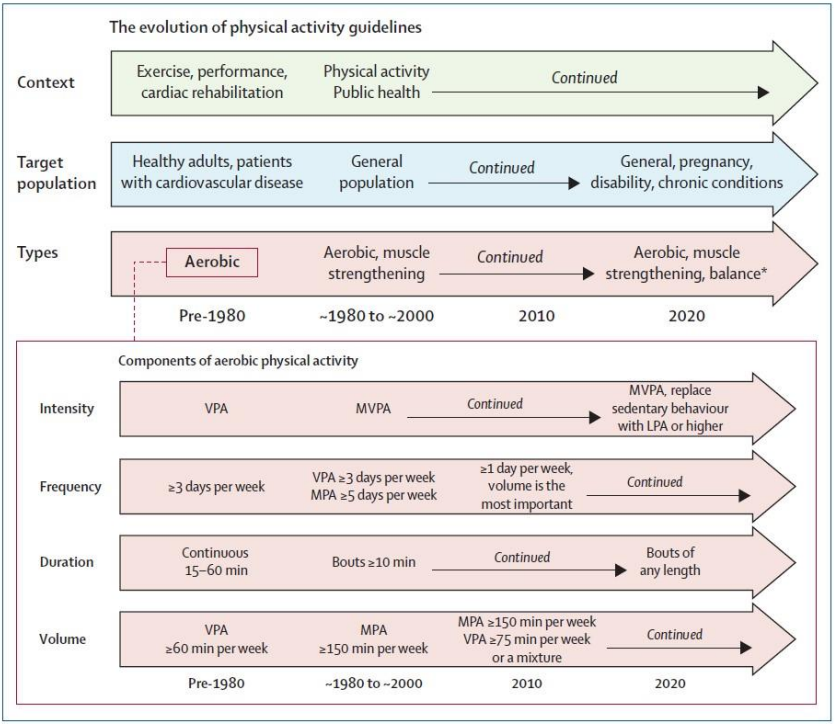

Figure: The evolution of physical activity guidelines and components of aerobic physical activity
VPA=vigorous-intensity physical activity. MVPA=moderate-to-vigorous intensity physical activity. MPA=moderate-intensity physical activity. LPA=light-intensity physical activity. *Primarily among older adults.

Technology Addiction and Its Effects on Exercise

Physical training is recognized as a special recognized subclass of physical activity. It is an organized, voluntary, constructed, persistent activity aimed at improving one or more elements of physical fitness (Bliznevsky et al., 2016). Physical exercise is described as scheduled and organized movements that develop or maintain parameters of physical fitness. Physical exercise has beneficial impacts both physical and psychological (Ivashchenko & O.O, 2016). People do exercise to enjoy themselves, improve a more positive sense of self, and socialize (Çakir, 2019). Besides the general wellness benefits of exercise, research has also shown that it protects mental health by helping to reduce depression

and anxiety (Koruç & Bayar, 2004). It is important that people feel physically, psychologically and socially well through exercise (Koçak, 2018). This review by Li et al. reviews developments in our current understanding of the mechanisms by means of which exercise can decrease online addiction and reinforces the idea that exercise-based interventions may be efficacious in this context. Mounting research evidence demonstrates that exercise can elevate levels of cortisol, neurotrophic factors and neurotransmitters; can improve the morphology of certain sections of the central nervous system, such as by stimulating hippocampal neurogenesis; can maintain the autonomic nervous system; and can control the reward drive. Simply put, exercise reduces addiction to the internet by modulating the neurobiology of the central and autonomic nervous systems. Thus, exercise-based treatments can be suggested to reduce addiction to the internet (Li, Wu, Tang, Chen, & Liu, 2020).

Future Directions and Research Needs

Considering the Future Directions of Technology and Physical Activity Integration; More integration of technologies such as smart devices, virtual reality, augmented reality into exercise and physical activity programs can contribute to individuals becoming more active. With Individualized Health Apps, applications that offer customized exercise and health recommendations to individuals using genetic data, biometric measurements and other personal health information may increase. In this way, it is possible to integrate technology with healthy living.

When we look at the Diversity and Effects of Technology, there is an inevitable need for more research to increase understanding of the specific effects of different types of technology (smartwatches, wearable technologies, virtual reality devices) on physical activity. Studies with more subjects and objective and valid scales should be planned.

Further studies are required to determine the impact of long-term technology use on physical activity habits and healthy

lifestyles, especially in younger generations. When we look at promising interventions and approaches in the future, it is important to develop digital applications that incorporate gamification principles to make exercise more attractive and provide sustainable motivation. Using virtual reality and augmented reality technologies, it is necessary to develop innovative approaches that will enable users to exercise in various environments. With these innovations, useful and fun use of technology will be possible. When we examine the ongoing development of technology and its effect on Physical Activity; developing AI-supported exercise plans that track and update individuals' performance is an inevitable process of our future. With the development of technology and socialization, the design and implementation of interactive and multiplayer exercise games will ensure the sociability of human nature.

Some innovations are also required in Community Engagement and Health Policies. Infrastructure Development for Digital Health, Health systems need to develop the infrastructure to integrate digital health applications. In this way, both easy access to health services and an effective process will be provided. Supporting education and campaign programs to raise public awareness about the effects of technology on healthy life is also an inevitable part of the process. All these directions can form a basis for research to fill existing knowledge gaps, to understand promising interventions and to evaluate the effects of the future development of technology on physical activity.

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CHAPTER II

Current Approaches for Mobilisation Applications in Arthritic Diseases

Ö.F. ÖZÇELEP[1]
A.TURHAN[2]

Introduction

There is a wide range of arthritic conditions that can impact the joints. This chapter will concentrate on the prevalent ailments, osteoarthritis and rheumatoid arthritis, and the mobilisation procedures employed in treating these conditions.

Osteoarthritis

Osteoarthritis (OA) is the prevalent type of arthritis that affects a majority of people at some stage of their lives (Rao, Balthillaya, Prabhu, & Kamath, 2018). Despite its prevalence, the aetiology of OA is still poorly understood, and imaging studies constitute a

[1] Öğretim Görevlisi, Kırşehir Ahi Evran Üniversitesi, Fizik Tedavi ve Rehabilitasyon Yüksekokulu
[2] Öğretim Görevlisi Doktor, Kırşehir Ahi Evran Üniversitesi, Fizik Tedavi ve Rehabilitasyon Yüksekokulu

significant part of the ongoing research in this area. (Bhagat, Neelapala & Gangavelli, 2020) The condition is believed to be primarily caused by a deficiency in the typical transmission of forces across a joint. (Nigam, Satpute & Hall, 2021) Trauma to the bones or ligaments, or changes in the joint's ability to transmit forces, such as alterations in the cartilage composition in ochronosis or ligaments in certain collagen disorders, could be the cause of it. However, osteoarthritis has a multifactorial aetiology, involving various factors such as genetics, race, ethnicity, obesity, age, and gender, as reported by Alkhawajah and Alshami. (Alkhawajah & Alshami, 2019)

Primary generalised OA occurs without an obvious underlying cause and has a genetic predisposition. It is more prevalent among women and typically affects the hands, hips, knees, bases of the thumbs and first metatarsophalangeal joints of the feet. Secondary OA cases arise from underlying causes, and various sources are recognised. The radiological characteristics in a specific joint can be similar to those observed in primary generalised OA. It is crucial to note that osteoarthritis (OA) can co-occur with other types of joint diseases, including rheumatoid arthritis.(Cao et al., 2017)

Erosive osteoarthritis (OA) is a classification of OA characterised by significant inflammatory features, such as destructive bony erosions in the joints. Although it seldom affects large joints, it typically affects the distal and proximal interphalangeal joints of the hands. Although clinical assessment can offer some insight into the inflammatory nature of this disease, the diagnosis of erosive OA is predominantly based on imaging findings. Erosive OA is most common in postmenopausal women.(Mostamand, Adeli, Ahmadi, & Hassanzadeh, 2023)

Rheumatoid Arthritis

Rheumatoid arthritis (RA) is an inflammatory arthritis linked with synovitis-induced joint inflammation (Emery, 2015). Additionally, inflammation beyond the joints may occur, such as tenosynovitis, soft-tissue (rheumatoid) nodules, and multi-systemic

effects not limited to the musculoskeletal system, like rheumatoid lung disease. (Bray, 2016) Rheumatoid arthritis is an autoimmune disease mediated by inflammatory pathways. The treatment of this disease has undergone considerable changes in recent years with the advent of biologic therapies in the form of disease-modifying anti-rheumatic drugs (DMARDs). These drugs are capable of inducing remission and preventing the severe joint destruction that was frequently seen prior to their introduction. (Harris, 2003) To achieve remission, it is essential to introduce DMARDs early in the treatment pathway, before there is any structural joint damage evident. This has led to an augmented function for sophisticated imaging techniques like MRI and ultrasound, both for preliminary diagnosis and for scrutinizing response to therapy.(do Prado et al., 2018)

Synovitis is believed to mediate joint damage, involving cartilage loss and bone erosion; with synovitis being a significant predictor of future structural joint damage, as evidenced by several studies (Alivernini, Tolusso, Petricca, Ferraccioli & Gremese, 2019). In the diagnosis of RA, clinical and radiological assessments, along with laboratory evaluation of inflammatory and immunologic markers, are commonly used. It is acknowledged that both ultrasound and magnetic resonance imaging are superior in their sensitivity to clinical assessment for synovitis detection (Alivernini et al., 2019). Rheumatoid arthritis (RA) is more prevalent in women and generally originates in small joints of the hands and feet, with a symmetrical presentation early in the disease. Subsequently, larger joints are affected. (Safiri et al., 2019)

Mobilisation Application

Manual therapy is the skilled application of passive motion to a joint, either within ('mobilisation') or beyond ('manipulation') its active range of motion. It includes oscillatory techniques, high-velocity, low-amplitude thrust techniques, prolonged stretching and muscle energy techniques. Manual therapy can be applied to joints,

muscles, or nerves, with treatment aims that include pain reduction, improving joint movement range and quality, increasing nerve mobility, lengthening muscles, and restoring normal function. Its therapeutic effects can be explained through three paradigms; physiological, biomechanical or physical, and psychological.(Dziedzic & Hammond, 2010)

The physiological impacts of manual therapy comprise reducing pain through the pain gate theory and stimulating the descending inhibitory tracts. Also, manual therapy can indirectly decrease pain by hampering muscle spasm that leads to diminished tensile forces on the periarticular structures. Consequently, intraarticular pressure is reduced, or nociceptor activity is decreased. (Melzack & Wall, 1965)

The biomechanical effects of manual therapy entail modifying tissue extensibility and fluid dynamics, thereby promoting repair and remodelling. It is crucial to recognize these effects for optimal therapeutic outcomes. Manual therapy temporarily increases tissue extensibility via the mechanisms of creep, which causes tissue elongation following application of a constant force or load, and preconditioning, which promotes elongation following repeated loading. (Kapandji, 2007)

The psychological impact of manual therapy, or any type of therapy involving direct physical contact, such as massage, incites a reaction related to the notion of 'laying on of hands'. The placebo response, which occurs when treatment has no actual therapeutic effect but produces a positive response due to incidental ingredients or components, can be enhanced by learned expectancy resulting from previous experience with a stimulus, as well as the therapeutic advantages of the patient-therapist interaction and relationship. (Huijbregts, 2011)

Despite these effects, most physiotherapists prefer mobility exercises and patient education to mobilisation, which are evidence-based approaches. This highlights the need to raise awareness of the appropriate use of mobilisations. (Feldman et al., 2022)

Mobilisations appear to be used as part of a comprehensive treatment programme for arthritis in peripheral joints, such as hip-knee OA, rheumatoid arthritis of the wrist or osteoarthritis of the thumb. Kaltenborn, Maitland and Mobilisation with Movement (MwM) are the most commonly used mobilisation techniques in the studies.

Examining the mobilisation frequencies used in the studies, we see that they are mostly performed with 3 sets of 10 repetitions.(Alkhawajah & Alshami, 2019; Bhagat, Neelapala, & Gangavelli, 2020; Takasaki, Hall, & Jull, 2013) In addition, there are mobilisations that are planned to be performed 3 times a week for 4 weeks for a total of 12 sessions and 15 times for 20 seconds in each session.(Kappetijn, van Trijffel, & Lucas, 2014; Sherazi et al., 2022)

In another study conducted in 2018, all participants received MWM, passive joint mobilisation and electrotherapy treatment with the same standardised exercise programme consisting of 12 sessions of approximately 50 minutes (three times a week). In this study, MWMs were performed in 3 sets of 10 repetitions.(Kaya Mutlu, Ercin, Razak Ozdıncler, & Ones, 2018) In contrast to these studies, there are also applications ranging from 3 sessions per week to 6 sessions per week. (Kiran et al., 2018)

There are studies that do not specify the number of sets and repetitions but determine the duration of the mobilisation applied. For example, in one study, knee mobilisation and manual cutaneous input were applied for 6 minutes at 1-week intervals (Courtney, Steffen, Fernández-De-Las-Peñas, Kim, & Chmell, 2016), while in another study, 20 minutes of mobilisations were applied 3 times a week.(Pawłowska, Bochyński, Pawłowski, Jerzak, & Grochulska, 2020)

Grade III of Maitland's Grading System is used to correct, compensate for or prevent intensity, stiffness and flexibility problems. The oscillation time is 2 or 3 oscillations per second for 1 to 2 minutes. (Shabbir et al., 2022) Joint mobilisation is performed in the early stages before a deformity develops, as it is very difficult

to achieve full ROM once a contracture has formed.(Chickermane, Panjikaran, & Balan, 2022)

Knee Osteoarthritis Application Results

In the literature, there are many studies on mobilisation applications in knee osteoarthritis. In a case series study looking at the immediate and short-term effects of MWMs in knee osteoarthritis, it was reported that mobilisations were effective in reducing pain and improving knee function. (Takasaki et al., 2013) In the study conducted by Altmış et al. to investigate the acute effects of Mulligan's movement mobilization (MwM) and taping on function and pain intensity in patients with osteoarthritis (OA), it was found that MwM accompanied by taping improved pain during functional activities as well as performance, and MwM without taping improved pain relief. It has been shown that it can also improve density, but is insufficient to increase performance. (Altmış, Oskay, Elbasan, Düzgün, & Tuna, 2018) Unlike these studies, it has been shown that MWM application is functionally more effective than the application of the post-isometric relaxation muscle energy technique, and both interventions increase functional performance in the short term in patients with chronic knee osteoarthritis, but are not functionally effective in a single session. Although a single session is not sufficient, it has been found that the application of both techniques reduces pain immediately and in the short term.(Taher, Bagheri, Ashnagar, & Jalaei, 2023)

A study conducted in 2014 showed that mobilization practices combined with exercise were effective in patients with knee osteoarthritis who complained of knee pain, decreased knee extension joint range of motion, and loss of function.(Kappetijn et al., 2014) Another example of combined treatments is the study conducted by Kiran et al. In this study, similar results were found in the study of Kappetijn et al. (Kiran et al., 2018) In another study investigating the effect of the combination of Mulligan mobilization with a supervised exercise program, it was stated that it was useful in relieving pain and improving range of motion, strength and

functional status in patients with knee osteoarthritis (Mehmood, Anwar, Tauqeer, Shabir, & Khalid, 2021), while in people with symptomatic knee osteoarthritis who received mobilization with movement for two weeks in addition to usual care, only significantly greater improvement has been reported than in people receiving usual care. Additionally, these effects have been found to have beneficial effects on disability, pain, function and patient satisfaction and persist for six months.(Nigam, Satpute, & Hall, 2021)

There are studies comparing mobilizations or comparing mobilizations with another physiotherapy method. One of these studies stated that both Maitland and Mulligan treatments were equally effective in reducing pain in knee osteoarthritis and improving functional mobility and pain-free squatting angle immediately after treatment. (Rao, Balthillaya, Prabhu, & Kamath, 2018) In the study comparing mobilizations with electrotherapy, it was shown that manual physical therapy consisting of MWM or passive mobilizations in the treatment of patients with knee OA provided superior benefits compared to electrotherapy in terms of pain level, knee ROM, quadriceps muscle strength and functional level.(Kaya Mutlu et al., 2018)

Studies comparing mobilizations with mock mobilizations are valuable because of their potential to reveal the pure effects of mobilizations. As a matter of fact, a study conducted in 2020 stated that Mulligan's techniques were effective in improving pain and functional mobility in individuals with knee osteoarthritis, while it was emphasized that the mechanisms underlying the observed effects should be further examined, as sham mobilization was also seen to reduce pain. (Bhagat et al., 2020) In another study designed to reveal these effects, MWM was shown to provide superior benefits over sham MWM in terms of local and widespread pain, physical function (walking), knee flexion and extension muscle strength, and knee flexion. (Alkhawajah & Alshami, 2019)

Besides these effects, mobilization improved balance in moderate to severe knee osteoarthritis(Mostamand et al., 2023),

although both Manual mobilization and conventional treatment had an equally positive effect on biomarkers, mobilizations significantly improved Serum Cartilage Oligomeric Matrix Protein and Type II Collagen C-Telopeptide, and post-articular conditional it has been found to improve pain modulation. (Shabbir et al., 2022) In addition, it has been stated that mobilization can provide a general decrease in deep tissue pressure sensitivity by strengthening the decreasing pain mechanisms.(Courtney et al., 2016)

In the review studies with high evidence value among the studies on the effects of mobilisations, it is possible to reduce pain (Li, Hu, Di, & Jiao, 2022), increase range of motion and thus restore function in patients with knee osteoarthritis with Mulligan mobilisations in particular and manual therapy methods in general. (Weleslassie et al., 2021) However, there is a need for methodologically better quality studies showing the long-term effects of mobilisations and free from potential bias.(Cao et al., 2017)

Hip Osteoarthritis Application Results

Adding grade B mobilization to a home exercise program (continuous stretches to hip flexion, abduction, extension, and medial rotation consisting of four repetitions of 60 seconds each) has been shown to have significant benefits, especially for pain relief and muscle strengthening with passive hip flexion. (Blackman & Atkins, 2014) However, the need for further research was emphasized. Although this pilot study revealed a workable design, the studies need improvement. Studies conducted to meet this need have shown that pain, hip flexion ROM and physical performance immediately improve after MWM application in elderly patients with hip OA. The sudden changes observed are clinically significant. However, future studies are needed to determine the long-term effects of these interventions. (Beselga, Neto, Alburquerque-Sendín, Hall, & Oliveira-Campelo, 2016) In this sense, it has been stated that mobilization increases hip range of motion, reduces pain, and improves hip function more than non-weight bearing exercises in hip

osteoarthritis, where a 20-minute mobilization session is applied 3 times a week for 2 weeks.(Pawłowska et al., 2020)

Thumb CMC Joint Osteoarthritis and Hand Rheumatoid Arthritis

Mobilization applications in arthritic diseases involving the hand and wrist are very limited in the literature. A 2011 study found that the Kaltenborn technique reduced pain in the CMC joint and scaphoid bone regions in older female patients, but did not provide an increase in motor function in patients with CMC. (Villafañe et al., 2011) Another study in rheumatoid arthritis patients showed that integrating manual mobilization of the hands of patients with RA into private healthcare services was feasible, safe and effective.(Levitsky et al., 2019)

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CHAPTER II

Smartphone Addiction and Physical Problems Caused by Smartphone Addiction

Seyde Büşra KODAK[1]

Introduction

Today, technology has become an integral part of life. Two of the most preferred tools of technology today are the internet and smart phones. These two tools provide convenience in many areas such as academic studies, trade, education and health services. In our age, individuals do not know what to do without the internet and smartphones (Kalyoncu 2019).

With the inclusion of the Internet in our lives, many changes have occurred in all our lives. With the Internet, many products, services and concepts that we have never heard of before have been rapidly integrated into our lives (Yildirim, Sumuer et al. 2016).

[1] Lecturer, Kırşehir Ahi Evran University

The adventure of the telephone until today begins with Graham Bell's invention of the telephone in 1876 (Kalba 2008, Yildirim, Sumuer et al. 2016). Although it has made progress, the development of the telephone has been limited due to the fact that it is wired. With the emergence of new generation wireless phones, the users of telephone technology, which solved the mobility problem, increased rapidly day by day and became one of the fastest developing technologies (Kalba 2008). Telephone and internet, which were once described as different mass communication tools, have rapidly intertwined and merged with the emergence of smartphones (Kuyucu 2017). It is no longer possible to talk about a single communication system. The merger has led to the emergence of an integrated communication system (Kuyucu 2017).

Developments in communication technologies have led to the rapid development of smartphone capacities. With 2G and 3G, the era of fast access to information has started, and especially the developments in 3G technology have led to major changes in smartphone technology. With 3G technology, users have started to access information more easily with their smartphones, which has caused smartphones to become an integral part of users' lives (Aslan and Aylaz 2014). Users have become incredibly integrated with their smartphones and have started to use them almost at the same rate as their clothes (Kuyucu 2017). Nowadays, almost all conceivable subjects are helped by smartphones, instead of taking notes, photos are taken with the phone, and even in the lessons, instead of taking notes, photos of presentations or materials are taken (Noyan, Enez Darçın et al. 2015).

At this point, smartphones, which are indispensable in life, have advanced with the developing technology, graphics processors and hardware features. In this way, smartphones have many advantages other than talking and messaging, such as surfing the internet, shopping, accessing information, listening to music, making simple designs and playing games, and even counting our heartbeats during our exercises. In fact, the most basic feature of smartphones that enables them to perform all these functions is that

they can connect to the internet. Thanks to these hardware and software features, smartphones have transformed from a phone into a portable small pocket computer (Aktaş, Yılmaz et al. 2017, Kuyucu 2017).

Providing the opportunity to do most of the daily work on the same device can be seen as the main reason why smartphones are so popular in human life (Türen, Erdem et al. 2017). The fact that smartphones are a part of daily life also causes some problems. Although a clear definition has not yet been made in the world of psychiatry, smartphone addiction has been an important subject of research and discussion as a type of addiction that develops depending on the frequency of smartphone use (Kuyucu 2017).

Addiction is everything that creates excitement in humans (Ünal 2015). Smartphone addiction, even if it has not yet been clearly defined, is also referred to as excessive use of the smartphone (Kuyucu 2017), which often occurs with symptoms such as inability to be separated from the phone, frequent checking the phone, inadequate sleep and decreased sleep quality due to excessive use (Townsend 2000). The fact that smartphones can easily access various features at any time, anywhere becomes a trap for some users. People who feel a sense of emptiness when their smartphone is not with them think that their smartphone has become an indispensable part of their lives. The behaviour of checking their phones for no reason and aimlessly opens the door to a problematic mobile phone use (Park, Lee et al. 2012). Today, the first thing that smartphone users do as soon as they get up in the morning and the last thing they do before going to sleep is to check their phones (Choi, Lee et al. 2012).

One of the underlying factors of smartphone addiction is easy access to the internet through the smartphone. The ease of access to the internet from anywhere with the advantage of being wireless is the main reason that increases addiction (Aslan and Aylaz 2014). There is also an increase in the addiction to smartphones with

internet connection. In other words, internet addiction is constantly expanding through smartphones (Kuyucu 2017).

Smartphones cause some problems along with the innovations and conveniences they bring to daily life. Smartphones, which have extremely useful and convenient features when used correctly, can have serious physical and psychological negative effects if used unconsciously and excessively. The main disorders that occur with the use of smartphones are as follows (Ünal 2015):

- Health problems such as headaches, eye and sleep problems due to continuous viewing of the screen

- Decrease in face-to-face communication due to social media follow-up and message communication and cause people to become a-socialised

- Impaired concentration due to the desire to constantly check the smartphone

- Due to the uncontrolled communication provided by the virtual environment, meeting the wrong people and causing people to be drawn to unhealthy and illegal channels

- Constant obsession with control and obsessive use can lead to anxiety and addiction,

- Causes accidents at home, at work, in traffic due to distraction,

- It is observed that spyware causes various problems such as interference in people's private lives and interception of passwords by foreign people (Ünal 2015).

It has been determined that smartphone addiction causes psychological problems such as attention deficit, social phobia, depression, hyperactivity and anxiety. People who withdraw into themselves by cutting off contact with the outside world due to smartphone use may be left with the problem of asociality. Interest in social life decreases and face-to-face communication is minimised (Kuyucu 2017). This situation causes socialisation to be expected

from virtual environments and isolates societies. People who communicate with Whatsapp and social media tools installed on smartphones are distanced from each other to the extent that they forget each other's voices and become prisoners of smartphones.

It is known that smartphone addiction causes physical problems as well as mental problems. It is possible to list these physical problems as follows (Aslan and Aylaz 2014):

Wrist Syndrome: In this syndrome, which is more common especially in computer addicts, physical symptoms such as hand paresthesia, structural deformities in the fingers, pain, decreased grip strength are observed.

Spasm in Neck Muscles: Static neck flexion due to smartphone use can cause neck muscles to contract, harden, and numbness in long-term use.

Decrease in Sleep Hours: Staying awake until late hours due to continuous use of smartphones can cause insomnia. In addition, constant exposure to blue light emitted from the phone screen during the day disrupts sleep quality and reduces work and school success.

Eye Problems: Excessive use of smartphones causes eye fatigue due to constant screen viewing. Symptoms such as eye fatigue, redness, burning and watery eyes can be seen (Aslan and Aylaz 2014).

In addition, the increasing use of smartphones among young people has introduced a new term to psychology. "Nomophobia (no mobile phobia)" is the fear of being deprived of smartphones and mobile internet. Characteristic features of nomophobic people; behaviours such as constantly checking whether there are messages or calls, feeling anxiety and tension in places where there is no coverage or restricted use, leaving the phone on 24 hours a day, going to bed with a smartphone are listed (Bragazzi, Del Puente et al. 2014). In studies, it has been stated that approximately 35% of university students are nomophobic (Minaz and Bozkurt 2017).

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