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PHYSIOTHERAPY

UČINEK MANUALNE TERAPIJE IN TERAPEVTSKE VADBE PRI PACIENTIH S KRONIČNO BOLEČINO V VRATU NA IZBOLJŠANJE FUNKCIJE, DEJAVNOSTI IN, SODELOVANJA V SKLADU Z MODELOM MEDNARODNE KLASIFIKACIJE FUNKCIONIRANJA, ZMANJŠANE ZMOŽNOSTI IN ZDRAVJA

THE EFFECT OF MANUAL THERAPY AND THERAPEUTIC EXERCISE ON PATIENTS WITH CHRONIC NECK PAIN TO IMPROVE FUNCTION, ACTIVITY, AND PARTICIPATION LEVEL IN ACCORDANCE WITH INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH

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POVZETEK

Uvod: Kronična bolečina v vratu je zahtevno stanje, ki je v sodobni civilizaciji postalo velik zdravstveni problem, je pogost vir invalidnosti, omejitev aktivnosti in sodelovanja.

Metodologija: Prvo randomizirano kontrolno preskušanje na Kosovu smo izvedli v zasebnem fizioterapevtskem centru. V raziskavo je bilo vključenih 111 pacientov (študija N56, kontrola N55). Študijska skupina je bila deležna novega multimodalnega fizioterapevtskega programa, ki je bil prirpavljen v skladu z dokazi podprto prakso v fizioterapiji: termoterapija, TENS, dinamične vaje, masaža globokega tkiva in pasivno raztezanje, kontrolna skupina pa je bila deležna: sprostitvene masaže, izometrične vadbe, aktivnega obsega gibanja, termoterapije, IF in hidroterapije. Vsi pacienti so prejeli 10 fizioterapevtskih obravnav. Za ocenjevanje učinkovitosti obravnave smo uporabili standardizirana merilna orodja v fizioterapiji: FRT, ST, DNFET, NRS, AROM, NDI, PSFS in MQOL. Podatke smo analizirali s statističnim programom SPSS, verzija 22.

Rezultati: Mlajši preiskovanci v študijski skupini so dosegali statistično značilne razlike v rezultatih funkcijskih testov izmerjenih pred in po obravnavi: NDI ($p = 0,003$), MQOL ($p = 0,052$), NPRS ($p = 0,002$), PSFS ($p = 0,009$), tudi AROM ($p = 0,040$) in DNFET ($p=0,001$). Mann-Whitneyjev U test je pokazal pomembne razlike med funkcijskimi rezultati preiskovancev kontrolne in študijske skupine ($p=0,001$). Regresijska analiza za meritve MQOL po fizioterapevtskem programu kaže, da sta fizično dobro počutje in eksistencialna podlestvica pomembna napovednika kakovosti življenja ($t = 5,515$. $p < 0,001$) ranljive populacije pacientov s kronično bolečino v vratu v našem vzorcu.

Zaključek: To je prvi RKP na Kosovu, ki nudi fizioterapevtom, zdravnikom in raziskovalcem uporabno orodje za izboljšanje dobrega počutja in bolečine s pomočjo novega multimodalnega fizioterapevtskega programa za paciente s kronično bolečino v vratu.

Ključne besede: spondiloza, bolečina, invalidnost/zmanjšana zmožnost, več modalni fizioterapevtski program, masaža globokega tkiva, kakovost življenja.

SUMMARY

Introduction: Chronic neck pain is a challenging condition that has become a major health problem in contemporary civilization, it is a frequent source of disability, activity limitation, and participation.

Methodology: We conducted first randomized control trial in Kosovo at the private physiotherapy clinical setting. The total number of patients included in the research was 111 (study N56, control N55). The study group received a new multimodal physiotherapy program which was prepared in accordance with evidence-based practice in physiotherapy: thermotherapy, TENS, dynamic exercises, deep tissue massage and passive stretching, while the control group received: relaxation massage, isometric exercise, active range of motion, thermotherapy, IF, and hydrotherapy. All patients have received 10 sessions of physical therapy. Standardized measurement tools in physiotherapy were used to evaluate the effectiveness of the treatment: FRT, ST, DNFET, NRS, AROM, NDI, PSFS, and MQOL. The data has been analyzed using the statistical program SPSS, version 22.

Results: Younger participants in study group showed statistically significant differences in pre and post results of functional tests: NDI ($p = 0.003$), MQOL ($p = 0.052$), NPRS ($p = 0.002$), PSFS ($p = 0.009$), also AROM ($p=0.040$) and DNFET ($p=0.001$). Mann-Whitney U test which showed significant differences between subjects of the control and study group ($p=0.001$). The regression analysis for the post-treatment measurements of MQOL indicates that physical wellbeing and the existential subscale are significant predictors of quality of life ($t = 5.515$. $p < 0,001$) of vulnerable sample of patients with chronic neck pain in our sample.

Conclusion: This is the first RCT in Kosovo which provides physiotherapists, doctors, and researchers with a useful tool for improving well-being and pain through a new multimodal physiotherapy program for patients with chronic neck pain.

Keywords: spondylosis, pain, disability, multimodal physiotherapy program, deep tissue massage, quality of life.

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LIST OF ABBREVIATIONS

CNP - Chronic neck pain

NP – Neck pain

IASP - International Association for the Study of Pain

ICD - International Classification of Diseases

ICF - International Classification of Functioning, Disability, and Health

KNGF - Royal Dutch Society for Physiotherapy

RCT - Rrandomized controlled trial

AROM - Active Range of Motion

NPRS - Numerical Pain Rating Scale

NDI - Neck Disability Index Questionnaire

ST - Spurling's test

FRT - Flex-Rotation test

DNFET - Deep Neck Flexor Endurance Test

MQOL - McGill Quality of Life Questionnaire

PSFS - Patient-Specific Functional Scale

PT – Physiotherapy

WCPT - World Physiotherapy

TENS - Transcutaneous electrical nerve stimulation

EE - Eccentric exercises

IFC - Interferential current

IFT - Interferential therapy

ROM - Range of motion

PROM – Passive range of motion

DNF - Deep neck flexors

CROM - Cervical Range of Motion instrument

FLEX – Flexion

EXT – Extension

LSB - Left side bending

RSB - Right side bending

LR - Left rotation

RR - Right rotation

CSB - Cervical side bending

CR – Cervical rotation

ADL - Activities of daily living

ODI - Oswestry Disability Index

SPSS - Statistical program

PCS - Physical component summary

MCS - Component summary measures

PCA - Principal Component Analysis

KMO - Kaiser-Meyer-Olkin

CI - Confidence intervals

H – Hypothesis

BMI – Body mass index

QOL – Quality of life

1 INTRODUCTION

Chronic neck pain (CNP) is a challenging condition that has become a major problem in contemporary civilization. It is a frequent medical problem that can interfere with regular activities. Even though neck pain is not the most common musculoskeletal problem, it is nevertheless quite important. It has a startling financial cost that includes medical costs, missed productivity, and challenges at work (Kazeminasab et al. 2022).

Neck pain (NP), also known as cervical discomfort, is typically accompanied with dull aches. It may worsen with movement of the neck or twisting of the head, it can be caused by a variety of disorders and diseases, and it can affect any of the tissues in the neck, with degenerative disorders being the most common cause (Hirpara et al. 2012). Cervical discomfort is a leading source of morbidity and disability in the overall population. It can influence an individual's physical, social, and psychological well-being. Furthermore, as the population of middle- and low-income countries ages, the prevalence of neck discomfort will rise dramatically in the next decades (Genebra et al. 2017).

According to the evidence, NP has been proven to be a risk factor for decreased general work productivity in young people and is significantly connected with disability and decreased quality of life. Due to expenditures associated with medical care, insurance, lost productivity, and sick leave, neck pain has major economic repercussions for both the individual and society (Jahre et al. 2020). Neck discomfort is one of the most common musculoskeletal issues, affecting up to 70% of the general population at some point in their lives. Most acute neck pain episodes disappear with or without therapy; however, some patients continue to feel discomfort or have repeated occurrences (Khired 2022).

Chronic neck pain (CNP) is defined as neck discomfort that lasts longer than three months and causes significant disability, poor quality of life, loss of work productivity, and a significant social and economic impact (Seyda et al. 2021a). The human neck is one of the most complicated regions of the body. This intricacy is due to its anatomic and physiologic design. Common disorders that could lead to chronic neck pain are degenerative changes, disc damage, radiculopathy, facet joint dysfunction, muscle strains, sprains, etc. (Cox et al. 2020; Misailidou et al. 2010).

Neck pain is a frequently experienced issue, but the majority of the causes are unknown, making diagnosis and therapy extremely difficult. One of the main issues in individuals with neck discomfort is a loss of cervical proprioception, which contributes to cervical sensorimotor control disorders. The cervical spine possesses a sensitive proprioceptive system that is critical for maintaining posture and balance (Peng et al. 2021). Chronic neck pain, whether attributed to work, injury, or other repetitive functional or motor activities with stress on the neck, is a frequent source of disability, activity limitation, and participation, and a common reason for consulting primary health care providers, including musculoskeletal physiotherapists, general practitioners, and physiatrists (Ghodrati et al. 2017).

The prognosis and perception of pain for persons with cervical disorders are significantly impacted by psychosocial factors. This approach is in line with the biopsychosocial paradigm, which holds that each person's experience of pain is unique and the result of interactions between biological, psychological, and social elements. Emotional and cognitive reactions to nociceptive information are also a part of experiencing pain. The patient's worries, concerns, and beliefs may influence how they react to an injury, pain, and therapy (Meints and Edwards 2018).

Pain in the lumbar and cervical regions is 20% more common in obese men and women. Chronic pain risk is raised by physical inactivity and overweight according body mass index (BMI) (Nilsen et al. 2011). Women with chronic pain have decreased serum levels of vitamin D and ferritin, according to statistical research (Eloqayli et al. 2018).

A cycle of despair, disability, and persistent pain can result from the patient's fear of pain and recovery, increased pain, and increased sensitivity to any slight discomfort. The likelihood of developing chronic pain is lower in those who practice religion (Baetz et al. 2008)**.** Additionally, religious practitioners are more likely to preserve psychological and physical health as well as employ constructive coping mechanisms (Baetz et al. 2008; Leeuw et al. 2007).Lower back and neck pain continue to be the top cause of years spent with a handicap and the fourth-largest cause of years lost to work, according to the Global Burden of Disease 2015 (Hurwitz et al. 2018; Kelly et al. 2012).

2 THEORETICAL PART

2.1 Definition of chronic neck pain and classification

Pain is more than a symptom, and it is rarely conveyed as a single complaint (Vinall et al. 2016). Intensity, duration, type, and meaning of pain vary greatly from person to person. The International Association for the Study of Pain (IASP) have released a revised definition about pain as “An unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage” (Stevens 2021). Pain located in the cervical region has different definitions based on evidence. Pain also varies with location, duration, etiology and severity (Misailidou et al. 2010). There are numerous definitions for the broad concept of chronic neck pain. According to Binder (2007), "chronic pain is considered any pain that lasts more than 4 months," and is "an uncomfortable feeling and emotional experience that is related to actual or potential tissue damage."

Another classification for chronic neck pain from The International Association for the Study of Pain defines “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” (Misailidou et al. 2010).

The categorization of pain related to duration is well defined into three phases. This categorization is recommended from the IASP and also from the Neck Pain Task Force. It spans the acute phase which lasts up to 7 days, a sub-acute phase which lasts more than 7 days and not less than three months, and a third chronic phase which is considered to be pain that lasts more than three months. The only difference between the two recommended institutions is the definition on the concepts of acute, subacute and chronic (Misailidou et al. 2010).

Regarding the types of neck pain according to evidence (Guzman et al. 2008), there are four of them that can be taken into account: first, there is no sign of substantial pathology, and daily life is not significantly disrupted; second, there is no obvious pathology, daily activities could be affected; third, neck ache accompanied by type three, where radiculopathy and neurological signs or symptoms could also be indicated and; fourth, significant neck pathology (such as a fracture, myelopathy, tumor, or spinal infection). Neck pain can be associated with degenerative processes or other pathologies

related to the structures in the cervical part, but the cause of the pain often remains unknown. Therefore, it is necessary to evaluate the damaged function related to the structures such as muscles, ligaments, and nerves, based on the given recommendations formulated by scientific evidence (Binder 2007) .

The International Classification of Diseases (ICD) categorizes neck pain in different levels regarding the severity of the symptoms: “cervicalgia, pain in thoracic spine, headaches, cervicocranial syndrome, sprain and strain of cervical spine, spondylosis with radiculopathy, and cervical disc disorder with radiculopathy”. According to the International Classification of Functioning, Disability, and Health (ICF), when classifying a patient with neck pain into one of the following categories, the patient should have important clinical signs and symptoms such as neck pain without serious medical conditions, limited range of motion, headache, and radiated pain (Childs et al. 2008).

According to the International Association for the Study of Pain (IASP), pain is an experience that is mediated by dispersed neural pathways in the brain. Regarding the mechanism, there are three basic pain phenotypes: nociceptive, neuropathic, and nociplastic pain (Fernández-de-las-Peñas et al. 2022). Nociceptive pain can be defined as pain caused by the activation of primary afferent neurons' peripheral receptive terminals in response to painful chemical, mechanical, or temperature stimuli. When pain sensation corresponds to the nociceptive input, the term nociceptive pain is frequently used in clinical settings (Smart et al. 2010).

The International Association for the Study of Pain defined pain as neuropathic: “1. a lesion or disease of the somatosensory nervous system (i.e., central or peripheral nervous system) is identifiable; 2. pain is limited to a ‘neuroanatomically plausible’ distribution of the system; and 3. supported by clinical examination findings as well as imaging and/or laboratory findings” (Scholz et al. 2019). The same organization defined nociplastic pain as “pain that arises from altered nociception despite no clear evidence of actual or threatened tissue damage causing the activation of peripheral nociceptors or evidence for disease or lesion of the somatosensory system causing the pain” (Kosek et al. 2016).

2.2 Cervical spondylosis

Neck spondylosis describes the aging-related degenerative changes to the neck area. In these circumstances, disc herniation due to aging causes the disc height to decrease and the foramina to narrow (Liang et al. 2019). Axial neck discomfort, cervical myelopathy, and cervical radiculopathy are the three clinical signs connected to cervical spondylosis. The most prevalent of these illnesses is axial neck discomfort, however its etiology is unclear. It is most likely that poor posture and weakness of the muscles would cause discomfort, which will activate nociceptive pathways in soft tissue structures (Kelly et al. 2012).

Neck pain is a very common symptom in the overall population. It is often considered to be simple neck pain with or without a specific cause. The condition known as cervical spondylosis is a natural aging disease process characterized by degenerative changes in the intervertebral disc (Miao et al. 2018).

Age-related degeneration of the cervical spinal components and intervertebral discs is the main risk factor and contributor to the rate of cervical spondylosis. The spinal canal and intervertebral foramina widen as a result of degenerative alterations in the surrounding structures, including the facets joints, ligamentum flavum, and posterior longitudinal ligament (Kelly et al. 2012). In addition, having a congenitally narrow vertebral canal, dystonic cerebral palsy that affects the cervical musculature, a congenitally compressed spinal cord, and engaging in certain sports like rugby, soccer, and horseback riding are all risk factors that may speed up the disease process and result in early-onset cervical spondylosis. These syndromes are caused by compression of the spinal cord, nerve roots, and spinal vasculature (Morishita et al. 2009). Axial pain is a symptom of cervical spine pathology, including disc herniations, discogenic pain, lateral osteophyte, uncovertebral and zygapophyseal joint hypertrophy. Neuropathic pain most typically affects the C6 and C7 nerve roots (Childress and Becker 2016).

2.3 Prevalence and incidence

Neck discomfort is a complex condition that has become a prominent issue in modern life. Even though neck discomfort is not the most frequent musculoskeletal

problem, it is nonetheless quite important. Neck pain has a significant economic impact, which includes treatment expenses, decreased productivity, and job-related issues. Neck discomfort had a global age-standardized prevalence and incidence rate of 3551.1 and 806.6 per 100,000 people in 2017 (Genebra et al. 2017).

Neck pain is predicted to have a lifetime prevalence of 40-70%. This will rise until the age range of 35-49. According to existing studies, the 1-year incidence of neck discomfort ranges between 10.4% and 21.3%, with a higher prevalence observed in office and computer workers (Kazeminasab et al. 2022). Females had a larger burden of neck pain than males. Females experienced 166.0 million cases of neck pain in 2017, while males experienced 122.7 million. In addition, females had greater years of impairment from neck pain than males. In 2017, the age-standardized prevalence of neck discomfort increased with age up to 70-74 years, subsequently decreasing with age (Genebra et al. 2017).

According to other scientific data, the prevalence of cervical pain in the general population ranges from 0.4% to 86.8%. Further, more scientific data reported that 15% - 20% of patients report pain in the cervical region every year and 1.5% -1.8% seek medical help. Pain in the cervical region is quite bothersome. A huge number of problems are associated with issues in the cervical region, such as decreased quality of life and expensive health-care costs (Hoy et al. 2010; Lauche et al. 2016; Takasaki and May 2014). A retrospective study in the United States compared the incidence of chronic whiplash among medical workers and the population performing other jobs. Most medical workers took a week off from work, while other occupants usually took up to six months off (Russell and Ferrari 2008).

There is a significant variance in the prevalence rate reported due to a lack of homogeneity of the studies. The prevalence is higher in women than in men, higher in higher-income countries compared to middle- and low-income countries, and higher in urban populations than in rural populations. Studies show that the incidence is higher in people aged 35-49. Since the prevalence is very high, patients with cervical pain seek frequent medical help (Lauche et al. 2016; Hoy et al. 2010).

Another research shows the high prevalence of neck pain in divorced persons, persons with low incomes and low level of education, persons who perform their professional activities in a sitting position, and persons who reported having a concomitant disease (Genebra et al. 2017).

Recent studies reported that 25% of adults under the age of 40, 50% of individuals over the age of 40, and 85% of individuals over the age of 60 exhibited some indication of degenerative changes. Most patients with spondylotic abnormalities of the cervical spine on radiographic imaging remain asymptomatic. Moreover, C6-C7 and C5-C6 are the levels that are most impacted. The most typical symptom of symptomatic cervical spondylosis is neck pain. Point prevalence of neck discomfort in the general population ranges from 0.4% to 41.5%, 1-year incidence from 4.8% to 79.5%, and lifetime prevalence up to 86.8%.

2.4 Pathoanatomic and Etiological factors

The pathophysiology of cervical spondylosis comprises a degenerative cascade that results in biomechanical alterations in the cervical spine, which manifest as secondary compression of neuronal and vascular systems. Intervertebral foramen narrowing, spondylosis, disc herniation, trauma resulting in dislocation fractures, or less frequently tumors, which can induce the mechanical tingling of nerve roots, can all contribute to instability (Caridi et al. 2011).

Spondylosis is the result of a wide variety of degenerative changes beginning in the cervical intervertebral disc. There are age-related biochemical, histological, and metabolic changes in the nucleus pulposus and annulus fibrosus. Radial fissures are one form of disc herniation that progress from the outside, allowing the nucleus to migrate toward the periphery of the disc (Theodore 2020). The nucleus pulposus begins to herniate through the fibers of the annulus fibrosus as it begins to lose its effectiveness at maintaining weight-bearing loads. This results in the loss of disc height, ligamentous laxity, buckling, and compression of the cervical spine. Further, disc desiccation increases the mechanical vulnerability of the annular fibers to compressive loads, leading to considerable changes in the load distribution along the cervical spine (Kokubo et al. 2008; Ferrara 2012).

The disc reduces and swells back into the canal. As a result of structural changes, neck facet joints, anterior uncovertebral joints, and vertebral bodies can all develop osteophytes (Caridi et al. 2011). Reactive bone formation is brought on by the annular and Sharpey's fibers peeling off from the margins of the vertebral body as the kyphosis progresses. These osteophytes, also known as bone spurs, can develop along the cervical spine's ventral or dorsal borders and can then protrude into the spinal canal and intervertebral foramina (Ferrara 2012).

In addition, a change in the load distribution along the spinal column results in increased axial loads on the facet and uncovertebral joints, which leads to joint hypertrophy or enlargement and speeds up the production of bone spurs in the nearby neural foramen. The spinal canal diameter decreases, and the cervical lordosis and motion are lost because of these degenerative alterations (Shedid and Benzel 2007).

Other contributing factors are poor body posture, office work, activities of daily living, biomechanical changes in the spine, etc. The most affected are those aged 18 and above; this is a large concern for society because of the great impact on socioeconomic cost (Ghodrati et al. 2017; van Dongen et al. 2016; Leininger et al. 2016). The cervical spine is likely to be impacted by various autoimmune illnesses since the immune system may attack the muscles, joints, and nerves in these conditions. Rheumatoid arthritis, polymyalgia rheumatica, multiple sclerosis, ankylosing spondylitis, systemic lupus erythematosus, and myositis are the most significant autoimmune illnesses. One of the first signs of cervical spine involvement in a patient's rheumatoid arthritis is neck pain. Nevertheless, patients with cervical spine involvement may also experience occipital headaches and other neurological symptoms (Kazeminasab et al. 2022; Jahre et al. 2020)

2.5 Psychological and psychosocial stress

Neck pain is caused by a variety of factors. According to research, variables affecting neck muscles that may result in muscle spasm and pain include sedentary lifestyle, poor posture, anxiety, depression, increased computer use, physical or mental stress, job situations, and neuromuscular stress, even though the exact cause of persistent neck discomfort is unknown. The main contributing factor to neck pain may be divided into biological and psychological risk factors, and it is obvious that both factors play a role in its occurrence (Büyükturan et al. 2021). Biological factors include neuromuscular disorders, autoimmune disease, genetics, gender, and age, while psychological factors include stress, anxiety, depression, cognitive variables, sleep problems, social support, personality, and behavior (Kazeminasab et al. 2022; Kim et al. 2018; Jahre et al. 2020; Liu et al. 2018; Martinez-Calderon et al. 2020). One systematic review (Tzenalis 2016) has described that chronic neck pain may come from the combination of three types of risk factors such as pathophysiological, psychological, and social factors. This is why the biopsychosocial treatment approach is widely used for chronic neck pain. This multidimensional treatment includes medication, psychological

support such as cognitive-behavioral therapy, relaxation training and biofeedback, and social therapy principles. Based on the author's conclusion, this new treatment approach seems to be very effective for chronic neck pain by improving quality of life. Also, the author recommended that future research should be conducted to find the most effective biopsychosocial treatment approach. According to the literature, there is a direct connection between psychological factors and neck discomfort. Prospective studies have shown that psychological factors influence the intensity of pain. Furthermore, neck pain has been discovered to be influenced by a number of critical characteristics, including stress, distress, anxiety, cognitive performance, and health-related behaviors (Kazeminasab et al. 2022). The strongest overall risk variables, according to this systematic analysis, are high levels of muscular tension, depression, role conflict, and high job demands. The vast majority of the above risk factors are thought to be changeable, highlighting the value of screening programs, appropriate education and the accessibility of resources (Kim et al. 2018). With regard to the origin of people's neck discomfort, catastrophizing may lead to dysfunctional sickness beliefs, which in turn may evoke unfavorable expectations and so contribute to a chronic course of disease with higher disability (Buitenhuis and de Jong 2011). The research claims that, when used to treat patients with depressive disorders, aerobic exercise has therapeutic benefits comparable to those of drug therapy or psychological counselling (Chen et al. 2017).

2.6 Physical examination and diagnosis

Degenerative cervical spondylosis patients may exhibit mechanical neck discomfort, radiculopathy, myelopathy, or a combination of these symptoms. The physical examination should focus on the issues raised in the history and differentiate between mechanical and neuropathic complaints (Theodore 2020; Butler et al. 2012).

Mechanical neck discomfort can be localized to the neck or can spread widely to the shoulders, head, chest, and back. Patients frequently find it challenging to determine the source of their discomfort. This complicates management because the pain could be caused by a degenerative intervertebral disk, deteriorated facet joints, or muscular and ligamentous components (Binder 2007).

The doctor should also ask the patient to indicate the location of their discomfort, the intensity of the pain and the degree to which it interferes with day-to-

day activities including sleeping, driving, and working. From this, the doctor also has access to the list of variables that can make the pain worse and better. The history and physical examination can decide the diagnosis. However, care must be taken, as diagnoses can simulate or coexist with neck radiculopathies, such as neuropathies resulting from nerve blocks (Bono et al. 2011).

Red-flag signs and symptoms, such as a history of malignancy, gait instability or sensory loss linked to myelopathy, and fever with nocturnal pain suggestive of spinal abscess, should be questioned of patients who present with neck discomfort, as all these issues demand prompt treatment (Theodore 2020).

A patient's history and physical examination are crucial in ruling out some of the more significant causes of pain in the neck that demand physician care. Differentiating between various painful neck disorders is less crucial, especially if the symptoms heal with time and conservative treatment. A crucial component of the physical examination is the observation of neck and head position. It is important to take note of any antalgic neck postures as well as any limitations on active and passive ranges of motion. Deficits in cervical rotation are primarily found in conditions affecting the upper cervical spine and atlanto-axial joint disease. Occipital pain is typically caused by disease in the C1–C3 cervical region (Popescu and Lee 2020).

Range of motion can be more helpful in determining asymmetry or provocation because discomfort can refer to a broad variety of areas and is often made worse by neck movement. Neck pain might be accompanied by excruciating neck spasms. Paresthesia, numbness, or weakness may be experienced by patients with cervical degenerative radiculopathy, and these symptoms frequently correspond to dermatomal distributions of the afflicted cervical nerve root. Nerve-root compression is presented by diminished deep-tendon reflexes, such as those of the biceps C6 or triceps C7(Childress and Becker 2016).

The myotomy typically does not lay at the base of each cervical dermatome due to the architecture of these structures. Since many muscles in the upper torso receive their primary supply from the cervical nerve roots, usually they are affected in cervical disorders (Kapitza et al. 2020).The Spurling test, the shoulder-abduction test, and the cervical-traction test are all provocative tests used to help diagnose cervical degenerative radiculopathy (Theodore 2020).

If neuropathic disorders are detected, additional testing should be done on the strength of the upper and lower extremities as well as the deep tendon reflexes. Upper extremity pain with a dermatomal basis, sensory abnormalities, and weakening are signs of radiculopathy. Comparable degrees of myelopathy in the neck, however, might cause less obvious lower extremity symptoms, such as balance issues, stiffness, and weakness. Examination may indicate hyperreflexia, the Lhermitte sign, and hand atrophy (Childres and Stuec 2020).

Mechanical compression and inflammation of a cervical nerve root result in cervical radiculopathy from spondylosis; the compression may be acute from a sudden disc herniation or chronic from hypertrophied facet joints. Compressed and inflamed nerve root pain (described as searing pain) that primarily radiates from the shoulder or upper back to the proximal arm is the most frequent sign of cervical degenerative radiculopathy and is known as neck pain (Abbed and Coumans 2007).

Painful neck motions and muscle spasms are the most typical examination results. To confirm the diagnosis, the Spurling test, the upper limb tension test, the shoulder abduction test, and the cervical traction test must be conducted (Theodore 2020).

We can talk about cervical radiculopathy when the patient complains of pain and a neurological disorder such as a tingling sensation, sensory disturbances, or even loss of motor skills in the arm, hand and fingers. There is a loss of power and even control in motion. There are no clinically defined criteria for a diagnosis of cervical radiculopathy, but the findings usually include symptoms of pain and fatigue of the wrist, forearm, shoulders, and neck. There may be a swelling feeling in the hands and severe aggravation or numbness. The pain mainly increases from the activity and is relieved by rest, but sometimes the pain increases at night, which causes sleep problems (Bono et al. 2011).

Imaging aids with the visualization of structural spine changes. Depending on the results, patients may be referred to a physiatrist, orthopedic surgeon, or a neurologist for additional assessment and treatment (Binder 2007). Medical professionals should incorporate further, more sophisticated imaging results to help confirm the diagnosis. X-rays, CT scans, or MRI scans may be requested even though they are not a part of the physical examination to confirm the diagnosis and determine the severity of cervical spondylosis. Evidence suggests that scanning does not enhance clinical outcomes since it

is associated with increased work attendance and inappropriate use of medical services. Additionally, unneeded screening has the potential to cause injury, such as exposure to radioactivity from X-rays and CT scans (Maher et al. 2017).

Whereas disc disorders such as protruding discs or degenerative disc conditions are frequently observed on pictures, they may not be the cause of pain, as they are found on images in up to 97% of people who are asymptomatic (Brinjikji et al. 2015). These inadvertent results could result in more examinations, expert referral, and more costly treatment, including surgery, limiting access to those treatment options for patients who truly require them. These abnormalities may also cause worry or concern in patients, perhaps postponing recuperation, if they do not realize that these manifestations are prevalent (Ganguli et al. 2019; Chou et al. 2012).

According to the data, individuals who had scanning without a clear medical reason showed no improvements in pain, activity, or their quality of life when compared with individuals who had no scanning. Furthermore, prospective research has indicated that persons who underwent scanning when it was not recommended used greater amounts of medical services, including injections and having surgery, and missed more job duties than other people who were not scanned (Lemmers et al. 2019; Webster et al. 2013; Hall et al. 2021).

Other specific tests during physical examination recommended by KNGF are active range of motion, segmental mobility and the cranial cervical flexion test. These can classify patients in the ICF impairment-based category of neck pain with headaches and the associated ICD categories of headaches or cervicocranial syndrome. Further, other tests such as the cranial cervical flexion test and deep neck flexor endurance can classify patients according to ICF impairment: neck pain with movement coordination impairments, sprain, or strain. When classifying a patient in the ICF impairment-based category of neck pain with radiating pain and the associated ICD categories of spondylosis with radiculopathy or cervical disc disorder with radiculopathy, the following physical examination measures may be useful: upper limb tension test, Spurling’s test and distraction test (Childs et al. 2008).

2.7 Evidence based physiotherapy treatment strategies for neck pain

The main challenge for physiotherapists is exploring the best strategies to assess and provide treatment for chronic neck pain associated with the degenerative component. Most of the studies have been researching the diverse methodology of conservative treatment strategies such as manual therapy, therapeutic exercise, traction, and cervical mobilization. There are also different methods of electrotherapy which could have a positive impact on pain, mobility, and function (Lauche et al. 2016; Cramer et al. 2012; Wong et al. 2016; Freimann et al. 2015; Gashi and Azemi 2022; Hidalgo et al. 2017; Rodríguez-Sanz et al. 2021; Skillgate et al. 2020; Halvorsen et al. 2015; Price et al. 2021).

As the population grows more sedentary and disorders in the cervical region increase, it is necessary to explore more effective evidence-based physiotherapeutic interventions to improve pain, disability and quality of life. Focusing on the association between neck pain and health related quality of life (HRQoL) is important for many reasons. First, it helps to quantify the potential impact of chronic neck pain on HRQoL, second, it provides insights to physiotherapy clinicians and general practitioners (GPs) as to the contribution of neck pain to the overall health status of an individual. Third, when appraised at the physiotherapy clinical level, if offers a view of the overall burden of neck pain on the HRQoL of individuals with chronic neck pain (Rezai et al. 2009; Gandra and Nyoman 2020; Weng et al. 2021).

From the researches mentioned above, we can see many combinations of different treatment methods including mobilization and manipulation, stretching, strength and flexibility, massage techniques and thermotherapy. However, we do not see the combination of deep tissue massage (Seyda et al. 2021b; Brosseau et al. 2012; Sherman et al. 2009; Hopper et al. 2013; Pico-Espinosa et al. 2020; Koren and Kalichman 2018; Kong et al. 2013; Bervoets et al. 2015; Miake-Lye et al. 2019; Rajabi et al. 2011), eccentric exercise (Hody et al. 2019; Kisilewicz et al. 2020; Kawczyn´ski et al. 2012; Chaabene et al. 2018; Binderup et al. 2010; Baumert et al. 2016; Alsultan et al. 2020; Heredia-Rizo et al. 2020), and passive stretching (Cunha et al. 2008; Tunwattanapong et al. 2016; Ylinen et al. 2007).

According to the above-mentioned evidence, each mentioned treatment technique has been studied and shown to be effective for patients with chronic pain. However, our

aim is to observe the combination of these techniques in the treatment of patients with chronic neck pain. Numerous studies (Dunning et al. 2016; Büyükturan et al. 2021; Cook et al. 2015; Rampazo et al. 2020; Seyda et al. 2021b; Boyles et al. 2011; Domingues et al. 2019; Cox et al. 2020; Bakken et al. 2021; Bernal-Utrera et al. 2020; Inge Ris et al. 2017; Ris et al. 2016) have proven that the combination of exercise with other treatments effectively reduces pain and improves the functional status and quality of life of persons suffering from chronic neck pain. However, it should be noted that the guidelines for exercise therapy have not given clear recommendations.

Some other authors (Cui et al. 2017; Calixtre et al. 2019; Cao et al. 2021; Dedering et al. 2018) have given priority to mechanical and manual traction and passive mobilization for the treatment of patients with chronic pain. They have confirmed that this type of technique has been effective in reducing pain but not in improving function and disability. Other authors (Fritz et al. 2014; Ding et al. 2021) have confirmed that mechanical traction and exercises together are more effective in all parameters of pain reduction and disability than just exercises.

Application of exercise and manual mobilization of the neck is shown to be very effective in pain reduction. One systematic review (Cho et al. 2019) evaluated the combination of upper cervical and upper thoracic spine mobilization which indicated better results in pain management. However, according to their recommendations, there is a moderate level of evidence regarding overall short-term outcomes.

Another author (Ayub et al. 2019)evaluated another method of mobilization called active and passive mobilization which is shown to be very effective in treating cervical radiculopathy. To reduce pain in muscles around the neck with latent trigger points, one study reported that applying soft tissue release in sternocleidomastoid and suboccipital muscles had a positive impact on pressure pain threshold (Kim and Lee 2018). Applying strengthening exercises in the cervical region has a positive impact by reducing pain and increasing muscular strength and flexibility. These data are consistent with other authors (Cramer et al. 2012; Lauche et al. 2016; Boyles et al. 2011; Leaver et al. 2010; Wong et al. 2016).

In another randomized controlled trial from (González Rueda et al. 2017), the authors included seventy-eight patients with chronic neck pain and restricted upper cervical

rotation. They divided the patients randomly into three groups: the first group was upper cervical mobilization, the second group was the inhibitory sub-occipital technique group, and the third was the control group. According to their results, the authors stated that there were no significant differences between groups regarding active cervical mobility and neck disability index. Their main conclusion was that adding manual therapy to a conventional physical therapy protocol for the cervical spine will increase the flexion–rotation test in the short- and mid-term in patients with chronic neck pain.

The objective of the study conducted by (Rodríguez-Sanz et al. 2021)was to compare the short (end of the intervention), medium (3 months), and medium-long (6 months) term effectiveness of adding a manual therapy approach to a cervical exercise protocol for the treatment of patients with chronic neck pain and upper cervical rotation restrictions in pain, disability, and cervical range of motion. According to their results, the first group statistically improved short- and medium-term in all variables, compared to the exercise group.

Another study (Cox et al. 2020) observed the relationship between neck strength, pain and disability. These authors made a secondary analysis of patients with chronic neck pain who completed a minimum of nine sessions of a neck-specific progressive resistance program at a physiotherapy clinic at the Melbourne Whiplash Centre between the years of 2002 and 2018. They evaluated the patients with the Neck Disability Index, Numerical Rating Scale of Pain, and multi-directional neck strength (flexion, extension, and lateral flexion) before and after treatment. According to their results, all these measurements showed significant improvements after nine sessions.

A recent study conducted by (Lee and Lee 2017) evaluated the effect of joint mobilization and therapeutic exercise applied to the cervical spine and upper thoracic spine for functional impairment caused by chronic neck pain. According to the results presented, both groups showed improvement in visual analog scale, neck disability index, and range of motion. Treating chronic neck pain is a complicated issue because there are many treatment methods available. However, the main challenge is which combination is the best treatment protocol for use.

Another randomized controlled clinical trial (Bakken et al. 2021) investigated the combination of home stretching exercises and spinal manipulative therapy for patients with

chronic neck pain. After two weeks of daily stretching exercises with and without added spinal manipulation, some clinical improvement was observed but there was no significant difference between groups. According to (Ghodrati et al. 2017) the combination of soft tissue release and muscle energy techniques combined with exercise produced a good physiotherapeutic protocol by improving movement, pain, and disability in patients with chronic neck pain.

Another systematic review conducted by (Price et al. 2021) concluded that using exercises such as motor control exercise combined with segmental exercise for patients with chronic neck pain in the short-term can lead to improvement in pain and disability. However, there is not enough evidence regarding the long-term treatment. The authors recommend future trials to observe the optimal dosage of exercise in the long term.

The use of thermotherapy as a supplementary treatment for persistent musculoskeletal pain has been well researched. Thermotherapy may be linked to an increase in muscle flexibility since it raises the temperature and blood flow to the muscles while reducing muscle fatigue when applied to the skin. Increased blood circulation promotes tissue healing by delivering protein, nutrients, and oxygen to the damage site. It also increases the metabolism of the tissue and the alignment of the connective tissue. These thermotherapy-related benefits can also lessen muscular spasms (Shin et al. 2020).

Massage's potential methods of action include the following: biomechanical, which results in less stiffness in the muscle-tendon unit; and physiological, which results in improved muscle warmth and blood flow, or lowers cortisol levels and enhances parasympathetic activity. Although the precise action mechanism of massage therapy is unknown, it is thought to reduce pain via the gate-control mechanism, increase lymph flow, regulate the circulatory systems, normalize muscle tones by reducing spasms, soften adhesions, and increase soft tissue mobility (Skillgate et al. 2020; Celenay et al. 2016).

Conservative treatment is considered important for chronic neck pain rehabilitation. Further, surgical intervention plays a crucial role in the treatment of patients with neurological implications, disc damage, cervical myelopathy, and many other conditions in which conservative treatment fails and patients experience a high degree of pain and disability.

Surgical treatment including anterior and posterior decompression, fusion, laminotomy, foraminotomy, or disc replacement has been very effective for many cervical disorders (Todd 2011). Despite the irreplaceable role of surgical treatment, based on the evidence, some secondary implications have been identified, such as degeneration of the segment near the intervention, narrowing of the intervertebral space because the level of the intervertebral disc lowers, etc. (Inge Ris et al. 2017; Gutman et al. 2018; Carragee et al. 2008).

Regarding the evidence, applying a multimodal physiotherapeutic approach in chronic neck pain can produce better outcomes in terms of strength, pain, function, and quality of life (O'Riordan et al. 2014). According to the evidence, therapeutic exercises were the only strategy with clinically significant effects for neck pain, despite other modalities such as electrotherapy and thermotherapy (Philadelphia Panel 2001).

2.8 The International Classification of Functioning, Disability and Health

The International Classification of Functioning, Disability, and Health (ICF) model emphasizes the ability to function as a component of health: the interplay of the individual's environment on the individual's body function, activity limitations, and participation restrictions all contribute to the individual's health and degree of disability (Ferreira et al. 2010).

Physical therapists can use the ICF model to identify how a patient's musculoskeletal function is impacting their activity and participation, use the interventions determined to be the most effective in treating the condition, and use appropriate outcome measures to monitor changes in the patient's level of disability (Childs et al. 2008).

The International Classification of Functioning, Disability, and Health is based on the bio-psycho-social concept of health. It has become widely used in rehabilitation medicine to define the consequences of disease and structure rehabilitation goals. The ICF is conceptually based on a unified framework that covers functioning within the following components: body functions (b), body structures (s), activities and participation (d), and contextual elements of environmental factors (e) and personal characteristics that are not defined in the ICF (Andelic et al. 2012).

Some of the regularly used neck pain-specific questionnaires that assess functioning and impairment and contain content-predetermined items were connected to the ICF. The three most frequently measured ICF categories within the body functions component were pain perception, sleep disruptions, and respiratory dysfunctions (Fairbairn et al. 2012). The questionnaires were found to address participation in leisure, work, and other daily activities such as eating, dressing, self-washing, reading, and housework within the domain of activities and participation. The examined questionnaires, however, are frequently challenging to interpret on a personal level in practice since they do not address the patient's perceived major neck pain-related issues (Andelic et al. 2012; Fairbairn et al. 2012).

2.9 Research gaps

Achieving the most appropriate physiotherapy protocol will be very beneficial to minimize patient complaints, to decrease disability and increase their health-related quality of life and quality of life. There is evidence regarding manual therapy, mobilization, and exercise as a stand-alone treatment applied for short and long-term efficacy for patients with chronic neck pain. This is also related to intensity, duration, and repetitions (Alshami and Bamhair 2021; Gashi and Azemi 2022; Ylinen et al. 2007; Groisman et al. 2020; Maicki et al. 2017; Franciscatto Stieven et al. 2020; Rodríguez-Sanz et al. 2021; Hurwitz et al. 2008)

However, it remains unclear whether neck pain is a risk factor or an outcome of poor health related quality of life (HRQoL). To our knowledge, only a few poorly designed studies (Roux et al. 2005; Cunha et al. 2008; Salo et al. 2010; P. Salo et al. 2012; Ris et al. 2016) reported that different physiotherapy interventions may have a positive effect on health-related quality of life. However, this correlation/relationship has not been examined in a randomized control trial, except in this study (Cerezo-Téllez et al. 2018), where secondary analysis was performed to determine HRQoL improvement.

Another study has been conducted to determine whether a manual therapy approach should be included in cervical exercise protocols for neck pain. The study concluded that the group receiving a cervical massage had a more effective range of motion (Celenay et al. 2016), while another study claimed that adding manual therapy to exercise has no additional benefit (Hidalgo et al. 2017). Due to these findings, there are more clinical trials

needed on the efficacy of a manual therapy and exercise approach for participants with neck pain, specifically deep tissue massage.

Based on the recommendations from the Royal Dutch Society for Physical Therapy (KNGF) ("KNGF Guideline Neck Pain" 2016), and Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Orthopaedic Section of the American Physical Therapy Association (Blanpied et al. 2017), and aside from the mandatory recommendation to include manipulation and mobilization techniques combined with exercise, massage was recommended as an additional technique to treat chronic neck pain. However, there is a lack of evidence regarding the type and dosage of massage techniques, particularly deep tissue massage. As this gap still needs to be addressed in evidence-based practice, our aim was to contribute to physiotherapy science by evidencing the role of deep tissue massage on function, participation, and quality of life for patients with chronic neck pain.

Another systematic review reported that there is not sufficient evidence for the application of a specific physiotherapy modality aimed a specific patient subgroup (Damgaard et al. 2013). According to this evidence, there is a lack of knowledge to support recommended evidence-based physiotherapy interventions related to subgroups of patients with chronic neck pain. A research study with a multi-component physiotherapy intervention program has not yet been conducted, which would examine the short-term effects of deep tissue massage and eccentric exercises in combination with passive stretching in patients with cervical spondylosis.

Our main goal is to contribute to new knowledge regarding the possibility of improving physiotherapy strategies or interventions and the possibility of changes in mandatory recommendations for the rehabilitation of neck pain based on the results from the current randomized control trial.

3 EMPIRICAL PART

3.1 Purpose and objectives of the research

The aim of the current randomized controlled trial (RCT) was to analyze the effect of a 2-week multimodal physiotherapy program (consisting of deep tissue massage, eccentric exercises, and passive stretching) with integrated health education for patients with cervical spondylosis. The importance of current RCT in the problem area is important in order to fill gaps in existing knowledge and possible improvement of current interventions in cervical spondylosis. Current RCT aims to include patients with chronic neck pain associated to degenerative spine disorder (cervical spondylosis), and looks to find new evidence about a multimodal physiotherapy protocol for this subgroup of patients related to disability, functions, participation, and quality of life.

Based on the subject of the research, several specific goals have been set:

1. To determine the differences in the initial and final measurement between the control and study group in relation to Active Range of Motion (AROM) and Numerical Pain Rating Scale (NPRS).

2. To determine the differences in the initial and final measurement between the control and study group in the variables from the Neck Disability Index Questionnaire (NDI).

3. To determine the differences in the tests for determining the Active Range of Motion (AROM) and Numerical Pain Rating Scale (NPRS) between the initial and final measurement in the subjects from the control and study group.

4. To determine differences in the initial measurement between the control and study groups for Spurling's test (ST), Flex-Rotation test (FRT), and Deep Neck Flexor Endurance Test (DNFET).

5. To determine proportional differences between the groups in the initial and final measurement in relation to the McGill Quality of Life Questionnaire (MQOL), Neck Disability Index (NDI), and Patient-Specific Functional Scale (PSFS).

6. To observe the effectiveness of deep tissue massage, eccentric exercise, and passive stretching for patients with cervical spondylosis.

7. To examine short-term effectiveness of multimodal physiotherapeutic protocol in disability, function, and activity level in patients with cervical spondylosis.

3.2 Research hypotheses, research questions

Research question.

Are deep tissue massage, eccentric exercise, and passive stretching more effective than isometric and active assisted exercise for patients with cervical spondylosis?

Considering the subject and objectives of the research, the following hypotheses have been set:

H0 This multimodal physiotherapy program is not different in efficiency than the standard program in reducing pain and disability and improving health-related quality of life in patients suffering from cervical spondylosis.

H1 There will be a statistically significant improvement in the results of the McGill Quality of Life Questionnaire (MQOL) and Neck Disability Index (NDI) in participants with cervical spondylosis in a multimodal physiotherapy (PT) intervention (deep tissue massage, eccentric exercises in combination with passive stretching) compared to participants in the control group (physiotherapy intervention based on an isometric and active exercise program).

H2 The novel physiotherapy (PT) intervention will have a positive effect on pain results in the study group compared to the control group based on Numerical Pain Rating Scale (NPRS).

H3 Participation in a PT intervention program will improve more than half of the functional results of the PSFS compared to subjects in the control group.

H4 There will be statistically significant differences in the initial and final measurement between the control and study groups in the variables from the Neck Disability Index (NDI), McGill Quality of Life Questionnaire (MQOL) and Patient-Specific Functional Scale (PSFS).

H5 There will be statistically significant differences in the tests for determining the Active Range of Motion (AROM) and Numerical Pain Rating Scale (NPRS) between the initial and final measurements in the subjects of the control and study group.

For the purpose of checking the partial connections of the regression model, we designed sub-hypotheses; The influence of the disability reduction factor in the neck is statistically significant for the quality of life of subjects included in physiotherapy (PT) interventions.

3.3 Research methodology

3.3.1 Data collection methods and techniques

This is a non-blinded Randomized Controlled Trial (RCT). Through this type of research, we can build useful predictions about the prevention, treatment, and diagnosis of human disorders, and as a gold standard in medicine (Cartwright 2010) we can use RCT to evaluate the effectiveness of a new protocol in a certain population and observe the efficacy of one treatment for a specific effect in the target population (Hannan 2008).

This design of the current RCT is considered the highest level of evidence to construct the causality between the intervention and the outcome (Zabor, Kaizer, and Hobbs 2020). Usually, RCT incorporates a strong methodology with high quality. Also, current RCT will be conducted by using different measurement instruments with strong evidence related to validity and reliability. We confirm that we have adhered to all the standards envisaged for a clinical randomized study in the field of physiotherapy as stated by World Physiotherapy (WCPT).

Ethical consideration

This RCT was aligned with the principles established by national and international regulations, including the Declaration of Helsinki (World Medical Association 2023) and the Physiotherapy Code of Ethics Kosovo Chamber of Physiotherapy (year 2019).

All personal data were handled following Regulation (EU) 2016/679 of the European Parliament and Council of the European Union (2016). The current randomized control trial has been conducted in the private physiotherapy clinical setting in Kosovo during year 2023. To carry out the research according to ethical medical standards, ethical permission was obtained from the ethical commission of the Kosovo Chamber of Physiotherapy (Prot. Nr. 473) and from Ethical Committee of Alma Mater Europaea-ECM (Decision Nr. 2/2023-24).

To receive permission from the ethical commission of the Kosovo Chamber of Physiotherapy we have sent a request explaining our project. Attached documents required by the chamber were a filled request, CV, copy of the working license, project proposal with informed consent and agreement declaration.

All patients received an informed consent and agreement declaration. They were informed about their rights to participate in the research. Also, they have been clearly informed that they can withdraw from the research without consequences.

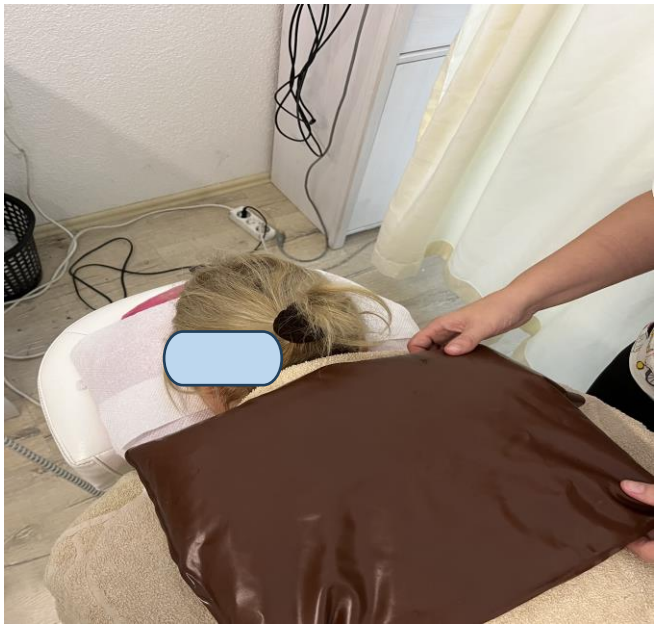
Experimental procedures

From the total number of patients (150 patients) which were evaluated according to the inclusion and exclusion criteria, only 111 patients were eligible and they were divided in study (N56) and control group (N55). The study group received multimodal physiotherapeutic treatment program including:

Thermotherapy

Thermotherapy was applied using fango packages, the patient was positioned in the prone position on the therapeutic bed and thermotherapy was applied for 15 min on the neck and upper back with a temperature of about 50°C degrees. (Picture 1).

Picture 1. Application of thermotherapy using fango



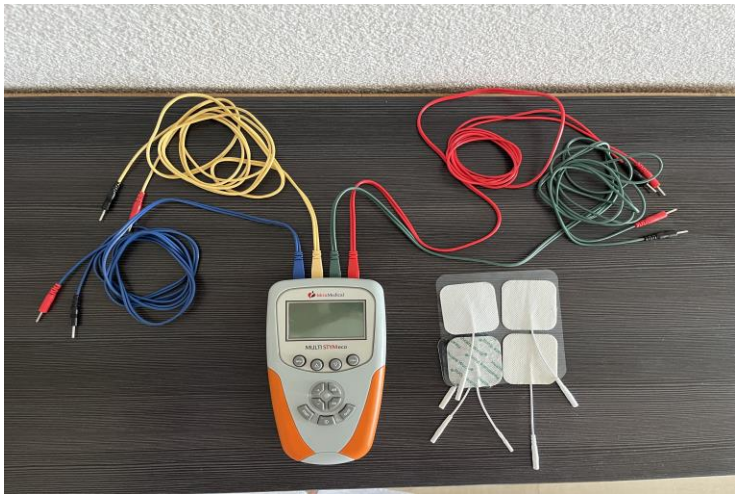
Source: Own source 2023.

Transcutaneous electrical nerve stimulation (TENS)

Transcutaneous electrical nerve stimulation is made up of a battery-powered device that provides electrical impulses to electrodes placed on the skin's surface. Electrodes are placed on or near the nerves that are causing the discomfort. It is a pain-relieving therapy that employs a low-voltage electric current (Martimbianco et al. 2019).

Transcutaneous electric nerve stimulation (TENS) produced (Iskra Medical d.o.o., Stegne 23, 1000 Ljubljana) as an electrical form of therapy was applied for 20 min (cervical pain program PO-4) in tender points on the neck, and on the upper back, while the patient was lying on the bed in a prone position. The four electrodes were applied on the tender points, while the intensity of the current was applied based on the patient's tolerance level. (Picture 2).

Picture 2. A- Transcutaneous electric nerve stimulation (TENS). B- Application of electrotherapy with four electrodes



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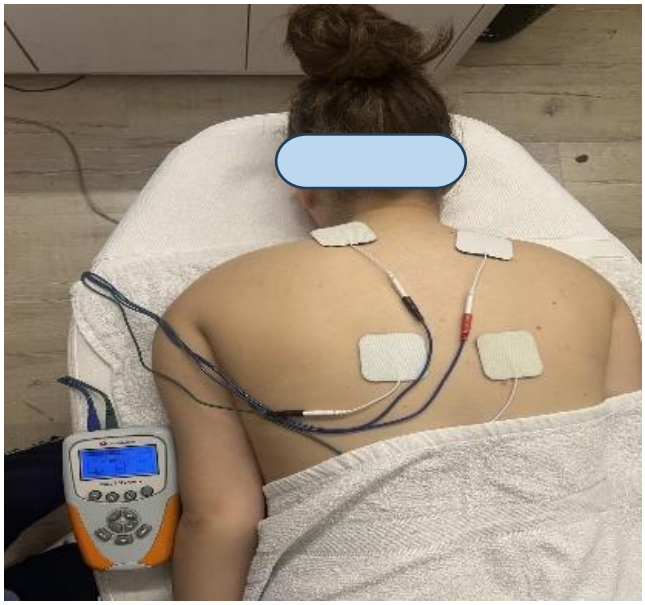
A



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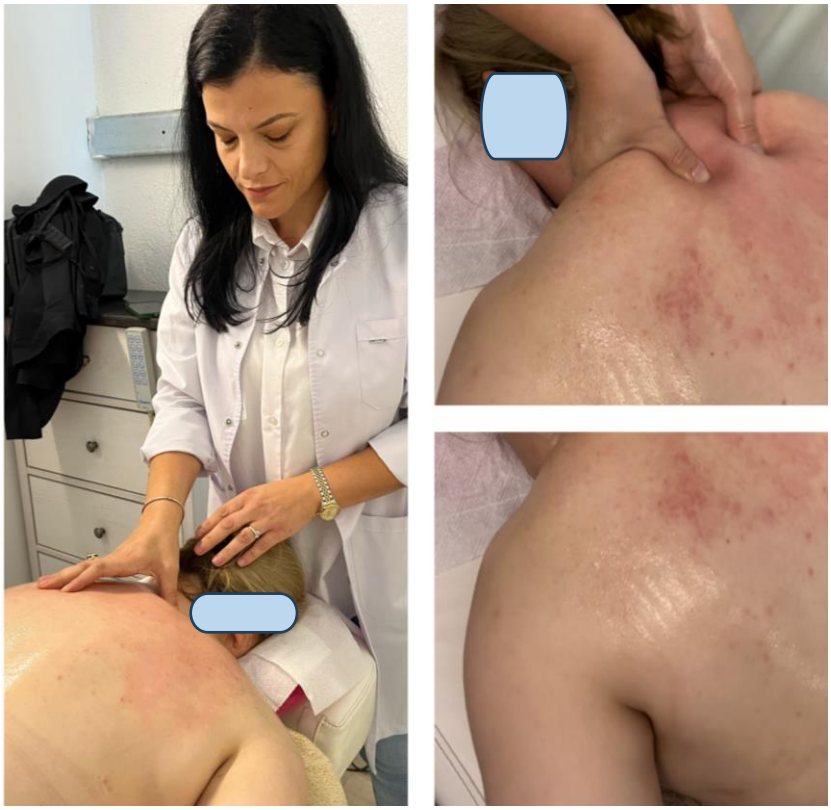
B

Deep tissue massage

The various techniques utilized in massage treatment can vary depending on the demands and physical characteristics of the patient. Swedish massage, deep tissue massage, sports massage, and chair massage are typical varieties (Miake-Lye et al. 2019). Deep tissue massage therapy includes the following components: massage of muscles in the neck, upper back, jaw, and chest using effleurage, a firm motion that incorporates compression and pressure release, and deep muscle/fascia massage to areas that cause concordant symptoms.

The study group had a deep massage of the neck muscles (prevertebral muscles and sub-occipital muscles) and the muscles of the upper back (levator scapulae and upper trapezius on both sides). The massage technique used by the therapist incorporated firm motions with compression and the release of pressure as well as deep muscle/fascia massage in areas that caused similar symptoms. The technique was applied while the patient was lying prone on the therapeutic bed and the session lasted 15 min. (Picture 3).

Picture 3. Application of deep tissue massage in cervical region



Source: Own source 2023.

Passive stretching exercise

Passive stretching was applied for the muscles responsible for movements in the neck in flexion, extension, side bending and rotation on the right and left side. Stretching was performed while the patient was lying supine on the therapeutic bed. The therapist was standing near the bed and the stretching was performed by holding the patient's head in each direction and stabilizing the opposite side by holding the stretch for up to 10 sec, with consideration for the pain tolerance of the patients. The stretching was repeated three times on each side, (Picture 4).

Picture 4. Passive stretching exercise for patients with neck pain

Source: Own source 2023.

Dynamic strengthening exercise

Dynamic strengthening exercises involve movement that cause muscle length to alter. These exercises involve two types of contractions (concentric and eccentric), which result in changes in muscle length and joint angles. During concentric contractions, the muscles contract as they shorten; during eccentric contractions, the muscles lengthen; during both forms of exercise, the muscles produce force and strengthen; additionally, as joint movement increases, other surrounding structures such as ligaments, capsules, and muscles gain flexibility, implying that dynamic strengthening will occur (Sowmya M.V 2014).

We selected the eccentric exercises (EE) from the category of therapeutic exercises, which are defined as lengthening contractions, because they occur when the force acting on the muscle is larger than the instantaneous force it produces, causing the muscle-tendon system to extend as it operates (Hody et al. 2019).

Eccentric exercises included in this protocol are scapular retraction and shoulder horizontal adduction and abduction, shoulder extension and flexion with scapular retraction, performed with elastic thera-bend, each exercise was performed 8-10 repetitions. A total of 10 sessions were conducted over a period of two weeks. All participants were advised to repeat the provided exercises at home and to facilitate the execution of the exercise following a proper technique. They were filmed with their own smartphone during the supervised sessions. (Picture 5).

Picture 5. Dynamic strengthening exercise

Source: Own source 2023.

Control group

All patients in the control group received a standard physiotherapy program including: Thermotherapy with paraffine, which was prepared using special equipment with high standards and from qualified staff. The patient lay in the prone position on the bed while the physiotherapist applied the paraffine for 15 min on the neck and upper back, (Picture 6).

Picture 6. Application of thermotherapy using paraffine

Source: Own source 2023.

Electrotherapy

Interferential current (IFC) is a medium-frequency electrotherapy with a carrying frequency of 4000 Hz. It was introduced by Dr. Nemec in 1950, and according to the evidence it has shown significant analgesic effects for patients with neck pain. Interferential therapy (IFT) (Iskra Medical d.o.o., Stegne 23, 1000 Ljubljana) was applied in the electrotherapy room. The patient was asked to stay seated or lying in a prone position, and two parallel electrodes were applied to the upper part of the shoulders for 20 min. The program chosen was neck pain, while the intensity of the current was applied based on the patient's tolerance level, (Picture 7).

Picture 7. A- Interferential current device. B-Application of electrotherapy using interferential current

Source: Own source 2023.

A

Source: Own source 2023.

B

Hydrotherapy

As part of the rehabilitation program, it is recommended to use hydrotherapy in an individual bathtub or in a common swimming pool for 7 minutes. Patients went to the special swimming pools where mineral water was collected at temperatures up to 40-43°C. Bathing in thermo-mineral water is done with clean bathing clothes in a pool separated by gender or in an individual bathtub. The whole body except the head is immersed in the

thermal mineral water. Patients in the pool were supervised by the physical therapist working in the private physiotherapy clinical setting, (Picture 8).

Picture 8. A- swimming pool and B- Individual bathtub with thermo-mineral water

Source: Own source 2023.

A

Source: Own source 2023.

B

Massage

Relaxation massage was applied on the neck and upper back for 5-7 min, while the patient was lying in prone position, (Picture 9).

Picture 9. Application of relaxation massage

Source: Own source 2023.

Active range of motion

Active range of motion exercise can be achieved when opposing muscles contract and relax, resulting in joint movement. It is usually performed by the patient independently and when the patient is able to voluntarily contract, control, and coordinate a movement. Active range of motion is usually less then passive range of motion (ROM).

The patients were asked to sit straight in a in with an upright position with relaxed shoulders, and then they were instructed to move the neck in all directions (Flexion, Extension, Left and Right Rotation, Left and Right-side bending) and to repeat each movement ten times, (Picture 10).

Picture 10. Active range of motion exercise for neck pain

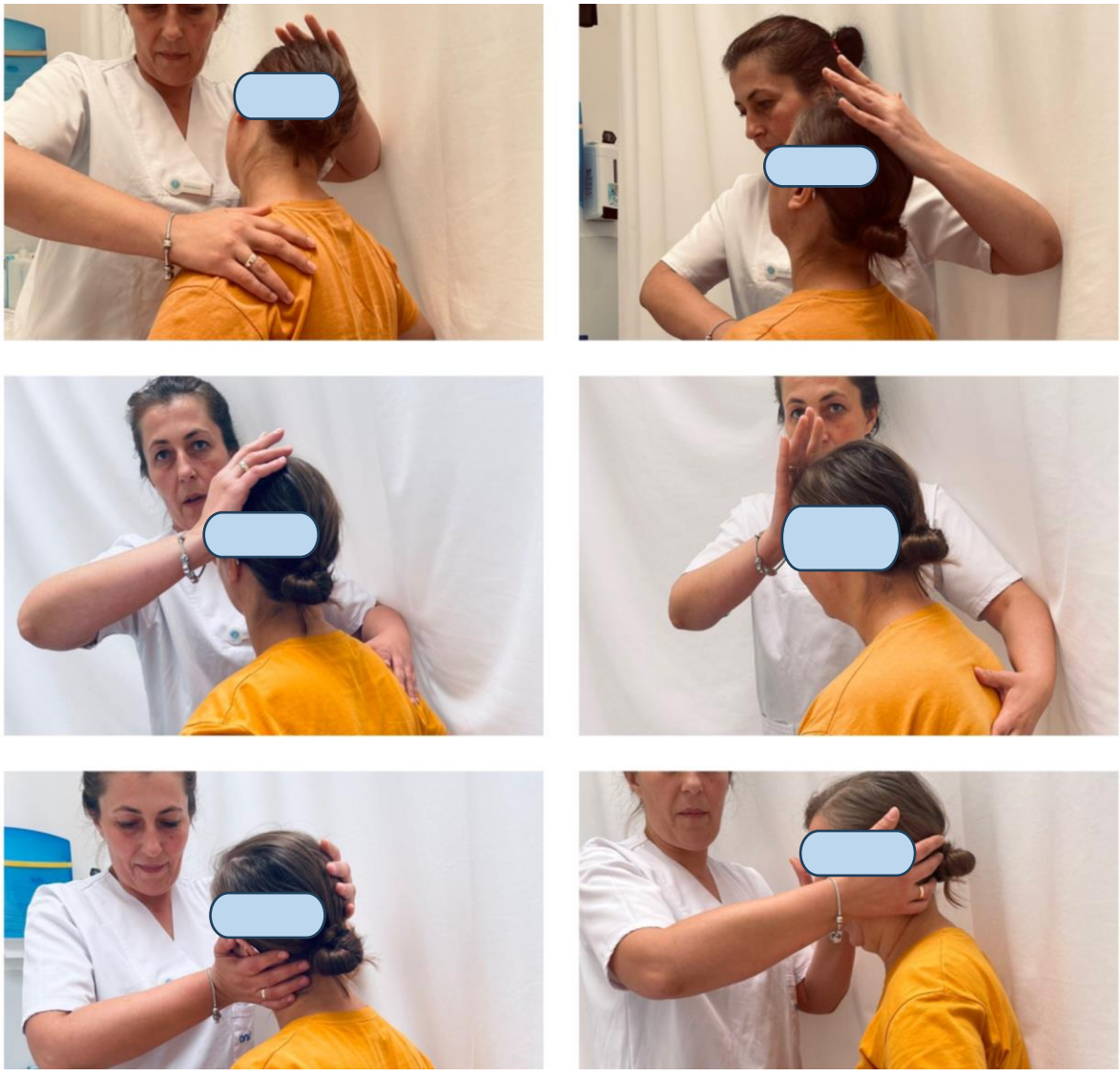
Source: Own source 2023.

Isometric exercise

Isometric strengthening exercise is a static form of muscle contraction; the contraction must be held against resistance for at least 6 seconds to develop muscle tension and allow metabolic changes to occur (Sowmya M.V 2014). Despite the absence of joint movement, isometric training is nonetheless regarded as effective because it builds a strong foundation for dynamic exercise and because many postural muscles act predominantly in an isometric manner. Isometric training improves endurance and strengthens muscles in a weak area of the range. Isometric exercise is most helpful when people are in a low state of training because the benefits of isometric exercise diminish as one's level of training grows.

Isometric exercises were performed while the patients were in a seated position. The palm of the therapist was placed in patient's forehead and the patient resisted this force for 5-8 seconds, relaxed, and then repeated the same procedure 3 times. The same exercise was applied for extension, side bending, and rotation. For extensor muscles, the palm of the therapist was placed on the posterior part of the head, while for side bending (left and right) and rotation (left and right) the palm was placed on the side of the patient's head and the same procedure as mentioned above was applied. All patients will receive 10 sessions of physical therapy, (Picture 11).

Picture 11. Isometric exercises



Source: Own source 2023.

3.3.2 Instrumentation description

Outcome measurement instruments that were used are presented scientifically with a high level of validity and reliability. The evaluation of patients was performed before and after treatment (two weeks) and general information was included (age, gender, profession, diagnosis, coexisting diagnosis, Covid-19 vaccination).

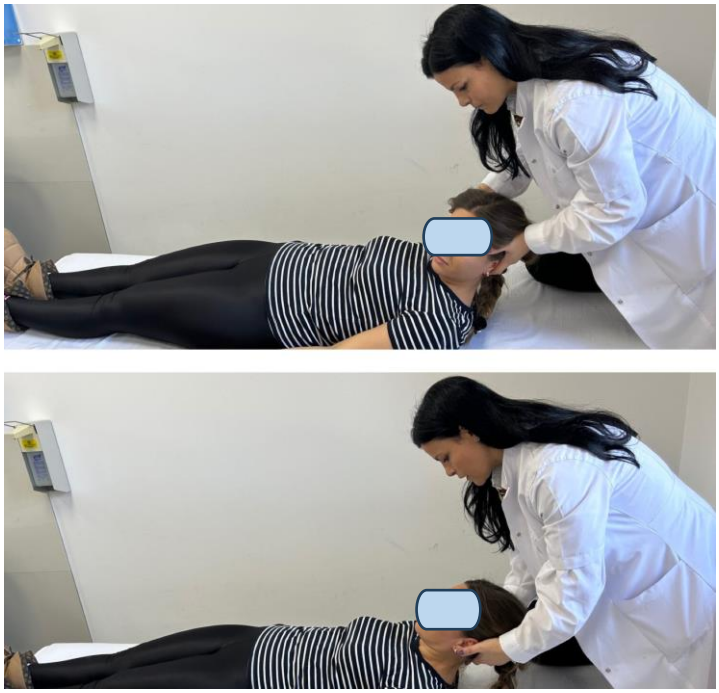
The measurement instruments that were used only before treatment are the Flex-Rotation test (FRT), Spurling's test (ST), and Deep Neck Flexor Endurance Test (DNFET). The instruments used before and after treatment are the Numerical Pain Rating Scale (NPRS), Active Range of Motion (AROM), Neck Disability Index (NDI), Patient Specific Functional Scale (PSFS), and McGill Quality of Life questionnaire (MQOL).

Flex- Rotation test

The Flex- Rotation test was performed in accordance with previously described guidelines with the goal of measuring passive range of motion (PROM) at the segment C1-C2, regardless of the cause of limitation, and in the least provocative manner possible to minimize the risk of symptom worsening. This test, according to the ICF, is an evaluation of impairment in body function and the movement of many joints, with specificity up to 90-95%, and sensitivity from 90-97% (Blanpied et al. 2017).

The test was completed while the patient lay relaxed in supine, with the cervical and upper thoracic spine passively flexed to end range, or to a tolerable limit specified by the patient if discomfort prohibited this. The head was then turned passively left and right (Picture 12). Range of motion was determined by either the individual reporting the onset of pain or the therapist encountering firm resistance; whichever happened first. At this point, the examiner made a visual estimate of the rotation range and declared whether the FRT was positive or negative, as well as which side was positive. A positive test was characterized as one in which the estimated range was reduced by more than 10º from the expected normal range of 44º (Blanpied et al. 2017; Hall et al. 2010).

Picture 12. Flex- Rotation test

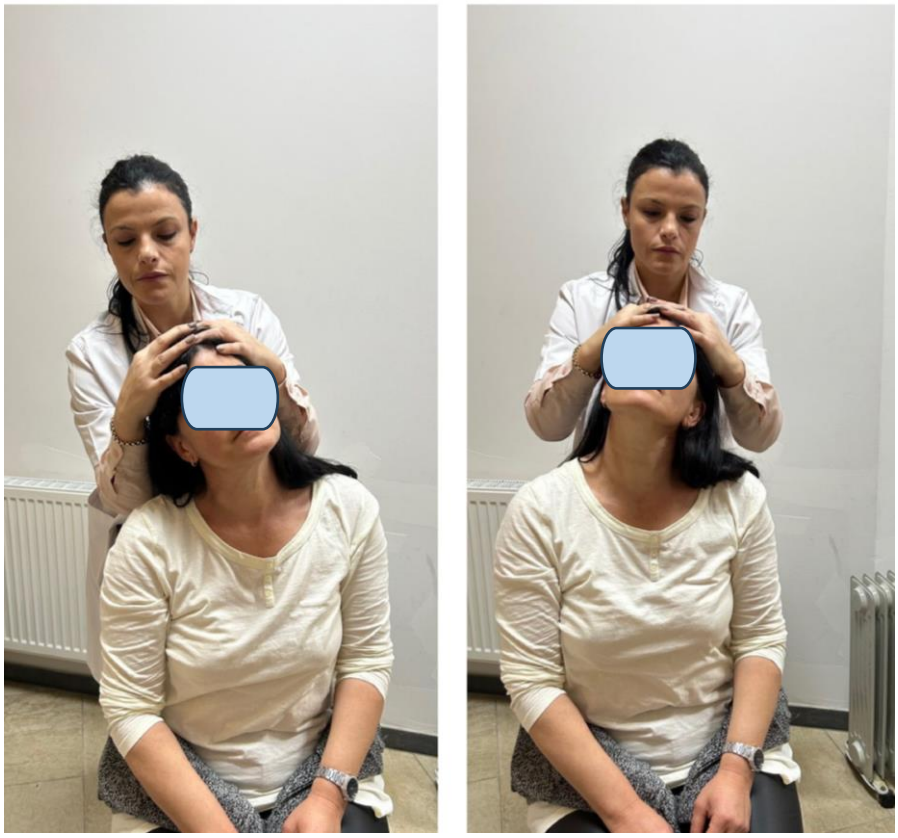


Source: Own source 2023.

Spurling's test

The Spurling's Test is performed during the examination of the cervical spine. Specificity ranges from 89%-100% (Verhagen 2021) and sensitivity ranges from 95% (Childress and Becker 2016). The test was performed while the patient bent their head over to the unaffected side first and then to the affected side. The examiner then carefully pressed straight down on the head. Reproduction of symptoms or pain radiating down the arm on the side to which the head is bent during compression, thus indicating pressure on the nerve root, is a positive test which may be indicative of cervical radiculopathy, (Picture 13).

Picture 13. Spurling's Test



Source: Own source 2023.

Deep Neck Flexor Endurance Test

The deep neck flexors (DNF) (longus capitis, longus colli, rectus capitis anterior and lateralis) are thought to help stabilize the cervical spine during gross neck movements. These muscles have a vital postural role in maintaining cervical lordosis. Previous research on cervical dysfunction has linked reduced endurance in deep neck flexor muscles with neck pain, which causes muscular insufficiency.

In such circumstances, DNF muscles have shown inadequate endurance in addition to impaired activation. Such anterior cervical flexor muscle weakness can have an impact on head and neck posture. Moreover, this muscular weakness may expose the cervical spine to reactive forces, contributing to non-radiological detection, clinical instability, or impairment when the extremities move in space during functional activities such as reaching or placing objects during the day (Iqbal et al. 2021; Domenech et al. 2011).

The flexor endurance test demonstrated strong intertester and intratester reliability, suggesting that it could be a helpful therapeutic tool for practitioners interested in the treatment and prevention of neck pain (Olson et al. 2006), (Picture 14).

The patient was asked to lie supine on a hook lying position. Upon instruction, the subject lifted the head and neck approximately 2.5 cm from resting position with the chin in a maximally tucked position. This was maintained isometrically (Picture 14). We timed the position using a stopwatch and recorded the results, scoring the variables in accordance with the normative data scores in healthy adults, which are as follows: men up to 38.9 seconds and women up to 29.4 seconds (Domenech et al. 2011).

Picture 14. Deep Neck Flexor Endurance Test

Source: Own source 2023.

Active Range of Motion

The range of motion will be measured with Cervical Range of Motion instrument (CROM) (produced by Performance Attainment Associates www.spine products.com)

before and after treatment. The movements measured by the instrument were: flexion (FLEX), extension (EXT), left and right-side bending (LSB, RSB) and rotation (LR, RR).

Flexion and extension

Measurement of FLEX and EXT was carried out by instructing the patient to sit erect in a straight back chair with the sacrum against the back of the chair, the thoracic spine away from the chair, arms hanging at the side, and feet flat on the floor. Then, we have positioned the CROM instrument on the patient's head and ensured it fits securely by adjusting the strap. Also, we have to ensure that before starting any movement, the goniometer reads 0° at a neutral position. Then, we asked the patient to flex and extend his/her neck, at which point readings are recorded at each extreme of the motion, (Picture 15).

Cervical side bending

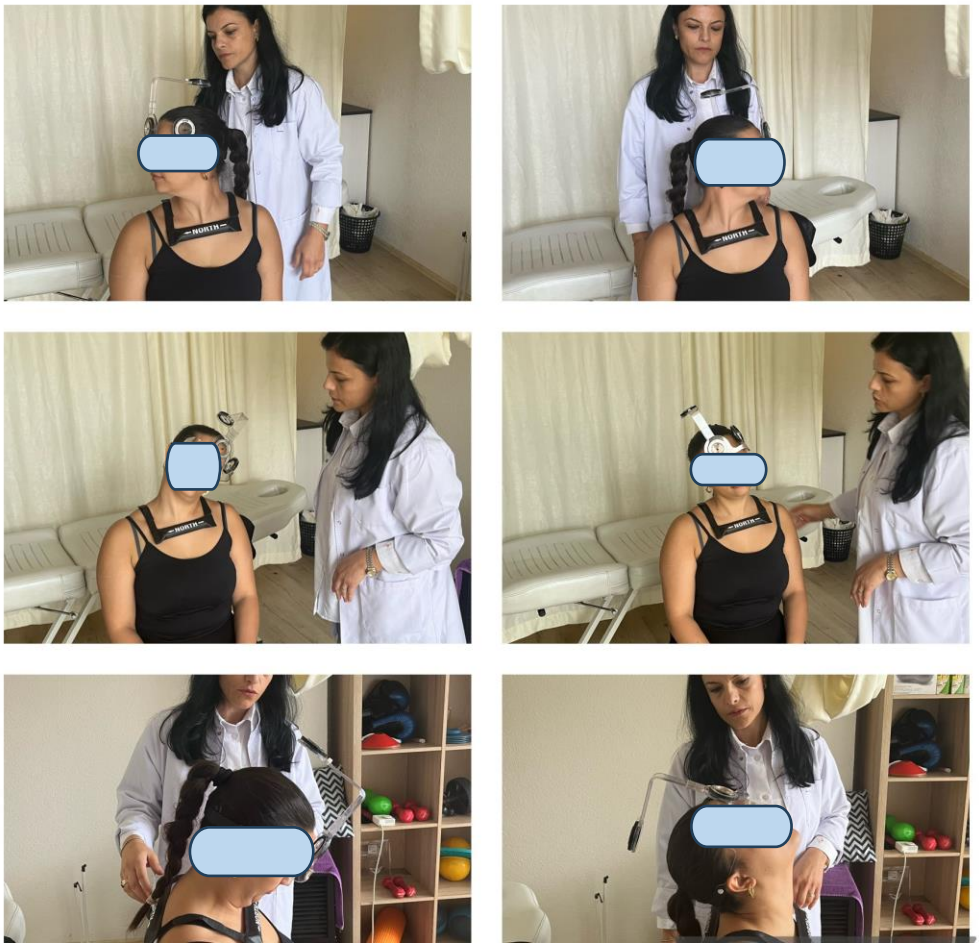
To measure cervical side bending (CSB) on both sides we asked the patient to sit up straight in a chair with the thoracic spine positioned against the back of the chair, arms dangling on the sides, and feet flat on the floor. We instructed the patient to look straight ahead, ideally at a fixed point of eye level and then we asked the patient to tilt their head laterally to the left, without rotating the head, while their shoulders remain fixed (the verbal instruction was to bring the ear as close as possible to the shoulders without lifting the shoulders). Further, we repeat the procedure for the opposite side and note the angle of flexion of the head. Normal flexion from the starting point on either side is 45° and the total angle of maximal lateral head flexion should be 90°, (Picture 15).

Cervical Rotation

To measure cervical rotation (CR) on both sides we asked the patient to sit up straight in a chair with the thoracic spine positioned against the back of the chair with arms dangling on the sides and feet flat on the floor. We instructed the patient to look straight ahead, ideally at a fixed point of eye level. We observed the patient from above. Next, we asked the patient to rotate their head to the left as far as possible without tilting or tipping their head, (Picture 15). Then we repeated the process for the opposite direction. Normal rotation is approximately 80° while the neck's total angle of rotation is 160°. For a rough

approximation, when observing from above, the patient's chin should just be slightly anterior to the shoulder during maximal rotation on either side.

Picture 15. Measurement of active range of motion with CROM



Source: Own source 2023.

Numerical pain rating scale

The Numerical Pain Rating Scale (NPRS) as an outcome measurement it is widely used, and has a good test -retest reliability. This is a unidimensional measure of pain intensity in adults, including those with chronic pain. It is an appropriate measure to assess the amount of pain and is recommend in the clinical practical guidelines for the management of neck pain. NPRS consists of 0 to 10 points, 0 represents 'no pain' and 10 'the worst pain possible' in the past 24 hours (Hawker et al. 2011). All the patients were asked about subjective feeling about pain before and after treatment (Appendix D).

The Patient-specific functional scale

The International Classification of Functioning, Disability, and Health (ICF) defines functional health status in terms of "impairments", "activity limitations", and "participation restrictions". One assessment that can potentially be used to measure 'activity restrictions' is the 'Patient Specific Functional Scale' (PSFS) which is also recommended in the clinical practical guideline for neck pain (Blanpied et al. 2017).

According to the evidence, the author Stratford et al. created the PSFS to allow individual patients to identify tasks that they were having problems in comparison to their preinjury status. The PSFS has been found to have strong validity and reliability, as well as to be a responsive tool for patients suffering from musculoskeletal disorders such as neck and low back pain, knee, and upper extremity pain (Stratford et al. 1995).

One experienced English translator translated the questionnaire into Albanian. The therapist asked all patients to answer items from the PSFS questionnaire before and after therapy based on their concerns. Patients picked key tasks specific to themselves and indicated the level of difficulty using both answer options, where 0 represents 'the inability to undertake an activity' and 10 represents 'the ability to perform the activity at the same level as before the condition'. The final score is calculated as follows: the total score is calculated by averaging the three activity scores, where a lower score indicates a greater level of activity restriction (Thoomes-de Graaf et al. 2020), (Appendix A).

Neck Disability Index

The Neck Disability Index (NDI), which was created in Canada by Vernon and Mior in 1991, is the most widely used instrument for assessing self-rated disability in patients with neck pain. Moreover, the NDI was developed from the Oswestry Disability Index (ODI) to assess 'activity limits' activities of daily living (ADL) in patients with neck pain. It is a self-reporting questionnaire with ten items: pain intensity, personal care, lifting, work, headaches, concentration, sleeping, driving, reading, and recreation. Each issue is graded on a 6-point scale ranging from 0 (no disability) to 5 (full disability). The numeric responses for each item are added together for a total score ranging from 0 to 50; higher scores indicate greater levels of disability. The NDI has been shown to be reliable and valid as an outcome measure for patients with NP (Shrestha et al. 2021; MacDermid et al. 2009;

Vernon 2008). We have received permission to use the questionnaire from MAPI group (https://eprovide.mapi-trust.org/) by filling the request form. All the patients were asked to fill in the questionnaire before and after treatment, (Appendix B).

McGill Quality of Life Questionnaire

The McGill Quality of Life Questionnaire (MQOL) is a 17-item multidimensional instrument created to assess general quality of life as well as physical well-being, physical symptoms, psychological symptoms, existential well-being, and support. It is designed for those with life-threatening illnesses at all stages (Cohen et al. 1996). To use the McGill Quality of Life Questionnaire, permission was required from the authors. We wrote an email (S. Robin Cohen Ph.D. investigator, Lady Davis Institute Jewish General Hospital, Department of Oncology and Medicine, McGill University) with a request for permission to use the McGill Quality of Life Questionnaire in current RCT. The authors requested that we complete out the application form and mail it back to them. Then, the authors then gave their consent for the use of the McGill Quality of Life Questionnaire. The questionnaire was translated by an English translator, and we asked the patients to fill in the questionnaire before and after treatment. (Appendix C).

3.3.3 Description of the sample

From the total number of patients (150 patients) which were evaluated according to the inclusion and exclusion criteria, only 111 patients with cervical spondylosis, aged 18-70, were eligible to participate in the research. Current RCT was conducted at the private physiotherapy clinical setting, in Kosovo during year 2023. We used convenience sample of patients with chronic neck pain in private clinical setting, then we applied randomized allocation of patients (according RCT principles) into the study and control group (using simple randomization list provided by neutral statistician).

Blinding of the therapist and participants was not possible as their cooperation was crucial to the implementation of the assessment and intervention, also because of the ethical consideration blinding of patients with chronic neck pain was not feasible.

All patients have been diagnosed and evaluated by the medical doctors and specialists (physiatrists) working in private physiotherapy clinical setting. They gave written recommendations about patients that were eligible in accordance with the

inclusion/exclusion criteria. Medical doctors and specialists evaluated patients through a neurological assessment and regarding muscle tone, muscle strength, and sensory loss. They have provided a medical report describing the medical diagnosis and recommended evidence-based physiotherapy treatment.

From the total number of patients allocated in study group N75, only N56 meet the inclusion criteria, while in the control group only N55 patients were eligible from N75 patients according to the inclusion criteria. All patients in the study group were treated by Arbnore Ibrahimaj Gashi, a clinical physiotherapist with Ph.D. in kinesiology and with 15 years of working experience. This means that the safety of patients is reassured during physiotherapy sessions together with the health team (medical doctors, physiatrist, etc.).

The inclusion criteria are as follows:

- Diagnosis of cervical spondylosis
- Patients presented with degeneration from C4-C7
- Documented history of pain lasting more than 3 months
- Age 18- 70
- Signing informed consent form.

The exclusion criteria are as follows:

- Acute (up to 4 weeks) and subacute (up to 12 weeks) neck pain
- Neck pain caused by definite pathological factors, such as cerebrovascular diseases involving vertebral arteries, spinal cord pathology, cervical cancer, or fracture
- Neck pain secondary to diseases such as rheumatoid arthritis, ankylosing spondylitis and cervical spine infection
- Suffering from cervical myelopathy or radiculopathy, coupled with motor, reflex, and/or sensory changes in the upper limb
- Previous surgery to the cervical spine
- Pregnancy.

3.3.4 Description of data processing

The collected data will be analyzed using the statistical program SPSS, version 22. During the analysis, we will follow the recommendations regarding data analysis. In the

case of randomized clinical studies (Furberg and Friedman 2012; Wassertheil-Smoller and Kim 2010) we will check whether the variables (of measurement tools like functional tests, scales, and questionnaires index, etc.) will be normally distributed (normal distribution). For the basic statistics of the measured variables, univariate analysis of the basic and composite variables will be performed, and their frequency distributions and descriptive statistics will be checked.

To determine the relationship between the independent and dependent variables, the multiple regression analysis will be performed, which is one of the most frequently used statistical approaches (Hayes 2013) for testing the model of functional tests/scales/index that predicts differences and/or explains the success of two different physiotherapy protocols. Multiple regression analysis will be performed to check how the assessment of the health-related quality of life SF-36 and quality of life (McGill Quality of Life Questionnaire) explains the differences between groups of patients with chronic neck pain.

We will build multivariable linear regression models to measure the association between grades of neck pain intensity, the physical component summary (PCS), and the component summary (MCS) measures of the MQOL scores, while also controlling for other covariates. To detect important associations between the main independent variable and outcomes, a three-step modeling approach will be used. First, univariate models will be built to obtain crude estimates [regression coefficients; 95% confidence intervals (CI)] of the association between chronic neck pain, covariates, and the PCS or MCS. Covariates with a $P \leq 0.25$ will be kept for the second phase of the modeling. In the second phase, we will build bivariate models that include chronic neck pain intensity and each of the covariates. We will keep covariates that lead to a 10% change in at least one of the neck pain grade regression coefficients (Rezai et al. 2009).

To gain insight into the basic structure of the data by revealing the common dimensions or factors of the set of observed variables, factor analysis will be performed (Cohen et al. 2014). The goal of factor analysis will be to adapt a larger number of observed and measured variables in patients with chronic neck pain, between which there is a connection, to a smaller number of variables that explain their mutual connection. In this way, new statistically constructed variables will be obtained and used in the continuation of the statistical analysis as independent variables in determining the connections between patient functional/activity level, the assessment of the quality of life (multiple regression

analysis), and as dependent variables in explaining/predicting differences in the results of functional tests/indexes/scales of the participants between the two studied PT interventions for chronic neck pain (discriminant analysis).

Multiple regression analysis

Multiple regression analysis will be used to help us analyze a linear relationship between a dependent and an independent variable (Cohen et al. 2014, 452). With regression analysis, we will be able to assess the contribution of individual parameters of the regression model and the statistical significance of the entire model. With a regression model, we will be able to predict the value of the dependent variable from the values of the independent variables. The task of multiple regression analysis itself is limited in particular to testing certain assumptions about the model. Regression analysis can therefore have a descriptive (we will estimate the parameters of the regression model and the statistical significance of the model) and predictive role (we will predict the value of the dependent variable from the values of the independent variables) (Cohen et al. 2014, 452-457).

The goal of testing hypothesis H1 was to find such a linear combination of the measured variables that the predetermined two groups of patients with chronic neck pain would be as different as possible from each other, and the error in the classification of units into two groups would be as small as possible. Based on the type of physiotherapy treatment protocol (according to evidence-based physiotherapy practice) of patients with chronic neck pain, we will divide the units in the research in advance into two groups (study g., control g.) and observe whether there were any statistically important differences between the groups in relation to the functional test results of evaluation function, activity, and participation level, according to ICF biopsychosocial model.

Canonical discriminant analysis

Discriminant analysis is a method for explaining differences between two groups of patients with chronic neck pain. We will try to find a linear combination of the measured variables, so that the new variables (discriminant functions) will ensure the greatest possible differentiation between the studied two groups and that the error in classifying the units into groups is the smallest one. The discriminant analysis therefore will have the function of explanation, as well as prediction, since one of the goals of discriminant analysis will be to fit (new) units as well as possible to pre-given groups(Cohen et al. 2014,

458-462). In the following, we will carry out a discriminant analysis to find out which variables (functional tests, scales, indexes, etc.) particularly differentiate the studied PT treatment protocols, or what best separates patients with chronic neck pain in two different PT treatment protocols. Structural weights will be used to determine which components of functional tests and other measurement tools separate the two groups of patients with chronic neck pain according to the height of the weights. The canonical correlation coefficient will be used to determine whether the groups really differ from each other in the studied components of functional test/measurement tools evaluating the effectiveness of PT protocol on the functional level, as well as on activity and participation level (according to ICF) and quality of life measured with the McGill questionnaire. Hypotheses will be tested and confirmed with a five percent risk.

3.4 Results

Internal consistency is calculated only for measures consistent from more items. It is measured with Cronbach's alpha, which is a measure of internal consistency; that is, how closely related a set of items are as a group, (Table 1).

Table 1: Internal consistency

		Internal consistency		
		Sample size (n)	N of items	Cronbach alpha
PSFS*	Pre-test	111	3	0.885
	Post-test	111	3	0.807
NDIQ**	Pre-test	111	10	0.857
	Post-test	111	10	0.916
AROM***	Pre-test	111	6	0.783
	Post-test	111	6	0.858
MQOL**** Total score	Pre-test	111	16	0.874
	Post-test	111	16	0.911
MQOL Dimensions		Original / After factor analysis (PCA)		
Physical	Pre-test	111	3 / 4	0.631 / 0.785
	Post-test	111	3 / 4	0.793 / 0.821
Psychological	Pre-test	111	4 / 3	0.692 / 0.747
	Post-test	111	4 / 3	0.821 / 0.855
Existential	Pre-test	111	6	0.834
	Post-test	111	6	0.837
Support	Pre-test	111	2	0.873
	Post-test	111	2	0.931

Source: Own source 2023.

* Patients Specific Functional Scale
**Active Range of motion
*** Neck Disability Index Questionnaire
****McGill Quality of Life questionnaire

Test-retest reliability is estimated by calculating the correlation coefficient of the measured values at two separate time points. A higher correlation between the values of the two test occasions indicates greater temporal stability. The test-retest reliability results indicate a significant positive correlation between the first and second assessments for all

measures and subscales. The Pearson correlation coefficients range from 0.482 to 0.890, demonstrating moderate to strong consistency over time. These results suggest that the instruments are stable and reliable for measuring the variables our sample, (Table 2).

Table 2: Test-retest reliability

		Test-Retest Reliability		
		n	Pearson correlation coefficient	P
NPRS* pain scale		111	0.603	< 0.001
Range of motion (AROM)	Flexion	111	0.874	< 0.001
	Extension	111	0.890	< 0.001
	Side bend left	111	0.777	<0.001
	Side bend right	111	0.619	<0.001
	Rotation left	111	0.872	<0.001
	Rotation right	111	0.833	<0.001
PSFS		111	0.622	<0.001
NDIQ		111	0.754	<0.001
MQOL Single item scale		111	0.482	<0.001
MQOL Total score		111	0.677	<0.001
			Original / after FA (PCA)	
MQOL Dimensions	Physical	111	0.679 /	<0.001
	Psychological	111	0.701 /	<0.001
	Existential	111	0.622	<0.001
	Support	111	0.803	<0.001

Source: Own source 2023.
*Numerical Rating Scale of pain

The Mann-Whitney U test was used to compare the age distribution between the control and study group. The results show that there is a significant difference in age between the two groups ($U = 898.000$, $p < 0.001$). The control group had a higher median age (58) compared to the study group (51), and the mean age in the control group was 56.2, while in the study group it was 47.5. The standard deviation in the control group was 9.4, while in the study group it was 12.6, (Table 3).

Table 3: Age of participants of control and study group

		Group		MW U statistics (p)
		Control	Study	
Age	N	55	56	898.000 (p<0.001)
	Minimum	22	19	
	Maximum	69	67	
	Median	58	51	
	Mean	56.2	47.5	
	Standard Deviation	9.4	12.6	

Source: Own source 2023.

The total number of participants in each group was 55 and 56, respectively. In the control group, 18 participants (32.7%) were male and 37 participants (67.3%) were female. In the study group, 15 participants (26.8%) were male and 41 participants (73.2%) were female. The Chi-square test was used to compare the gender distribution between the control and study groups. The results indicate that there is no significant difference in gender distribution between the two groups ($\chi^2 = 0.469$, $p = 0.494$), (Table 4).

Table 4: Gender of participants of control and study group

		Group				Chi-square test (p)
		Control		Study		
		F	f %	f	f %	
Gender	Male	18	32.7%	15	26.8%	0.469 (0.494)
	Female	37	67.3%	41	73.2%	
	Total	55	100.0%	56	100.0%	

Source: Own source 2023.

In the control group, the most frequent professions were housewife (27.3%) and worker (29.1%), but also retired (16.4 %), while in the study group, the most frequent professions were housewife (33.9%) and teacher (17.9%), and only 2 participants were retired (3.6 %). The Likelihood Ratio test was used to compare the distribution of

professions between the control and study groups. The results indicate a significant difference in the most frequent professions between the two groups (Likelihood Ratio = 20.508, p = 0.039), (Table 5).

Table 5: Profession of participants of control and study group

		Group				Likelihood Ratio (p)
		Control		Study		
		F	f %	F	f %	20.508 (0.039)
Profession	Retired	9	16.4%	2	3.6%	
	Businesswomen	2	3.6%	4	7.1%	
	Housewife	15	27.3%	19	33.9%	
	Worker	16	29.1%	15	26.8%	
	Teacher	5	9.1%	10	17.9%	
	Information Technology	2	3.6%	0	0.0%	
	Policeman	2	3.6%	0	0.0%	
	Dentist	1	1.8%	0	0.0%	
	Lawyer	2	3.6%	1	1.8%	
	Economist	0	0.0%	1	1.8%	
	Student	0	0.0%	3	5.4%	
	Doctor	1	1.8%	1	1.8%	
	Total	55	100.0%	56	100.0%	

Source: Own source 2023.

All the participants of control and study group have had a diagnosis of cervical spondylosis. In the control group, the most frequent co-existing diagnoses were lumbago with sciatica (58.2%) and gonarthrosis (29.1%). In the study group, the most frequent co-existing diagnoses were no disease (37.5%) and lumbago with sciatica (42.9%). One participant in the study group had a co-existing diagnosis of thoracal syndrome. The Likelihood Ratio test was used to compare the distribution of co-existing diagnoses between the control and study group. The results indicate a significant difference in co-existing diagnoses between the two groups (Likelihood Ratio = 11.247, p = 0.010), (Table 6).

Table 6: Diagnosis and co-existing diagnosis of participants of control and study group

		Group				Likelihood Ratio (p)
		Control		Study		
		F	f %	F	f %	
Diagnosis	Cervical spondylosis	55	100.0%	56	100.0%	/
	Total	55	100.0%	56	100.0%	
Co-existing diagnosis	No disease	7	12.7%	21	37.5%	11.247 (0.010)
	Lumbago with sciatica	32	58.2%	24	42.9%	
	Gonarthrosis	16	29.1%	10	17.9%	
	Thoracal syndrome	0	0.0%	1	1.8%	
	Total	55	100.0%	56	100.0%	

Source: Own source 2023.

In the control group, 39 participants (70.9%) had received the COVID vaccination, while 16 participants (29.1%) had not. In the study group, 46 participants (82.1%) had received the COVID vaccination, while 10 participants (17.9%) had not. The Chi-square test was used to compare the distribution of COVID vaccination status between the control and study groups. The results indicate that there is no significant difference in COVID vaccination status between the two groups ($\chi^2 = 1.965$, $p = 0.161$), (Table 7).

Table 7: Covid vaccination of participants of control and study group

		Group				Chi-square test (p)
		Control		Study		
		F	f %	F	f %	
Covid Vaccination	Yes	39	70.9%	46	82.1%	1.965 (0.161)
	No	16	29.1%	10	17.9%	
	Total	55	100.0%	56	100.0%	

Source: Own source 2023.

Table 8 presents the anthropometric measurements of participants in the control and study groups, along with the results of t-tests comparing the groups. The control group's weight ranged from 58 kg to 103 kg, with a median of 86 kg and a mean of 84.0 kg. The standard deviation was 11.3 kg. The study group's weight ranged from 57 kg to 116 kg, with a median of 76 kg and a mean of 78.1 kg. The standard deviation was 12.2 kg. The t-test for weight shows a significant difference between the control and study groups ($t = 2.635$, $p = 0.010$).

The height in both groups ranged from 1.5 m to 1.9 m, with a median of 1.7 m and a mean of 1.69 m for the control group, and a mean of 1.70 m for the study group. The standard deviation for both groups was 0.08 m. The t-test for height shows no significant difference between the control and study groups ($t = -0.154$, $p = 0.878$).

The BMI in the control group ranged from 22.0 to 39.1, with a median of 29.4 and a mean of 29.3. The standard deviation was 3.7. The study group's BMI ranged from 21.5 to 34.4, with a median of 27.0 and a mean of 27.1. The standard deviation was 3.2. The t-test for BMI shows a significant difference between the control and study groups ($t = 3.390$, $p = 0.001$). In summary, there are significant differences in weight and BMI between the control and study groups, but no significant difference in height.

Table 8: Anthropometry of participants of control and study group

		Group		t test*
		Control	Study	
Weight (kg)*	N	55	56	2.635 (0.010)
	Minimum	58	57	
	Maximum	103	116	
	Median	86	76	
	Mean	84.0	78.1	
	Standard Deviation	11.3	12.2	
Height (m)	N	55	56	-0.154 (0.878)
	Minimum	1.5	1.5	
	Maximum	1.9	1.9	
	Median	1.7	1.7	
	Mean	1.69	1.70	
	Standard Deviation	0.08	0.08	
BMI*	N	55	56	3.390 (0.001)
	Minimum	22.0	21.5	
	Maximum	39.1	34.4	
	Median	29.4	27.0	
	Mean	29.32	27.10	
	Standard Deviation	3.70	3.18	

Source: Own source 2023.

*Variables are normally distributed (Shapiro-Wilk test)

Table 9: Flex rotation test and Spurling's test for participants of control and study group

			Group				Chi-square test	
			Control		Study			
			f	f %	f	f %	Test statistic	Sig.
Before treatment	FRTL* Left side	Negative	31	56.4%	28	50.0%	0.451	0.502
		Positive	24	43.6%	28	50.0%		
		Total	55	100.0%	56	100.0%		
	FRTR** Right side	Negative	27	49.1%	33	58.9%	1.081	0.298
		Positive	28	50.9%	23	41.1%		
		Total	55	100.0%	56	100.0%		
	ST*** Left side	Negative	35	63.6%	39	69.6%	0.450	0.502
		Positive	20	36.4%	17	30.4%		
		Total	55	100.0%	56	100.0%		
	ST Right side	Negative	34	61.8%	44	78.6%	3.728	0.054
		Positive	21	38.2%	12	21.4%		
		Total	55	100.0%	56	100.0%		

Source: Own source 2023.

* Flexion rotation test left

** Flexion rotation test right

***Spurling's Test

If the significance is < 0.05, the data are not normally distributed.

Table 10: Testing ordinal and numeric variables for normality with one sample Kolmogorov-Smirnov test

		N	Test statistic	Sig.
Pain evaluation	NPRS-pain scale before treatment	111	0.146	0.184
	NPRS-pain scale before treatment	111	0.000	0.000
Specific Test	Deep flexion endurance test (seconds) – before treatment	111	0.121	0.000
Range of motion (AROM)	Flexion (degrees) before treatment	111	0.144	0.000
	Flexion (degrees) after treatment	111	0.188	0.000
	Extension (degrees) before treatment	111	0.170	0.000
	Extension (degrees) after treatment	111	0.199	0.000
	Side bend left (degrees) before treatment	111	0.139	0.000
	Side bend left (degrees) after treatment	111	0.154	0.000
	Side bend right (degrees) before treatment	111	0.159	0.000
	Side bend right (degrees) after treatment	111	0.149	0.000
	Rotation left (degrees) before treatment	111	0.129	0.000
	Rotation left (degrees) after treatment	111	0.155	0.000
	Rotation right (degrees) before treatment	111	0.122	0.000
	Rotation right (degrees) after treatment	111	0.108	0.000
Patient specific functional scale	PSFS Before treatment	111	0.120	0.000
	PSFT after treatment	111	0.151	0.000
Neck disability index questionnaire	NDIQ Before treatment	111	0.092	0.022
	NDIQ after treatment	111	0.102	0.006

Source: Own source 2023.

The mean (SD) of the Deep Flexion Endurance Test hold times for the control group was 21.3 ± 12.1 seconds, whereas for the study group it was 28.6 ± 11.6 seconds.

Table 11: Deep Flexion Endurance Test for participants of control and study group

		N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Deep Flexion Endurance Test (seconds)	Control	55	21.27	12.12	18.00	24.55	1.0	50.0
	Study	56	28.64	11.64	25.53	31.76	4.0	50.0
	Total	111	24.99	12.39	22.66	27.32	1.0	50.0

Source: Own source 2023.

We tested the average hold time for the Deep Flexion Endurance Test and whether there was a difference between subjects of the control and study group. We used the Mann-Whitney U test which showed significant differences between subjects of the control and study group (p=0.001), (Table 12).

Table 12: Deep flexion endurance test for participants of control and study group – test statistics for differences between groups

		Mann-Whitney U test		
		Pre-test		Post-test
		MW U statistics	Sig.	
Deep flexion endurance test (seconds)	Control group - Study group	991.500	0.001	/

Source: Own source 2023.

The NPRS for pain is an 11-point numeric rating scale, with 0 representing “no pain” and 10 “unbearable pain.” As shown in Table 13, NPRS pain intensity score obtained during the current RCT before treatment showed a comparable mean score in study (7.2 ± 1.6) and control group (6.9 ± 2). After treatment the average score was lower in study group, as the average score in control group was reported at 3.8 ± 2 and in the study group at 1.9 ± 2.0, (Table 13).

Table 13: NPRS pain scale for participants of control and study group

		N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
NPRS - pain scale before treatment (0-10)	Control	55	6.93	2.06	6.37	7.48	3	10
	Study	56	7.16	1.63	6.73	7.60	3	10
	Total	111	7.05	1.85	6.70	7.39	3	10
NPRS - pain scale after treatment (0-10)	Control	55	3.82	2.14	3.24	4.40	0	8
	Study	56	1.93	1.95	1.41	2.45	0	6
	Total	111	2.86	2.25	2.44	3.29	0	8

Source: Own source 2023.

Before treatment there was no statistically significant difference between the control and study group (p=0.500); after treatment the difference between the control and study group was statistically significant (p < 0.001). (Table 14).

Table 14: NPRS pain scale for participants of control and study group – test statistics for differences between groups in pre-test and post-test

		Pre-test		Post-test	
		MW U statistics	Sig.	MW U statistics	Sig.
NPRS* - pain scale (0-10)	Control group - Study group	1427.500	0.500	793.000	0.000

Source: Own source 2023.
*Numerical Rating scale of pain

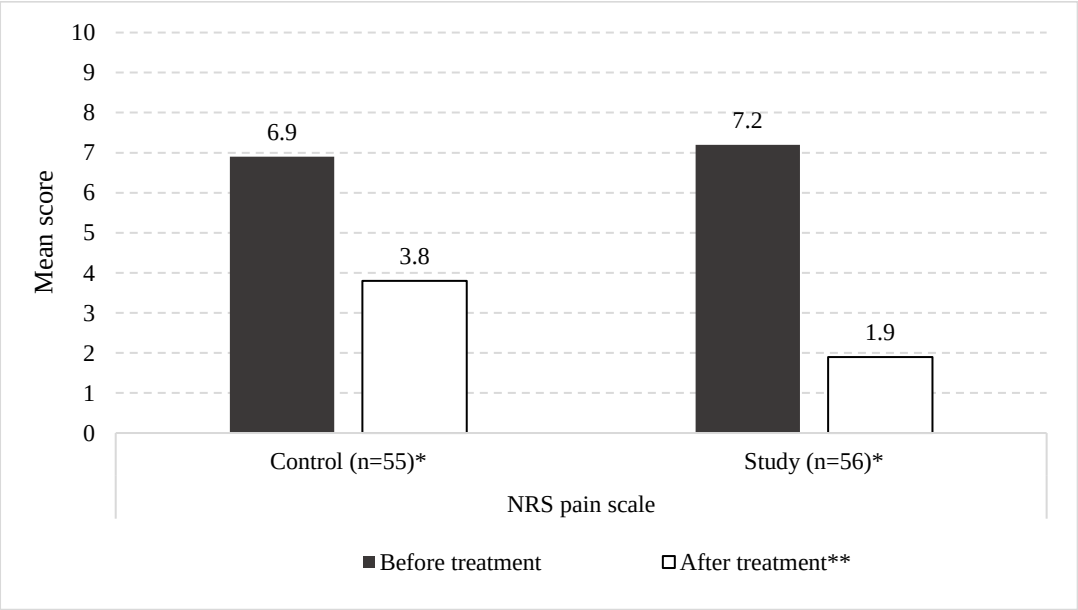
As seen in Table 15, the Wilcoxon signed rank test also revealed that the decrease of the mean NPRS score was statistically significant in both groups ($p < 0.001$).

Table 15: NPRS pain scale for participants of control and study group – test statistics for differences within groups in time

		Wilcoxon test	
		Pre-test – Post-test	
		Z	Sig.
NPRS* - pain scale (0-10)	Control group	-6.358	0.000
NPRS* - pain scale (0-10)	Study group	-6.481	0.000

Source: Own source 2023. *Numerical Rating scale of pain

Graph 1: The comparison of NPRS pain scale withing groups in time



Source: Own source 2023.
* Difference in time is statistically significant ($p \leq 0.05$).
** Difference between groups is statistically significant ($p \leq 0.05$).

Table 16: Range of motion "Flexion" for participants of control and study group

		N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Flexion (degrees) – before	Control	55	44.36	11.14	41.35	47.38	20	70
	Study	56	50.54	14.19	46.74	54.34	20	80
	Total	111	47.48	13.09	45.02	49.94	20	80
Flexion (degrees) – after	Control	55	55.05	10.98	52.09	58.02	30	80
	Study	56	60.55	11.23	57.55	63.56	30	90
	Total	111	57.83	11.40	55.69	59.97	30	90

Source: Own source 2023.

As seen in Table 17, the results of the Mann-Whitney U test have shown that before treatment there was a statistically significant difference with flexion (p=0.024). After treatment there was also a statistically significant difference (p = 0.010).

Table 17: Range of motion "Flexion" for participants of control and study group – test statistics for differences between groups in pre-test and post-test

		Pre-test		Post-test	
		MW U statistics	Sig.	MW U statistics	Sig.
Flexion (degrees)	Control group - Study group	1158.500	0.024	1112.500	0.010

Source: Own source 2023.

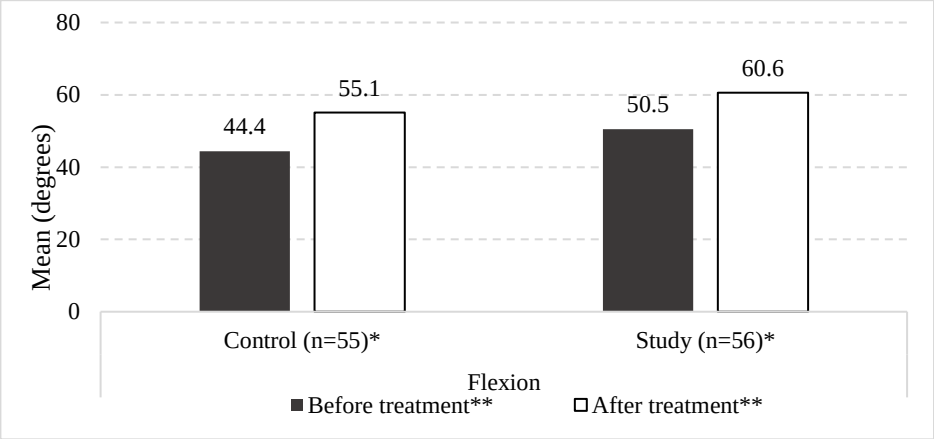
The paired samples statistics with the Wilcoxon test revealed that the differences between the before and after treatment figures are statistically significant for both the control and study group (p < 0.001), (Table 18).

Table 18: Range of motion "Flexion" for participants of control and study group – test statistics for differences within groups in time

		Wilcoxon test	
		Pre-test – Post-test	
		Z	Sig.
Flexion (degrees)	Control group	-6.449	0.000
Flexion (degrees)	Study group	-5.990	0.000

Source: Own source 2023.

Graph 2: The comparison of flexion withing groups before and after treatment



Source: Own source 2023.
* Difference in time is statistically significant ($p \leq 0.05$).
** Difference between groups is statistically significant ($p \leq 0.05$).

Table 19: Range of motion "Extension" for participants of control and study group

		N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Extension (degrees) – before	Control	55	49.96	12.25	46.65	53.28	20	70
	Study	56	55.89	13.74	52.21	59.57	18	70
	Total	111	52.95	13.30	50.45	55.46	18	70
Extension (degrees) – after	Control	55	58.89	12.47	55.52	62.26	20	80
	Study	56	65.41	11.04	62.45	68.37	32	78
	Total	111	62.18	12.17	59.89	64.47	20	80

Source: Own source 2023.

As seen in Table 20, the results of the Mann-Whitney U test have shown that before treatment there was a statistically significant difference with extension between groups (p=0.002). After treatment, there was also a statistically significant difference (p = 0.001).

Table 20: Range of motion "Extension" for participants of control and study group – test statistics for differences between groups in pre-test and post-test

		Pre-test		Post-test	
		MW U statistics	Sig.	MW U statistics	Sig.
Extension (degrees)	Control group - Study group	1032.500	0.002	988.000	0.001

Source: Own source 2023.

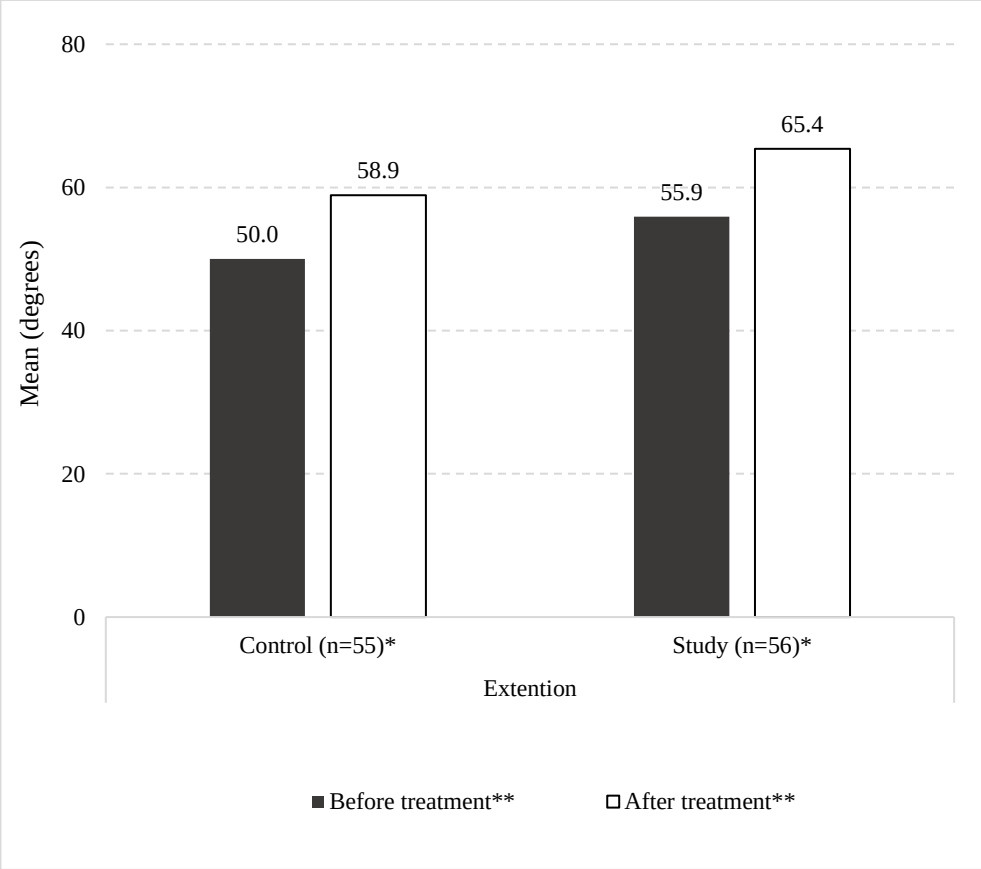
The paired samples statistics with the Wilcoxon test revealed that the difference between the before and after treatment figures is statistically significant for both the control and study group (p < 0.001), (Table 21).

Table 21: Range of motion "Extension" for participants of control and study group – test statistics for differences within groups in time

		Wilcoxon test	
		Pre-test – Post-test	
		Z	Sig.
Extension (degrees)	Control group	-6.369	0.000
Extension (degrees)	Study group	-6.350	0.000

Source: Own source 2023.

Graph 3: The comparison of extension withing groups before and after treatment



Source: Own source 2023.

* Difference in time is statistically significant ($p \leq 0.05$).

** Difference between groups is statistically significant ($p \leq 0.05$).

Table 22: Range of motion "Side bend left" for participants of control and study group

		N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Side bend left (degrees) – before	Control	55	33.82	8.32	31.57	36.07	18	52
	Study	56	35.04	7.38	33.06	37.01	18	52
	Total	111	34.43	7.85	32.96	35.91	18	52
Side bend left (degrees) – after	Control	55	45.69	9.01	43.25	48.13	20	70
	Study	56	48.52	8.26	46.31	50.73	20	70
	Total	111	47.12	8.72	45.48	48.76	20	70

Source: Own source 2023.

As seen in Table 23, the results of the Mann-Whitney U test have shown that before treatment there was not a statistically significant difference with the side bend left between groups (p=0.424). After treatment there was a statistically significant difference between te control and study group (p = 0.022).

Table 23: Range of motion "Side bend left" for participants of control and study group – test statistics for differences between groups in pre-test and post-test

		Pre-test		Post-test	
		MW U statistics	Sig.	MW U statistics	Sig.
Side bend left (degrees)	Control group - Study group	1406.50	0.424	115.00	0.022

Source: Own source 2023.

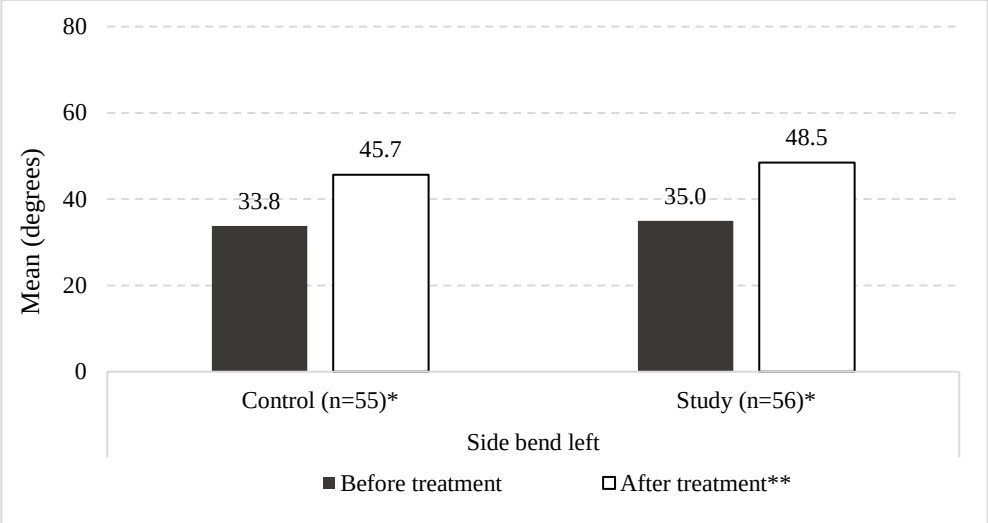
The paired samples statistics with the Wilcoxon test (Table 24) revealed that the difference before and after treatment is statistically significant for both the control and study group (p < 0.001).

Table 24: Range of motion "Side bend left" for participants of control and study group – test statistics for differences within groups in time

		Wilcoxon test	
		Pre-test – Post-test	
		Z	Sig.
Side bend left (degrees)	Control group	-6.492	0.000
Side bend left (degrees)	Study group	-6.526	0.000

Source: Own source 2023.

Graph 4: The comparison of side bend left within groups before and after treatment



Source: Own source 2023.

* Difference in time is statistically significant ($p \leq 0.05$).

** Difference between groups is statistically significant ($p \leq 0.05$).

Table 25: Range of motion "Side bend right" for participants of control and study group

		N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Side bend right (degrees) – before	Control	55	28.60	7.16	26.66	30.54	12	40
	Study	56	30.34	8.74	28.00	32.68	12	58
	Total	111	29.48	8.01	27.97	30.98	12	58
Side bend right (degrees) – after	Control	55	41.05	8.22	38.83	43.28	16	60
	Study	56	44.20	9.30	41.71	46.69	16	64
	Total	111	42.64	8.88	40.97	44.31	16	64

Source: Own source 2023.

As seen in Table 26, the results of the Mann-Whitney U test have shown that before treatment there was no statistically significant difference with the side bend right between groups (p=0.477). After treatment there also was no statistically significant difference between the control and study group (p = 0.058).

Table 26: Range of motion "Side bend right" for participants of control and study group – test statistics for differences between groups in pre-test and post-test

		Pre-test		Post-test	
		MW U statistics	Sig.	MW U statistics	Sig.
Side bend right (degrees)	Control group - Study group	1421.00	0.477	1222.00	0.058

Source: Own source 2023.

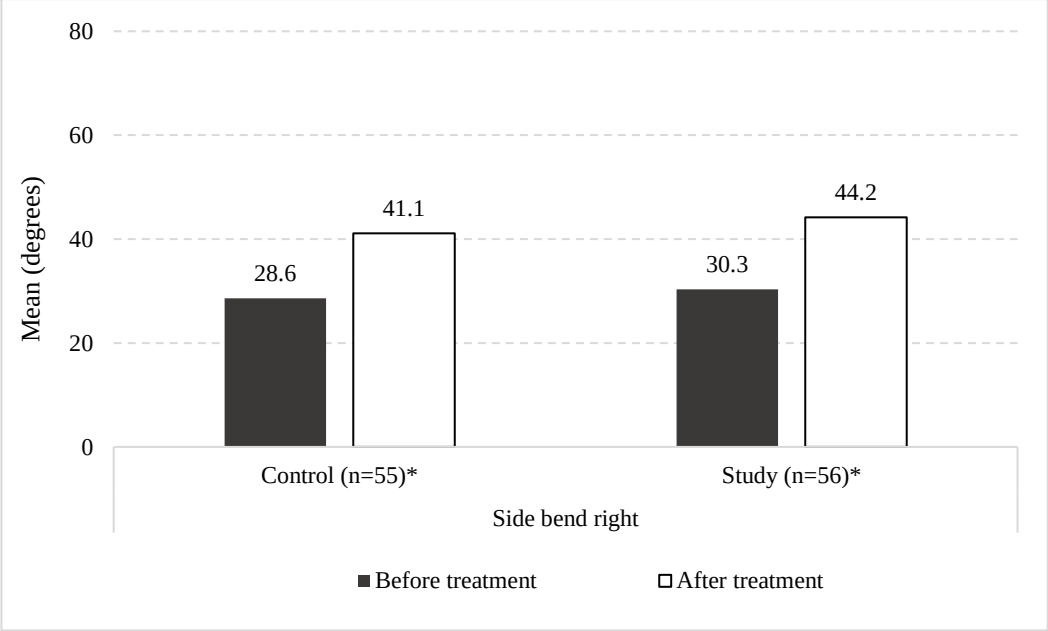
The paired sample statistics with the Wilcoxon test revealed that the difference before and after treatment is statistically significant for both the control and study group ($p < 0.001$), (Table 27).

Table 27: Range of motion "Side bend right" for participants of control and study group – test statistics for differences within groups in time

		Wilcoxon test	
		Pre-test – Post-test	
		Z	Sig.
Side bend right(degrees)	Control group	-6.415	0.000
Side bend right(degrees)	Study group	-6.517	0.000

Source: Own source 2023.

Graph 5: The comparison of side bend right withing groups before and after treatment



Source: Own source 2023.
* Difference in time is statistically significant ($p \leq 0.05$).
** Difference between groups is statistically significant ($p \leq 0.05$).

Table 28: Range of motion »Rotation left« for participants of control and study group

		N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Rotation left (degrees) – before	Control	55	51.20	10.97	48.24	54.16	10	70
	Study	56	52.55	13.25	49.01	56.10	30	80
	Total	111	51.88	12.14	49.60	54.17	10	80
Rotation left (degrees) – after	Control	55	59.73	10.73	56.83	62.63	20	76
	Study	56	65.25	12.43	61.92	68.58	38	90
	Total	111	62.51	11.89	60.28	64.75	20	90

Source: Own source 2023.

As seen in Table 29, the results of the Mann-Whitney U test have shown that before treatment there was no statistically significant difference with rotation left between groups

(p=0.983). After treatment, there was a statistically significant difference between the control and study group (p = 0.045).

Table 29: Range of motion "Rotation left" for participants of control and study group – test statistics for differences between groups in pre-test and post-test

		Pre-test		Post-test	
		MW U statistics	Sig.	MW U statistics	Sig.
Rotation left (degrees)	Control group - Study group	1537.00	0.983	1205.00	0.045

Source: Own source 2023.

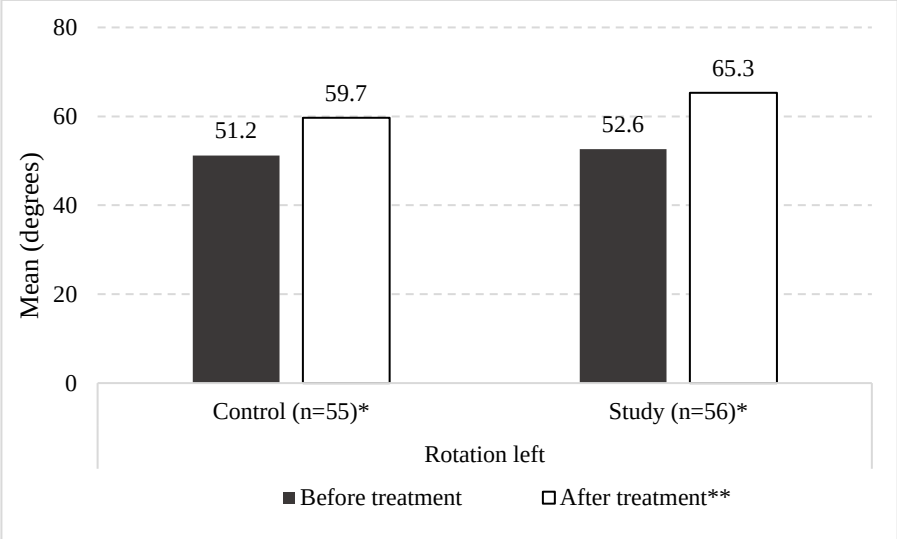
The paired samples statistics with the Wilcoxon test revealed that the difference before and after treatment is statistically significant for both the control and study group (p < 0.001), (Table 30).

Table 30: Range of motion "Rotation left" for participants of control and study group – test statistics for differences within groups in time

		Wilcoxon test	
		Pre-test – Post-test	
		Z	Sig.
Rotation left (degrees)	Control group	-6.232	0.000
Rotation left (degrees)	Study group	-6.352	0.000

Source: Own source 2023.

Graph 6: The comparison of left rotation withing groups before and after treatment



Source: Own source 2023.
* Difference in time is statistically significant ($p \leq 0.05$).
** Difference between groups is statistically significant ($p \leq 0.05$).

Table 31: Range of motion "Rotation right" for participants of control and study group

		N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Rotation right (degrees) – before	Control	55	51.60	9.94	48.91	54.29	26	72
	Study	56	54.36	13.18	50.83	57.89	27	87
	Total	111	52.99	11.71	50.79	55.19	26	87
Rotation right (degrees) – after	Control	55	61.20	9.33	58.68	63.72	40	76
	Study	56	65.45	11.84	62.28	68.62	39	90
	Total	111	63.34	10.83	61.30	65.38	39	90

Source: Own source 2023.

As seen in Table 32, the results of the Mann-Whitney U test have shown that before treatment there was no statistically significant difference with rotation left between groups (p=0.241). After treatment, there was a statistically significant difference between the control and study group (p = 0.028).

Table 32: Range of motion "Rotation right" for participants of control and study group – test statistics for differences between groups in pre-test and post-test

		Pre-test		Post-test	
		MW U statistics	Sig.	MW U statistics	Sig.
Rotation right (degrees)	Control group - Study group	1343.50	0.241	1169.50	0.028

Source: Own source 2023.

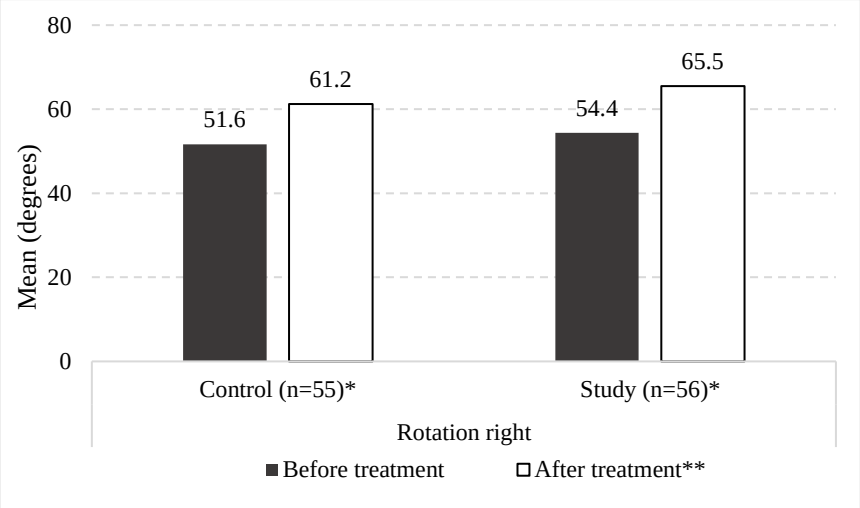
The paired samples statistics with the Wilcoxon test revealed that the difference before and after treatment is statistically significant for both the control and study group ($p < 0.001$). (Table 33).

Table 33: Range of motion "Rotation right" for participants of control and study group – test statistics for differences within groups in time

		Wilcoxon test	
		Pre-test – Post-test	
		Z	Sig.
Rotation right (degrees)	Control group	-6.232	0.000
Rotation right (degrees)	Study group	-6.352	0.000

Source: Own source 2023.

Graph 7: The comparison of right rotation withing groups before and after treatment



Source: Own source 2023.
* Difference in time is statistically significant ($p \leq 0.05$).
** Difference between groups is statistically significant ($p \leq 0.05$).

The Patient Specific Functional scale (PSFS) was used before and after treatment. The mean score before the treatment was similar in the control (3.8 ± 2.1) and study group (4.2 ± 1.8). Participants in both groups showed some progression in the mean score after treatment; a greater increase was noticed in the study group (8.1 ± 6.6), (Table 34).

Table 34: Patient specific functional scale (PSFS) for participants of control and study group

		N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
PSFS - Total score 1 before treatment	Control	55	3.77	2.12	3.20	4.34	0.0	8.0
	Study	56	4.24	1.76	3.77	4.71	0.3	8.0
	Total	111	4.01	1.95	3.64	4.37	0.0	8.0
PSFS - Total score 2 after treatment	Control	55	6.55	2.30	5.93	7.17	0.0	10.0
	Study	56	8.12	1.68	7.68	8.57	3.7	10.0
	Total	111	7.35	2.15	6.94	7.75	0.0	10.0

Source: Own source 2023.

Before treatment there was no statistically significant difference between the control and study group (p=0.314) and after treatment the difference between the control and study group was statistically significant (p < 0.001), (Table 35).

Table 35: Patient specific functional scale (PSFS) results for participants of control and study group– test statistics for differences between groups in pre-test and post-test

		Mann-Whitney U test			
		Pre-test		Post-test	
		MW U statistics	Sig.	MW U statistics	Sig.
PSFS* - Total score	Control group - Study group	1287.00	0.314	878.000	0.000

Source: Own source 2023.

***** Patient specific functional scale

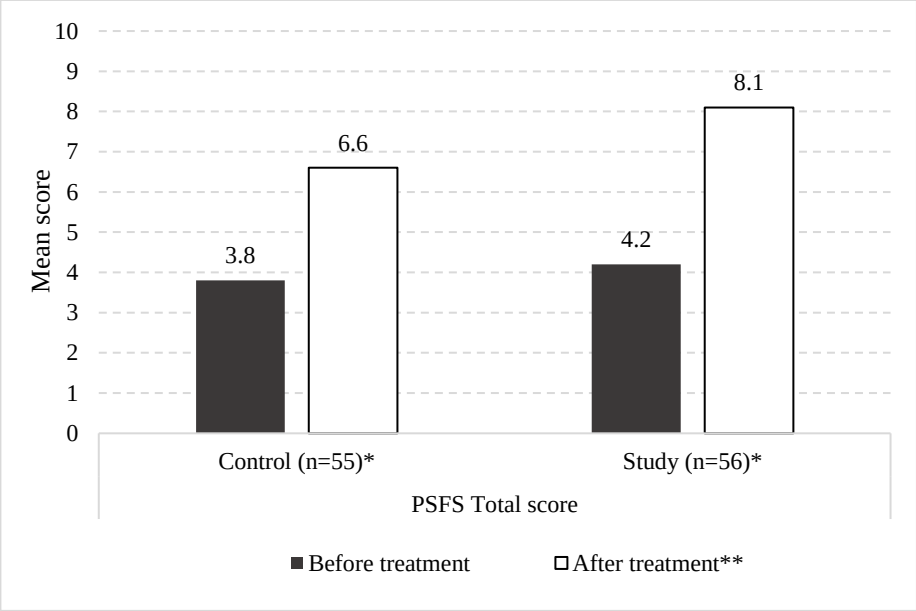
The paired sample statistics with the Wilcoxon test revealed that the difference before and after treatment is statistically significant for both the control and study group (p < 0.001). (Table 36).

Table 36: Patient specific functional scale (PSFS) results for participants of control and study group – test statistics for differences within groups in time

		Wilcoxon test	
		Pre-test – Post-test	
		Z	Sig.
PSFS - Total score	Control group	-0.599	0.000
PSFS - Total score	Study group	-6.435	0.000

Source: Own source 2023.

Graph 8: The comparison of PSFS results within groups before and after treatment



Source: Own source 2023.
* Difference in time is statistically significant ($p \leq 0.05$).
** Difference between groups is statistically significant ($p \leq 0.05$).

One of the important instruments in our study was the neck disability index questionnaire. The study group show improvement from 20.0 ± 8.0 to 9.0 ± 7.0 and the control group also showed improvement, but this was not as visible (from 19.7 ± 7.8 to 14.8 ± 8. 2).

Table 37: Neck disability index questionnaire (NDI) for participants of control and study group

		N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
NDI* - Total score 1 (percentage)	Control	55	39.4	15.6	35.2	43.6	10	78
	Study	56	39.9	15.9	35.7	44.2	12	82
	Total	111	39.7	15.7	36.7	42.6	10	82
NDI* - Total score 2 (percentage)	Control	55	29.5	16.3	25.1	33.9	2	66
	Study	56	18.1	13.9	14.4	21.8	0	54
	Total	111	23.7	16.2	20.7	26.8	0	66

Source: Own source 2023.
* Neck disability index

Before treatment there was no statistically significant difference between the control and study group (p=0.883), and after treatment the difference between the control and study group was statistically significant (p < 0.001), (Table 38).

Table 38: NDI results for participants of control and study group– test statistics for differences between groups in pre-test and post-test

		Mann-Whitney U test			
		Pre-test		Post-test	
		MW U statistics	Sig.	MW U statistics	Sig.
NDI* - Total score (percentage)	Control group - Study group	1515.000	0.883	894.000	0.000

Source: Own source 2023.
*Neck Disability Index

The paired sample statistics with the Wilcoxon test revealed that the difference before and after treatment is statistically significant for both the control and study group (p < 0.001), (Table 39).

Table 39: NDI results for participants of control and study group – test statistics for differences within groups in time

		Wilcoxon test	
		Pre-test – Post-test	
		Z	Sig.
NDI* - Total score (percentage)	Control group	-6.136	0.000
NDI* - Total score (percentage)	Study group	-6.455	0.000

Source: Own source 2023.
*Neck Disability Index

Table 40: NDI Classification for participants of control and study group – test statistics for differences within groups in time

		Group			
		Control		Study	
		F	f %	f	f %
NDI* intervals 1 (before)	No disability	0	0.0%	0	0.0%
	Mild	15	27.3%	14	25.0%
	Moderate	23	41.8%	26	46.4%
	Severe	15	27.3%	15	26.8%
	Complete	2	3.6%	1	1.8%
	Total	55	100.0%	56	100.0%
NDI* intervals 2 (after)	No disability	7	12.7%	17	30.4%
	Mild	21	38.2%	29	51.8%
	Moderate	18	32.7%	8	14.3%
	Severe	9	16.4%	2	3.6%
	Complete	0	0.0%	0	0.0%
	Total	55	100.0%	56	100.0%

Source: Own source 2023.
*Neck Disability Index

Table 41: Chi-square test for pre-test

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	0.543*	3	0.909
Likelihood Ratio	0.549	3	0.908
Linear-by-Linear Association	0.016	1	0.900
N of Valid Cases	111		

Source: Own source 2023.
*2 cells (25.0%) have expected a count less than 5. The minimum expected count is 1.49.

Table 42: Chi-square test for post-test

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	13.739*	3	0.003
Likelihood Ratio	14.338	3	0.002
Linear-by-Linear Association	13.056	1	0.000
N of Valid Cases	111		

Source: Own source 2023.

*0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.45.

Prior to data analysis of the McGill questionnaire, items that were negative were transposed (items 1-3 physical symptoms; items 5-8 psychological symptoms). Principal component analysis was used to determine whether some MQOL items could be combined into meaningful subscales as defined in prior research. As the instrument has been evaluated as reliable and valid many times, we followed the suggested scoring and subscales and checked the reliability and validity of this subscales. The first part of the questionnaire (part A) is a single item numerical scale (SIS) to measure overall quality of life.

Table 43: McGill QOL SIS scale for participants of control and study group

		n	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Considering all parts of my life - physical, emotional, social, spiritual and financial over the past 2 days, the quality of my life has been (Very bad - Excellent)	Control	55	5.5	1.6	5.1	6.0	2	9
	Study	56	5.4	1.8	4.9	5.9	1	9
	Total	111	5.5	1.7	5.1	5.8	1	9
Considering all parts of my life - physical, emotional, social, spiritual and financial over the past 2 days, the quality of my life has been (Very bad - Excellent)	Control	55	7.7	1.6	7.2	8.1	4	10
	Study	56	8.8	1.2	8.5	9.1	5	10
	Total	111	8.3	1.5	8.0	8.6	4	10

Source: Own source 2023.

The Mann-Whitney U test was used for comparing pre-test and post-test data in two groups (control group and study group) regarding the single-item evaluation of Quality of Life (QOL) using PART A - Single-item Scale. The pre-test data's p-value ($p = 0.571$) for the control group implies that there was no significant difference in the QOL evaluation used before the intervention. The significant difference in the post-test data between the control group and the study group ($p < 0.001$) suggests that there is a significant change in the single-item evaluation of Quality of Life (QOL) between the control and study group, where the participants have evaluated their quality of life to be higher than those in control group. (Table 44).

Table 44: McGill QOL SIS scale for participants of control and study group– test statistics for differences between groups in pre-test and post-test

		Mann-Whitney U test			
		Pre-test		Post-test	
		MW U statistics	Sig.	MW U statistics	Sig.
Single item evaluation of Quality of life – PART A	Control group - Study group	1445.500	0.571	899.000	0.000

Source: Own source 2023.

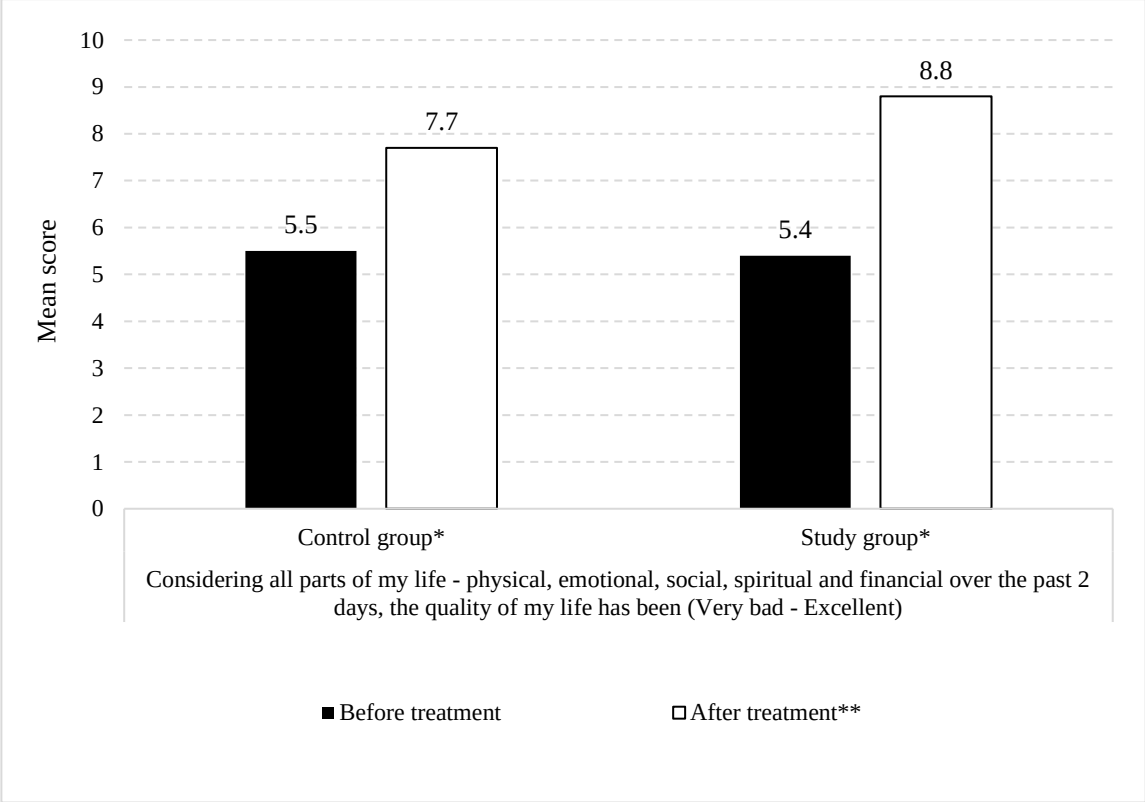
Both groups have achieved a statistically significant increase in the evaluation of quality of life with single item scale.

Table 45: McGill QOL SIS scale for participants of control and study group – test statistics for differences within groups in time

		Wilcoxon test	
		Pre-test – Post-test	
		Z	Sig.
Single item evaluation of Quality of life – PART A	Control group	-6.158	0.000
Single item evaluation of Quality of life – PART A	Study group	-6.475	0.000

Source: Own source 2023.

Graph 9: The comparison of McGill QOL SIS scale within groups before and after treatment



Source: Own source 2023.
* Difference in time is statistically significant ($p \leq 0.05$).
** Difference between groups is statistically significant ($p \leq 0.05$).

We have used the three items that measure problems with physical symptoms and general physical well-being and calculated the mean of items to form a subscale. Prior to that, principal component analysis was used to evaluate the validity of these items in order to form a subscale.

Table 46: McGill QOL PART B – Physical symptoms - for participants of control and study group

		n	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Symptom 1 (No problem - Tremendous problem) before treatment	Control	55	6.7	1.8	6.2	7.2	4	10
	Study	56	7.1	1.7	6.6	7.5	3	10
	Total	111	6.9	1.8	6.6	7.2	3	10
Symptom 1 (No problem - Tremendous problem) after treatment	Control	55	3.3	1.8	2.9	3.8	1	8
	Study	56	2.2	1.6	1.8	2.7	0	7
	Total	111	2.8	1.8	2.4	3.1	0	8
Symptom 2 (No problem - Tremendous problem) before treatment	Control	55	5.1	2.9	4.3	5.9	0	10
	Study	56	4.6	2.8	3.8	5.3	0	10
	Total	111	4.8	2.8	4.3	5.4	0	10
Symptom 2 (No problem - Tremendous problem) after treatment	Control	55	2.5	2.1	1.9	3.0	0	8
	Study	56	1.6	1.6	1.2	2.0	0	8
	Total	111	2.0	1.9	1.7	2.4	0	8
Symptom 3 (No problem - Tremendous problem) before treatment	Control	55	5.2	3.0	4.4	6.0	0	10
	Study	56	5.3	2.6	4.6	6.0	0	9
	Total	111	5.3	2.8	4.7	5.8	0	10
Symptom 3 (No problem - Tremendous problem) after treatment	Control	55	2.6	2.0	2.0	3.1	0	7
	Study	56	1.9	1.5	1.5	2.3	0	7
	Total	111	2.2	1.8	1.9	2.6	0	7
Over the past two days, I have felt... (Physically terrible - Physically well) before treatment	Control	55	5.2	1.4	4.8	5.6	1	9
	Study	56	5.1	1.7	4.6	5.5	1	9
	Total	111	5.1	1.5	4.8	5.4	1	9
Over the past two days, I have felt... (Physically terrible - Physically well) after treatment	Control	55	7.7	1.6	7.3	8.2	3	10
	Study	56	8.5	1.8	8.1	9.0	1	10
	Total	111	8.1	1.7	7.8	8.5	1	10

Source: Own source 2023.

The result of Principal Component Analysis (PCA) for the physical symptoms subscale provides evidence that the measurement instrument has construct validity in both measurements. The result is one extracted component etc. factor in both measurements. The extracted factors align well with the expected constructs, and the variables show significant associations with these factors, implied by strong component weights (from 0.628 to 0.788 in pre-test and from 0.733 to 0.916 in post-test) The KMO and Bartlett's tests further support the meaningfulness of the analysis (KMO in pre-test is 0.690 and in post-test is 0.730; Bartletts test is significant in both measurements). Furthermore, the relatively high percentage of variance (pre-test=49.570 %; post-test=65.578 %) explained by the first component indicates that the measurement instrument effectively captures the primary construct for both measurements, (Table 47).

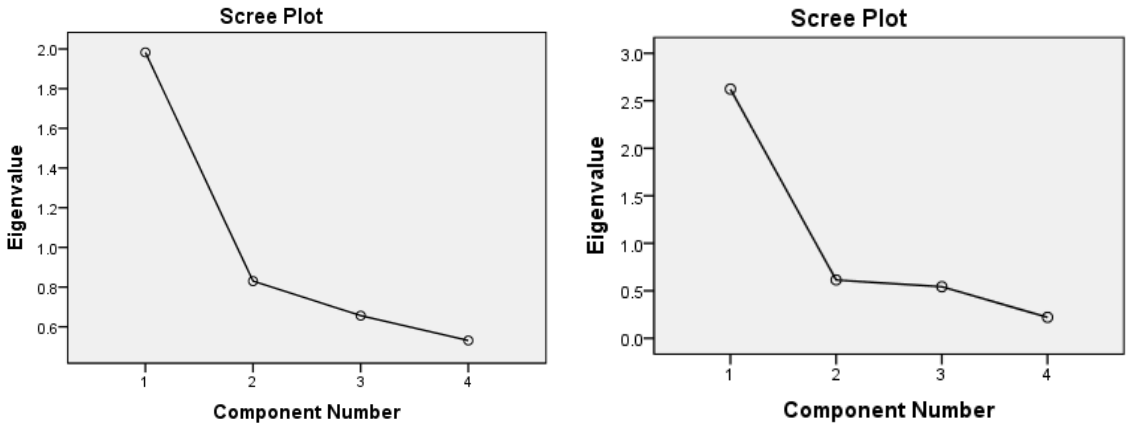
Table 47: McGill QOL PART B – Physical symptoms - principal component analysis on items for pre-test and post-test data

	Pre-test data (n=111)		Post-test data (n=111)	
Item	Extracted communalities	Component Matrix weight	Extracted communalities	Component Matrix weight
Physical symptom 1 (Tremendous problem - No problem)	0.621	0.788	0.838	0.916
Physical symptom 2 (Tremendous problem - No problem)	0.470	0.686	0.640	0.800
Physical symptom 3 (Tremendous problem - No problem)	0.497	0.705	0.537	0.780
Over the past two days, I have felt... (Physically terrible - Physically well)	0.395	0.628	0.608	0.733
KMO and Bartlett's test	0.692 59.976 (<0.001)		0.730 177.586 (<0.001)	
Total variance Explained 1st component	49.570 %		65.578 %	
Eigenvalue 1st component / 2nd component	1.983 / 0.830		2.623 / 0.614	

Source: Own source 2023.

Scree-plot also confirms one factor solution for both measurements (Graph 10).

Graph 10: McGill QOL PART B – Physical symptoms - principal component analysis – scree plot



Pre-test Post-test

Source: Own source 2023.

For further analysis, we have computed a new variable as the mean of all four items for each measurement and have used it in further analyses. Another subscale in McGill is the subscale on psychological wellbeing. In the table below there are basic results on each of the items of this scale and, afterwards, results for Factor Analysis (PCA) are presented, (Table 48).

Table 48: McGill QOL PART C – Psychological symptoms - for participants of the control and study group

		N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Over the past two days, I have been depressed (Not at all - Extremely) before treatment	Control	55	1.5	1.6	1.0	1.9	1	9
	Study	56	2.4	2.1	1.8	2.9	1	9
	Total	111	1.9	1.9	1.6	2.3	1	9
Over the past two days, I have depressed (Not at all - Extremely) after treatment	Control	55	1.2	.6	1.0	1.4	1	5
	Study	56	1.3	.5	1.1	1.4	1	3
	Total	111	1.2	.6	1.1	1.3	1	5
Over the past two days, I have been nervous or worried. (Not at all - Extremely) before treatment	Control	55	5.2	2.3	4.6	5.8	1	10
	Study	56	4.6	2.0	4.1	5.2	1	8
	Total	111	4.9	2.1	4.5	5.3	1	10
Over the past two days, I have been nervous or worried. (Not at all - Extremely) after treatment	Control	55	3.1	1.6	2.6	3.5	1	7
	Study	56	2.0	1.5	1.6	2.4	1	6
	Total	111	2.5	1.6	2.2	2.9	1	7
Over the past two days, how much of the time did you feel sad? (never - Always) before treatment	Control	55	3.9	2.1	3.3	4.4	1	10
	Study	56	3.4	1.8	3.0	3.9	1	10
	Total	111	3.7	2.0	3.3	4.0	1	10
Over the past two days, how much of the time did you feel sad? (never - Always) after treatment	Control	55	2.5	1.7	2.0	2.9	1	8
	Study	56	1.7	1.1	1.4	2.0	1	6
	Total	111	2.1	1.5	1.8	2.4	1	8

Source: Own source 2023.

Based on the results for pre-test data, we see that there are two components or factors extracted. The lower KMO value suggests that the items used might not so good for factor analysis and, as we can see, the item “I have been depressed” has very low communality after extraction. The first component explains 46.541% of the variance, while the second component explains 35.193%. In the post-test data, the results of PCA have resulted in one factor and overall, the results are better (higher value KMO, more explained

variance), but the item "I have been depressed" also stands out with low communality value, although it has appropriate weigh after extraction, (Table 49).

Table 49: McGill QOL PART C – Psychological symptoms - principal component analysis on items for pre-test and post-test data

	Pre-test data (n=111)			Post-test data (n=111)	
Item	Extracted communalities	Component Matrix weight		Extracted communalities	Component Matrix weight
		F1	F2		
Over the past two days, I have been depressed (Extremely - Not at all)	0.837	-0.058	0.913	0.215	0.464
Over the past two days, I have been nervous or worried. (Extremely - Not at all)	0.889	0.942	0.049	0.684	0.827
Over the past two days, how much of the time did you feel sad? (Always - Never)	0.845	0.903	0.172	0.798	0.893
Over the past two days, when I thought of the future. I was... (Terrified - Not afraid)	0.698	0.395	0.736	0.776	0.881
KMO and Bartlett's test	0.551 140.086 (<0.001)			0.628 185.406 (<0.001)	
Total variance Explained 1st component / 2nd component	46.541 % / 35.193 % (rotated solution; Varimax rotation)			61.821 %	
Eigenvalue 1st component / 2nd component	2.130 / 1.140			2.473 / 0.963	

Source: Own source 2023.

As our goal is to prepare a variable for psychological well-being that is as valid and reliable as possible, we will repeat the procedure without the item "Depressed". Results are presented further on.

The result provides evidence that the measurement instrument with three items has a better construct validity in both measurements. The result is one extracted component etc. factor in both measurements. The extracted factors align well with the expected constructs, and the variables show significant associations with these factors, which is implied by strong component weights (from 0.650 to 0.897 in pre-test and from 0.878 to 0.889 in post-test). The KMO and Bartlett's tests further support the assumption that the items are suitable from the analysis (KMO in pre-test is 0.603 and in post-test is 0.735; Bartletts test is significant in both measurements). Furthermore, the high percentage of variance (pre-test=67.718 %; post-test=77.848 %) explained by the first component indicates that the measurement instrument is suitable for the psychological subscale in both measurements, (Table 50).

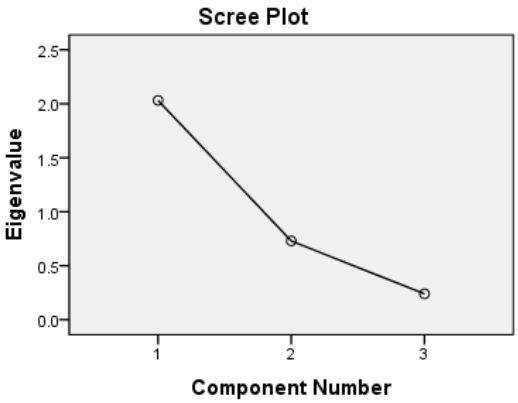
Table 50: McGill QOL PART C – Psychological symptoms - principal component analysis on items for pre-test and post-test data – repeated without one item

	Pre-test data (n=111)		Post-test data (n=111)	
Item	Extracted communalities	Component Matrix weight	Extracted communalities	Component Matrix weight
Over the past two days, I have been nervous or worried. (Extremely - Not at all)	0.805	0.897	0.790	0.889
Over the past two days, how much of the time did you feel sad? (Always - Never)	0.804	0.897	0.775	0.880
Over the past two days, when I thought of the future, I was... (Terrified - Not afraid)	0.422	0.650	0.771	0.878
KMO and Bartlett's test	0.603 (<0.001)		0.735 (<0.001)	
Total variance Explained 1st component / 2nd component	67.718 %		77.848 %	
Eigenvalue 1st component / 2nd component	2.032 / 0.729		2.335 / 0.347	

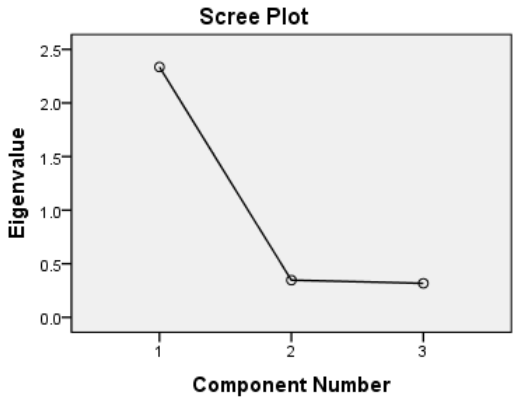
Source: Own source 2023.

Scree-plot confirms one factor solution for pre-test and post-test measurement, (Graph 11).

Graph 11: McGill QOL PART B – Psychological symptoms - principal component analysis – scree plot – repeated without one item



Pre-test



Post-test

Source: Own source 2023.

For further analyses, we have computed a new variable as the mean of all three items for each measurement.

Table 51: McGill QOL PART C – Existential wellbeing for participants of control and study group

		N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Over the past two days, when I thought of the future, I was... (Not afraid - terrified) before treatment	Control	55	4.8	2.1	4.2	5.4	1	10
	Study	56	3.8	2.1	3.3	4.4	1	10
	Total	111	4.3	2.2	3.9	4.7	1	10
Over the past two days, when I thought of the future, I was... (Not afraid - terrified) after treatment	Control	55	2.5	1.6	2.1	2.9	1	8
	Study	56	1.7	1.1	1.4	2.0	1	6
	Total	111	2.1	1.4	1.8	2.4	1	8
Over the past two days, my life has been... (Utterly meaningless and without purpose - Very purposeful and meaningful) before treatment	Control	55	8.2	1.7	7.7	8.6	2	10
	Study	56	8.1	2.0	7.6	8.7	4	10
	Total	111	8.2	1.8	7.8	8.5	2	10
Over the past two days, my life has been... (Utterly meaningless and without purpose - Very purposeful and meaningful) after treatment	Control	55	9.2	1.2	8.9	9.5	5	10
	Study	56	9.6	.7	9.4	9.8	7	10
	Total	111	9.4	1.0	9.2	9.6	5	10
Over the past two days, when I thought about my whole life, I felt that in achieving life goals I have... (Made no progress whatsoever - Progressed to complete fulfillment) before treatment	Control	55	7.5	1.9	7.0	8.0	3	10
	Study	56	7.3	2.3	6.7	7.9	3	10
	Total	111	7.4	2.1	7.0	7.8	3	10
Over the past two days, when I thought about my whole life, I felt that in achieving life goals I have... (Made no progress whatsoever - Progressed to complete fulfillment) after treatment	Control	55	8.6	1.6	8.2	9.1	3	10
	Study	56	9.1	1.2	8.7	9.4	5	10
	Total	111	8.9	1.4	8.6	9.1	3	10
Over the past two days, when I thought about my life, I felt that my life to this point has been... (Completely worthless - Very worthwhile) before treatment	Control	55	8.9	1.3	8.6	9.3	5	10
	Study	56	8.7	1.7	8.2	9.2	5	10
	Total	111	8.8	1.5	8.5	9.1	5	10
Over the past two days, when I thought about my life, I felt that my life to this point has been... (Completely worthless - Very worthwhile) after treatment	Control	55	9.5	1.0	9.3	9.8	5	10
	Study	56	9.8	.6	9.6	9.9	7	10
	Total	111	9.7	.8	9.5	9.8	5	10
Over the past two days, I have felt that I have... (No control over my life - Complete control over my life) before treatment	Control	55	8.3	1.8	7.8	8.8	5	10
	Study	56	7.9	2.5	7.2	8.6	2	10
	Total	111	8.1	2.2	7.7	8.5	2	10
Over the past two days, I have felt that I have... (No control over my life - Complete control over my life) after treatment	Control	55	9.3	1.1	8.9	9.6	5	10
	Study	56	9.4	1.0	9.2	9.7	7	10
	Total	111	9.3	1.0	9.1	9.5	5	10
Over the past two days, I felt good about myself as a person...	Control	55	2.6	2.4	1.9	3.2	1	8
	Study	56	2.4	2.3	1.7	3.0	1	9

		N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
(Completely disagree - Completely agree) before treatment	Total	111	2.5	2.3	2.0	2.9	1	9
Over the past two days, I felt good about myself as a person... (Completely disagree - Completely agree) after treatment	Control	55	1.5	1.1	1.2	1.8	1	7
	Study	56	1.3	1.1	1.0	1.6	1	7
	Total	111	1.4	1.1	1.2	1.6	1	7
To me the past two days were... (A burden - A gift) before treatment	Control	55	9.3	1.1	9.0	9.6	5	10
	Study	56	9.1	1.5	8.7	9.5	4	10
	Total	111	9.2	1.3	8.9	9.4	4	10
To me the past two days were... (A burden - A gift) after treatment	Control	55	9.8	0.5	9.6	9.9	8	10
	Study	56	9.8	0.5	9.7	9.9	8	10
	Total	111	9.8	0.5	9.7	9.9	8	10

Source: Own source 2023.

The Kaiser-Meyer-Olkin (KMO) values on subscale existential well-being indicate appropriate sampling adequacy, both values indicate that data are suitable fort he analysis (KMO pre-test=0,804; KMO post-test=0,787). The Bartlett's test confirmed that the correlation matrices were significantly different from the identity matrices, justifying the factor analysis ($p < 0,001$).

Further findings reveal that a single dominant component consistently accounted for a substantial proportion of variance in both pre-test (58,205 %) and post-test (58,554 %) assessments. The weights extracted from the factor analysis exhibit substantial correlations etc. indicating strong associations with the underlying factors. However, the The Kaiser-Meyer-Olkin (KMO) values on subscale existential well-being indicate appropriate sampling adequacy. Both values indicate that data are suitable for the analysis (KMO pre-test=0.804; KMO post-test=0.787). The Bartlett's test confirmed that the correlation matrices were significantly different from the identity matrices, justifying the factor analysis ($p < 0.001$).

Further findings reveal that a single dominant component consistently accounted for a substantial proportion of variance in both pre-test (58.205 %) and post-test (58.554 %) assessments. The weights extracted from the factor analysis exhibit substantial item "To me the past two days were..." seems to have the least correlation with the underlying factors, as indicated by its lower component matrix weights compared to the other items; nevertheless, the weight is not lower than recommended (0.4). Because overall results

suggest a strong underlying dimension across both time points, representing a unifying factor in participants' perceptions of the existential aspect of their quality of life, we will keep all items in the analysis, (Table 52).

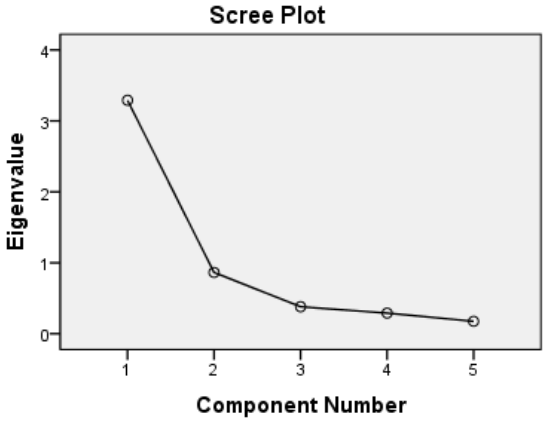
Table 52: McGill QOL PART C – Existential well-being - principal component analysis for pre-test and post-test data

	Pre-test data (n=111)		Post-test data (n=111)	
Item	Extracted communalities	Component Matrix weight	Extracted communalities	Component Matrix weight
Over the past two days, my life has been... (Utterly meaningless and without purpose - Very purposeful and meaningful)	0.738	0.859	0.680	0.825
Over the past two days, when I thought about my whole life, I felt that in achieving life goals I have... (Made no progress whatsoever - Progressed to complete fulfillment)	0.746	0.863	0.723	0.850
Over the past two days, when I thought about my life, I felt that my life to this point has been... (Completely worthless - Very worthwhile)	0.765	0.875	0.577	0.760
Over the past two days, I have felt that I have... (No control over my life - Complete control over my life)	0.735	0.857	0.630	0.794
Over the past two days, I felt good about myself as a person... (Completely disagree - Completely agree)	0.245	0.495	0.494	0.702
To me the past two days were... (A burden - A gift)	0.246	0.514	0.290	0.538
KMO and Bartlett's test	0.804 339.998 (< 0.001)		0.787 294.812 (< 0.001)	
Total variance Explained 1st component	58.205 %		56.554 %	
Eigenvalue 1st component / 2nd component	3.492 / 1.083		3.393 / 0.877	

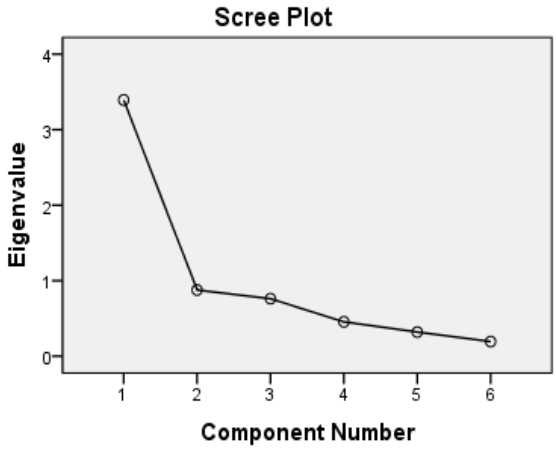
Source: Own source 2023.

Scree-plot confirms one factor solution for pre-test and post-test measurement (Graph 12).

Graph 12: McGill QOL PART B – Existential wellbeing - principal component analysis – scree plot



Pre-test



Post-test

Source: Own source 2023.

For further analyses, we have computed new variable as the mean of all six items for each measurement.

Table 53: McGill QOL PART C – Support - for participants of control and study group

		N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Over the past two days the world has been... (An impersonal unfeeling place - Caring and responsive to my needs) before treatment	Control	55	9.1	1.3	8.7	9.4	5	10
	Study	56	8.8	1.6	8.4	9.3	5	10
	Total	111	8.9	1.5	8.7	9.2	5	10
Over the past two days the world has been... (An impersonal unfeeling place - Caring and responsive to my needs) after treatment	Control	55	9.5	.9	9.2	9.7	7	10
	Study	56	9.5	1.0	9.2	9.8	6	10
	Total	111	9.5	.9	9.3	9.7	6	10
Over the past two days, I have felt supported... (Not at all - Completely) before treatment	Control	55	9.5	1.0	9.3	9.8	7	10
	Study	56	9.2	1.3	8.9	9.5	6	10
	Total	111	9.4	1.1	9.1	9.6	6	10
Over the past two days, I have felt supported... (Not at all - Completely) after treatment	Control	55	9.6	.9	9.4	9.9	7	10
	Study	56	9.6	.9	9.3	9.8	6	10
	Total	111	9.6	.9	9.4	9.8	6	10

Source: Own source 2023.

The result of Principal Component Analysis (PCA) for the support subscale provides strong evidence that the measurement instrument has construct validity in both measurements. The result is one extracted component etc. factor in both measurements. The extracted factors align excellent with the expected constructs, and the variables show significant associations with these factors, which is implied by strong component weights (0.967 in pre-test and 0.949 in post-test). The KMO and Bartlett's tests further support the meaningfulness of the analysis, although KMO values are somewhat lower (KMO in pre-test and post-test is 0.500; Bartletts test is significant in both measurements). Furthermore, very high percentage of variance (pre-test=93.591 %; post-test=90.007 %) explained by the

first component indicates that the measurement instrument is valid and can be interpreted contextually as planned, (Table 54).

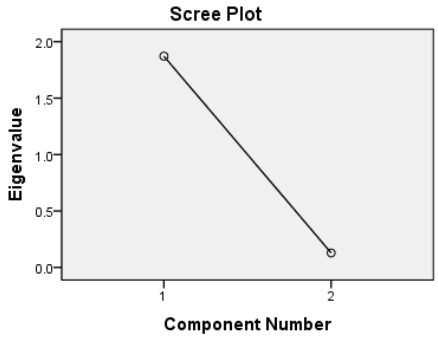
Table 54: McGill QOL PART C – Support subscale - principal component analysis on items for pre-test and post-test data

	Pre-test data (n=111)		Post-test data (n=111)	
Item	Extracted communalities	Component Matrix weight	Extracted communalities	Component Matrix weight
Over the past two days the world has been... (An impersonal unfeeling place - Caring and responsive to my needs)	0.936	0.967	0.900	0.949
Over the past two days, I have felt supported... (Not at all - Completely)	0.936	0.967	0.900	0.949
KMO and Bartlett's test	0.500 154.871 (<0.001)		0.500 110.919 (<0.001)	
Total variance Explained 1st component	93.591 %		90.007 %	
Eigenvalue 1st component / 2nd component	1.872 / 0.128		1.800 / 0.200	

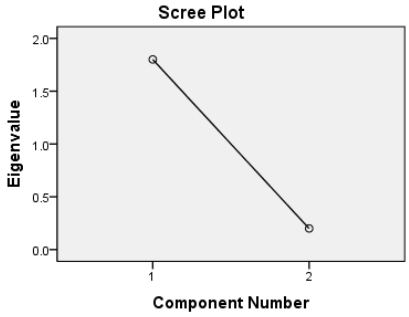
Source: Own source 2023.

Scree-plot also confirms one factor solution for both measurements (Graph13).

Graph 13: McGill QOL PART C – Support subscale - principal component analysis – scree plot



Pre-test



Post-test

Source: Own source 2023.

For further analysis, we have computed a new variable as the mean of both items for each measurement. In Table 55, the results of the One-Sample Kolmogorov-Smirnov tests examining the normality of various quality of life (MQOL) variables before and after intervention are presented. The Kolmogorov-Smirnov test statistic and significance level (sig.) are reported for each variable. For almost all variables both before and after intervention p-values are less than 0.001, indicating that the distribution of responses significantly deviates from a normal distribution. Only the subscale of the physical dimension of QOL before and the total score before the intervention are normally distributed.

Overall, the low p-values across all tested variables suggest that the assumptions of normality are violated. Consequently, we considered the non-normal distribution of the data when interpreting and analyzing the differences between groups and in time for all MQOL variables, as this is a more appropriate statistical method. Conclusions are drawn from subsequent analyses.

Table 55: Testing MQOL variables for normality with One sample Kolmogorov - Smirnov test

	N	Test statistic	Sig.
Considering all parts of my life - physical, emotional, social, spiritual and financial - over the past 2 days, the quality of my life has been (Very bad - Excellent) BEFORE	111	0.131	0.000
Quality of life - physical BEFORE	111	0.060	0.200
Quality of life - psychological BEFORE	111	0.117	0.001
Quality of life – existential BEFORE	111	0.126	0.000
Quality of life – support BEFORE	111	0.294	0.000
Quality of life - total score BEFORE	111	0.061	0.200
Considering all parts of my life - physical, emotional, social, spiritual and financial - over the past 2 days, the quality of my life has been (Very bad - Excellent) AFTER	111	0.207	0.000
Quality of life - physical AFTER	111	0.177	0.000
Quality of life – psychological AFTER	111	0.241	0.000
Quality of life – existential AFTER	111	0.238	0.000
Quality of life – support AFTER	111	0.386	0.000
Quality of life - total score AFTER	111	0.147	0.000

Source: Own source 2023.

Table 56: Descriptive statistics for MQOL dimensions and total score

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Quality of life - physical before treatment	Control	55	4.5	1.6	0.2	4.1	5.0	1.3	7.8
	Study	56	4.5	1.6	0.2	4.1	5.0	1.8	8.3
	Total	111	4.5	1.6	0.2	4.2	4.8	1.3	8.3
Quality of life - physical after treatment	Control	55	7.3	1.4	0.2	7.0	7.7	3.8	9.5
	Study	56	8.2	1.4	0.2	7.8	8.6	4.3	10.0
	Total	111	7.8	1.5	0.1	7.5	8.0	3.8	10.0
Quality of life - psychological before treatment	Control	55	5.4	1.7	0.2	4.9	5.8	1.7	9.0
	Study	56	6.0	1.7	0.2	5.6	6.5	3.0	9.0
	Total	111	5.7	1.7	0.2	5.4	6.0	1.7	9.0
Quality of life – psychological after treatment	Control	55	7.3	1.4	0.2	7.0	7.7	3.7	9.0
	Study	56	8.2	1.1	0.2	7.9	8.5	5.3	9.0
	Total	111	7.8	1.3	0.1	7.5	8.0	3.7	9.0
Quality of life – existential before treatment	Control	55	8.3	1.3	0.2	7.9	8.6	4.5	9.8
	Study	56	8.1	1.6	0.2	7.7	8.5	5.3	9.8
	Total	111	8.2	1.4	0.1	7.9	8.5	4.5	9.8
Quality of life – existential after treatment	Control	55	9.1	0.8	0.1	8.9	9.4	6.8	9.8
	Study	56	9.4	0.6	0.1	9.2	9.6	7.5	9.8
	Total	111	9.3	0.8	0.1	9.1	9.4	6.8	9.8
Quality of life – support before treatment	Control	55	9.3	1.0	0.1	9.0	9.6	6.0	10.0
	Study	56	9.0	1.4	0.2	8.6	9.4	6.0	10.0
	Total	111	9.2	1.2	0.1	8.9	9.4	6.0	10.0
Quality of life – support after treatment	Control	55	9.6	0.9	0.1	9.3	9.8	7.0	10.0
	Study	56	9.5	0.9	0.1	9.3	9.8	6.0	10.0
	Total	111	9.5	0.9	0.1	9.4	9.7	6.0	10.0
Quality of life - total score before treatment	Control	55	6.9	1.0	0.1	6.7	7.2	4.6	9.1
	Study	56	6.9	1.3	0.2	6.6	7.3	4.3	9.1
	Total	111	6.9	1.2	0.1	6.7	7.1	4.3	9.1
Quality of life - total score after treatment	Control	55	8.4	0.9	0.1	8.2	8.6	6.1	9.6
	Study	56	8.8	0.8	0.1	8.6	9.1	6.8	9.7
	Total	111	8.6	0.9	0.1	8.5	8.8	6.1	9.7

Source: Own source 2023.

Table 57 presents the results of the Mann-Whitney U tests conducted to assess differences between the control and study groups in terms of McGill Quality of Life (MQOL) subscales and total score before and intervention. For the 'Quality of life – physical' subscale, there is no significant difference between the control and study groups in the pre-test (U = 1505.000, p = 0.836). However, in the post-test, the Mann-Whitney U test shows a significant difference (U = 938.000, p = 0.000), indicating that the study group's score was significantly higher compared to the control group results regarding their physical symptoms.

For the 'Quality of life – psychological' subscale, the pre-test comparison indicates a significant difference (U = 1197.500, p = 0.043) between the control and study group. This difference remains significant in the post-test comparison (U = 943.000, p = 0.001), indicating sustained improvement in the study group. Regarding the 'Quality of life – existential' and 'Quality of life – support' subscales, no significant differences are observed between the control and study groups in both pre-test and post-test assessments. For the 'Quality of life – TOTAL SCORE,' there is no significant difference between the groups in the pre-test phase (U = 1535.000, p = 0.976). However, a significant difference emerges in the post-test phase (U = 989.000, p = 0.001).

Table 57: McGill QOL subscales and total score for participants of control and study group– test statistics for differences between groups in the pre-test and post-test

		Mann-Whitney U test			
		Pre-test		Post-test	
		MW U statistics	Sig.	MW U statistics	Sig.
Quality of life – physical PART B	Control group - Study group	1505.000	0.836	938.000	0.000
Quality of life – psychological PART C	Control group - Study group	1197.500	0.043	943.000	0.001
Quality of life – existential PART C	Control group - Study group	1513.000	0.873	1290.500	0.126
Quality of life – support PART C	Control group - Study group	1462.500	0.618	1496.000	0.750
Quality of life – TOTAL SCORE	Control group - Study group	1535.000	0.976	989.000	0.001

Source: Own source 2023.

The within groups test statistics shows improvement for all subscales in both groups in time ($p < 0.05$).

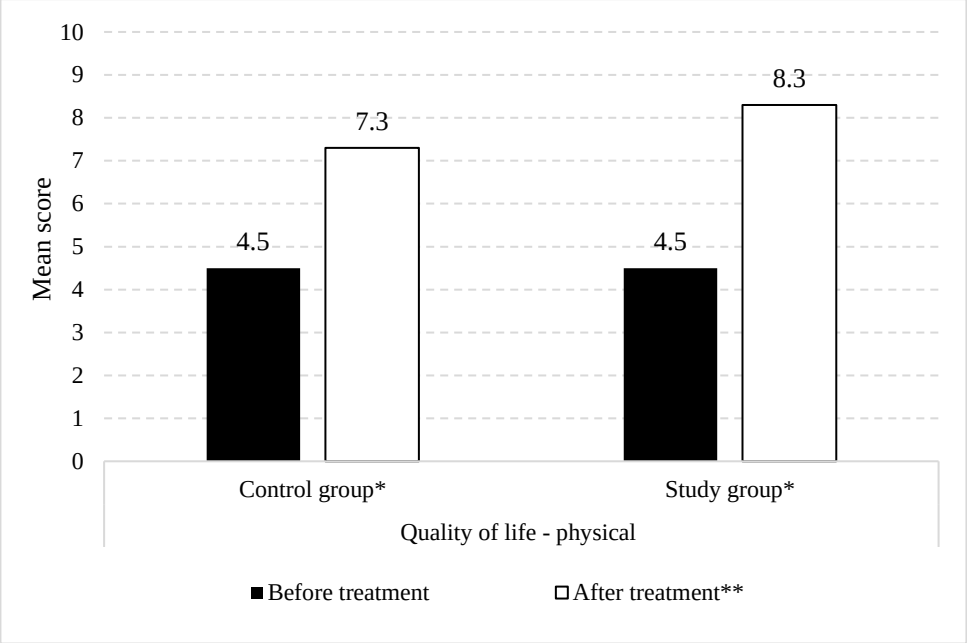
Table 58: McGill QOL SIS subscales and total score for participants of control and study group – test statistics for differences within groups in time

		Wilcoxon test	
		Pre-test – Post-test	
		Z	Sig.
Quality of life – physical PART B	Control group	-6.459	0.000
Quality of life – physical PART B	Study group	-5.896	0.000
Quality of life – psychological PART C	Control group	-6.111	0.000
Quality of life – psychological PART C	Study group	-6.231	0.000
Quality of life – existential PART C	Control group	-6.444	0.000
Quality of life – existential PART C	Study group	-6.514	0.000
Quality of life – support PART C	Control group	-6.224	0.000
Quality of life – support PART C	Study group	-5.772	0.000
Quality of life – TOTAL SCORE	Control group	-4.106	0.000
Quality of life – TOTAL SCORE	Study group	-6.511	0.000

Source: Own source 2023.

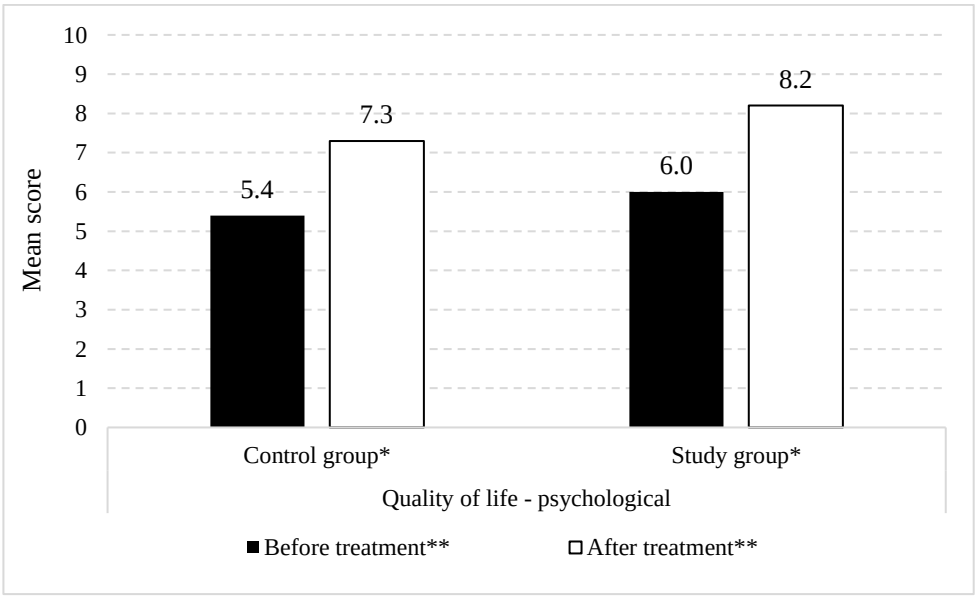
In summary, the Mann-Whitney U test and Wilcoxon signed rank test results indicate significant improvements in the study group compared to the control group for 'Quality of life – physical' and 'Quality of life – psychological' subscales, as well as the 'Quality of life – TOTAL SCORE,' in the post-test assessment. Both groups achieved significant improvement after intervention. These findings suggest that the intervention had a positive impact on these aspects of the quality of life.

Graph 14: The comparison of McGill QOL physical scale within groups before and after treatment



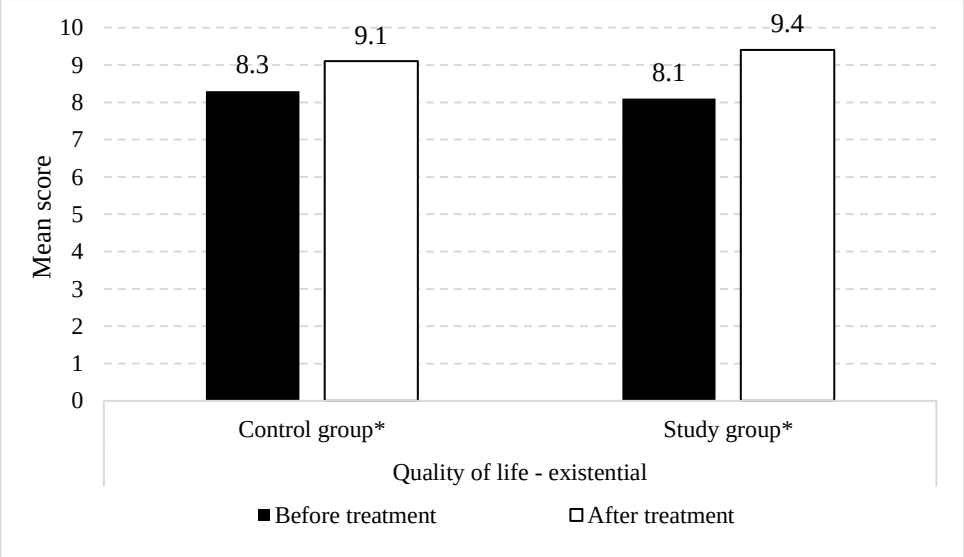
Source: Own source 2023.
* Difference in time is statistically significant ($p \leq 0.05$).
** Difference between groups is statistically significant ($p \leq 0.05$).

Graph 15: The comparison of McGill QOL psychological scale within groups before and after treatment



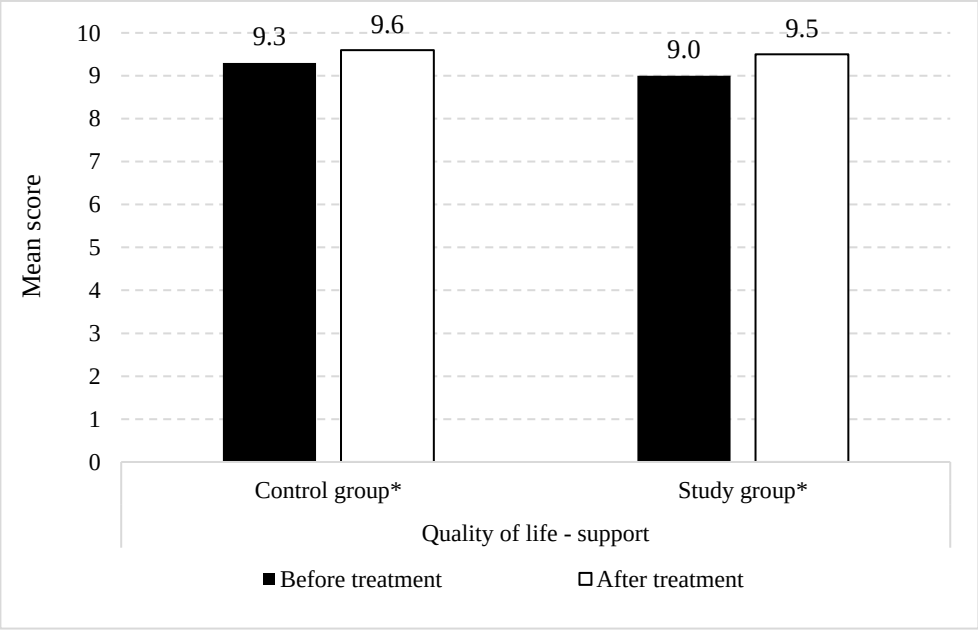
Source: Own source 2023.
* Difference in time is statistically significant ($p \leq 0.05$).
** Difference between groups is statistically significant ($p \leq 0.05$).

Graph 16: The comparison of McGill QOL existential scale within groups before and after treatment



Source: Own source 2023.
* Difference in time is statistically significant ($p \leq 0.05$).
** Difference between groups is statistically significant ($p \leq 0.05$).

Graph 17: The comparison of McGill QOL total score within groups before and after treatment



Source: Own source 2023.
* Difference in time is statistically significant ($p \leq 0.05$).
** Difference between groups is statistically significant ($p \leq 0.05$).

Table 59: MQOL Part 4 for participants of control and study group – test statistics for differences within groups in time

		Group			
		Control		Study	
		F	f %	f	f %
List or describe the things which had the greatest effect on your quality of life – BEFORE	Pain	37	67.3%	39	69.6%
	financial position	2	3.6%	4	7.1%
	coexisting disease	6	10.9%	10	17.9%
	difficulties in concentration	2	3.6%	1	1.8%
	Headache	5	9.1%	0	0.0%
	not supported by family	3	5.5%	2	3.6%
	Total	55	100.0%	56	100.0%
List or describe the things which had the greatest effect on your quality of life – AFTER	Pain	34	61.8%	34	60.7%
	financial position	2	3.6%	4	7.1%
	coexisting disease	4	7.3%	10	17.9%
	difficulties in concentration	3	5.5%	2	3.6%
	Headache	3	5.5%	0	0.0%
	not supported by family	9	16.4%	6	10.7%
	Total	55	100.0%	56	100.0%

Source: Own source 2023.

The chi-square test did not confirm significant differences in descriptive answers about the issue which had the greatest effect on participant quality of life (pre-test p=0.101; post-test p=0.218). although some differences are evident from the answers that were written and coded. (Table 60, 61).

Table 60: Chi-square test for pre-test between groups

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.244*	5	0.203
Likelihood Ratio	9.207	5	0.101
Linear-by-Linear Association	1.556	1	0.212
N of Valid Cases	111		

Source: Own source 2023.

*8 cells (66.7%) have expected count less than 5. The minimum expected count is 1.49.

Table 61: Chi-square test for post-test between groups

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.030*	5	0.218
Likelihood Ratio	8.291	5	0.141
Linear-by-Linear Association	0.809	1	0.368
N of Valid Cases	111		

Source: Own source 2023.

*0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.45.

Additional analysis regarding the differences between Control and Study Group

As the initial comparisons between the control and study group showed some statistically significant differences, we have performed discriminant analysis to obtain further insight into the differences between them and to be able to understand the key variables contributing to the differences between the control and study group. We have 111 cases in the analysis. There are 55 cases in the control group and 56 cases in the study group. There were no missing cases with the variables used in the analysis.

The result of testing the equality of the group means between the control and study group has shown that there are statistically significant differences in age ($p < 0.001$), BMI ($p=0.001$), neck flexion as part of AROM functionality test ($p=0.012$) and neck extension

as part of the AROM functionality test (p=0.018), (Table 62). We can also see the importance of variables when interpreting Wilks' Lambda: the smaller the statistic, the more important the independent variable is to the discriminant function.

Table 62: Tests of Equality of Group Means

	Wilks' Lambda	F	df1	df2	Sig.
Age	0.867	16.740	1	109	0.000
BMI – before	0.905	11.489	1	109	0.001
Flexion (degrees) – before	0.944	6.480	1	109	0.012
Extension (degrees) – before	0.950	5.750	1	109	0.018
Side bend left (degrees) - before	0.994	0.666	1	109	0.416
Side bend right (degrees) - before	0.988	1.312	1	109	0.255
Rotation left (degrees) – before	0.997	0.343	1	109	0.559
Rotation right (degrees) - before	0.986	1.545	1	109	0.217
FRTL Left side – before	0.996	0.445	1	109	0.506
FRTR Right side – before	0.990	1.072	1	109	0.303
ST Left side – before	0.996	0.444	1	109	0.507
ST Right side – before	0.966	3.788	1	109	0.054
NPRS - pain scale before treatment (0-10)	0.996	0.439	1	109	0.509
PSFS - Total score 1 – before	0.985	1.605	1	109	0.208
NDI - Total score 1- before	1.000	0.029	1	109	0.865

Source: Own source 2023.

As we have only 2 groups, there is only one discriminant function. From the given results in table 63, it appears that function 1 explains 100.0% of the variance, because we only have 1 function. Canonical correlation coefficient is 0.5 and the Wilks' Lambda value of 0.752 indicates the strength of discrimination. The associated chi-square statistic has a significance level of 0.016, indicating that the differences between groups are statistically significant at the 0.05 level, (Table 63).

Table 63: Summary of canonical discriminant function

	Eigenvalue	% of variance	Canonical Correlation	Wilks' Lambda	Chi-square	df	Sig.
Function 1	0.330	100.0 %	0.498	0.752	28.966	15	0.016

Source: Own source 2023.

Results suggest that the linear combinations of the predictor variables are important in separating the two groups, but as we would like the groups to be as equal as possible, we are interested in identifying the variables most important in separating the control and study group. In the summary output of canonical discriminant functions, we will check the standardized canonical discriminant coefficients and the structure matrix. As we can see in the table below, the Age and BMI of the participants are the most important factors that differentiate the control and study group, followed by Neck Flexion (degrees) and Neck extension (degrees).

Table 64: Standardized coefficients and the structure matrix

	Standardized Canonical Discriminant Function Coefficients	**Structure Matrix**
	Function	Function
	1	1
Age	0.624	0.628
BMI – before	0.379	0.565
Flexion (degrees) – before	-0.292	-0.424
Extension (degrees) – before	-0.397	-0.400
Side bend left (degrees) - before	-0.047	-0.136
Side bend right (degrees) - before	0.316	-0.191
Rotation left (degrees) – before	0.004	-0.098
Rotation right (degrees) - before	-0.060	-0.207
FRTL Left side – before	-0.345	-0.111
FRTR Right side – before	0.013	0.173
ST Left side – before	-0.071	0.111
ST Right side – before	0.187	0.324
NPRS - pain scale before treatment (0-10)	0.009	-0.110
PSFS - Total score 1 – before	-0.112	-0.211
NDI - Total score 1 – before	-0.125	-0.028

Source: Own source 2023.

In the next step we have made additional correlation analysis, where we analyzed the age at which the impact of this variable starts to show (correlation with other variables included in the analyses). We have found out that by the limit of age 53, there is no correlation to or impact on other variables in the younger group of participants (except BMI). So, we decided to divide the control and study group into two groups (53 and younger and 54 and older). As we can see from the correlation analysis on the whole sample, there was a statistically significant positive correlation between age and BMI and a significant positive correlation between age and neck flexion, neck side bend, PSFS score and NDI score. Further, there was a statistically significant negative correlation between age, the psychological dimension of quality of life, and the total score for quality of life. As we divided the sample into two age groups, there are no more statistically significant correlations, except the positive correlation with age and BMI.

So, in order to eliminate the influence of the age variable on the results in the control and study group, we will prepare all the analysis for hypotheses twice, separately for both groups. We have showed with this preliminary analysis that age is an important factor, but we would also like to get a better understanding of the other variables important for differentiation between the control and study group.

Table 65: Correlation analysis of age and other variables and measures pre-test

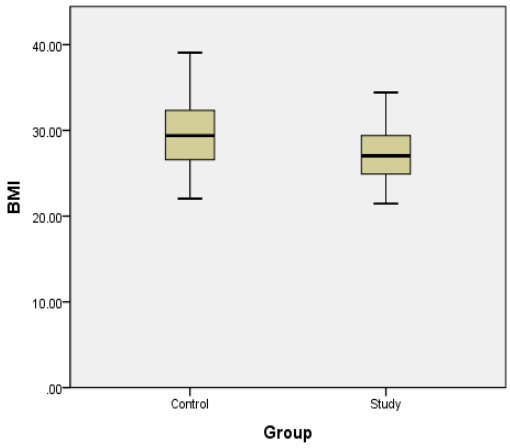
		Whole sample Age	Up to 53 years Age	54 years and more Age
Age	Spearman's rho	1.000	1.000	1.000
	Sig. (2-tailed)			
	N	111	52	57
BMI – before	Spearman's rho	**0.458****	**0.422****	**0.402****
	Sig. (2-tailed)	**0.000**	**0.002**	**0.002**
	N	**111**	**52**	**57**
Flexion (degrees) - before	Spearman's rho	**-0.274****	-0.153	0-.099
	Sig. (2-tailed)	**0.004**	0.278	0.465
	N	**111**	52	57
Extension (degrees) – before	Spearman's rho	-0.142	-0.181	0.104
	Sig. (2-tailed)	0.136	0.199	0.443
	N	111	52	57
Side bend left (degrees) – before	Spearman's rho	-0.126	0.016	0.106
	Sig. (2-tailed)	0.189	0.910	0.431
	N	111	52	57
Side bend right (degrees) – before	Spearman's rho	**-0.265****	-0.194	-0.038
	Sig. (2-tailed)	**0.005**	0.169	0.777
	N	**111**	52	57
Rotation left (degrees) – before	Spearman's rho	0.000	-0.128	0.154
	Sig. (2-tailed)	0.996	0.366	0.253
	N	111	52	57
Rotation right (degrees) – before	Spearman's rho	-0.180	-0.090	-0.006
	Sig. (2-tailed)	0.059	0.524	0.967
	N	111	52	57
PSFS - Total score 1 - before	Spearman's rho	**-0.262****	-0.185	0.007
	Sig. (2-tailed)	**0.005**	0.190	0.960

		Whole sample Age	Up to 53 years Age	54 years and more Age
	N	**111**	52	57
NDI - Total score - before	Spearman's rho	**0.241***	0.123	-0.042
	Sig. (2-tailed)	**0.011**	0.386	0.759
	N	**111**	52	57
Quality of life – Single item scale (Very bad - Excellent) – before	Spearman's rho	-0.068	-0.047	0.122
	Sig. (2-tailed)	0.477	0.743	0.367
	N	111	52	57
Quality of life - physical – before	Spearman's rho	-0.178	-0.211	0.174
	Sig. (2-tailed)	0.061	0.134	0.194
	N	111	52	57
Quality of life - psychological – before	Spearman's rho	**-0.372****	-0.193	-0.111
	Sig. (2-tailed)	**0.000**	0.170	0.411
	N	**111**	52	57
Quality of life – existential – before	Spearman's rho	**-0.221***	-0.197	-0.040
	Sig. (2-tailed)	**0.020**	0.161	0.769
	N	**111**	52	57
Quality of life – support – before	Spearman's rho	-0.039	0.000	-0.177
	Sig. (2-tailed)	0.684	0.999	0.187
	N	111	52	57
Quality of life - total score – before	Spearman's rho	**-0.271****	-0.245	0.056
	Sig. (2-tailed)	**0.004**	0.080	0.680
	N	**111**	52	57

Source: Own source 2023.
** Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

For the BMI, there are two outliers that are severely obese (BMI > 35) in the control group, so we also eliminated these from our sample for the hypotheses testing. There were no severely obese participants in the study group.

Graph 18: Body mass index in control and study group



Source: Own source 2023.

Table 66: Sample for the analysis for hypotheses

	Group			
	Control		Study	
	f	f %	f	f %
Up to 53 years	18	34.0%	34	60.7%
54 years and more	35	66.0%	22	39.3%
Total	53	100.0%	56	100.0%

Source: Own source 2023.

We have checked once again if there are any statistically significant differences in the parameters in the pre-test phase of our measurements. The analysis with the Mann-Whitney U test has shown that in the group of participants up to 53 years old, there is no statistically significant difference in measured parameters before intervention ($p > 0.05$). The groups of participants are equal regarding of all the important parameters, and any differences afterwards are based on the different interventions that the participants of each group were exposed to.

Table 67: Testing of differences between parameters for the control and study group in the age group up to 53 years

	Mann-Whitney U	P
BMI	272.500	0.519
NPRS - pain scale before treatment (0-10)	293.000	0.799
Flexion (degrees) – before	229.000	0.136
Extension (degrees) – before*	215.000	0.076
Side bend left (degrees) – before	266.000	0.433
Side bend right (degrees) – before	263.500	0.405
Rotation left (degrees) – before	298.500	0.884
Rotation right (degrees) – before	301.000	0.922
PSFS - Total score 1 – before	306.000	1.000
NDI - Total score – before	274.000	0.537
Quality of life – Single item scale (Very bad - Excellent) – before	272.500	0.511
Quality of life - physical – before	287.500	0.721
Quality of life - psychological – before	298.500	0.885
Quality of life - existential- before	291.500	0.779
Quality of life – support – before	300.000	0.901

Source: Own source 2023.

The analysis with the Mann-Whitney U test for the group 54 years and more has shown that there is a statistically significant difference in BMI (p = 0.007) and neck extension (p=0.046) before intervention. We will have to take that into consideration when interpreting the results. Otherwise, there are no important differences between groups, (Table 67).

Table 68: Testing of differences between parameters for control and study group in age group 54 years and more

	Mann-Whitney U	P
BMI*	221.000	0.007
NPRS - pain scale before treatment (0-10)	330.500	0.361
Flexion (degrees) - before	325.000	0.323
Extension (degrees) – before*	264.500	0.046
Side bend left (degrees) - before	310.500	0.216
Side bend right (degrees) - before	351.000	0.574
Rotation left (degrees) - before	380.500	0.940
Rotation right (degrees) - before	337.000	0.426
PSFS - Total score 1 - before	343.500	0.494
NDI - Total score - before	351.000	0.577
Quality of life – Single item scale (Very bad - Excellent) – before	346.500	0.523
Quality of life - physical - before	336.500	0.425
Quality of life - psychological - before	320.000	0.285
Quality of life - existential- before	329.500	0.360
Quality of life – support - before	358.500	0.631

Source: Own source 2023.

*$p \leq 0.05$.

For participants which are younger (53 years or less) in the control group there was a noticeable improvement from 33.1 ± 10.7 to 21.4 ± 13.6. The study group also showed a noticeable improvement (from 36.1 ± 13.8 to 13.4 ± 9.9). In the group of older participants. the initial results were higher in both the control and study group. Also, in both groups we noticed an improvement after intervention (CG from 43.3 ± 16.9 to 34.2 ± 16.3 / SG from 45.8 ± 17.5 to 25.4 ± 16.1). In both cases. the improvement was higher in the study group, (Table 69).

Table 69: Neck disability index questionnaire (NDI) for participants of control and study group for younger and older participants

			n	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Up to 53 years	NDI - Total score before treatment (percentage)	Control	18	33.1	10.7	27.8	38.5	10	50
		Study	34	36.1	13.8	31.3	40.9	12	64
		Total	52	35.1	12.8	31.5	38.6	10	64
	NDI - Total score after treatment (percentage)	Control	18	21.4	13.6	14.7	28.2	2	50
		Study	34	13.4	9.9	10.0	16.9	0	44
		Total	52	16.2	11.8	12.9	19.5	0	50
54 years and more	NDI - Total score before treatment (percentage)	Control	35	43.3	16.9	37.4	49.1	10	78
		Study	22	45.8	17.5	38.1	53.6	12	82
		Total	57	44.2	17.0	39.7	48.8	10	82
	NDI - Total score after treatment (percentage)	Control	35	34.2	16.3	28.6	39.8	4	66
		Study	22	25.4	16.1	18.2	32.5	0	54
		Total	57	30.8	16.7	26.4	35.2	0	66

Source: Own source 2023.

Before treatment, there was no statistically significant difference between the control and study group in the group of younger participants (p=0.537) and in the group of older participants (p=0.577). In both age groups, participants were equal regarding the Neck disability index evaluation. After treatment, the difference between the control and study group was statistically significant in both cases (Up to 53 years; p = 0.003 / 54 years and more; p = 0.004). (Table 70).

Table 70: NDI results for participants of control and study group– test statistics for differences between groups pre-test and post-test for younger and older participants

			Mann-Whitney U test			
			Pre-test		Post-test	
			MW U statistics	Sig.	MW U statistics	Sig.
Up to 53 years	NDI - Total score (percentage)	Control group - Study group	274.000	0.537	195.500	0.003
54 years and more	NDI - Total score (percentage)	Control group - Study group	351.000	0.577	262.000	0.004

Source: Own source 2023.

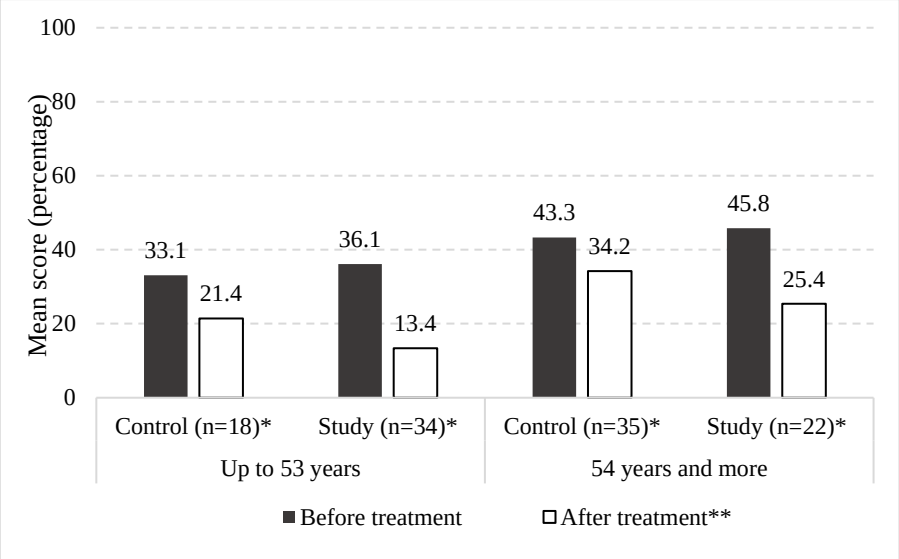
The paired samples statistics with the Wilcoxon test revealed that the difference before and after treatment is statistically significant for both the control and study group ($p < 0.001$). Both younger and older participants have made progress regarding the NDI evaluation. (Table 71).

Table 71: NDI results for participants of control and study group – test statistics for differences within groups in time for younger and older participants

			Wilcoxon test	
			Pre-test – Post-test	
			Z	Sig.
Up to 53 years	NDI - Total score (percentage)	Control group	-3.628	0.000
	NDI - Total score (percentage)	Study group	-5.090	0.000
54 years and more	NDI - Total score (percentage)	Control group	-4.869	0.000
	NDI - Total score (percentage)	Study group	-4.018	0.000

Source: Own source 2023.

Graph 19: The comparison of NDI within groups before and after treatment for younger and older participants



Source: Own source 2023.
* Difference in time is statistically significant ($p \leq 0.05$).
** Difference between groups is statistically significant ($p \leq 0.05$).

The part of the first hypothesis is to test the MQOL results before and after treatment. This instrument has more than one evaluation scale and therefore we will provide the results separately first for younger participants and later for the older participants.

Table 72: McGill Quality of life questionnaire for participants of the control and study group up to 53 years

		n	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Single item evaluation of Quality of life (0 Very bad – 10 Excellent) PRE-TEST	Control	18	5.8	1.2	5.2	6.5	4	8
	Study	34	5.6	1.6	5.0	6.1	3	9
	Total	52	5.7	1.5	5.3	6.1	3	9
Quality of life - physical symptoms and wellbeing (0 tremendous problem – 10 no problem) PRE-TEST	Control	18	4.9	1.3	4.2	5.6	3	8
	Study	34	4.9	1.5	4.4	5.4	2	8
	Total	52	4.9	1.4	4.5	5.3	2	8
Quality of life - psychological subscale (0 – worst feelings – 10 best feelings) PRE-TEST	Control	18	6.3	1.3	5.6	7.0	4	9
	Study	34	6.4	1.5	5.8	6.9	4	9
	Total	52	6.4	1.4	5.9	6.8	4	9
Quality of life – existential subscale (0 worst – 10 best) PRE-TEST	Control	18	8.6	1.3	8.0	9.3	5	10
	Study	34	8.4	1.5	7.9	8.9	5	10
	Total	52	8.5	1.4	8.1	8.9	5	10
Quality of life - support subscale (0 worst – 10 best) PRE-TEST	Control	18	9.3	0.9	8.8	9.8	7	10
	Study	34	9.1	1.2	8.7	9.6	6	10
	Total	52	9.2	1.1	8.9	9.5	6	10
Quality of life - total score (Mean of 5 subscale scores) PRE-TEST	Control	18	7.4	0.7	7.0	7.7	6	8
	Study	34	7.2	1.2	6.8	7.6	5	9
	Total	52	7.3	1.1	7.0	7.6	5	9
Single item evaluation of Quality of life (Very bad - Excellent) POST-TEST	Control	18	8.1	1.6	7.3	8.9	5	10
	Study	34	9.1	1.0	8.8	9.5	5	10
	Total	52	8.8	1.3	8.4	9.2	5	10
	Control	18	7.8	1.4	7.1	8.5	4	10

		n	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Quality of life - physical symptoms and wellbeing (0 tremendous problem – 10 no problem) POST-TEST	Study	34	8.6	1.1	8.2	9.0	4	10
	Total	52	8.3	1.3	8.0	8.7	4	10
Quality of life - psychological subscale (0 – worst feelings – 10 best feelings) POST-TEST	Control	18	8.0	1.3	7.3	8.6	4	9
	Study	34	8.5	0.8	8.3	8.8	6	9
	Total	52	8.3	1.0	8.1	8.6	4	9
Quality of life – existential subscale (0 worst – 10 best) POST-TEST	Control	18	9.5	0.4	9.3	9.8	9	10
	Study	34	9.6	0.4	9.5	9.8	8	10
	Total	52	9.6	0.4	9.5	9.7	8	10
Quality of life - support subscale (0 worst – 10 best) POST-TEST	Control	18	9.6	0.8	9.2	10.0	7	10
	Study	34	9.7	0.7	9.5	9.9	7	10
	Total	52	9.7	0.7	9.5	9.9	7	10
Quality of life - total score (Mean of 5 subscale scores) POST-TEST	Control	18	8.8	0.6	8.5	9.1	8	10
	Study	34	9.1	0.6	8.9	9.3	7	10
	Total	52	9.0	0.6	8.8	9.2	7	10

Source: Own source 2023.

Before treatment, there was no statistically significant difference between the control and study group in the group of younger participants ($p>0,05$). Before the intervention, younger participants were equal regarding to their evaluation of the Quality of life and its subscales. After treatment, the difference between the control and study group was statistically significant in case of single item evaluation of Quality of life ($p=0,015$), and in improvement with physical symptoms and wellbeing ($p=0,004$), psychological wellbeing ($p=0,019$) and the total score of Quality of life ($p=0,012$), (Table 73).

Table 73: McGill Quality of life questionnaire for participants of the control and study group– test statistics for differences between groups pre-test and post-test for younger participants

		Mann-Whitney U test			
		Pre-test		Post-test	
		MW U statistics	Sig.	MW U statistics	Sig.
Single item evaluation of Quality of life	Control group - Study group	272.500	0.511	186.500	0.015
Quality of life - physical symptoms and wellbeing	Control group - Study group	287.500	0.721	156.000	0.004
Quality of life - psychological subscale	Control group - Study group	298.500	0.885	190.000	0.019
Quality of life – existential subscale	Control group - Study group	291.500	0.360	281.000	0.599
Quality of life – support	Control group - Study group	300.000	0.810	288.000	0.664
Quality of life - total score	Control group - Study group	293.500	0.376	176.500	0.012

Source: Own source 2023.

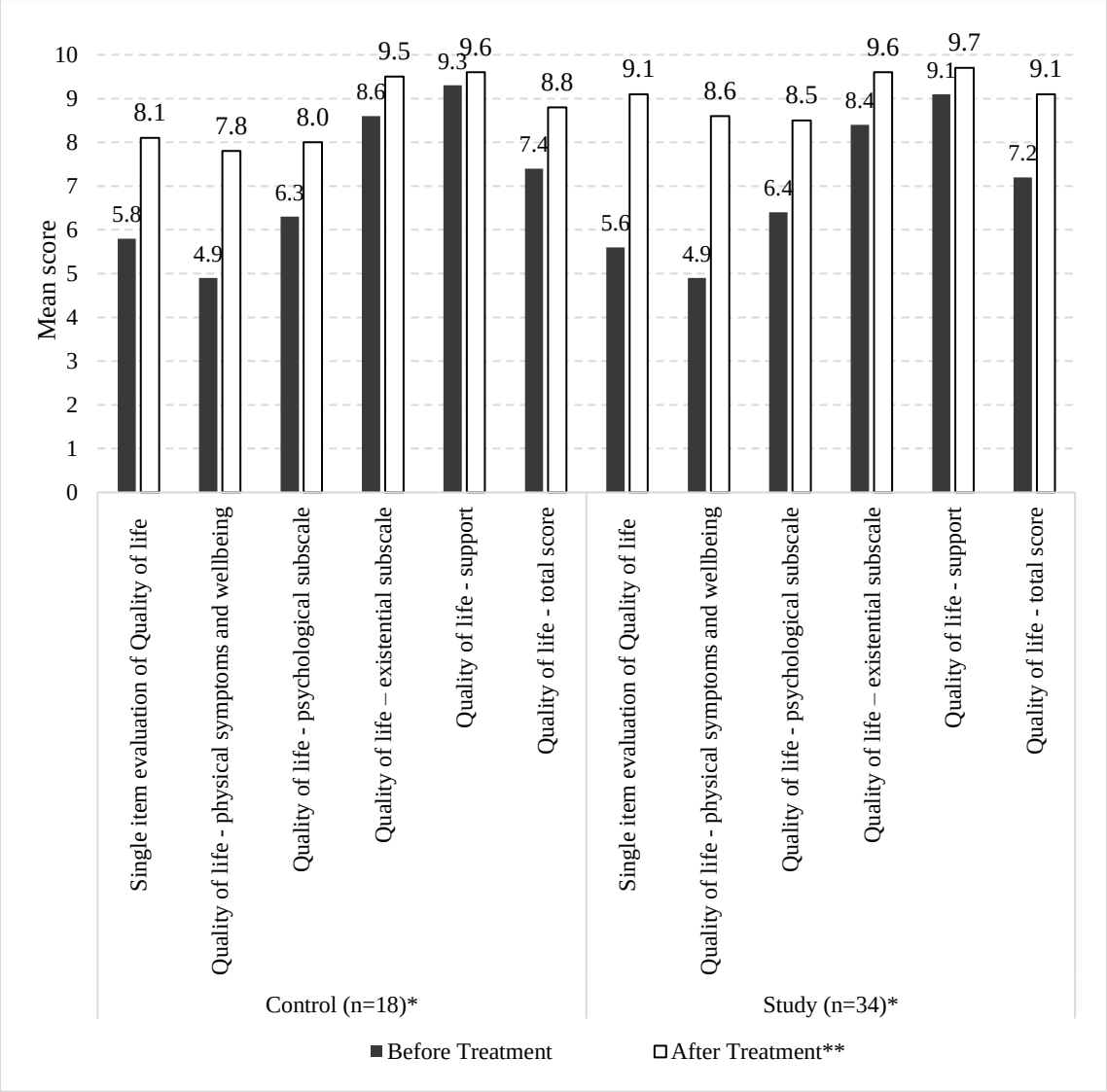
The paired sample statistics with the Wilcoxon test revealed that the difference before and after treatment is statistically significant for both the control and study group between participants ($p < 0.001$). Both groups have improved their result in time, (Table 74).

Table 74: McGill Quality of life questionnaire for participants of the control and study group – test statistics for differences within groups in time for younger participants

		Wilcoxon test	
		Pre-test – Post-test	
		Z	Sig.
Single item evaluation of Quality of life	Control group	-3.559	0.000
Single item evaluation of Quality of life	Study group	-5.107	0.000
Quality of life - physical symptoms and wellbeing	Control group	-3.730	0.000
Quality of life - physical symptoms and wellbeing	Study group	-5.091	0.000
Quality of life - psychological subscale	Control group	-3.415	0.001
Quality of life - psychological subscale	Study group	-4.869	0.000
Quality of life – existential subscale	Control group	-3.301	0.001
Quality of life – existential subscale	Study group	-4.595	0.000
Quality of life - support	Control group	-2.060	0.039
Quality of life - support	Study group	-3.237	0.001
Quality of life - total score	Control group	-3.681	0.000
Quality of life - total score	Study group	-5.088	0.000

Source: Own source 2023.

Graph 20: The comparison of McGill Quality of life questionnaire within groups before and after treatment for younger participants



Source: Own source 2023.

* Difference in time is statistically significant ($p \leq 0.05$).

** Difference between groups is statistically significant for single item scale QOL, physical symptoms and wellbeing, psychological subscale and Total score QOL ($p \leq 0.05$).

Table 75: McGill Quality of life questionnaire for participants of the control and study group, aged 54 years and over

		n	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Single item evaluation of Quality of life (0 Very bad – 10 Excellent) PRE-TEST	Control	35	5.4	1.8	4.8	6.0	2	9
	Study	22	5.1	2.0	4.2	6.0	1	9
	Total	57	5.3	1.9	4.8	5.8	1	9
Quality of life - physical symptoms and wellbeing (0 tremendous problem – 10 no problem) PRE-TEST	Control	35	4.3	1.7	3.7	4.9	1	8
	Study	22	4.0	1.7	3.2	4.7	2	8
	Total	57	4.2	1.7	3.7	4.6	1	8
Quality of life - psychological subscale (0 – worst feelings – 10 best feelings) PRE-TEST	Control	35	4.9	1.7	4.3	5.5	2	9
	Study	22	5.5	1.8	4.7	6.3	3	9
	Total	57	5.1	1.7	4.6	5.6	2	9
Quality of life – existential subscale (0 worst – 10 best) PRE-TEST	Control	35	8.1	1.2	7.6	8.5	6	10
	Study	22	7.7	1.7	7.0	8.4	5	10
	Total	57	7.9	1.4	7.6	8.3	5	10
Quality of life - support subscale (0 worst – 10 best) PRE-TEST	Control	35	9.3	1.1	8.9	9.7	6	10
	Study	22	8.8	1.6	8.1	9.5	6	10
	Total	57	9.1	1.3	8.8	9.5	6	10
Quality of life - total score (Mean of 5 subscale scores) PRE-TEST	Control	35	6.7	1.1	6.3	7.1	5	9
	Study	22	6.5	1.4	5.9	7.1	4	9
	Total	57	6.6	1.2	6.3	6.9	4	9
Single item evaluation of Quality of life (Very bad - Excellent) POST-TEST	Control	35	7.5	1.6	6.9	8.0	4	10
	Study	22	8.3	1.4	7.7	8.9	5	10
	Total	57	7.8	1.6	7.4	8.2	4	10
Quality of life - physical symptoms and wellbeing (0 tremendous problem –	Control	35	7.1	1.4	6.6	7.5	4	10
	Study	22	7.6	1.5	6.9	8.2	5	10
	Total	57	7.3	1.5	6.9	7.6	4	10

		n	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
10 no problem) POST-TEST								
Quality of life - psychological subscale (0 – worst feelings – 10 best feelings) POST-TEST	Control	35	7.0	1.3	6.5	7.4	4	9
	Study	22	7.6	1.4	7.0	8.2	5	9
	Total	57	7.2	1.4	6.9	7.6	4	9
Quality of life – existential subscale (0 worst – 10 best) POST-TEST	Control	35	8.9	0.9	8.6	9.2	7	10
	Study	22	9.1	0.8	8.7	9.4	8	10
	Total	57	9.0	0.9	8.7	9.2	7	10
Quality of life - support subscale (0 worst – 10 best) POST-TEST	Control	35	9.5	0.9	9.2	9.9	7	10
	Study	22	9.3	1.2	8.8	9.9	6	10
	Total	57	9.5	1.0	9.2	9.7	6	10
Quality of life - total score (Mean of 5 subscale scores) POST-TEST	Control	35	8.2	0.9	7.8	8.5	6	10
	Study	22	8.4	1.0	8.0	8.9	7	10
	Total	57	8.3	0.9	8.0	8.5	6	10

Source: Own source 2023.

Before treatment there was no statistically significant difference between the control and study group for the group of older participants ($p>0.05$). In both age groups, participants were equal before treatment. After treatment the difference between the control and study group was statistically significant in the evaluation of quality of life with the single item scale ($p = 0.052$), (Table 76).

Table 76: McGill Quality of life questionnaire for participants of the control and study group– test statistics for differences between groups pre-test and post-test for older participants

		Mann-Whitney U test			
		Pre-test		Post-test	
		MW U statistics	Sig.	MW U statistics	Sig.
Single item evaluation of Quality of life	Control group - Study group	346.500	0.523	269.000	0.052
Quality of life - physical symptoms and wellbeing	Control group - Study group	336.500	0.425	309.500	0.214
Quality of life - psychological subscale	Control group - Study group	320.000	0.285	291.000	0.121
Quality of life – existential subscale	Control group - Study group	329.500	0.360	358.500	0.659
Quality of life – support	Control group - Study group	358.500	0.631	369.500	0.758
Quality of life - total score	Control group - Study group	331.000	0.376	318.000	0.271

Source: Own source 2023.

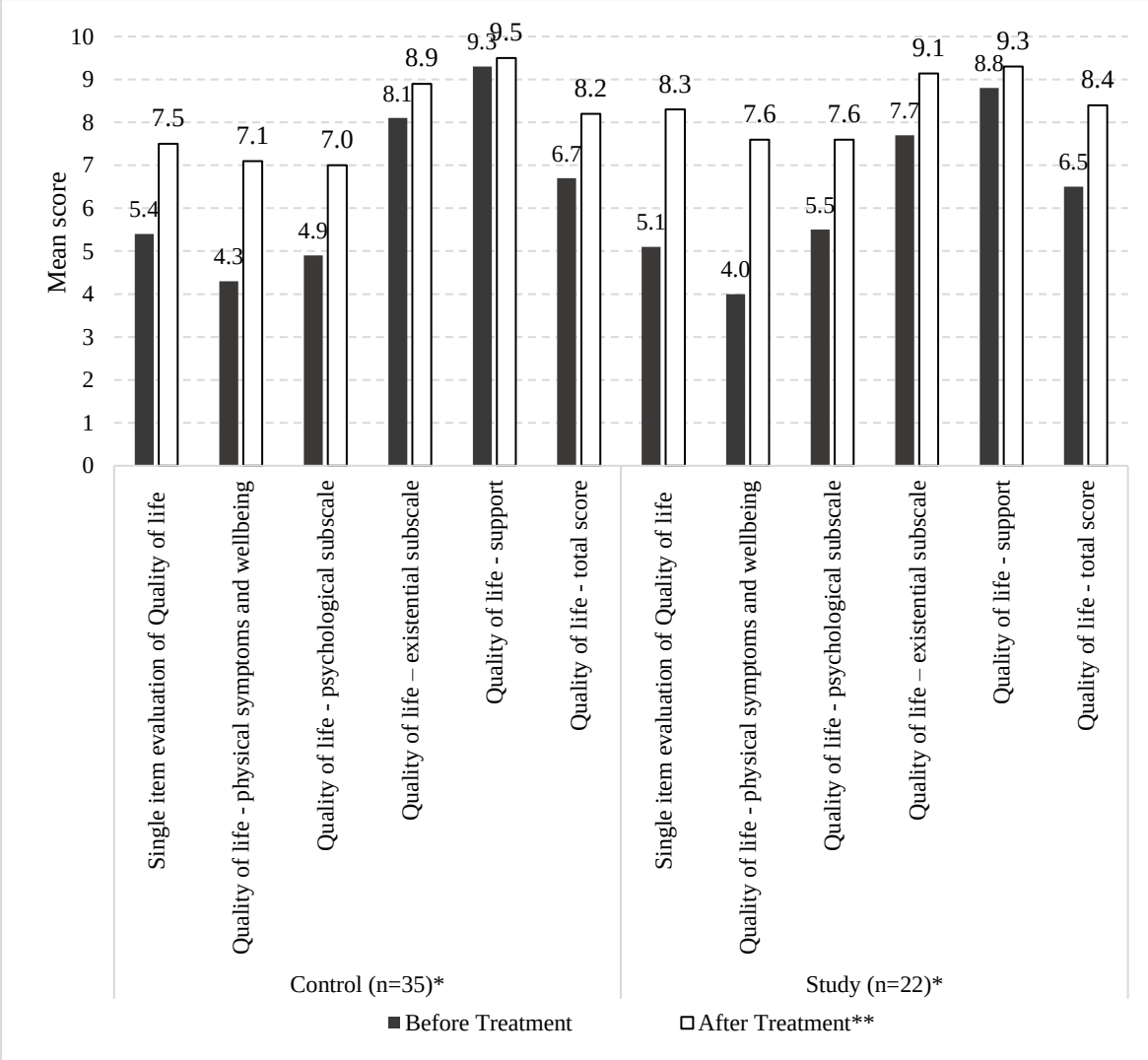
The paired sample statistics with the Wilcoxon test revealed that the difference before and after treatment is statistically significant for both the control and study group between participants ($p < 0.001$). Both groups have improved their result in time, (Table 77).

Table 77: McGill Quality of life questionnaire for participants of the control and study group – test statistics for differences within groups in time for the older participants

		Wilcoxon test	
		Pre-test – Post-test	
		Z	Sig.
Single item evaluation of Quality of life	Control group	-4.917	0.000
Single item evaluation of Quality of life	Study group	-4.301	0.000
Quality of life - physical symptoms and wellbeing	Control group	-5.166	0.000
Quality of life - physical symptoms and wellbeing	Study group	-4.110	0.000
Quality of life - psychological subscale	Control group	-4.872	0.000
Quality of life - psychological subscale	Study group	-3.937	0.000
Quality of life – existential subscale	Control group	-4.161	0.000
Quality of life – existential subscale	Study group	-3.464	0.000
Quality of life - support	Control group	-2.716	0.007
Quality of life - support	Study group	-2.585	0.010
Quality of life - total score	Control group	-5.160	0.000
Quality of life - total score	Study group	-4.110	0.000

Source: Own source 2023.

Graph 21: The comparison of McGill Quality of life questionnaire within groups before and after treatment for younger participants



Source: Own source 2023.

* Difference in time is statistically significant ($p \leq 0.05$).

** Difference between groups is statistically significant in case of single item scale evaluation of Quality of life ($p \leq 0.05$).

In the first hypothesis, we have tried to prove that there is a statistically significant improvement in the results of the MQOL and NDI in participants with cervical spondylosis in a physiotherapy program (PT) (deep tissue massage, eccentric exercises in combination with passive stretching) compared to participants in the control group (PT program based on an isometric and active- assisted exercise program). We can fully confirm that for the group of younger participants, but in the group of older participants the result is in favor to confirm that regarding NDI evaluation, regarding the MQOL, we have confirmed that only in single item evaluation of Quality of life and not for other subscales or the total score.

For the younger participants (53 years or less) in the study group there was a noticeable improvement of pain from 6.9 ± 1.6 to 1.6 ± 1.7. The control group also showed a noticeable improvement (from 6.9 ± 2.2 to 3.9 ± 2.6). In the group of older participants, the initial results were higher in both the control and study group. In both groups, we also noticed improvement after intervention (CG from 7.1 ± 2.0 to 3.9 ± 1.9 / SG from 7.6 ± 1.6 to 2.5 ± 2.3). Further, in both cases, the improvement regarding the perceived level of pain was higher in the study group. (Table 78).

Table 78: NPRS evaluation for participants of the control and study group for younger and older participants

			n	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Up to 53 years	NPRS - pain scale before treatment (0-10)	Control	18	6.9	2.2	5.8	8.0	3	10
		Study	34	6.9	1.6	6.3	7.5	3	10
		Total	52	6.9	1.8	6.4	7.4	3	10
	NPRS - pain scale after treatment (0-10)	Control	18	3.9	2.6	2.6	5.2	0	8
		Study	34	1.6	1.7	1.0	2.1	0	6
		Total	52	2.4	2.3	1.7	3.0	0	8
54 years and more	NPRS - pain scale before treatment (0-10)	Control	35	7.1	2.0	6.4	7.7	3	10
		Study	22	7.6	1.6	6.9	8.3	4	10
		Total	57	7.3	1.9	6.8	7.8	3	10
	NPRS - pain scale after treatment (0-10)	Control	35	3.9	1.9	3.2	4.5	0	8
		Study	22	2.5	2.3	1.5	3.5	0	6
		Total	57	3.4	2.1	2.8	3.9	0	8

Source: Own source 2023.

Before treatment there was no statistically significant difference between the control and study group in the group of younger participants (p=0.799) and in the group of older participants (p=0.361). In both age groups, participants were equal regarding the evaluation of pain before treatment. After treatment, the difference between the control and study group was statistically significant in both cases (Up to 53 years; p = 0.002 / 54 years

and more; p = 0.023). Participants of the study group had better results regarding the level of pain in the post-test phase. (Table 79).

Table 79: NPRS results for participants of the control and study group– test statistics for differences between groups pre-test and post-test for younger and older participants

			Mann-Whitney U test			
			Pre-test		Post-test	
			MW U statistics	Sig.	MW U statistics	Sig.
Up to 53 years	NPRS pain scale	Control group - Study group	293.000	0.799	147.000	0.002
54 years and more	NPRS pain scale	Control group - Study group	330.500	0.361	247.500	0.023

Source: Own source 2023.

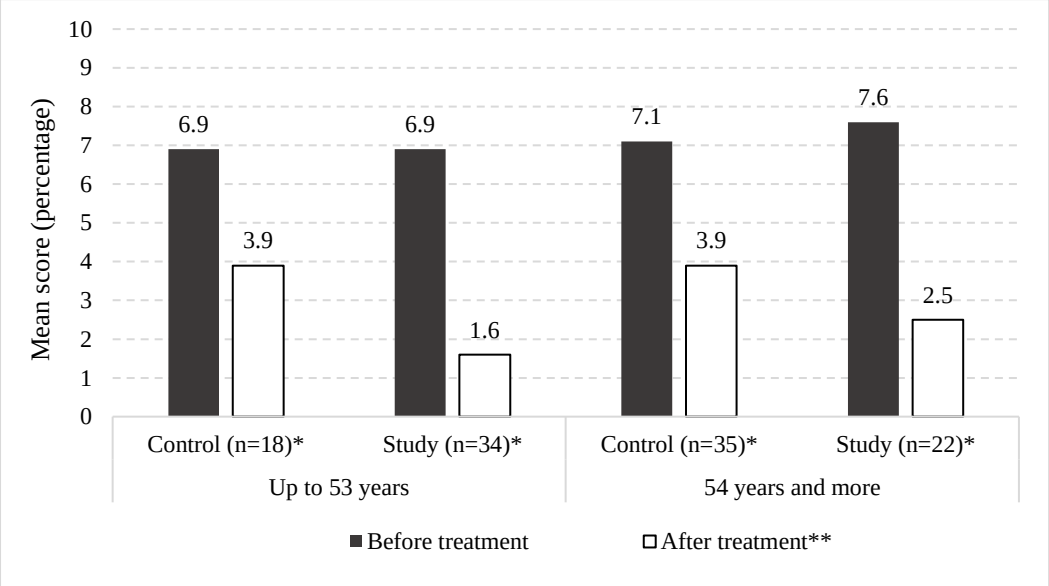
The paired sample statistics with the Wilcoxon test revealed that the difference before and after treatment is statistically significant for both the control and study group (p < 0.001), (Table 80).

Table 80: NPRS pain evaluation results for participants of the control and study group – test statistics for differences within groups in time for younger and older participants

			Wilcoxon test	
			Pre-test – Post-test	
			Z	Sig.
Up to 53 years	NPRS pain scale	Control group	-3.655	0.000
	NPRS pain scale	Study group	-5.114	0.000
54 years and more	NPRS pain scale	Control group	-5.079	0.000
	NPRS pain scale	Study group	-4.033	0.000

Source: Own source 2023.

Graph 22: The comparison of NPRS within groups before and after treatment for younger and older participants



Source: Own source 2023.
* Difference in time is statistically significant ($p \leq 0.05$).
** Difference between groups is statistically significant ($p \leq 0.05$).

There was a significant improvement after intervention in both groups (control and study) between younger and older participants. The improvement was higher in the study group. After the intervention, there was also a statistically significant difference between the control and study group, which was not present before the intervention. So, in both cases, with younger and older participants, we can confirm the hypotheses, that the new PT program will have a positive effect on pain results in the study group compared to the control group.

Within participants which are younger (53 years or less) in the study group, there was a noticeable improvement of the total score on the PSFS scale from 4.6 ± 1.6 to 8.7 ± 1.1. The control group also showed a noticeable improvement (from 4.3 ± 2.6 to 6.9 ± 2.6). In the group of older participants, the initial results were higher in both the control and study group. In both groups we also noticed improvement after intervention (CG from 3.6 ± 1.8 to 6.5 ± 2.1 / SG from 3.7 ± 1.8 to 7.3 ± 2.0). Further, in both cases, the progress was higher in the study group, (Table 81).

Table 81: PSFS evaluation for participants of the control and study group for younger and older participants

			n	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Up to 53 years	PSFS score - before treatment (0-10)	Control	18	4.3	2.6	3.0	5.6	0	8
		Study	34	4.6	1.6	4.0	5.2	1	8
		Total	52	4.5	2.0	3.9	5.1	0	8
	PSFS score - after treatment (0-10)	Control	18	6.9	2.6	5.6	8.2	0	10
		Study	34	8.7	1.1	8.3	9.1	6	10
		Total	52	8.1	2.0	7.5	8.6	0	10
54 years and more	PSFS score - before treatment (0-10)	Control	35	3.6	1.8	2.9	4.2	0	8
		Study	22	3.7	1.8	2.9	4.5	0	6
		Total	57	3.6	1.8	3.1	4.1	0	8
	PSFS score - after treatment (0-10)	Control	35	6.5	2.1	5.7	7.2	1	10
		Study	22	7.3	2.0	6.4	8.2	4	10
		Total	57	6.8	2.1	6.2	7.3	1	10

Source: Own source 2023.

Before treatment, there was no statistically significant difference between the control and study group in the group of younger participants (p=1.000), and in the group of older participants (p=0.494). In both age groups, participants were equal regarding their functional scale evaluation before the intervention. After treatment, the difference between the control and study group was statistically significant in the case of younger participants and not in the case of older participants (Up to 53 years; p = 0.009 / 54 years and more; p = 0.193), (Table 82).

Table 82: PSFS results for participants of the control and study group– test statistics for differences between groups pre-test and post-test for younger and older participants

			Mann-Whitney U test			
			Pre-test		Post-test	
			MW U statistics	Sig.	MW U statistics	Sig.
Up to 53 years	PSFS	Control group - Study group	306.000	1.000	171.000	0.009
54 years and more	PSFS	Control group - Study group	343.500	0.494	306.000	0.193

Source: Own source 2023.

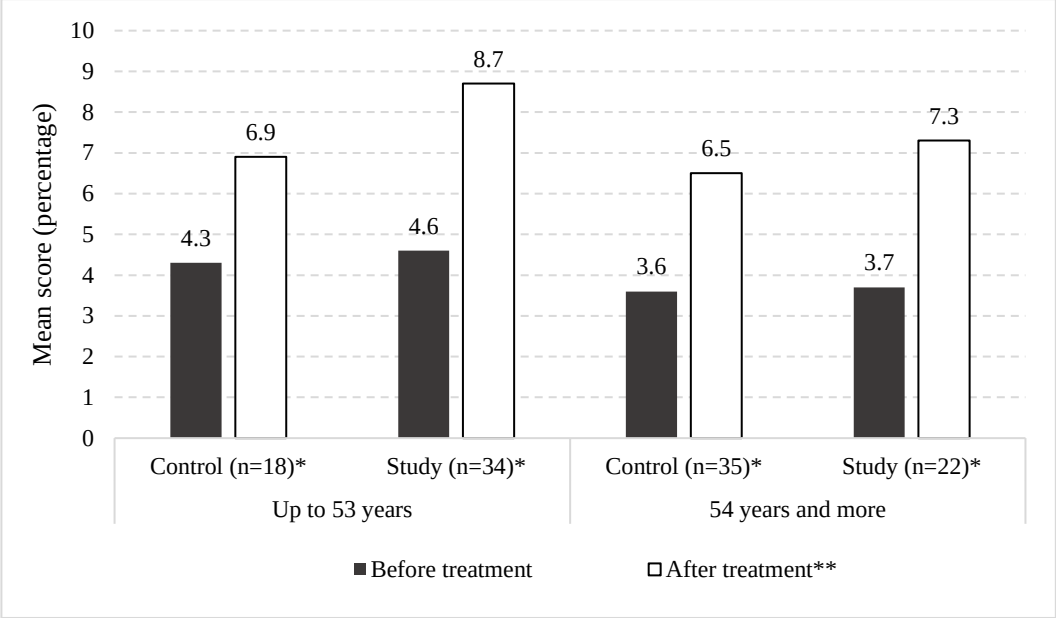
The paired sample statistics with the Wilcoxon test revealed that the difference before and after treatment is statistically significant for both the control and study group ($p < 0.001$). Both have made progress over time, (Table 83).

Table 83: PSFS pain evaluation results for participants of control and study group – test statistics for differences within groups in time for younger and older participants

			Wilcoxon test	
			Pre-test – Post-test	
			Z	Sig.
Up to 53 years	NPRS pain scale	Control group	-3.528	0.000
	NPRS pain scale	Study group	-5.091	0.000
54 years and more	NPRS pain scale	Control group	-4.786	0.000
	NPRS pain scale	Study group	-3.952	0.000

Source: Own source 2023.

Graph 23: The comparison of PSFS within groups before and after treatment for younger and older participants



Source: Own source 2023.
*Difference in time is statistically significant ($p \leq 0.05$).
** Difference between groups is statistically significant only for younger participants ($p \leq 0.05$).

There was a significant improvement after intervention in both groups (control and study) between younger and older participants. The improvement was higher in the study group in both cases. In the case of younger participants, after intervention there was also a statistically significant difference between the control and study group, which was not present before the intervention. This is not the case for older participants: there was no statistically significant difference before or after the intervention between the control and study group, although we have noticed a higher improvement in the study group.

We can confirm the hypotheses that the new PT program will have a positive effect on the results of PSFS in the study group compared to the control group, only for the group of younger participants. As we can also see from the results, the result of the PSFS evaluation was lower in the group of older participants, so they already started the study with the lower score, and therefore the progress was not so evident.

We have already tested the differences between the initial and final measurements for NDI, MQOL and PSFS, where we have seen that both the control and study group have made progress after the intervention according to their symptoms, pain and other

measurements. Additionally, we also used the discriminant analysis to identify which of the variables we measured and separated the most between the control and study group before and after the intervention in both age groups.

We have used 52 cases in the analysis for the group of younger participants. There are 18 cases in the control group and 34 cases in the study group. There were no missing cases with the variables used in the analysis. The result of testing the equality of group means between control and study group has shown that there were no statistically significant differences between groups ($p > 0.05$) before the intervention. We can also see the importance of variables when interpreting Wilks' Lambda: the smaller the statistic, the more important the independent variable is to the discriminant function. Therefore, in the pre-test variable, the statistic is near 1, which means that none of the included parameters are important for differentiating between groups.

After the intervention, all the variables are significant for differentiation between the control and study group. The lowest Wilks' Lambda is with quality of life ($p=0.001$), then NDI ($p=0.018$) and PSFS score ($p=0.044$). All variables significantly differentiate the two groups through the linear function etc. combination, (Table 84).

Table 84: Tests of Equality of Group Means for younger participants

		Wilks' Lambda	F	df1	df2	Sig.
Pre-test	NDIQ - Total score 1 - before	0.987	0.647	1	50	0.425
	PSFS - Total score 1 - before	0.996	0.184	1	50	0.670
	Quality of life - total score 1 - before	0.995	0.238	1	50	0.628
Post-test	NDIQ - Total score 1 - after	0.893	5.968	1	50	0.018
	PSFS - Total score 1 - after	0.922	4.254	1	50	0.044
	Quality of life - total score 1 - after	0.811	11.689	1	50	0.001

Source: Own source 2023.

As we have only 2 groups, there is only one discriminant function. From the given results in table 85, we can see that the parameters in the pre-test phase did not separate the control and study group (Eigenvalue: 0.021; Chi-square=1.021; p=0.796). Furthermore, in

the post-test phase, after intervention, NDI, PSFS and Quality of life – total score were significantly discriminating between the control and study group (Eigenvalue: 0.313; Chi-square=13.223; p=0.004). We have seen in the previous analysis that the participants of the study groups have a better result with all of these parameters in the post-test, (Table 85).

Table 85: Summary of canonical discriminant function for younger participants

		Eigenvalue	% of variance	Canonical Correlation	Wilks' Lambda	Chi-square	Df	Sig.
Pre-test	Function 1	0.021	100.0	0.144	0.979	1.021	3	0.796
Post-test	Function 1	0.313	100.0	0.488	0.761	13.223	3	0.004

Source: Own source 2023.

Results suggest that the linear combinations of the predictor variables were important in separating the two groups only after the intervention, which suggest that the intervention therapy was more successful in the study group. This finding is enough to be able to confirm hypothesis 4 for our group of younger participants. We have used 57 cases in the analysis for the group of older participants. There are 35 cases in the control group and 22 cases in the study group. There were no missing cases with the variables used in the analysis. The result of testing the equality of group means between the control and study group has shown that there were no statistically significant differences between groups ($p > 0.05$) before the intervention. We can also see the importance of variables when interpreting Wilks' Lambda: the smaller the statistic, the more important the independent variable is to the discriminant function. Therefore, in the pre-test phase, the statistic is near 1, which means that none of the included parameters are differentiated between groups. After the intervention, NDI is significant for differentiation between the control and study group. The Wilks' Lambda value is still near 1 and is statistically significant ($p=0.050$), (Table 86).

Table 86: Tests of Equality of Group Means for older participants

		Wilks' Lambda	F	df1	df2	Sig.
Pre-test	NDIQ - Total score 1 - before	0.995	0.302	1	55	0.585
	PSFS - Total score 1 - before	0.998	0.084	1	55	0.773
	Quality of life - total score 1 - before	0.990	0.550	1	55	0.462
Post-test	NDIQ - Total score 1 - after	0.932	4.023	1	55	0.050
	PSFS - Total score 1 - after	0.981	1.049	1	55	0.310
	Quality of life - total score 1 - after	0.963	2.116	1	55	0.151

Source: Own source 2023.

As we have only 2 groups, there is only one discriminant function as the result. From the given results in table 87, we can see that the linear combination of the parameters in the pre-test phase did not separate the control and study group (Eigenvalue: 0.018; Chi-square=0.971; p=0.808). The result is similar in the post-test phase, where the discriminant function also is not statistically significant. Regarding test statistics, there is more differentiation present compared to the pre-test phase (Eigenvalue: 0.090; Chi-square=4.613; p=0.202), (Table 87).

Table 87: Summary of the canonical discriminant function for older participants

		Eigenvalue	% of variance	Canonical Correlation	Wilks' Lambda	Chi-square	df	Sig.
Pre-test	Function 1	0.018	100.0	0.134	0.982	0.971	3	0.808
Post-test	Function 1	0.090	100.0	0.287	0.917	4.613	3	0.202

Source: Own source 2023.

Results suggest that the linear combinations of the predictor variables were not important in separating the two groups before and after the intervention. This suggests that the intervention therapy was not more successful in the study group with older participants as in the control group.

Table 88: AROM results for participants of control and study group up to 53 years

		n	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Flexion (degrees) – before	Control	18	47.1	9.5	42.4	51.9	30	70
	Study	34	53.5	14.5	48.4	58.6	30	75
	Total	52	51.3	13.3	47.6	55.0	30	75
Extension (degrees) - before	Control	18	50.6	15.0	43.1	58.0	20	70
	Study	34	56.2	14.6	51.1	61.3	18	70
	Total	52	54.3	14.8	50.1	58.4	18	70
Side bend left (degrees) – before	Control	18	37.1	9.1	32.6	41.6	20	52
	Study	34	35.6	7.2	33.1	38.1	22	52
	Total	52	36.1	7.8	33.9	38.3	20	52
Side bend right (degrees) – before	Control	18	30.2	6.5	27.0	33.4	20	40
	Study	34	32.3	7.5	29.7	34.9	18	50
	Total	52	31.6	7.2	29.6	33.6	18	50
Rotation left (degrees) – before	Control	18	50.5	15.3	42.9	58.1	10	70
	Study	34	52.3	13.2	47.7	56.9	30	70
	Total	52	51.7	13.9	47.8	55.5	10	70
Rotation right (degrees) – before	Control	18	54.4	11.8	48.5	60.3	26	72
	Study	34	55.7	12.0	51.5	59.9	34	80
	Total	52	55.3	11.9	51.9	58.6	26	80
Flexion (degrees) – after	Control	18	57.4	9.9	52.5	62.4	40	80
	Study	34	63.2	9.7	59.8	66.6	40	90
	Total	52	61.2	10.1	58.4	64.0	40	90
Extension (degrees) – after	Control	18	60.6	15.2	53.0	68.2	20	80
	Study	34	66.4	9.5	63.1	69.7	40	76
	Total	52	64.4	12.0	61.1	67.7	20	80
Side bend left (degrees) – after	Control	18	48.2	8.4	44.0	52.4	40	60
	Study	34	50.6	6.5	48.4	52.9	38	70
	Total	52	49.8	7.3	47.8	51.8	38	70
Side bend right (degrees) – after	Control	18	43.2	6.6	39.9	46.5	28	50
	Study	34	47.1	6.4	44.9	49.4	38	64

		n	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
	Total	52	45.8	6.7	43.9	47.6	28	64
Rotation left (degrees) - after	Control	18	59.5	14.5	52.3	66.7	20	74
	Study	34	66.6	11.3	62.6	70.5	47	90
	Total	52	64.1	12.8	60.6	67.7	20	90
Rotation right (degrees) – after	Control	18	63.2	10.7	57.8	68.5	40	76
	Study	34	67.5	10.5	63.8	71.1	50	85
	Total	52	66.0	10.7	63.0	69.0	40	85

Source: Own source 2023.

Before treatment there was no statistically significant difference between the control and study group in the group of younger participants ($p>0.05$). Before the intervention, younger participants were equal when evaluated with functional tests. After treatment, the difference between the control and study group was statistically significant in case of flexion ($p=0.040$), (Table 89).

Table 89: AROM measurements for participants of the control and study group– test statistics for differences between groups pre-test and post-test for younger participants

		Mann-Whitney U test			
		Pre-test		Post-test	
		MW U statistics	Sig.	MW U statistics	Sig.
Flexion (degrees)	Control group - Study group	229.000	0.136	204.500	0.040
Extension (degrees)	Control group - Study group	215.000	0.076	229.500	0.129
Side bend left (degrees)	Control group - Study group	266.000	0.433	262.000	0.129
Side bend right (degrees)	Control group - Study group	263.500	0.405	231.500	0.145
Rotation left (degrees)	Control group - Study group	298.500	0.884	239.500	0.193
Rotation right (degrees	Control group - Study group	301.000	0.922	253.000	0.302

Source: Own source 2023.

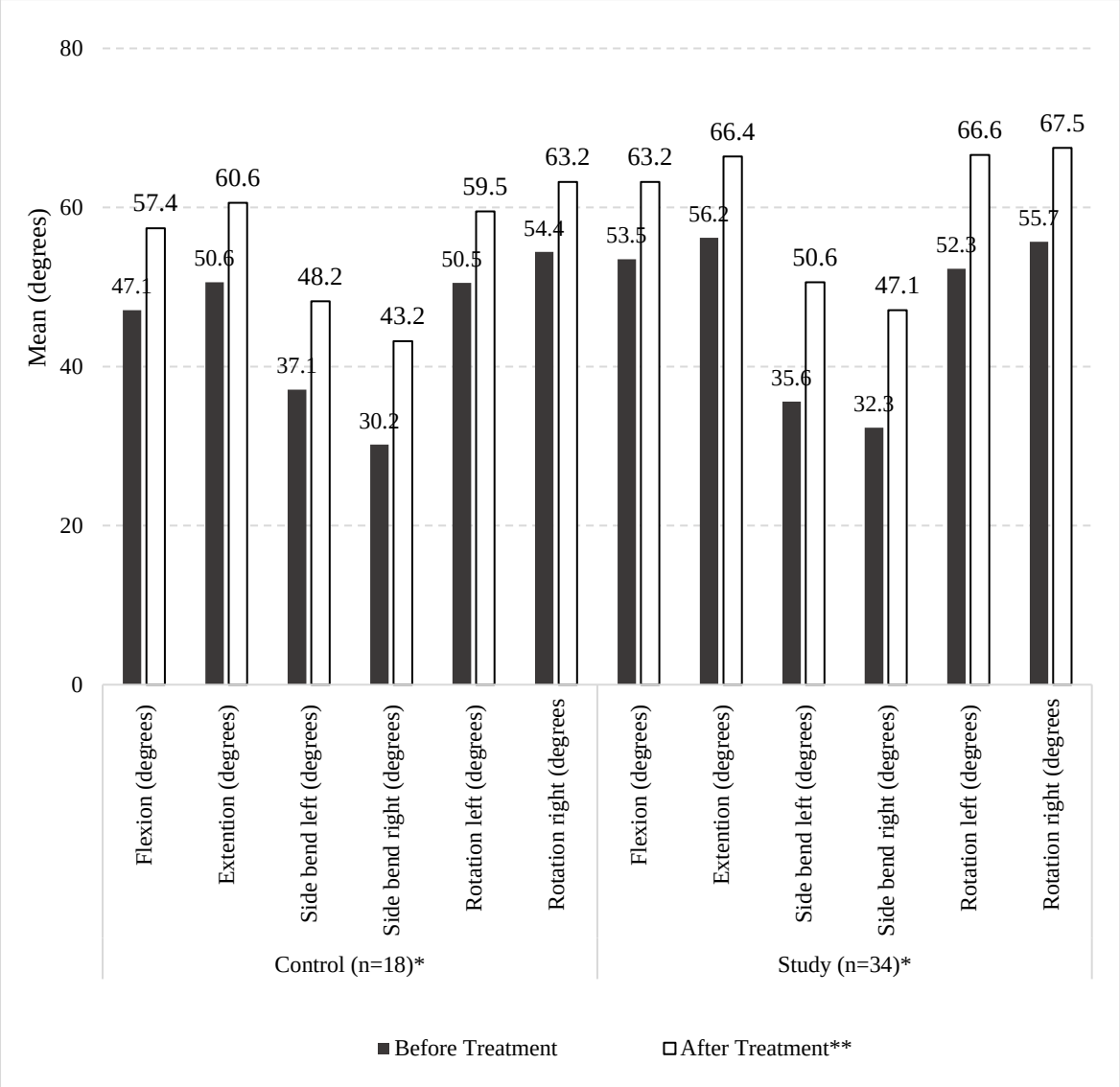
The paired sample statistics with the Wilcoxon test revealed that the difference before and after treatment is statistically significant for both the control and study group between participants ($p < 0.001$), (Table 90).

Table 90: AROM measurements for participants of the control and study group – test statistics for differences within groups in time for younger participants

		Wilcoxon test	
		Pre-test – Post-test	
		Z	Sig.
Flexion (degrees)	Control group	-3.655	0.000
Flexion (degrees)	Study group	-4.467	0.000
Extension (degrees)	Control group	-3.633	0.000
Extension (degrees)	Study group	-4.950	0.000
Side bend left (degrees)	Control group	-3.753	0.000
Side bend left (degrees)	Study group	-5.098	0.000
Side bend right (degrees)	Control group	-3.741	0.000
Side bend right (degrees)	Study group	-5.097	0.000
Rotation left (degrees)	Control group	-3.539	0.000
Rotation left (degrees)	Study group	-5.029	0.000
Rotation right (degrees	Control group	-3.550	0.000
Rotation right (degrees	Study group	-4.955	0.000

Source: Own source 2023.

Graph 24: The comparison of AROM measurements within groups before and after treatment for younger participants



Source: Own source 2023.

* Difference in time is statistically significant ($p \leq 0.05$).

** Difference between groups is statistically significant for flexion ($p \leq 0.05$).

Table 91: AROM results for participants of the control and study group aged 54 years and more

		n	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Flexion (degrees) - before	Control	35	43.0	11.8	39.0	47.1	20	70
	Study	22	46.0	12.7	40.3	51.6	20	80
	Total	57	44.2	12.1	40.9	47.4	20	80
Extension (degrees) - before	Control	35	49.5	10.4	45.9	53.0	22	68
	Study	22	55.4	12.6	49.8	61.0	30	70
	Total	57	51.8	11.6	48.7	54.8	22	70
Side bend left (degrees) – before	Control	35	31.9	7.6	29.3	34.5	18	50
	Study	22	34.2	7.8	30.7	37.6	18	50
	Total	57	32.8	7.7	30.7	34.8	18	50
Side bend right (degrees) – before	Control	35	27.6	7.6	25.0	30.2	12	40
	Study	22	27.3	9.8	23.0	31.6	12	58
	Total	57	27.5	8.4	25.3	29.7	12	58
Rotation left (degrees) – before	Control	35	51.4	8.4	48.5	54.3	36	70
	Study	22	53.0	13.6	46.9	59.0	30	80
	Total	57	52.0	10.6	49.2	54.8	30	80
Rotation right (degrees) – before	Control	35	50.0	8.1	47.2	52.8	36	70
	Study	22	52.3	14.8	45.7	58.8	27	87
	Total	57	50.9	11.1	47.9	53.8	27	87
Flexion (degrees) - after	Control	35	54.1	11.5	50.1	58.0	30	76
	Study	22	56.5	12.3	51.0	61.9	30	80
	Total	57	55.0	11.8	51.9	58.1	30	80
Extension (degrees) - after	Control	35	58.2	10.7	54.5	61.9	32	72
	Study	22	63.9	13.2	58.1	69.7	32	78
	Total	57	60.4	11.9	57.3	63.6	32	78
Side bend left (degrees) – after	Control	35	44.3	9.4	41.0	47.5	20	70
	Study	22	45.2	9.6	41.0	49.5	20	60
	Total	57	44.6	9.4	42.1	47.1	20	70
Side bend right (degrees) – after	Control	35	40.0	9.0	36.9	43.1	16	60
	Study	22	39.7	11.2	34.7	44.7	16	60

		n	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
	Total	57	39.9	9.8	37.3	42.5	16	60
Rotation left (degrees) – after	Control	35	59.7	8.7	56.7	62.6	38	76
	Study	22	63.2	14.0	57.0	69.4	38	90
	Total	57	61.0	11.1	58.1	64.0	38	90
Rotation right (degrees) – after	Control	35	43.0	11.8	39.0	47.1	40	70
	Study	22	46.0	12.7	40.3	51.6	39	90
	Total	57	61.1	10.3	58.3	63.8	39	90

Source: Own source 2023.

Before treatment, there was no statistically significant difference between the control and study group in the group of younger participants ($p>0.05$) with exception of extension ($p=0.046$). Also, after treatment the only difference between the control and study group was statistically significant in the case extension ($p=0.026$), (Table 92).

Table 92: AROM measurements for participants of the control and study group– test statistics for differences between groups pre-test and post-test for older participants

		Mann-Whitney U test			
		Pre-test		Post-test	
		MW U statistics	Sig.	MW U statistics	Sig.
Flexion (degrees)	Control group - Study group	325.000	0.323	340.000	0.455
Extension (degrees)	Control group - Study group	264.500	0.046	250.000	0.026
Side bend left (degrees)	Control group - Study group	310.500	0.216	323.500	0.306
Side bend right (degrees)	Control group - Study group	351.000	0.574	365.500	0.747
Rotation left (degrees)	Control group - Study group	380.500	0.940	332.000	0.377
Rotation right (degrees	Control group - Study group	337.000	0.426	319.000	0.277

Source: Own source 2023.

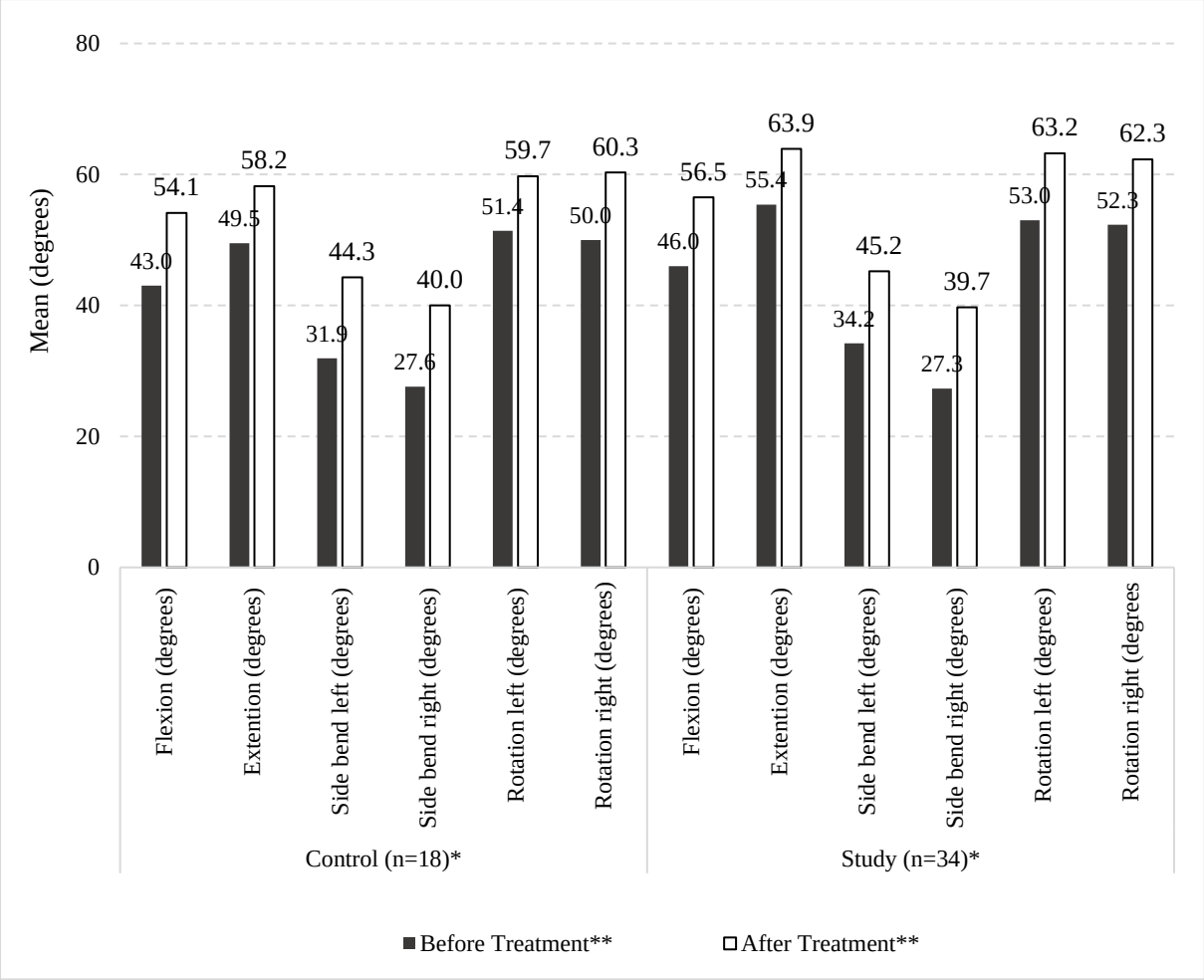
The paired sample statistics with the Wilcoxon test revealed that the difference before and after treatment is statistically significant for both the control and study group ($p < 0,001$), (Table 93).

Table 93: AROM measurements for participants of the control and study group – test statistics for differences within groups in time for older participants

		Wilcoxon test	
		Pre-test – Post-test	
		Z	Sig.
Flexion (degrees)	Control group	-5.201	0.000
Flexion (degrees)	Study group	-4.467	0.000
Extension (degrees)	Control group	-5.203	0.000
Extension (degrees)	Study group	-4.950	0.000
Side bend left (degrees)	Control group	-5.181	0.000
Side bend left (degrees)	Study group	-5.098	0.000
Side bend right (degrees)	Control group	-5.101	0.000
Side bend right (degrees)	Study group	-5.097	0.000
Rotation left (degrees)	Control group	-5.065	0.000
Rotation left (degrees)	Study group	-5.029	0.000
Rotation right (degrees	Control group	-5.011	0.000
Rotation right (degrees	Study group	-4.955	0.000

Source: Own source 2023.

Graph 25: AROM measurements within groups before and after treatment for older participants



Source: Own source 2023.
* Difference in time is statistically significant ($p \leq 0.05$).
** Difference between groups is statistically significant for extension ($p \leq 0.05$).

Regression analysis

To gain more insight into the evaluation of different variables that are important, we have prepared additional regression analyses where we tested which independent variables (specific areas of quality of life from the MQOL questionnaire) have the most influence on the dependent variable, which is Quality of life. As the areas of life that we have measured are correlated with other functional tests. We have included them as independent variables (they expressed the level of pain, the psychological wellbeing, the self-evaluation of life in general and the level of perceived support). At first, we present

the results for younger participants (53 years and less) and later also for older participants (54 years and more).

Using the enter method, a significant model was presented for pre (F=11.377; p=0.000) and post-test data (F=21.864; p=0.000). With pre-test data 49.2 % of variance of dependent variable Quality of life was explained with independent variables and with post-test data. Further, 62.1 % of the variance in the quality of life can be explained by the predictors in the model. In both the pre-test and post-test measurements, the VIF values for all predictor variables are well below the common threshold of 5, so multicollinearity should not have been a problem in our regression analysis for either the pre-test or post-test measurements. However, on the other hand, the correlation coefficients between independent variables are in the range of 0.2 to 0.5 and indicate low to moderate correlations with the exception of higher correlation between support and existential subscale in the second measurement (0.765). We will have to carefully evaluate the result regarding these two variables.

Overall, before treatment, the physical symptoms and wellbeing score (t=3.314; p=0.002) is a single significant predictor of quality of life in younger participants, while the psychological wellbeing, existential subscale, and support subscale scores do not show a statistically significant influence on the dependent variable. The coefficient (B=0.431) with physical symptoms and wellbeing indicates that for every one-unit increase in physical wellbeing, the estimated quality of life score increases by 0.431 units. As mentioned, this relationship is statistically significant, suggesting that higher physical wellbeing is associated with a higher quality of life score before treatment.

The regression analysis for the post-treatment measurements of quality of life indicates that physical wellbeing and the existential subscale are significant predictors of quality of life. Additionally, in the post-treatment phase, the support subscale shows a significant negative association with quality of life. This negative coefficient might be a manifestation of multicollinearity between the “existential subscale” and “support” variable, so we excluded the “support subscale” due to a lower correlation with the dependent variable (all correlation tables are in the appendix) and repeated the analyses once again. The adjusted R^2 value of 62.9% (F=25.866; p=0.000) indicates that the new model accounts for a substantial portion of the variance in quality of life after treatment, which suggests that these predictor variables collectively have a strong influence on the

quality of life in this context. Again, most influence is with the variable physical symptoms and well-being.

The coefficient (B = 0.615) indicates that for every one-unit increase in the physical wellbeing score after treatment, the estimated quality of life score increases by 0.615 units. This relationship is highly statistically significant (t = 5.515. p < 0,001), suggesting that higher physical wellbeing is strongly associated with a higher quality of life score after treatment. Another significant variable is the existential subscale of the MQOL questionnaire. The coefficient (B = 0.799) indicates that for every one-unit increase in the existential subscale score after treatment, the estimated quality of life score increases by 0.799 units. This relationship is statistically significant (t = 2.579, p = 0.013). Overall, after treatment, the analysis suggests that physical symptoms and wellbeing and the existential subscale are significant predictors of quality of life. However, the psychological wellbeing variable does not show a statistically significant influence in quality of life after treatment (t=1.299; p=0.200), (Table 94).

Table 94: Regression model for pre and post-test measurements for younger participants with dependent variable Quality of life (single item statement)

n=52		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
Before treatment (pre-test) F=11.377 (p=0.000) / Adjusted R^2=49.2 %	(Constant)	-1.272	1.325		-0.960	0.342	-3.937	1.393		
	Quality of life - physical symptoms and wellbeing*	0.431	0.130	0.415	3.314	0.002	0.169	0.692	0.688	1.453
	Quality of life - psychological wellbeing	0.052	0.128	0.051	0.411	0.683	-0.204	0.309	0.693	1.443
	Quality of life – existential subscale	0.240	0.146	0.229	1.649	0.106	-0.053	0.534	0.560	1.784
	Quality of life – support subscale	0.269	0.158	0.208	1.695	0.097	-0.050	0.588	0.720	1.389
After treatment (post-test) F=21.864 (p=0.000) / Adjusted R^2=62.1%	(Constant)	-7.214	2.772		-2.602	0.012	-12.791	-1.636		
	Quality of life - physical wellbeing*	0.672	0.111	0.639	6.045	0.000	0.449	0.896	0.665	1.504
	Quality of life - psychological wellbeing	0.161	0.142	0.121	1.130	0.264	-0.125	0.447	0.647	1.546
	Quality of life – existential subscale*	1.492	0.446	0.464	3.343	0.002	0.594	2.390	0.386	2.592
	Quality of life – support subscale*	-0.542	0.259	-0.289	-2.094	0.042	-1.063	-0.021	0.390	2.565
After treatment (post-test) F=25.866 (p=0.000) / Adjusted R^2=62.9%	(Constant)	-5.589	2.754		-2.029	0.048	-11.126	-0.052		
	Quality of life - physical wellbeing*	0.615	0.112	0.585	5.515	0.000	0.391	0.840	0.707	1.414
	Quality of life - psychological wellbeing	0.190	0.146	0.143	1.299	0.200	-0.104	0.485	0.653	1.531
	Quality of life – existential subscale*	0.799	0.310	0.249	2.579	0.013	0.176	1.423	0.856	1.169

Source: Own source 2023.

* Independent variable is statistically significant ($p \leq 0.05$).

Using the enter method with the older group of participants, a significant model was presented for pre (F=7.782; p=0.000) and post-test data (F=22.410; p=0.000). With pre-test data, 32.6 % of the variance in the dependent variable Quality of life was explained with

independent variables. With post-test data, 60.5 % of the variance in quality of life can be explained by the predictors in the model.

In both the pre-test and post-test measurements, the VIF values for all predictor variables are well below the common threshold of 5, except for the variable “Psychological well being” in the measurement after treatment, where it is near that value (4.131). Also, the correlation coefficients between variables confirm a higher correlation of that variable with physical wellbeing (0.824) and existential subscale (0.732) in the second measurement. Other independent variables are in the expected range and indicate low to moderate correlations with the dependent variable (table of correlations in appendix). We will have to carefully evaluate the results regarding the psychological variable in the regression model after treatment.

Overall, before treatment, the physical symptoms and wellbeing score ($t=2.068$; $p=0.044$) is a single significant predictor of quality of life in younger participants, while the psychological wellbeing, existential subscale, and support subscale scores do not show a statistically significant influence on the dependent variable. The coefficient ($B=0.388$) with physical symptoms and wellbeing indicates that for every one-unit increase in the physical wellbeing, the estimated quality of life score increases by 0.388 units.

As we mentioned, this relationship is statistically significant, suggesting that higher physical wellbeing is associated with a higher quality of life score before treatment. The regression analysis for the post-treatment measurements of quality of life indicates that only psychological wellbeing is significant predictor of quality of life and that it has a much higher influence than any other predictor. However, when interpreting this result, we must be aware that this variable correlates highly with other independent variables and therefore this might be a manifestation of multicollinearity between variables. So, we repeated the analysis without this variable to get a more reliable model and results. The adjusted R^2 value of repeated analysis 51.7% indicates a somewhat lower proportion of the variance in quality of life after treatment. However, it is still moderately high and it shows that the included three independent variables are important for the evaluation of quality of life. Again, most influence is with the variable physical symptoms and well-being.

The coefficient ($B = 0.441$) indicates that for every one-unit increase in the physical wellbeing score after treatment, the estimated quality of life score increases by 0.411 units.

This relationship is highly statistically significant (t = 3.249, p = 0.002), suggesting that a higher physical wellbeing is strongly associated with a higher quality of life after treatment. Another significant variable is the existential subscale of the MQOL questionnaire.

The coefficient (B = 0.725) indicates that for every one-unit increase in the existential subscale score after treatment, the estimated quality of life score increases by 0.725 units. This relationship is also highly statistically significant (t = 2.973, p = 0.004). Overall, the analysis suggests that after treatment, physical symptoms and wellbeing and the existential subscale are significant predictors of quality of life. One the other hand, the support subscale does not show a statistically significant influence on the quality of life after treatment (t=-0.247; p=0.806), (Table 95).

Table 95: Regression model for pre and post-test measurements for older participants with dependent variable Quality of life (single item statement)

n=57		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
Before treatment (pre-test) F=7.782 (p=0.000) / Adjusted R^2=32.6 %	(Constant)	0.001	1.710		0.000	1.000	-3.430	3.432		
	Quality of life - physical symptoms and wellbeing 1*	0.388	0.187	0.342	2.068	0.044	0.012	0.764	0.439	2.278
	Quality of life - psychological wellbeing 1	0.066	0.143	0.060	0.462	0.646	-0.220	0.352	0.703	1.422
	Quality of life – existential subscale 1	0.355	0.202	0.268	1.752	0.086	-0.051	0.761	0.516	1.938
	Quality of life – support subscale 1	0.056	0.195	0.039	0.286	0.776	-0.335	0.447	0.641	1.559
After treatment (post-test) F=22.410 (p=0.000) / Adjusted R^2=60.5%	(Constant)	-1.161	1.500		-0.774	0.442	-4.171	1.849		
	Quality of life - physical symptoms and wellbeing 2	0.032	0.168	0.030	0.192	0.849	-0.305	0.370	0.288	3.477
	Quality of life - psychological wellbeing 2*	0.696	0.195	0.609	3.564	0.001	0.304	1.088	0.242	4.131
	Quality of life – existential subscale 2	0.282	0.253	0.160	1.113	0.271	-0.226	0.790	0.343	2.916
	Quality of life – support subscale 2	0.124	0.163	0.082	0.762	0.450	-0.203	0.452	0.612	1.633
After treatment (post-test) F=21.007 (p=0.000) / Adjusted R^2=51.7%	(Constant)	-1.499	1.654		-0.906	0.369	-4.816	1.819		
	Quality of life - physical symptoms and wellbeing 2*	0.441	0.136	0.411	3.249	0.002	0.169	0.714	0.538	1.858
	Quality of life – existential 2*	0.725	0.244	0.411	2.973	0.004	0.236	1.214	0.452	2.214
	Quality of life – support 2	-0.043	0.173	-0.028	-0.247	0.806	-0.389	0.304	0.667	1.499

Source: Own source 2023.

* Independent variable is statistically significant ($p \leq 0.05$).

Table 96: Regression model 1 (before treatment) – correlation between variables

			Considering all parts of my life - physical, emotional, social, spiritual and financial over the past 2 days, the quality of my life has been (Very bad - Excellent) 1	Quality of life - physical 1	Quality of life - psychological 1	Quality of life – existential 1	Quality of life – support 1
Up to 53 years (n=52)	Pearson Correlation	Considering all parts of my life - physical, emotional, social, spiritual and financial over the past 2 days, the quality of my life has been (Very bad - Excellent) 1	1,000	,603	,403	,555	,452
		Quality of life - physical 1	,603	1,000	,487	,464	,270
		Quality of life - psychological 1	,403	,487	1,000	,458	,217
		Quality of life - exitential_1	,555	,464	,458	1,000	,527
		Quality of life - support_1	,452	,270	,217	,527	1,000
	Sig. (1-tailed)	Considering all parts of my life - physical, emotional, social, spiritual and financial over the past 2 days, the quality of my life has been (Very bad - Excellent) 1		,000	,002	,000	,000
		Quality of life - physical 1	,000		,000	,000	,026
		Quality of life - psychological 1	,002	,000		,000	,061
		Quality of life - exitential_1	,000	,000	,000		,000
		Quality of life - support_1	,000	,026	,061	,000	
54 years and more (n=57)	Pearson Correlation	Considering all parts of my life - physical, emotional, social, spiritual and financial over the past 2 days, the quality of my life has been (Very bad - Excellent) 1	1,000	,570	,351	,537	,372
		Quality of life - physical 1	,570	1,000	,517	,655	,531
		Quality of life - psychological 1	,351	,517	1,000	,400	,171
		Quality of life - exitential_1	,537	,655	,400	1,000	,527
		Quality of life - support_1	,372	,531	,171	,527	1,000
	Sig. (1-tailed)	Considering all parts of my life - physical, emotional, social, spiritual and financial over the past 2 days, the		,000	,004	,000	,002

		quality of my life has been (Very bad - Excellent) 1					
		Quality of life - physical 1	,000		,000	,000	,000
		Quality of life - psychological 1	,004	,000		,001	,102
		Quality of life - exitential_1	,000	,000	,001		,000
		Quality of life - support_1	,002	,000	,102	,000	

Source: Own source 2023.

Table 97: Regression model 2 (after treatment) – correlation between variables

			Considering all parts of my life - physical, emotional, social, spiritual and financial over the past 2 days, the quality of my life has been (Very bad - Excellent) 2	Quality of life - physical 2	Quality of life - psychological2	Quality of life – existential 2	Quality of life – support 2
Up to 53 years (n=52)	Pearson Correlation	Considering all parts of my life - physical, emotional, social, spiritual and financial over the past 2 days, the quality of my life has been (Very bad - Excellent) 2	1,000	,727	,551	,455	,320
		Quality of life - physical 2	,727	1,000	,537	,261	,340
		Quality of life - psychological_2	,551	,537	1,000	,373	,301
		Quality of life - exitential_2	,455	,261	,373	1,000	,765
		Quality of life - support_2	,320	,340	,301	,765	1,000
	Sig. (1-tailed)	Considering all parts of my life - physical, emotional, social, spiritual and financial over the past 2 days, the quality of my life has been (Very bad - Excellent) 1		,000	,000	,000	,010
		Quality of life - physical 2	,000		,000	,031	,007
		Quality of life - psychological_2	,000	,000		,003	,015
		Quality of life - exitential_2	,000	,031	,003		,000
		Quality of life - support_2	,010	,007	,015	,000	
54 years and more (n=57)	Pearson Correlation	Considering all parts of my life - physical, emotional, social, spiritual and financial over the past 2 days, the quality of my life has been (Very bad - Excellent) 2	1,000	,676	,778	,672	,389
		Quality of life - physical 2	,676	1,000	,824	,676	,444
		Quality of life - psychological_2	,778	,824	1,000	,732	,333
		Quality of life - exitential_2	,672	,676	,732	1,000	,571

		Quality of life - support_2	,389	,444	,333	,571	1,000
	Sig. (1-tailed)	Considering all parts of my life - physical, emotional, social, spiritual and financial over the past 2 days, the quality of my life has been (Very bad - Excellent) 2		,000	,000	,000	,001
		Quality of life - physical 2	,000		,000	,000	,000
		Quality of life - psychological_2	,000	,000		,000	,006
		Quality of life - exitential_2	,000	,000	,000		,000
		Quality of life - support_2	,001	,000	,006	,000	

Source: Own source 2023.

In Table 96 and 97 is described regression model before and after treatment in patients up to 53 years (n=52) and 54 years and more (n=57) with Pearson correlation for variable Quality of life, (Table 96, 97).

3.5 Discussion

In this chapter, the results presented in the previous chapter have been critically discussed and interpreted to articulate a comprehensive narrative that addresses the research objectives and provides a clear understanding of the validity of the underlying hypotheses of this current RCT. For this purpose, the results have been discussed in light of additional research literature. For higher legibility, the chapter has been divided into three sections. While the first section discusses the key findings of this current RCT, along with their implications in practice and future research, the second section discusses the validity and reliability of the results. Finally, the third section discusses the key limitations that might have affected the scope and outcomes of this RCT.

Discussion of the Findings

Neck Disability Index and Health-Related Quality of Life

The current RCT findings are consistent with hypothesis H1, which states that cervical spondylosis patients who underwent a physiotherapy program that included deep tissue massage, eccentric exercises, and passive stretching experienced statistically significant improvements in their NDI (Neck Disability Index) and MQOL (McGill Quality

of Life Questionnaire) scores compared to those in the control group who underwent an isometric and active-assisted exercise. Younger participants (up to 53 years old) showed significant improvements in both NDI and MQOL in the study group, with statistically significant changes found in both the overall score and all MQOL subscales.

This is consistent with other research (Sbardella et al. 2021), showing that manual treatments, eccentric exercises, and passive stretching together can significantly lessen neck discomfort and improve the general quality of life in younger people with cervical spondylosis. In contrast, although NDI indicated substantial increases in the study group for people aged 54 and beyond, MQOL improvements were only statistically significant in the single-item evaluation of Quality of life. This could be explained by variations in how different ages respond to treatments. According to research, older people may recover more slowly as a result of musculoskeletal changes brought on by ageing (Kern et al. 2017).

In the context of cervical spondylosis, the results of the Neck Disability Index (NDI) and McGill Quality of Life Questionnaire (MQOL) observed in this current RCT may be closely connected. Improvements in NDI scores are likely a sign of decreased pain and improved neck function because the NDI evaluates both neck pain and impairment. The consequent improvement in overall quality of life, as measured by MQOL scores, may be a result of these physical changes.

Participants are more likely to report better levels of well-being and satisfaction in a variety of life domains, including physical, psychological, existential, and social elements when they receive relief from neck discomfort and an improvement in functioning. The fact that increased NDI and MQOL scores are correlated highlights the good effects of cervical spondylosis therapies on people's overall well-being. Therefore, based on the results, it can be concluded that hypothesis H1 is valid.

Numeric Rating Scale of Pain Results

The findings offer strong support for hypothesis H2, showing that the new physiotherapy program had a notable favorable impact on pain outcomes as measured by the Numeric Pain Rating Scale (NPRS). After the intervention, the study group's members' pain levels significantly decreased for both younger and older individuals, with improvements that were statistically significant when compared to the control group.

This shows that the multimodal physical therapy program was more successful at reducing pain than the conventional isometric and active-assisted exercise program because it included deep tissue massage, eccentric activities, and passive stretching. These results are consistent with the advantages of multimodal pain treatment techniques, such as massage therapy and eccentric exercises, which have been demonstrated to lessen pain and enhance function in musculoskeletal diseases such as cervical spondylosis (Landesa-Piñeiro and Leirós-Rodríguez 2022; Gashi and Azemi 2022).

Furthermore, the program's effectiveness across a range of age groups is highlighted by the fact that the study group beat the control group in pain reduction for both younger and older individuals. A noteworthy discovery is the program's success across a broad age spectrum. The fact that the study group outperformed the control group in terms of pain reduction for both younger and older people highlight the innovative physiotherapy approach's broad applicability and potential advantages. This shows that the program's elements are flexible and advantageous for people of all ages, offering a prospective means of addressing persistent neck pain throughout the lifespan.

As such, it can be stated that the current RCT findings strongly suggest that the multimodal physiotherapy program is superior to the traditional method for relieving the pain of chronic neck pain. This is consistent with mounting research that highlights the benefits of multimodal pain management strategies, such as massage therapy and eccentric exercises, in enhancing pain outcomes and functional ability in musculoskeletal diseases (López-de-Uralde-Villanueva et al. 2020) These findings show the potential advantages of combining deep tissue massage, eccentric movements, and passive stretching into physiotherapy programs and have practical implications for healthcare providers and individuals looking for effective therapies for persistent neck discomfort. Thus, the results of this study imply that the H2 hypothesis is valid.

Patient-Specific Functional Scale Results

The findings also shed light on the validity of hypothesis H3, which proposed that involvement in a physical therapy (PT) intervention program would result in more than half of the functional improvement in the Patient-specific Functional Scale (PSFS) compared to participants in the control group. Both the control and study groups' PSFS scores for

persons who were 53 years old or younger significantly increased following the intervention. The research group, however, showed a noticeably greater improvement, validating the idea. This shows that the younger age group's functional results were more significantly impacted by the PT intervention program (Noorduyn et al. 2020).

In contrast, for participants who were older (54 years and older), both groups demonstrated improvement, although there was no statistically significant difference between the control and study groups. Even though the research group showed more progress, it was not statistically significant. Despite not being substantially different from the control group in this age range, this suggests that the PT intervention had a good effect. The results are also consistent with current research (Bayattork et al. 2019) demonstrating that older people may respond to therapies differently and at varying rates of improvement.

Initial measurements for the Flex-Rotation and Spurling's tests revealed no discernible variations in the majority of the examined parameters between the control and study groups. This shows that, prior to receiving the intervention, participants in the two groups shared comparable baseline characteristics with regard to these particular neck tests. Although Spurling's test on the right side did not reach conventional statistical significance, there was a trend towards significance ($p=0.054$), suggesting that there may have been some initial differences between the control and study groups in this particular test (Andrade 2019).

On the other hand, the Deep Neck Flexor Endurance Test findings revealed that the study group's mean endurance time was much longer than that of the control group. This shows that prior to the intervention, study group individuals had a stronger baseline performance in terms of deep neck flexor endurance. This can be a result of random variation or variations in participant characteristics that were not taken into account in the study (Blomgren et al. 2018). Therefore, it is clear that the H3 hypothesis of this current RCT is valid.

Difference between the Control and study Groups in Terms of Neck Disability, Quality of Life, and Patient-Specific Functional Scale Results

The results of the discriminant analysis provided insight into the intervention's success in addressing hypothesis H4, which was concerned with variations in the control

and study groups' responses to questions from the Neck Disability Index Questionnaire (NDI), McGill Quality of Life Questionnaire (MQOL), and Patient-Specific Functional Scale (PSFS). Prior to the intervention, none of the characteristics substantially distinguished between the control and study groups for the younger individuals, according to the analysis. However, following the intervention, each of the three variables, such as NDI, PSFS, and Quality of Life, became a major discriminator, demonstrating that the intervention was effective in enhancing these elements of the study group's health. This finding is in line with the findings of (Balthillaya et al. 2022a). This validates the prediction that, following the intervention, there would be statistically significant variations in these variables across the groups. In contrast, neither before or after the intervention did any of the factors substantially distinguish between the control and study groups for the older individuals. Contrary to the prediction, this shows that the intervention did not result in substantially different results between the two groups in this age range.

These results are consistent with other studies showing that older people may react differently to some treatments and that the efficacy of interventions might vary among various age groups (Balthillaya et al. 2022). Therefore, based on the interpretation of the results of this current RCT, it can be stated that hypothesis H4 is valid.

Differences between the Control and study Groups in Terms of Active Range of Motion and Numerical Rating Scale of Pain Results

Finding the differences between the control and study groups' initial and end measurements for active range of motion (AROM) and the Numerical Rating Scale of Pain (NPRS) was one of the study's goals. The AROM and NPRS scores in both groups would statistically differ between the initial and final assessments, according to hypothesis H5. Except for the parameter of extension, there were no statistically significant changes between the control and study groups before treatment according to the AROM results for persons under the age of 53. However, the change in flexion following therapy was statistically significant. This was in line with the outcomes of the physiotherapy interventions used by previous researchers (Khan et al. 2022). This supports the study's premise and shows that the intervention significantly increased AROM in the younger participant group, supporting the hypothesis.

Prior to treatment, there was not a significant difference in AROM between the control and study groups for persons aged 54 and above, with the exception of extension. The only notable improvement found following therapy was in extension. These results are consistent with the idea that the intervention significantly affected extension in the older participant group.

According to the results, there was no discernible change in the NPRS pain scale scores between the control and study groups before therapy. However, following therapy, there was a noticeable change, with the study group reporting lower pain levels. This lends credence to the idea that the intervention would significantly reduce the severity of the pain (Lichtman et al. 2018). Overall, the study's findings support hypothesis H5, showing that both younger and older individuals experienced substantial changes in AROM and pain intensity as a result of the intervention.

The findings of the Mann-Whitney U test and the Wilcoxon signed-rank test offered solid statistical support for these variations within and between groups. These results demonstrate the intervention's efficacy in enhancing AROM and minimizing pain, providing insightful information for clinical practice and the treatment of neck-related problems. This aligns with the existing body of empirical knowledge, which suggests that physiotherapeutic interventions can effectively improve the AROM of patients with severe neck pain, while also reducing the pain experienced by such patients (Shamsi et al. 2021). This further increases the validity of the finding that the intervention used in the current RCT can not only reduce the pain of patients with severe neck pain but can also reduce the disability of such individuals. Based on these results, it is clear that hypothesis H5 of this current RCT is valid.

Outcomes of Regression Analysis

The regression analysis investigated how different independent variables, especially facets of quality of life, affected the dependent variable, or quality of life. The model was significant both before and after treatment for younger individuals (53 years and under), accounting for 49.2% and 62.1% of the variation in Quality of Life, respectively. Before therapy, quality of life was strongly predicted by physical symptoms and well-being, but not by psychological well-being, the existential subscale, or the support subscale.

Following therapy, the existential and physical well-being subscales continued to be important predictors, but the support subscales did not.

The model was significant for both pre- and post-treatment assessments in older participants (54 years and above), accounting for 32.6% and 60.5%, respectively, of the variation in Quality of Life. The only significant predictor prior to therapy was physical symptoms and well-being, whereas significant predictors following treatment were psychological well-being and the existential subscale. The results suggest that whatever areas of quality of life substantially affect the overall quality of life depend on age and stage of treatment (Canovas and Dagneaux 2018).

Before therapy, physical symptoms and well-being had a substantial impact on younger participants' quality of life (β=0.415, p=0.001). Post-treatment, there were substantial effects on the existential subscale (β=0.464, p=0.002), support subscale (β=-0.289, p=0.042), and physical wellbeing (β=0.639, p0.001). For older participants, similar patterns were maintained, with physical symptoms and well-being impacting pre-treatment quality of life (β=0.342, p=0.044). Along with the existential subscale (β=0.411, p=0.004), post-treatment psychological wellbeing (β=0.609, p=0.001) and physical symptoms and wellbeing (β=0.411, p=0.002) were significant predictors in the second evaluation. These findings highlight how crucial it is to focus on particular components of well-being to improve quality of life.

According to the current results of the regression analysis in our RCT study clinical physiotherapists have to consider specific alterations in pathophysiological processes including physical, sensory and cognitive, medical and cognitive co-morbidities associated with ageing and how these impact upon the presentation and normal physiological response to neck pain and its physiotherapeutic intervention strategies and to health related quality of life of vulnerable population with neck pain in Kosovo.

Implications of the Findings

The results of the current RCT have significant implications for future studies and clinical practice related to neck discomfort and its management. First, the findings highlight how well the intervention program, which comprised deep tissue massage, eccentric movements, and passive stretching, performed well in enhancing active range of motion

(AROM) and lowering pain levels. This implies that this multimodal intervention, regardless of the patient's age, may be helpful in clinical practice. To improve patient outcomes, clinicians can think about including these strategies in their treatment plans.

Second, the age-related variations in treatment outcomes emphasize the necessity of individualized care. Following the intervention, younger people showed a substantial improvement in their AROM, Neck Disability Index (NDI), and McGill Quality of Life Questionnaire (MQOL) ratings. In contrast, older participants primarily showed improvements in extension and NDI. Clinicians should consider age when creating treatment regimens since older patients may have particular demands and healing trajectories. The results of the current RCT also highlight the significance of evaluating and addressing many aspects of quality of life in neck pain patients. Physical symptoms, psychological health, existential considerations, and social support all have an impact on quality of life. To enhance the overall well-being of patients with neck pain, clinicians should consider assessments and therapies that focus on these dimensions.

Validity and Reliability of the Results

In this current RCT, both the validity of the collected data and the reliability or internal consistency of the measures have been critically analyzed. For several measures and subscales, the study calculates internal consistency using Cronbach's alpha. Internal consistency is a key component in determining an instrument's dependability because it quantifies how closely connected a group of objects are to one another (Vaske, Beaman, and Sponarski 2017). Most of the measures and subscales in this current RCT had Cronbach's alpha values over 0.7, which is typically regarded as satisfactory (Vaske et al. 2017). This shows that the components of any scale or measure are sufficiently associated and consistently measure the variable they are meant to evaluate.

For instance, the Post-test Cronbach's alpha values for the McGill Quality of Life Questionnaire (MQOL) Total score, Neck Disability Index Questionnaire (NDIQ), Range of Motion (AROM), and Pain Scale Functional Subscale (PSFS) are all above 0.8. As a result, it may be inferred that these measurements have high levels of internal consistency and are accurate for evaluating the corresponding constructs (Taber 2018). Some subscales, however, initially have lower Cronbach's alpha values which then increase following factor analysis (PCA). For instance, the pre-test Cronbach's alpha values for the Physical and

Psychological components of MQOL are lower, but following factor analysis, they dramatically increase. This shows that these subscales' internal consistency may have been less than ideal at first, but that it improved once factor structure was taken into account.

By utilizing Pearson correlation coefficients, which measure the consistency of measurements over time, the current RCT also looks at test-retest reliability. All measures and subscales show moderate to significant positive correlations (ranging from 0.482 to 0.890) between the first and second evaluations (Schober et al. 2018).

This suggests that the instruments are dependable for measuring the variables in this sample since they retain consistency across time. With correlation values ranging from 0.777 to 0.890, the Range of Motion (AROM) measurements, for instance, provide strong test-retest reliability (Akoglu 2018). The correlation coefficients show that the NPRS pain scale, PSFS, NDIQ, and MQOL categories also exhibit significant test-retest reliability.

To examine the age distribution between the control and study groups, the study uses a Mann-Whitney U test. According to the findings, there is an age gap between the two groups, with the control group being older. While such a difference in the baseline age of the two groups can be regarded as a potential confounding factor of this current RCT, previous researchers have demonstrated that an objective and adequate provision of intervention, as well as an accurate analysis of the results, can produce highly dependable outcomes in RCT studies despite there being minor demographic differences between the two groups (Mendes Fernandes et al. 2023, 42; O'Keeffe et al. 2020).

The results of the current RCT imply that the majority of the metrics employed to gauge the success of the intervention show strong test-retest reliability and internal consistency. This further indicates the reliability of the results, as well as their generalizability to a larger population of individuals with chronic neck pain.

Limitations and Drawbacks

The findings of this current RCT are associated with two major limitations and/or potential drawbacks. Even if the study made an effort to account for confounding factors, some baseline differences in characteristics may still have an impact on the intervention's actual effects and skew the findings. Another drawback is that the study participants'

potential comorbidities or pre-existing medical issues were not taken into account (Whittaker et al. 2021).

Chronic neck discomfort is frequently linked to other medical conditions like osteoarthritis or psychological conditions like anxiety and depression (Kazeminasab et al. 2022). The ability of the current RCT to link changes in quality of life and pain only to the intervention may be constrained if these comorbidities are not taken into account in the analysis. A more complete picture of the elements affecting the outcomes might be provided by comprehending the effects of these coexisting conditions. Several other significant aspects should be taken into account when interpreting the results of this current RCT in addition to the limitations already highlighted. These restrictions both highlight areas for potential future research and underline the need for caution when generalizing the results.

The sample size of this current RCT is a serious drawback. The results' ability to be applied to a larger population may be constrained by the participants' very limited number. Furthermore, there may have been bias in the recruitment procedure because not all people who experience persistent neck pain participated in the research by volunteering (Hickey et al. 2018). The findings' external validity may be impacted by this bias.

The study's follow-up period may not have been long enough to fully document the impact of the intervention. The long-term effects of an intervention might not be fully reflected by short-term changes since chronic neck discomfort might be a long-term problem (Hagen et al. 2017). A longer follow-up time would provide a more thorough analysis of the long-lasting consequences.

A major issue with the current RCT methodology is the reliance on self-reported measures for determining pain and quality of life. This adds to the risk of response bias. Participants may have over- or under-reported their symptoms, maybe as a result of recollection bias or social desirability bias, among other things (Prince et al. 2020). These biases may result in inaccurate data, which would reduce the current RCT internal validity. By minimizing the influence of subjectivity and supplying a more objective basis for evaluating the intervention's effects, the use of objective measures or clinical assessments such as medical examinations and diagnostic tools could improve the validity of the

findings. The study's overall rigor and credibility would increase as a result of this methodological improvement.

While it is important to recognize these limitations, they also provide a starting point for future studies targeted at addressing these issues and bolstering the body of knowledge in the field of managing persistent neck discomfort. Increased sample size, longer-term follow-up evaluations, and the use of more objective measurement techniques all offer possible ways to improve the validity and generalizability of this research's findings. Additionally, initiatives to lessen participant recruitment bias can result in a more representative study group, enabling a wider application of the findings to those with persistent neck pain.

Another major limitation of the current RCT was the inability to conduct a single or double-blinded RCT. Blinding of the participants and the individuals involved in the evaluation of the results in an RCT study minimizes bias in the findings, thereby increasing the validity of the outcomes (Bhide et al. 2018). However, in the current RCT, the blinding of the participants was not possible as their cooperation was crucial for implementing the intervention. Meanwhile, the providers involved in the provision of the intervention also evaluated the outcomes. This prohibited the blinding of the evaluators in the study. In the end, acknowledging and actively addressing these limitations will promote knowledge expansion and the creation of more efficient interventions for this pervasive and frequently crippling disorder.

Contribution to Science

This current RCT makes a substantial contribution to the field of treating chronic neck discomfort. It answers a crucial question about the efficiency of a multimodal physical therapy program for individuals with persistent neck pain that includes deep tissue massage, eccentric exercises, and passive stretching in comparison to a traditional isometric and active-assisted exercise routine. The results of the current RCT offer important new perspectives on how to treat this common and crippling ailment.

First, the current RCT shows that the multimodal physiotherapy program is more effective than the conventional method at reducing pain and enhancing function, as shown by the large pain reductions and enhancements in active range of motion. This implies that deep tissue massage and eccentric movements may help those with chronic neck discomfort

achieve better results. Second, the current RCT emphasizes the value of individualized care by highlighting age-related variations in treatment outcomes.

Despite the results obtained in current RCT clinical physiotherapists in Kosovo have to demonstrate ability to adapt functional assessment strategies and others (based on ICF biopsychosocial model of health; assessment strategies of structural and functional level, activity level, participation level of each patient with neck pain from Kosovo), novel physiotherapy treatment plans and evaluation to the specific needs of vulnerable population of patients with neck pain in Kosovo.

The Neck Disability Index (NDI), the McGill Quality of Life Questionnaire (MQOL), and the Patient-Specific Functional Scale (PSFS) all indicated significant improvements in the younger patients, but the older participants mainly benefited in a few areas. This emphasizes the necessity for individualized therapies depending on age and personal traits. Current RCT also emphasizes the importance of considering several areas of quality of life, such as physical, psychological, existential, and social components, when managing neck discomfort. It demonstrates how particular aspects of quality of life, like bodily symptoms and well-being, psychological well-being, and existential considerations, contribute to general well-being and contentment.

The current RCT makes a significant contribution despite its drawbacks, such as sample size and blinding restrictions, by offering evidence-based insights into successful therapies for chronic neck pain. It educates medical professionals on the possible advantages of multimodal treatments, the value of individualized care, and the significance of treating various aspects of quality of life. These findings emphasize the importance of including deep tissue massage, eccentric movements, and passive stretching in physiotherapy programs, and have practical implications for enhancing quality of life and managing pain in those with chronic neck pain.

Future research in developing evidence-based physiotherapy interventions for neck pain should be aimed also at in-depth research on understanding of the impact of beliefs held by health professionals, care givers and family on the identification, recognition, effective physiotherapy interventions and management of pain in older people in Kosovo.

4 CONCLUSION

In conclusion, this doctoral thesis shed successfully light on the efficacy of a multimodal physiotherapy program and produced significant insights into the treatment of chronic neck pain. The key study question has been addressed by the research findings, which highlight the benefits of a multimodal strategy that include deep tissue massage, eccentric exercises, and passive stretching over a traditional isometric and active-assisted exercise program.

The findings of the current RCT conclusively prove the validity of all hypotheses and demonstrate that the multimodal physiotherapy program is superior in reducing pain, enhancing active range of motion, and enhancing the quality of life for people with persistent neck discomfort. These findings highlight the potential advantages of adding eccentric motions and deep tissue massage into physiotherapy therapies and provide helpful clinical practice guidelines. Current RCT further highlights the value of customized therapy by emphasizing age-related variability in treatment outcomes. Older participants mostly exhibited improvement in specific areas, but younger people had considerable gains across numerous categories. This underlines the importance of individualized therapies depending on age and personal traits.

The current RCT also underlines the importance of evaluating many dimensions, such as physical, psychological, existential, and social elements, when assessing quality of life. The interaction of these factors was discovered to affect general health, underscoring the need for holistic care in the treatment of neck discomfort. Based on the findings of the current RCT project, there are opportunities for deeper studies in the future. The study's shortcomings, such as its sample size restrictions and inability to conduct a blinded RCT, highlight areas where future research can further assist in understanding the treatment of chronic neck pain. Given the persistent nature of neck discomfort, further investigation of the intervention's long-term consequences is also necessary.

In conclusion, by providing evidence-based insights and useful consequences for healthcare practitioners, this doctoral thesis greatly advances the topic of managing persistent neck pain. It highlights the value of multimodal physical therapy, the significance of tailored care, and the complexity of quality-of-life evaluations.

Future studies can improve the knowledge and treatment choices accessible to people with persistent neck pain by addressing open-ended issues and building on existing findings. In the end, the current RCT described here provides doctors and researchers with a useful tool to improve the well-being and pain treatment of patients with chronic neck pain.Future research should be also directed towards an in-depth investigation of the understanding of the impact of beliefs held by clinical physiotherapists, medical doctors, care givers, relatives on the identification, recognition, physiotherapy interventions and management of neck pain in a very diverse vulnerable population with neck pain in Kosovo.

5 LITERATURE

1. Abbed, Khalid M., and Jean Valéry C.E. Coumans. 2007. Cervical Radiculopathy: Pathophysiology, Presentation, and Clinical Evaluation. *Neurosurgery*. doi:10.1227/01.NEU.0000249223.51871.C2.
2. Akoglu, Haldun. 2018. User's Guide to Correlation Coefficients. *Turkish Journal of Emergency Medicine* 18 (3): 91–93. doi:10.1016/j.tjem.2018.08.001.
3. Alshami, Ali M., and Duaa A. Bamhair. 2021. Effect of Manual Therapy with Exercise in Patients with Chronic Cervical Radiculopathy: A Randomized Clinical Trial. *Trials* 22 (1). BioMed Central Ltd. doi:10.1186/s13063-021-05690-y.
4. Alsultan, Feras, Corrado Cescon, Nicola R. Heneghan, Alison Rushton, Marco Barbero, and Deborah Falla. 2020. Eccentric Exercise and Delayed Onset Muscle Soreness Reduce the Variability of Active Cervical Movements. *Journal of Biomechanics* 111 (October). Elsevier Ltd. doi:10.1016/j.jbiomech.2020.109962.
5. Andelic, Nada, Jan Borre Johansen, Erik Bautz-Holter, Anne Marit Mengshoel, Eva Bakke, and Cecilie Roe. 2012. Linking Self-Determined Functional Problems of Patients with Neck Pain to the International Classification of Functioning, Disability, and Health (ICF). *Patient Preference and Adherence* 6: 749–55. doi:10.2147/PPA.S36165.
6. Andrade, Chittaranjan. 2019. The P Value and Statistical Significance: Misunderstandings, Explanations, Challenges, and Alternatives. *Indian Journal of Psychological Medicine* 41 (3): 210–15. doi:10.4103/IJPSYM.IJPSYM_193_19.
7. Ayub, Afsah, Muhammad Osama, Shakil-Ur-Rehman, and Shakeel Ahmad. 2019. Effects of Active versus Passive Upper Extremity Neural Mobilization Combined with Mechanical Traction and Joint Mobilization in Females with Cervical Radiculopathy: A Randomized Controlled Trial. *Journal of Back and Musculoskeletal Rehabilitation* 32 (5). IOS Press: 725–30. doi:10.3233/BMR-170887.

8. Baetz, Marilyn, and Rudy Bowen. 2008. Chronic Pain and Fatigue: Associations with Religion and Spirituality. *Pain Research and Management* 13 (5): 383–88. doi:10.1155/2008/263751.
9. Baetz, Marilyn, Rudy Bowen, and Mdcm Frcpc. 2008. Chronic Pain and Fatigue: Associations with Religion and Spirituality. *Pain Res Manage*. Vol. 13.
10. Bakken, Anders Galaasen, Andreas Eklund, Anna Warnqvist, Søren O'Neill, and Iben Axén. 2021. The Effect of Two Weeks of Spinal Manipulative Therapy and Home Stretching Exercises on Pain and Disability in Patients with Persistent or Recurrent Neck Pain; a Randomized Controlled Trial. *BMC Musculoskeletal Disorders* 22 (1). BioMed Central Ltd. doi:10.1186/s12891-021-04772-x.
11. Balthillaya, Ganesh M, Shradha S Parsekar, Ranganath Gangavelli, Narayan Prabhu, Shyamasunder N Bhat, and Bhamini Krishna Rao. 2022a. Effectiveness of Posture-Correction Interventions for Mechanical Neck Pain and Posture among People with Forward Head Posture: Protocol for a Systematic Review. *BMJ Open* 12 (3): e054691. doi:10.1136/bmjopen-2021-054691.
12. Baumert, Philipp, Mark J. Lake, Claire E. Stewart, Barry Drust, and Robert M. Erskine. 2016. Genetic Variation and Exercise-Induced Muscle Damage: Implications for Athletic Performance, Injury and Ageing. *European Journal of Applied Physiology*. Springer Verlag. doi:10.1007/s00421-016-3411-1.
13. Bayattork, Mohammad, Markus D. Jakobsen, Emil Sundstrup, Foad Seidi, Hans Bay, and Lars L. Andersen. 2019. Musculoskeletal Pain in Multiple Body Sites and Work Ability in the General Working Population: Cross-Sectional Study among 10,000 Wage Earners. *Scandinavian Journal of Pain* 19 (1): 131–37. doi:10.1515/sjpain-2018-0304.
14. Bernal-Utrera, Carlos, Juan Jose Gonzalez-Gerez, Ernesto Anarte-Lazo, and Cleofas Rodriguez-Blanco. 2020. Manual Therapy versus Therapeutic Exercise in Non-Specific Chronic Neck Pain: A Randomized Controlled Trial. *Trials* 21 (1). BioMed Central. doi:10.1186/s13063-020-04610-w.
15. Bervoets, Diederik C., Pim A.J. Luijsterburg, Jeroen J.N. Alessie, Martijn J. Buijs, and Arianne P. Verhagen. 2015. Massage Therapy Has Short-Term Benefits for People with Common Musculoskeletal Disorders Compared to No

Treatment: A Systematic Review. *Journal of Physiotherapy* 61 (3). Australian Physiotherapy Association: 106–16. doi:10.1016/j.jphys.2015.05.018.

16. Bhide, Amar, Prakesh S. Shah, and Ganesh Acharya. 2018. A Simplified Guide to Randomized Controlled Trials. *Acta Obstetricia et Gynecologica Scandinavica* 97 (4): 380–87. doi:10.1111/aogs.13309.
17. Binder, Allan I. 2007. Cervical Spondylosis and Neck Pain. *British Medical Journal*. doi:10.1136/bmj.39127.608299.80.
18. Binderup, Asbjørn T., Lars Arendt-Nielsen, and Pascal Madeleine. 2010. Pressure Pain Threshold Mapping of the Trapezius Muscle Reveals Heterogeneity in the Distribution of Muscular Hyperalgesia after Eccentric Exercise. *European Journal of Pain* 14 (7): 705–12. doi:10.1016/j.ejpain.2009.11.001.
19. Blanpied, Peter R., Anita R. Gross, James M. Elliott, Laurie Lee Devaney, Derek Clewley, David M. Walton, Cheryl Sparks, and Eric K. Robertson. 2017. Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health from the Orthopaedic Section of the American Physical Therapy Association. *Journal of Orthopaedic and Sports Physical Therapy*. Movement Science Media. doi:10.2519/jospt.2017.0302.
20. Blomgren, Johannes, Erika Strandell, Gwendolen Jull, Irene Vikman, and Ulrik Röijezon. 2018. Effects of Deep Cervical Flexor Training on Impaired Physiological Functions Associated with Chronic Neck Pain: A Systematic Review. *BMC Musculoskeletal Disorders* 19 (1): 415. doi:10.1186/s12891-018-2324-z.
21. Bono, Christopher M., Gary Ghiselli, Thomas J. Gilbert, D. Scott Kreiner, Charles Reitman, Jeffrey T. Summers, Jamie L. Baisden, et al. 2011. An Evidence-Based Clinical Guideline for the Diagnosis and Treatment of Cervical Radiculopathy from Degenerative Disorders. *Spine Journal*. doi:10.1016/j.spinee.2010.10.023.
22. Boyles, Robert, Patrick Toy, James Mellon, Margaret Hayes, and Bradley Hammer. 2011. Effectiveness of Manual Physical Therapy in the Treatment of Cervical Radiculopathy: A Systematic Review. *Journal of Manual and Manipulative Therapy*. doi:10.1179/2042618611Y.0000000011.
23. Brinjikji, W., P.H. Luetmer, B. Comstock, B.W. Bresnahan, L.E. Chen, R.A. Deyo, S. Halabi, et al. 2015. Systematic Literature Review of Imaging Features

of Spinal Degeneration in Asymptomatic Populations. *American Journal of Neuroradiology* 36 (4): 811–16. doi:10.3174/ajnr.A4173.

24. Brosseau, Lucie, George A. Wells, Peter Tugwell, Lynn Casimiro, Michael Novikov, Laurianne Loew, Danijel Sredic, et al. 2012. Ottawa Panel Evidence-Based Clinical Practice Guidelines on Therapeutic Massage for Neck Pain. *Journal of Bodywork and Movement Therapies* 16 (3): 300–325. doi:10.1016/j.jbmt.2012.04.001.
25. Buitenhuis, Jan, and Peter J. de Jong. 2011. Fear Avoidance and Illness Beliefs in Post-Traumatic Neck Pain. *Spine* 36 (December): S238–43. doi:10.1097/BRS.0b013e3182388400.
26. Butler, Joseph S., F. Cumhur Öner, Ashley R. Poynton, and John M. O'Byrne. 2012. Degenerative Cervical Spondylosis: Natural History, Pathogenesis, and Current Management Strategies. *Advances in Orthopedics* 2012. Hindawi Limited: 1–3. doi:10.1155/2012/916987.
27. Büyükturan, Buket, Senem Şaş, Caner Kararti, and Öznur Büyükturan. 2021. The Effects of Combined Sternocleidomastoid Muscle Stretching and Massage on Pain, Disability, Endurance, Kinesiophobia, and Range of Motion in Individuals with Chronic Neck Pain: A Randomized, Single-Blind Study. *Musculoskeletal Science and Practice* 55 (October). Elsevier Ltd. doi:10.1016/j.msksp.2021.102417.
28. Calixtre, Letícia B., Ana Beatriz Oliveira, Lianna Ramalho de Sena Rosa, Susan Armijo-Olivo, Corine M. Visscher, and Francisco Alburquerque-Sendín. 2019. Effectiveness of Mobilisation of the Upper Cervical Region and Craniocervical Flexor Training on Orofacial Pain, Mandibular Function and Headache in Women with TMD. A Randomised, Controlled Trial. *Journal of Oral Rehabilitation* 46 (2). Blackwell Publishing Ltd: 109–19. doi:10.1111/joor.12733.
29. Canovas, F., and L. Dagneaux. 2018. Quality of Life after Total Knee Arthroplasty. *Orthopaedics & Traumatology: Surgery & Research* 104 (1): S41–46. doi:10.1016/j.otsr.2017.04.017.
30. Cao, Shengnan, Yuanzhen Chen, Feng Zhang, Shifei Sun, Congan Wang, Guangjian Hou, Dandan Wang, Guodong Sun, and Bin Shi. 2021. Clinical Efficacy and Safety of 'Three-Dimensional Balanced Manipulation' in the Treatment of Cervical Spondylotic Radiculopathy by Finite Element Analysis.

BioMed Research International 2021. Hindawi Limited. doi:10.1155/2021/5563296.

31. Caridi, John M., Matthias Pumberger, and Alexander P. Hughes. 2011. Cervical Radiculopathy: A Review. *HSS Journal*. doi:10.1007/s11420-011-9218-z.
32. Carragee, Eugene J, Eric L Hurwitz, Ivan Cheng, Linda J Carroll, Margareta Nordin, Jaime Guzman, Paul Peloso, et al. 2008. Treatment of Neck Pain Injections and Surgical Interventions: Results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. *Number 4S*. Vol. 33.
33. Cartwright, Nancy. 2010. What Are Randomised Controlled Trials Good For? *Philosophical Studies* 147 (1). Springer Netherlands: 59–70. doi:10.1007/s11098-009-9450-2.
34. Celenay, Seyda Toprak, Derya Ozer Kaya, and Turkan Akbayrak. 2016. Cervical and Scapulothoracic Stabilization Exercises with and without Connective Tissue Massage for Chronic Mechanical Neck Pain: A Prospective, Randomised Controlled Trial. *Manual Therapy* 21 (February). Churchill Livingstone: 144–50. doi:10.1016/j.math.2015.07.003.
35. Cerezo-Téllez, Ester, María Torres-Lacomba, Orlando Mayoral-Del-Moral, Soraya Pacheco-Da-Costa, David Prieto-Merino, and Beatriz Sánchez-Sánchez. 2018. Health Related Quality of Life Improvement in Chronic Non-Specific Neck Pain: Secondary Analysis from a Single Blinded, Randomized Clinical Trial. *Health and Quality of Life Outcomes* 16 (1). BioMed Central Ltd. doi:10.1186/s12955-018-1032-6.
36. Chaabene, Helmi, Olaf Prieske, Yassine Negra, and Urs Granacher. 2018. Change of Direction Speed: Toward a Strength Training Approach with Accentuated Eccentric Muscle Actions. *Sports Medicine* 48 (8). Springer International Publishing: 1773–79. doi:10.1007/s40279-018-0907-3.
37. Chen, Chong, Shin Nakagawa, Yan An, Koki Ito, Yuji Kitaichi, and Ichiro Kusumi. 2017. The Exercise-Glucocorticoid Paradox: How Exercise Is Beneficial to Cognition, Mood, and the Brain While Increasing Glucocorticoid Levels. *Frontiers in Neuroendocrinology* 44 (January): 83–102. doi:10.1016/j.yfrne.2016.12.001.
38. Childres, Marc A, and Samantha Jayne Stuec. 2020. Neck Pain: Initial Evaluation and Management. *American Family Physician* 102 (3): 150–56.

39. Childress, Marc A, and Blair A Becker. 2016. Nonoperative Management of Cervical Radiculopathy. *American Family Physician*. http://www.choosingwisely.org.

40. Childs, John D., Joshua A. Cleland, James M. Elliott, Deydre S. Teyhen, Robert S. Wainner, Julie M. Whitman, Bernard J. Sopky, Joseph J. Godges, and Timothy W. Flynn. 2008. Neck Pain: Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability, and Health from the Orthopaedic Section of the American Physical Therapy Association. *Journal of Orthopaedic and Sports Physical Therapy*. Movement Science Media. doi:10.2519/jospt.2008.0303.

41. Cho, Juchul, Eunsang Lee, and Seungwon Lee. 2019. Upper Cervical and Upper Thoracic Spine Mobilization versus Deep Cervical Flexors Exercise in Individuals with Forward Head Posture: A Randomized Clinical Trial Investigating Their Effectiveness. *Journal of Back and Musculoskeletal Rehabilitation* 32 (4). IOS Press: 595–602. doi:10.3233/BMR-181228.

42. Chou, Roger, Richard A. Deyo, and Jeffrey G. Jarvik. 2012. Appropriate Use of Lumbar Imaging for Evaluation of Low Back Pain. *Radiologic Clinics of North America* 50 (4): 569–85. doi:10.1016/j.rcl.2012.04.005.

43. Cohen, Patricia, G. Stephen West, and S. Leona Aiken. 2014. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. United Kingdom: Taylor and Francis.

44. Cohen, S Robin, M Balfour, F R C S Mount, Jon J N Tomas, B A Lauren, and F Mount. 1996. Existential Well-Being Is an Important Determinant of Quality of Life Evidence from the McGill Quality of Life Questionnaire. *American Cancer Society* 77 (3): 576–86.

45. Cook, Andrea J., Robert D. Wellman, Daniel C. Cherkin, Janet R. Kahn, and Karen J. Sherman. 2015. Randomized Clinical Trial Assessing Whether Additional Massage Treatments for Chronic Neck Pain Improve 12- and 26-Week Outcomes. *Spine Journal* 15 (10). Elsevier Inc.: 2206–15. doi:10.1016/j.spinee.2015.06.049.

46. Cox, Laura G.W., Karina T. Savur, Robert J. De Nardis, and Ross A. Iles. 2020. Progressive Resistance Exercise for Improving Pain and Disability in Chronic Neck Pain: A Case Series. *Physiotherapy Research International* 25 (4). John Wiley and Sons Ltd. doi:10.1002/pri.1863.

47. Cramer, Holger, Christian Baumgarten, Kyung Eun Choi, Romy Lauche, Felix Joyonto Saha, Frauke Musial, and Gustav Dobos. 2012. Thermotherapy Self-Treatment for Neck Pain Relief-A Randomized Controlled Trial. *European Journal of Integrative Medicine* 4 (4). doi:10.1016/j.eujim.2012.04.001.

48. Cui, Xue Jun, Min Yao, Xiu Lan Ye, Ping Wang, Wei Hong Zhong, Rui Chun Zhang, Hui Ying Li, et al. 2017. Shi-Style Cervical Manipulations for Cervical Radiculopathy. *Medicine (United States)* 96 (31). Lippincott Williams and Wilkins. doi:10.1097/MD.0000000000007276.

49. Cunha, Ana Cláudia Violino, Thomaz Nogueira Burke, Fábio Jorge Renovato França, and Amélia Pasqual Marques. 2008. Effect of Global Posture Reeducation and of Static Stretching on Pain, Range of Motion, and Quality of Life in Women with Chronic Neck Pain: A Randomized Clinical Trial. *Clinics* 63 (6): 763–70. doi:10.1590/S1807-59322008000600010.

50. Damgaard, Pia, Else Marie Bartels, Inge Ris, Robin Christensen, and Birgit Juul-Kristensen. 2013. Evidence of Physiotherapy Interventions for Patients with Chronic Neck Pain: A Systematic Review of Randomised Controlled Trials. *ISRN Pain* 2013 (April). Hindawi Limited: 1–23. doi:10.1155/2013/567175.

51. Dedering, Åsa, Anneli Peolsson, Joshua A. Cleland, Marie Halvorsen, Mikael A. Svensson, and Marie Kierkegaard. 2018. The Effects of Neck-Specific Training Versus Prescribed Physical Activity on Pain and Disability in Patients With Cervical Radiculopathy: A Randomized Controlled Trial. *Archives of Physical Medicine and Rehabilitation* 99 (12). W.B. Saunders: 2447–56. doi:10.1016/j.apmr.2018.06.008.

52. Ding, Xing, Jinze Wu, Qixing Shen, Jinhai Xu, and Wen Mo. 2021. Clinical Control Study of Traditional Chinese Medicine Hot Compress Combined with Traction in the Treatment of Cervical Spondylotic Radiculopathy Study Protocol. *Medicine (United States)* 100 (4). Lippincott Williams and Wilkins. doi:10.1097/MD.0000000000023880.

53. Domenech, Manuel A., Phil S. Sizer, Gregory S. Dedrick, Michael K. McGalliard, and Jean Michel Brismee. 2011. The Deep Neck Flexor Endurance Test: Normative Data Scores in Healthy Adults. *PM and R* 3 (2): 105–10. doi:10.1016/j.pmrj.2010.10.023.

54. Domingues, Lucia, Fernando Manuel Pimentel-Santos, Eduardo Brazete Cruz, Ana Cristina Sousa, Ana Santos, Ana Cordovil, Anabela Correia, et al. 2019. Is a Combined Programme of Manual Therapy and Exercise More Effective than Usual Care in Patients with Non-Specific Chronic Neck Pain? A Randomized Controlled Trial. *Clinical Rehabilitation* 33 (12). SAGE Publications Ltd: 1908–18. doi:10.1177/0269215519876675.

55. Dongen, J. M. van, R. Groeneweg, S. M. Rubinstein, J. E. Bosmans, R. A.B. Oostendorp, R. W.J.G. Ostelo, and M. W. van Tulder. 2016. Cost-Effectiveness of Manual Therapy versus Physiotherapy in Patients with Sub-Acute and Chronic Neck Pain: A Randomised Controlled Trial. *European Spine Journal* 25 (7). Springer Verlag: 2087–96. doi:10.1007/s00586-016-4526-0.

56. Dunning, James R., Raymond Butts, Firas Mourad, Ian Young, Cesar Fernandez-De-Las Penãs, Marshall Hagins, Thomas Stanislawski, et al. 2016. Upper Cervical and Upper Thoracic Manipulation versus Mobilization and Exercise in Patients with Cervicogenic Headache: A Multi-Center Randomized Clinical Trial. *BMC Musculoskeletal Disorders* 17 (1). BioMed Central Ltd. doi:10.1186/s12891-016-0912-3.

57. Eloqayli, Haytham, Ali Al-Yousef, and Raid Jaradat. 2018. Vitamin D and Ferritin Correlation with Chronic Neck Pain Using Standard Statistics and a Novel Artificial Neural Network Prediction Model. *British Journal of Neurosurgery* 32 (2). Taylor and Francis Ltd: 172–76. doi:10.1080/02688697.2018.1436691.

58. Fairbairn, Kate, Kate May, Yvonne Yang, Sharan Balasundar, Cheryl Hefford, and J. Haxby Abbott. 2012. Mapping Patient-Specific Functional Scale (PSFS) Items to the International Classification of Functioning, Disability and Health (ICF). *Physical Therapy* 92 (2): 310–17. doi:10.2522/ptj.20090382.

59. Fernández-de-las-Peñas, César, Jo Nijs, Randy Neblett, Andrea Polli, Maarten Moens, Lisa Goudman, Madhura Shekhar Patil, Roger D. Knaggs, Gisele Pickering, and Lars Arendt-Nielsen. 2022. Phenotyping Post-COVID Pain as a Nociceptive, Neuropathic, or Nociplastic Pain Condition. *Biomedicines* 10 (10): 2562. doi:10.3390/biomedicines10102562.

60. Ferrara, Lisa A. 2012. The Biomechanics of Cervical Spondylosis. *Advances in Orthopedics* 2012. Hindawi Limited: 1–5. doi:10.1155/2012/493605.

61. Ferreira, Manuela L., Bruna M. Borges, Isabella L. Rezende, Luciana P. Carvalho, Luiz P.S. Soares, Roberto Abou Id Dabes, Gabriela Carvalho, Adriana S. Drummond, Gustavo C. MacHado, and Paulo H. Ferreira. 2010. Are Neck Pain Scales and Questionnaires Compatible with the International Classification of Functioning, Disability and Health? A Systematic Review. *Disability and Rehabilitation*. doi:10.3109/09638281003611045.

62. Franciscatto Stieven, Fábio, Giovanni Esteves Ferreira, Matheus Wiebusch, Francisco Xavier de Araújo, Luis Henrique Telles da Rosa, and Marcelo Faria Silva. 2020. No Added Benefit of Combining Dry Needling with Guideline-Based Physical Therapy When Managing Chronic Neck Pain: A Randomized Controlled Trial 2 3. www.jospt.org.

63. Freimann, Tiina, Eda Merisalu, and Mati Pääsuke. 2015. Effects of a Home-Exercise Therapy Programme on Cervical and Lumbar Range of Motion among Nurses with Neck and Lower Back Pain: A Quasi-Experimental Study. *BMC Sports Science, Medicine and Rehabilitation* 7 (1). Springer Nature. doi:10.1186/s13102-015-0025-6.

64. Fritz, Julie M., Anne Thackeray, Gerard P. Brennan, and John D. Childs. 2014. Exercise Only, Exercise with Mechanical Traction, or Exercise with over-Door Traction for Patients with Cervical Radiculopathy, with or without Consideration of Status on a Previously Described Subgrouping Rule: A Randomized Clinical Trial. *Journal of Orthopaedic and Sports Physical Therapy* 44 (2). Movement Science Media: 45–57. doi:10.2519/jospt.2014.5065.

65. Furberg, Curt D., and Lawrence M. Friedman. 2012. Approaches to Data Analyses of Clinical Trials. *Progress in Cardiovascular Diseases* 54 (4): 330–34. doi:10.1016/j.pcad.2011.07.002.

66. Gandra, A. S., and Murdana Nyoman. 2020. Relationship between Neck Pain and Quality of Life among Specialist Residents: A Cross-Sectional Study. In , 12–15. Scitepress. doi:10.5220/0009061400120015.

67. Ganguli, Ishani, Arabella L. Simpkin, Claire Lupo, Arlene Weissman, Alexander J. Mainor, E. John Orav, Meredith B. Rosenthal, Carrie H. Colla, and Thomas D. Sequist. 2019. Cascades of Care After Incidental Findings in a US National Survey of Physicians. *JAMA Network Open* 2 (10): e1913325. doi:10.1001/jamanetworkopen.2019.13325.

68. Gashi, Arbnore Ibrahimaj, and Arjeta Azemi. 2022. Comparative Efficacy of Isometric versus Dynamic Exercises on Cervical Spondylosis. *Sport Mont* 20 (2). Montenegrin Sports Academy: 23–26. doi:10.26773/smj.220604.

69. Genebra, Caio Vitor Dos Santos, Nicoly Machado Maciel, Thiago Paulo Frascareli Bento, Sandra Fiorelli Almeida Penteado Simeão, and Alberto De Vitta. 2017. Prevalence and Factors Associated with Neck Pain: A Population-Based Study. *Brazilian Journal of Physical Therapy* 21 (4). Revista Brasileira de Fisioterapia: 274–80. doi:10.1016/j.bjpt.2017.05.005.

70. Ghodrati, Maryam, Zahra Mosallanezhad, Mohsen Shati, Forouzan Rastgar Koutenaei, Mohammad Reza Nourbakhsh, and Mehdi Noroozi. 2017. The Effect of Combination Therapy; Manual Therapy and Exercise, in Patients With Non-Specific Chronic Neck Pain: A Randomized Clinical Trial. *Physical Treatments: Specific Physical Therapy Journal*, July. Negah Scientific Publisher, 113–21. doi:10.32598/ptj.7.2.113.

71. González Rueda, Vanessa, Carlos López De Celis, Martín Eusebio Barra López, Andoni Carrasco Uribarren, Sara Castillo Tomás, and Cesar Hidalgo García. 2017. Effectiveness of a Specific Manual Approach to the Suboccipital Region in Patients with Chronic Mechanical Neck Pain and Rotation Deficit in the Upper Cervical Spine: Study Protocol for a Randomized Controlled Trial. *BMC Musculoskeletal Disorders* 18 (1). BioMed Central Ltd. doi:10.1186/s12891-017-1744-5.

72. Groisman, Sandro, Tais Malysz, Luciano de Souza da Silva, Tamara Rocha Ribeiro Sanches, Karoline Camargo Bragante, Franciele Locatelli, Cleder Pontel Vigolo, et al. 2020. Osteopathic Manipulative Treatment Combined with Exercise Improves Pain and Disability in Individuals with Non-Specific Chronic Neck Pain: A Pragmatic Randomized Controlled Trial. *Journal of Bodywork and Movement Therapies* 24 (2). Churchill Livingstone: 189–95. doi:10.1016/j.jbmt.2019.11.002.

73. Gutman, Gabriel, Derek H. Rosenzweig, and Jeff D. Golan. 2018. Surgical Treatment of Cervical Radiculopathy. *Spine*. Lippincott Williams and Wilkins. doi:10.1097/BRS.0000000000002324.

74. Guzman, Jaime, Scott Haldeman, Linda J Carroll, Eugene J Carragee, Eric L Hurwitz, Paul Peloso, Margareta Nordin, et al. 2008. Clinical Practice Implications of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain

and Its Associated Disorders From Concepts and Findings to Recommendations. *Number 4S*. Vol. 33.

75. Hagen, Roger, Odin Hjemdal, Stian Solem, Leif Edward Ottesen Kennair, Hans M. Nordahl, Peter Fisher, and Adrian Wells. 2017. Metacognitive Therapy for Depression in Adults: A Waiting List Randomized Controlled Trial with Six Months Follow-Up. *Frontiers in Psychology* 8 (January). doi:10.3389/fpsyg.2017.00031.
76. Hall, Amanda M, Kris Aubrey-Bassler, Bradley Thorne, and Chris G Maher. 2021. Do Not Routinely Offer Imaging for Uncomplicated Low Back Pain. *BMJ*, February, n291. doi:10.1136/bmj.n291.
77. Hall, Toby, Kathy Briffa, and Diana Hopper. 2010. The Influence of Lower Cervical Joint Pain on Range of Motion and Interpretation of the Flexion-Rotation Test. *Journal of Manual and Manipulative Therapy* 18 (3): 126–31. doi:10.1179/106698110X12640740712293.
78. Halvorsen, Marie, Marie Kierkegaard, Karin Harms-Ringdahl, Anneli Peolsson, and Asa Dedering. 2015. Dimensions Underlying Measures of Disability, Personal Factors, and Health Status in Cervical Radiculopathy: A Cross-Sectional Study. *Medicine (United States)* 94 (24). Lippincott Williams and Wilkins. doi:10.1097/MD.0000000000000999.
79. Hannan, Edward L. 2008. Randomized Clinical Trials and Observational Studies Guidelines for Assessing Respective Strengths and Limitations. *Cardiovascular Interventions* 1 (3): 211–17.
80. Hawker, Gillian A., Samra Mian, Tetyana Kendzerska, and Melissa French. 2011. Measures of Adult Pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). *Arthritis Care & Research* 63 (S11). doi:10.1002/acr.20543.
81. Hayes, F. Andrew. 2013. *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*. Third edition. New York: The Guilford Press. .
82. Heredia-Rizo, Alberto Marcos, Kristian Kjær Petersen, Lars Arendt-Nielsen, and Pascal Madeleine. 2020. Eccentric Training Changes the Pressure Pain and

Stiffness Maps of the Upper Trapezius in Females with Chronic Neck-Shoulder Pain: A Preliminary Study. *Pain Medicine (United States)* 21 (9). Oxford University Press: 1936–46. doi:10.1093/PM/PNZ360.

83. Hickey, Graeme L, Stuart W Grant, Joel Dunning, and Matthias Siepe. 2018. Statistical Primer: Sample Size and Power Calculations—Why, When and How?†. *European Journal of Cardio-Thoracic Surgery* 54 (1): 4–9. doi:10.1093/ejcts/ezy169.
84. Hidalgo, Benjamin, Toby Hall, Jean Bossert, Axel Dugeny, Barbara Cagnie, and Laurent Pitance. 2017. The Efficacy of Manual Therapy and Exercise for Treating Non-Specific Neck Pain: A Systematic Review. *Journal of Back and Musculoskeletal Rehabilitation*. IOS Press. doi:10.3233/BMR-169615.
85. Hirpara, Kieran Michael, Joseph S. Butler, Roisin T. Dolan, John M. O'Byrne, and Ashley R. Poynton. 2012. Nonoperative Modalities to Treat Symptomatic Cervical Spondylosis. *Advances in Orthopedics* 2012. Hindawi Limited: 1–5. doi:10.1155/2012/294857.
86. Hody, Stéphanie, Jean Louis Croisier, Thierry Bury, Bernard Rogister, and Pierre Leprince. 2019. Eccentric Muscle Contractions: Risks and Benefits. *Frontiers in Physiology*. Frontiers Media S.A. doi:10.3389/fphys.2019.00536.
87. Hopper, Diana, Yogita Bajaj, Chor Kei Choi, Osama Jan, Toby Hall, Kim Robinson, and Kathy Briffa. 2013. A Pilot Study to Investigate the Short-Term Effects of Specific Soft Tissue Massage on Upper Cervical Movement Impairment in Patients with Cervicogenic Headache. *Journal of Manual and Manipulative Therapy* 21 (1): 18–23. doi:10.1179/2042618612Y.0000000018.
88. Hoy, D. G., M. Protani, R. De, and R. Buchbinder. 2010. The Epidemiology of Neck Pain. *Best Practice and Research: Clinical Rheumatology*. Bailliere Tindall Ltd. doi:10.1016/j.berh.2011.01.019.
89. Hurwitz, Eric L., Eugene J. Carragee, Gabrielle van der Velde, Linda J. Carroll, Margareta Nordin, Jaime Guzman, Paul M. Peloso, et al. 2008. Treatment of Neck Pain: Noninvasive Interventions. *European Spine Journal* 17 (S1). Springer Science and Business Media LLC: 123–52. doi:10.1007/s00586-008-0631-z.
90. Hurwitz, Eric L., Kristi Randhawa, Hainan Yu, Pierre Côté, and Scott Haldeman. 2018. The Global Spine Care Initiative: A Summary of the Global

Burden of Low Back and Neck Pain Studies. *European Spine Journal*. Springer Verlag. doi:10.1007/s00586-017-5432-9.

91. Iqbal, Zaheen A., Ahmad H. Alghadir, and Shahnawaz Anwer. 2021. Efficacy of Deep Cervical Flexor Muscle Training on Neck Pain, Functional Disability, and Muscle Endurance in School Teachers: A Clinical Trial. *BioMed Research International* 2021. Hindawi Limited. doi:10.1155/2021/7190808.
92. Jahre, Henriette, Margreth Grotle, Kaja Smedbråten, Kate M. Dunn, and Britt Elin Øiestad. 2020. Risk Factors for Non-Specific Neck Pain in Young Adults. A Systematic Review. *BMC Musculoskeletal Disorders*. BioMed Central Ltd. doi:10.1186/s12891-020-03379-y.
93. Kapitza, Camilla, Kerstin Lüdtke, Brigitte Tampin, and Nikolaus Ballenberger. 2020. Application and Utility of a Clinical Framework for Spinally Referred Neck-Arm Pain: A Crosssectional and Longitudinal Study Protocol. *PLoS ONE* 15 (12 December). Public Library of Science. doi:10.1371/journal.pone.0244137.
94. Kawczyn´ski, Adam, Kawczyn´ Kawczyn´ski, Afshin Samani, C É Sar, Ferna´ndez Ferna´, Ferna´ndez-De-Las-Pen˜as Pen˜, Jan Chmura, and Pascal Madeleine. 2012. SENSORY MAPPING OF THE UPPER TRAPEZIUS MUSCLE IN RELATION TO CONSECUTIVE SESSIONS OF ECCENTRIC EXERCISE. *Journal of Strength and Conditioning Research* 26 (6): 1577–83. www.nsca-jscr.org.
95. Kazeminasab, Somaye, Seyed Aria Nejadghaderi, Parastoo Amiri, Hojjat Pourfathi, Mostafa Araj-Khodaei, Mark J.M. Sullman, Ali Asghar Kolahi, and Saeid Safiri. 2022. Neck Pain: Global Epidemiology, Trends and Risk Factors. *BMC Musculoskeletal Disorders*. BioMed Central Ltd. doi:10.1186/s12891-021-04957-4.
96. Kelly, John C., Patrick J. Groarke, Joseph S. Butler, Ashley R. Poynton, and John M. O'Byrne. 2012. The Natural History and Clinical Syndromes of Degenerative Cervical Spondylosis. *Advances in Orthopedics* 2012. Hindawi Limited: 1–5. doi:10.1155/2012/393642.
97. Kern, Helmut, Cristian Hofer, Stefan Loefler, Sandra Zampieri, Paolo Gargiulo, Alfonc Baba, Andrea Marcante, Francesco Piccione, Amber Pond, and Ugo Carraro. 2017. Atrophy, Ultra-Structural Disorders, Severe Atrophy and Degeneration of Denervated Human Muscle in SCI and Aging. Implications for

Their Recovery by Functional Electrical Stimulation, Updated 2017. *Neurological Research* 39 (7): 660–66. doi:10.1080/01616412.2017.1314906.

98. Khan, Zainab Khalid, Syed Imran Ahmed, Aftab Ahmed Mirza Baig, and Waqas Ahmed Farooqui. 2022. Effect of Post-Isometric Relaxation versus Myofascial Release Therapy on Pain, Functional Disability, Rom and Qol in the Management of Non-Specific Neck Pain: A Randomized Controlled Trial. *BMC Musculoskeletal Disorders* 23 (1): 567. doi:10.1186/s12891-022-05516-1.
99. Khired, Zenat. 2022. The Prevalence of and Factors Associated With Neck Pain Among Jazan Adult Population. *Cureus*, August. doi:10.7759/cureus.28008.
100. Kim, Rebecca, Colin Wiest, Kelly Clark, Chad Cook, and Maggie Horn. 2018. Identifying Risk Factors for First-Episode Neck Pain: A Systematic Review. *Musculoskeletal Science and Practice*. Elsevier Ltd. doi:10.1016/j.msksp.2017.11.007.
101. Kim, Seong Joong, and Jung Hoon Lee. 2018. Effects of Sternocleidomastoid Muscle and Suboccipital Muscle Soft Tissue Release on Muscle Hardness and Pressure Pain of the Sternocleidomastoid Muscle and Upper Trapezius Muscle in Smartphone Users with Latent Trigger Points. *Medicine (United States)* 97 (36). Lippincott Williams and Wilkins. doi:10.1097/MD.0000000000012133.
102. Kisilewicz, Aleksandra, Pascal Madeleine, Zofia Ignasiak, Bogdan Ciszek, Adam Kawczynski, and Ryan Godsk Larsen. 2020. Eccentric Exercise Reduces Upper Trapezius Muscle Stiffness Assessed by Shear Wave Elastography and Myotonometry. *Frontiers in Bioengineering and Biotechnology* 8 (August). Frontiers Media S.A. doi:10.3389/fbioe.2020.00928.
103. KNGF Guideline Neck Pain. 2016. www.fysionet.nl.
104. Kokubo, Yasuo, Kenzo Uchida, Shigeru Kobayashi, Takafumi Yayama, Ryuichiro Sato, Hideaki Nakajima, Takaharu Takamura, et al. 2008. Herniated and Spondylotic Intervertebral Discs of the Human Cervical Spine: Histological and Immunohistological Findings in 500 En Bloc Surgical Samples - Laboratory Investigation. *Journal of Neurosurgery: Spine* 9 (3): 285–95. doi:10.3171/SPI/2008/9/9/285.
105. Kong, Ling Jun, Hong Sheng Zhan, Ying Wu Cheng, Wei An Yuan, Bo Chen, and Min Fang. 2013. Massage Therapy for Neck and Shoulder Pain: A

Systematic Review and Meta-Analysis. *Evidence-Based Complementary and Alternative Medicine*. doi:10.1155/2013/613279.

106. Koren, Yogev, and Leonid Kalichman. 2018. Deep Tissue Massage: What Are We Talking About? *Journal of Bodywork and Movement Therapies*. Churchill Livingstone. doi:10.1016/j.jbmt.2017.05.006.

107. Kosek, Eva, Milton Cohen, Ralf Baron, Gerald F. Gebhart, Juan-Antonio Mico, Andrew S.C. Rice, Winfried Rief, and A. Kathleen Sluka. 2016. Do We Need a Third Mechanistic Descriptor for Chronic Pain States? *Pain* 157 (7): 1382–86. doi:10.1097/j.pain.0000000000000507.

108. Landesa-Piñeiro, Laura, and Raquel Leirós-Rodríguez. 2022. Physiotherapy Treatment of Lateral Epicondylitis: A Systematic Review. *Journal of Back and Musculoskeletal Rehabilitation* 35 (3): 463–77. doi:10.3233/BMR-210053.

109. Lauche, Romy, Christoph Stumpe, Johannes Fehr, Holger Cramer, Ying Wu Cheng, Peter M. Wayne, Thomas Rampp, Jost Langhorst, and Gustav Dobos. 2016. The Effects of Tai Chi and Neck Exercises in the Treatment of Chronic Nonspecific Neck Pain: A Randomized Controlled Trial. *Journal of Pain* 17 (9). Churchill Livingstone Inc.: 1013–27. doi:10.1016/j.jpain.2016.06.004.

110. Leaver, Andrew M., Kathryn M. Refshauge, Christopher G. Maher, and James H. McAuley. 2010. Conservative Interventions Provide Short-Term Relief for Non-Specific Neck Pain: A Systematic Review. *Journal of Physiotherapy* 56 (2). Australian Physiotherapy Association: 73–85. doi:10.1016/S1836-9553(10)70037-0.

111. Lee, Keun-Su, and Joon-Hee Lee. 2017. Effect of Maitland Mobilization in Cervical and Thoracic Spine and Therapeutic Exercise on Functional Impairment in Individuals with Chronic Neck Pain. *The Journal of Physical Therapy Science* 29: 531–35.

112. Leeuw, Maaike, Mariëlle E.J.B. Goossens, Steven J. Linton, Geert Crombez, Katja Boersma, and Johan W.S. Vlaeyen. 2007. The Fear-Avoidance Model of Musculoskeletal Pain: Current State of Scientific Evidence. *Journal of Behavioral Medicine*. doi:10.1007/s10865-006-9085-0.

113. Leininger, Brent, Christine McDonough, Roni Evans, Tor Tosteson, Anna N.A. Tosteson, and Gert Bronfort. 2016. Cost-Effectiveness of Spinal Manipulative Therapy, Supervised Exercise, and Home Exercise for Older Adults with

Chronic Neck Pain. *Spine Journal* 16 (11). Elsevier Inc.: 1292–1304. doi:10.1016/j.spinee.2016.06.014.

114. Lemmers, G. P. G., W. van Lankveld, G. P. Westert, P. J. van der Wees, and J. B. Staal. 2019. Imaging versus No Imaging for Low Back Pain: A Systematic Review, Measuring Costs, Healthcare Utilization and Absence from Work. *European Spine Journal* 28 (5): 937–50. doi:10.1007/s00586-019-05918-1.

115. Liang, Long, Minshan Feng, Xin Cui, Shuaiqi Zhou, Xunlu Yin, Xingyu Wang, Mao Yang, et al. 2019. The Effect of Exercise on Cervical Radiculopathy: A Systematic Review and Meta-Analysis. *Medicine* 98 (45). NLM (Medline): e17733. doi:10.1097/MD.0000000000017733.

116. Lichtman, Aron H., Eberhard Albert Lux, Robert McQuade, Sandro Rossetti, Raymond Sanchez, Wei Sun, Stephen Wright, Elena Kornyeyeva, and Marie T. Fallon. 2018. Results of a Double-Blind, Randomized, Placebo-Controlled Study of Nabiximols Oromucosal Spray as an Adjunctive Therapy in Advanced Cancer Patients with Chronic Uncontrolled Pain. *Journal of Pain and Symptom Management* 55 (2): 179-188.e1. doi:10.1016/j.jpainsymman.2017.09.001.

117. Liu, Fushui, Ting Fang, Fanyuan Zhou, Meimei Zhao, Mei Chen, Jianyu You, Yuli Jin, Jinmei Xie, and Zhongyong Liu. 2018. Association of Depression/Anxiety Symptoms with Neck Pain: A Systematic Review and Meta-Analysis of Literature in China. *Pain Research and Management*. Hindawi Limited. doi:10.1155/2018/3259431.

118. López-de-Uralde-Villanueva, Ibai, Hector Beltran-Alacreu, Josué Fernández-Carnero, and Roy La Touche. 2020. Pain Management Using a Multimodal Physiotherapy Program Including a Biobehavioral Approach for Chronic Nonspecific Neck Pain: A Randomized Controlled Trial. *Physiotherapy Theory and Practice* 36 (1): 45–62. doi:10.1080/09593985.2018.1480678.

119. MacDermid, Joy C., David M. Walton, Sarah Avery, Alanna Blanchard, Evelyn Etruw, Cheryl Mcalpine, and Charlie H. Goldsmith. 2009. Measurement Properties of the Neck Disability Index: A Systematic Review. In *Journal of Orthopaedic and Sports Physical Therapy*, 39:400–416. Movement Science Media. doi:10.2519/jospt.2009.2930.

120. Maher, Chris, Martin Underwood, and Rachelle Buchbinder. 2017. Non-Specific Low Back Pain. *The Lancet* 389 (10070): 736–47. doi:10.1016/S0140-6736(16)30970-9.

121. Maicki, Tomasz, Jan Bilski, Elzbieta Szczygiel, and Rafal Trąbka. 2017. PNF and Manual Therapy Treatment Results of Patients with Cervical Spine Osteoarthritis. *Journal of Back and Musculoskeletal Rehabilitation* 30 (5). IOS Press: 1095–1101. doi:10.3233/BMR-169718.

122. Martimbianco, Ana Luiza C., Gustavo J.M. Porfírio, Rafael L. Pacheco, Maria Regina Torloni, and Rachel Riera. 2019. Transcutaneous Electrical Nerve Stimulation (TENS) for Chronic Neck Pain. *Cochrane Database of Systematic Reviews*. John Wiley and Sons Ltd. doi:10.1002/14651858.CD011927.pub2.

123. Martinez-Calderon, Javier, Mar Flores-Cortes, Jose Miguel Morales-Asencio, and Alejandro Luque-Suarez. 2020. Erratum: Which Psychological Factors Are Involved in the Onset and/or Persistence of Musculoskeletal Pain? An Umbrella Review of Systematic Reviews and Meta-Analyses of Prospective Cohort Studies (Clinical Journal of Pain DOI: 10.1097/AJP.0000000000000847). *Clinical Journal of Pain*. Lippincott Williams and Wilkins. doi:10.1097/AJP.0000000000000838.

124. Meints, S. M., and R. R. Edwards. 2018. Evaluating Psychosocial Contributions to Chronic Pain Outcomes. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*. Elsevier Inc. doi:10.1016/j.pnpbp.2018.01.017.

125. MENDES FERNANDES, Tânia, Roberto MÉNDEZ-SÁNCHEZ, Ana S. PUENTE-GONZÁLEZ, Francisco J. MARTÍN-VALLEJO, Deborah FALLA, and Carolina VILA-CHÃ. 2023. A Randomized Controlled Trial on the Effects of 'Global Postural Re-Education' versus Neck Specific Exercise on Pain, Disability, Postural Control, and Neuromuscular Features in Women with Chronic Non-Specific Neck Pain. *European Journal of Physical and Rehabilitation Medicine* 59 (1). doi:10.23736/S1973-9087.22.07554-2.

126. Miake-Lye, Isomi M., Selene Mak, Jason Lee, Tana Luger, Stephanie L. Taylor, Roberta Shanman, Jessica M. Beroes-Severin, and Paul G. Shekelle. 2019. Massage for Pain: An Evidence Map. *Journal of Alternative and Complementary Medicine*. Mary Ann Liebert Inc. doi:10.1089/acm.2018.0282.

127. Miao, Qiang, Jian Hong Qiang, and Yan Li Jin. 2018. Effectiveness of Percutaneous Neuromuscular Electrical Stimulation for Neck Pain Relief in Patients with Cervical Spondylosis. *Medicine (United States)* 97 (26). Lippincott Williams and Wilkins. doi:10.1097/MD.0000000000011080.

128. Misailidou, Victoria, Paraskevi Malliou, Anastasia Beneka, Alexandros Karagiannidis, and Georgios Godolias. 2010. Assessment of Patients with Neck Pain: A Review of Definitions, Selection Criteria, and Measurement Tools. *Journal of Chiropractic Medicine*. doi:10.1016/j.jcm.2010.03.002.

129. Morishita, Yuichiro, Masatoshi Naito, Henry Hymanson, Masashi Miyazaki, Guizhong Wu, and Jeffrey C. Wang. 2009. The Relationship between the Cervical Spinal Canal Diameter and the Pathological Changes in the Cervical Spine. *European Spine Journal* 18 (6): 877–83. doi:10.1007/s00586-009-0968-y.

130. Nilsen, Tom Ivar Lund, Andreas Holtermann, and Paul J. Mork. 2011. Physical Exercise, Body Mass Index, and Risk of Chronic Pain in the Low Back and Neck/Shoulders: Longitudinal Data from the Nord-Trøndelag Health Study. *American Journal of Epidemiology* 174 (3): 267–73. doi:10.1093/aje/kwr087.

131. Noorduyn, Julia C.A., Tess Glastra van Loon, Victor A. van de Graaf, Nienke W. Willigenburg, Ise K. Butter, Gwendolyne G.M. Scholten-Peeters, Michel W. Coppieters, et al. 2020. Functional Outcomes of Arthroscopic Partial Meniscectomy Versus Physical Therapy for Degenerative Meniscal Tears Using a Patient-Specific Score: A Randomized Controlled Trial. *Orthopaedic Journal of Sports Medicine* 8 (10): 232596712095439. doi:10.1177/2325967120954392.

132. O'Keeffe, Mary, Peter O'Sullivan, Helen Purtill, Norma Bargary, and Kieran O'Sullivan. 2020. Cognitive Functional Therapy Compared with a Group-Based Exercise and Education Intervention for Chronic Low Back Pain: A Multicentre Randomised Controlled Trial (RCT). *British Journal of Sports Medicine* 54 (13): 782–89. doi:10.1136/bjsports-2019-100780.

133. Olson, Lee E., A. Lynn Millar, Jeremy Dunker, Jennifer Hicks, and Devin Glanz. 2006. Reliability of a Clinical Test for Deep Cervical Flexor Endurance. *Journal of Manipulative and Physiological Therapeutics* 29 (2): 134–38. doi:10.1016/j.jmpt.2005.12.009.

134. O'Riordan, Cliona, Amanda Clifford, Pepijn Van De Ven, and John Nelson. 2014. Chronic Neck Pain and Exercise Interventions: Frequency, Intensity, Time, and Type Principle. *Archives of Physical Medicine and Rehabilitation*. W.B. Saunders. doi:10.1016/j.apmr.2013.11.015.

135. Peng, Baogan, Liang Yang, Yongchao Li, Tanghua Liu, and Yanqing Liu. 2021. Cervical Proprioception Impairment in Neck Pain-Pathophysiology, Clinical Evaluation, and Management: A Narrative Review. *Pain and Therapy* 10 (1): 143–64. doi:10.1007/s40122-020-00230-z.

136. Philadelphia Panel. 2001. Philadelphia Panel Evidence-Based Clinical Practice Guidelines on Selected Rehabilitation Interventions for Neck Pain. *Physical Therapy* 81 (10): 1701–17.

137. Pico-Espinosa, Oscar Javier, Emmanuel Aboagye, Pierre Côté, Anna Peterson, Lena W. Holm, Irene Jensen, and Eva Skillgate. 2020. Deep Tissue Massage, Strengthening and Stretching Exercises, and a Combination of Both Compared with Advice to Stay Active for Subacute or Persistent Non-Specific Neck Pain: A Cost-Effectiveness Analysis of the Stockholm Neck Trial (STONE). *Musculoskeletal Science and Practice* 46 (April). Elsevier Ltd. doi:10.1016/j.msksp.2020.102109.

138. Popescu, Adrian, and Haewon Lee. 2020. Neck Pain and Lower Back Pain. *Medical Clinics of North America*. W.B. Saunders. doi:10.1016/j.mcna.2019.11.003.

139. Price, Jonathan, Alison Rushton, Vasileios Tyros, and Nicola R. Heneghan. 2021. Expert Consensus on the Important Chronic Non-Specific Neck Pain Motor Control and Segmental Exercise and Dosage Variables: An International e-Delphi Study. *PLoS ONE* 16 (7 July). Public Library of Science. doi:10.1371/journal.pone.0253523.

140. Prince, Stephanie A., Luca Cardilli, Jennifer L. Reed, Travis J. Saunders, Chris Kite, Kevin Douillette, Karine Fournier, and John P. Buckley. 2020. A Comparison of Self-Reported and Device Measured Sedentary Behaviour in Adults: A Systematic Review and Meta-Analysis. *International Journal of Behavioral Nutrition and Physical Activity* 17 (1): 31. doi:10.1186/s12966-020-00938-3.

141. Rajabi, Reza, Abolfazl Farahani, Parvin Shahcheraghi, and Shahrzad Zandi. 2011. A Comparison of Two Methods of Strengthening Exercises with and Without Massage on Alleviation of the Chronic Neck Pain. *World Journal of Sport Sciences* 5 (3): 158–62.

142. Rampazo, Érika Patrícia, Ana Laura Martins De Andrade, Viviane Ribeiro Da Silva, Cláudio Gregório Nuernberg Back, and Richard Eloin Liebano. 2020.

Photobiomodulation Therapy and Transcutaneous Electrical Nerve Stimulation on Chronic Neck Pain Patients: Study Protocol Clinical Trial (SPIRIT Compliant). *Medicine (United States)* 99 (8). Lippincott Williams and Wilkins. doi:10.1097/MD.0000000000019191.

143. Rezai, Mana, Pierre Côté, J. David Cassidy, and Linda Carroll. 2009. The Association between Prevalent Neck Pain and Health-Related Quality of Life: A Cross-Sectional Analysis. *European Spine Journal* 18 (3): 371–81. doi:10.1007/s00586-008-0823-6.

144. Ris, I., K. Søgaard, B. Gram, K. Agerbo, E. Boyle, and B. Juul-Kristensen. 2016. Does a Combination of Physical Training, Specific Exercises and Pain Education Improve Health-Related Quality of Life in Patients with Chronic Neck Pain? A Randomised Control Trial with a 4-Month Follow Up. *Manual Therapy* 26 (December). Churchill Livingstone: 132–40. doi:10.1016/j.math.2016.08.004.

145. Ris, Inge, Birgit Juul-Kristensen, Eleanor Boyle, Alice Kongsted, Claus Manniche, and Karen Søgaard. 2017. Chronic Neck Pain Patients with Traumatic or Non-Traumatic Onset: Differences in Characteristics. A Cross-Sectional Study. *Scandinavian Journal of Pain* 14 (January). Elsevier B.V.: 1–8. doi:10.1016/j.sjpain.2016.08.008.

146. Rodríguez-Sanz, Jacobo, Miguel Malo-Urriés, María Orosia Lucha-López, Carlos López-De-Celis, Albert Pérez-Bellmunt, Jaime Corral-De-Toro, and César Hidalgo-García. 2021. Comparison of an Exercise Program with and without Manual Therapy for Patients with Chronic Neck Pain and Upper Cervical Rotation Restriction. Randomized Controlled Trial. *PeerJ* 9 (November). PeerJ Inc. doi:10.7717/peerj.12546.

147. Roux, C. H., F. Guillemin, S. Boini, F. Longuetaud, N. Arnault, S. Hercberg, and S. Briançon. 2005. Impact of Musculoskeletal Disorders on Quality of Life: An Inception Cohort Study. *Annals of the Rheumatic Diseases* 64 (4): 606–11. doi:10.1136/ard.2004.020784.

148. Russell, Anthony, and Robert Ferrari. 2008. Whiplash: Social Interventions and Solutions. *Journal of Rheumatology*. doi:10.3899/jrheum.080280.

149. Salo, Petri K., Arja H. Häkkinen, Hannu Kautiainen, and Jari J. Ylinen. 2010. Effect of Neck Strength Training on Health-Related Quality of Life in Females

with Chronic Neck Pain: A Randomized Controlled 1-Year Follow-up Study. *Health and Quality of Life Outcomes* 8 (May). doi:10.1186/1477-7525-8-48.

150. Salo, Petri, Niina Ylönen-Käyrä, Arja Häkkinen, Hannu Kautiainen, Esko Mälkiä, and Jari Ylinen. 2012. Effects of Long-Term Home-Based Exercise on Health-Related Quality of Life in Patients with Chronic Neck Pain: A Randomized Study with a 1-Year Follow-Up. *Disability and Rehabilitation* 34 (23): 1971–77. doi:10.3109/09638288.2012.665128.

151. Sbardella, Silvia, Chiara La Russa, Andrea Bernetti, Massimiliano Mangone, Andrea Guarnera, Letizia Pezzi, Marco Paoloni, et al. 2021. Muscle Energy Technique in the Rehabilitative Treatment for Acute and Chronic Non-Specific Neck Pain: A Systematic Review. *Healthcare* 9 (6): 746. doi:10.3390/healthcare9060746.

152. Schober, Patrick, Christa Boer, and Lothar A. Schwarte. 2018. Correlation Coefficients: Appropriate Use and Interpretation. *Anesthesia & Analgesia* 126 (5): 1763–68. doi:10.1213/ANE.0000000000002864.

153. Scholz, Joachim, Nanna B. Finnerup, Nadine Attal, Qasim Aziz, Ralf Baron, Michael I. Bennett, Rafael Benoliel, et al. 2019. The IASP Classification of Chronic Pain for ICD-11: Chronic Neuropathic Pain. *Pain* 160 (1): 53–59. doi:10.1097/j.pain.0000000000001365.

154. Seyda, Toprak Celenay, Oguzhan Mete, Abdullah Sari, and Ozer Kaya Derya. 2021a. A Comparison of Kinesio Taping and Classical Massage in Addition to Cervical Stabilization Exercise in Patients with Chronic Neck Pain. *Complementary Therapies in Clinical Practice* 43 (May). Churchill Livingstone. doi:10.1016/j.ctcp.2021.101381.

155. Shamsi, Sharick, FaisalM Alyazedi, SamihaMohamed Abdelkader, Shabana Khan, and Ali Akhtar. 2021. Efficacy of Sustained Natural Apophyseal Glides in the Management of Mechanical Neck Pain: A Randomized Clinical Trial. *Indian Journal of Medical Specialities* 12 (4): 199. doi:10.4103/injms.injms_30_21.

156. Shedid, Daniel, and Edward C. Benzel. 2007. Cervical Spondylosis Anatomy: Pathophysiology and Biomechanics. *Neurosurgery*. doi:10.1227/01.NEU.0000215430.86569.C4.

157. Sherman, Karen J., Daniel C. Cherkin, Rene J. Hawkes, Diana L. Miglioretti, and Richard A. Deyo. 2009. Randomized Trial of Therapeutic Massage for

Chronic Neck Pain. *Clinical Journal of Pain* 25 (3). Lippincott Williams and Wilkins: 233–38. doi:10.1097/AJP.0b013e31818b7912.

158. Shin, Ho Jin, Sung Hyeon Kim, Suk Chan Hahm, and Hwi Young Cho. 2020. Thermotherapy plus Neck Stabilization Exercise for Chronic Nonspecific Neck Pain in Elderly: A Single-Blinded Randomized Controlled Trial. *International Journal of Environmental Research and Public Health* 17 (15). MDPI AG: 1–12. doi:10.3390/ijerph17155572.

159. Shrestha, Dipak, Rohit Shrestha, Margreth Grotle, Øystein P. Nygaard, and Tore K. Solberg. 2021. Validation of the Nepali Versions of the Neck Disability Index and the Numerical Rating Scale for Neck Pain. *Spine* 46 (5). NLM (Medline): E325–32. doi:10.1097/BRS.0000000000003810.

160. Skillgate, Eva, Oscar Javier Pico-Espinosa, Pierre Côté, Irene Jensen, Peter Viklund, Matteo Bottai, and Lena W. Holm. 2020. Effectiveness of Deep Tissue Massage Therapy, and Supervised Strengthening and Stretching Exercises for Subacute or Persistent Disabling Neck Pain. The Stockholm Neck (STONE) Randomized Controlled Trial. *Musculoskeletal Science and Practice* 45 (February). Elsevier Ltd. doi:10.1016/j.msksp.2019.102070.

161. Smart, Keith M., Catherine Blake, Anthony Staines, and Catherine Doody. 2010. Clinical Indicators of 'Nociceptive', 'Peripheral Neuropathic' and 'Central' Mechanisms of Musculoskeletal Pain. A Delphi Survey of Expert Clinicians. *Manual Therapy* 15 (1): 80–87. doi:10.1016/j.math.2009.07.005.

162. Sowmya M.V. 2014. Isometric Neck Exercises versus Dynamic Neck Exercises in Chronic Neck Pain. *IOSR Journal of Nursing and Health Science* 3 (2): 32–43. doi:10.9790/1959-03213243.

163. Stevens, Bonnie. 2021. Revisions to the IASP Definition of Pain—What Does This Mean for Children? *Paediatric and Neonatal Pain* 3 (3): 101–5. doi:10.1002/pne2.12047.

164. Stratford P., Gill C., Westaway M., and Binkley J. 1995. Assessing Disability and Change on Individual Patients: A Report of a Patient Specific Measure. *Physiotherapy Canada* 47 (4): 258–63.

165. Taber, Keith S. 2018. The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education. *Research in Science Education* 48 (6): 1273–96. doi:10.1007/s11165-016-9602-2.

166. Takasaki, Hiroshi, and Stephen May. 2014. Mechanical Diagnosis and Therapy Has Similar Effects on Pain and Disability as 'wait and See' and Other Approaches in People with Neck Pain: A Systematicreview. *Journal of Physiotherapy* 60 (2). Australian Physiotherapy Association: 78–84. doi:10.1016/j.jphys.2014.05.006.

167. Theodore, Nicholas. 2020. Degenerative Cervical Spondylosis. *New England Journal of Medicine* 383 (2). Massachusetts Medical Society: 159–68. doi:10.1056/nejmra2003558.

168. Thoomes-de Graaf, Marloes, César Fernández-De-Las-Peñas, and Joshua A. Cleland. 2020. The Content and Construct Validity of the Modified Patient Specific Functional Scale (PSFS 2.0) in Individuals with Neck Pain. *Journal of Manual and Manipulative Therapy* 28 (1). Taylor and Francis Ltd.: 49–59. doi:10.1080/10669817.2019.1616394.

169. Todd, Andrew G. 2011. Cervical Spine: Degenerative Conditions. *Current Reviews in Musculoskeletal Medicine* 4 (4): 168–74. doi:10.1007/s12178-011-9099-2.

170. Tunwattanapong, Punjama, Ratcharin Kongkasuwan, and Vilai Kuptniratsaikul. 2016. The Effectiveness of a Neck and Shoulder Stretching Exercise Program among Office Workers with Neck Pain: A Randomized Controlled Trial. *Clinical Rehabilitation* 30 (1). SAGE Publications Ltd: 64–72. doi:10.1177/0269215515575747.

171. Tzenalis, Anastasis. 2016. The Biopsychosocial Treatment Approach for Chronic Neck and Back Pain: A Systematic Review of Randomized Controlled Trials. *European Psychomotricity Journal* 8 (1): 29–48.

172. Vaske, Jerry J., Jay Beaman, and Carly C. Sponarski. 2017. Rethinking Internal Consistency in Cronbach's Alpha. *Leisure Sciences* 39 (2): 163–73. doi:10.1080/01490400.2015.1127189.

173. Verhagen, Arianne P. 2021. Physiotherapy Management of Neck Pain. *Journal of Physiotherapy* 67 (1): 5–11. doi:10.1016/j.jphys.2020.12.005.

174. Vernon, Howard. 2008. The Neck Disability Index: State-of-the-Art, 1991-2008. *Journal of Manipulative and Physiological Therapeutics*. doi:10.1016/j.jmpt.2008.08.006.

175. Vinall, Jillian, Maria Pavlova, Gordon Asmundson, Nivez Rasic, and Melanie Noel. 2016. Mental Health Comorbidities in Pediatric Chronic Pain: A

Narrative Review of Epidemiology, Models, Neurobiological Mechanisms and Treatment. *Children* 3 (4): 40. doi:10.3390/children3040040.

176. Wassertheil-Smoller, Sylvia, and Mimi Y. Kim. 2010. Statistical Analysis of Clinical Trials. *Seminars in Nuclear Medicine*. doi:10.1053/j.semnuclmed.2010.04.001.

177. Webster, Barbara S., Ann Z. Bauer, YoonSun Choi, Manuel Cifuentes, and Glenn S. Pransky. 2013. Iatrogenic Consequences of Early Magnetic Resonance Imaging in Acute, Work-Related, Disabling Low Back Pain. *Spine* 38 (22): 1939–46. doi:10.1097/BRS.0b013e3182a42eb6.

178. Weng, Helen Y., Jack L. Feldman, Lorenzo Leggio, Vitaly Napadow, Jeanie Park, and Cynthia J. Price. 2021. Interventions and Manipulations of Interoception. *Trends in Neurosciences*. Elsevier Ltd. doi:10.1016/j.tins.2020.09.010.

179. Whittaker, J.L., L.K. Truong, K. Dhiman, and C. Beck. 2021. Osteoarthritis Year in Review 2020: Rehabilitation and Outcomes. *Osteoarthritis and Cartilage* 29 (2): 190–207. doi:10.1016/j.joca.2020.10.005.

180. Wong, Jessica J., Heather M. Shearer, Silvano Mior, Craig Jacobs, Pierre Côté, Kristi Randhawa, Hainan Yu, et al. 2016. Are Manual Therapies, Passive Physical Modalities, or Acupuncture Effective for the Management of Patients with Whiplash-Associated Disorders or Neck Pain and Associated Disorders? An Update of the Bone and Joint Decade Task Force on Neck Pain and Its Associated Disorders by the OPTIMa Collaboration. *Spine Journal*. Elsevier Inc. doi:10.1016/j.spinee.2015.08.024.

181. Ylinen, Jari, Hannu Kautiainen, Kaija Wirén, and Arja Häkkinen. 2007. Stretching Exercises vs Manual Therapy in Treatment of Chronic Neck Pain: A Randomized, Controlled Cross-over Trial. *Journal of Rehabilitation Medicine* 39 (2): 126–32. doi:10.2340/16501977-0015.

182. Zabor, Emily C., Alexander M. Kaizer, and Brian P. Hobbs. 2020. Randomized Controlled Trials. *Chest*. Elsevier Inc. doi:10.1016/j.chest.2020.03.013.

APPENDICES

Appendix A: The Patients-Specific Functional Scale

The Patient-Specific Functional Scale

This useful questionnaire can be used to quantify activity limitation and measure functional outcome for patients with any orthopaedic condition.

Clinician to read and fill in below: Complete at the end of the history and prior to physical examination.

Initial Assessment:

I am going to ask you to identify up to three important activities that you are unable to do or are having difficulty with as a result of your _____problem. Today, are there any activities that you are unable to do or having difficulty with because of your _____problem? (Clinician: show scale to patient and have the patient rate each activity).

Follow-up Assessments:

When I assessed you on (state previous assessment date), you told me that you had difficulty with (read all activities from list at a time). Today, do you still have difficulty with: (read and have patient score each item in the list)?

Patient-specific activity scoring scheme (Point to one number):

0 1 2 3 4 5 6 7 8 9 10

Unable to perform activity

Able to perform activity at the same level as before injury or problem

(Date and Score)

Activity	Initial					
1.						
2.						
3.						
4.						
5.						
Additional						
Additional						

Total score = sum of the activity scores/number of activities
Minimum detectable change (90%CI) for average score = 2 points
Minimum detectable change (90%CI) for single activity score = 3 points

PSFS developed by: Stratford, P., Gill, C., Westaway, M., & Binkley, J. (1995). Assessing disability and change on individual patients: a report of a patient specific measure. Physiotherapy Canada, 47, 258-263.

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Appendix B: Neck Disability Index

Neck Disability Index

THIS QUESTIONNAIRE IS DESIGNED TO HELP US BETTER UNDERSTAND HOW YOUR **NECK PAIN** AFFECTS YOUR ABILITY TO MANAGE EVERYDAY -LIFE ACTIVITIES. PLEASE MARK IN EACH SECTION THE **ONE BOX** THAT APPLIES TO YOU.
ALTHOUGH YOU MAY CONSIDER THAT TWO OF THE STATEMENTS IN ANY ONE SECTION RELATE TO YOU, PLEASE MARK THE BOX THAT **MOST CLOSELY** DESCRIBES YOUR PRESENT -DAY SITUATION.

SECTION 1 - PAIN INTENSITY

- ❑ I have no neck pain at the moment.
- ❑ The pain is very mild at the moment.
- ❑ The pain is moderate 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.

SECTION 2 - PERSONAL CARE

- ❑ I can look after myself normally without causing extra neck pain.
- ❑ I can look after myself normally, but it causes extra neck pain.
- ❑ It is painful to look after myself, and I am slow and careful.
- ❑ I need some help but 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.

SECTION 3 – LIFTING

- ❑ I can lift heavy weights without causing extra neck pain.
- ❑ I can lift heavy weights, but it gives me extra neck pain.
- ❑ Neck pain prevents me from lifting heavy weights off the floor but I can manage if items are conveniently positioned, ie. on a table.
- ❑ Neck pain prevents me from lifting heavy weights, but I can manage light weights if they are conveniently positioned.
- ❑ I can lift only very light weights.
- ❑ I cannot lift or carry anything at all.

SECTION 4 – READING

- ❑ I can read as much as I want with no neck pain.
- ❑ I can read as much as I want with slight neck pain.
- ❑ I can read as much as I want with moderate neck pain.
- ❑ I can't read as much as I want because of moderate neck pain.
- ❑ I can't read as much as I want because of severe neck pain.
- ❑ I can't read at all.

SECTION 5 – HEADACHES

- ❑ I have no headaches at all.
- ❑ I have slight headaches that come infrequently.
- ❑ I have moderate headaches that come infrequently.
- ❑ I have moderate headaches that come frequently.
- ❑ I have severe headaches that come frequently.
- ❑ I have headaches almost all the time.

SECTION 6 – CONCENTRATION

- ❑ I can concentrate fully without difficulty.
- ❑ I can concentrate fully with slight difficulty.
- ❑ I have a fair degree of difficulty concentrating.
- ❑ I have a lot of difficulty concentrating.
- ❑ I have a great deal of difficulty concentrating.
- ❑ I can't concentrate at all.

SECTION 7 – WORK

- ❑ I can do as much work as I want.
- ❑ I can only do my usual work, but no more.
- ❑ I can do most of my usual work, but no more.
- ❑ I can't do my usual work.
- ❑ I can hardly do any work at all.
- ❑ I can't do any work at all.

SECTION 8 – DRIVING

- ❑ I can drive my car without neck pain.
- ❑ I can drive my car with only slight neck pain.
- ❑ I can drive as long as I want with moderate neck pain.
- ❑ I can't drive as long as I want because of moderate neck pain.
- ❑ I can hardly drive at all because of severe neck pain.
- ❑ I can't drive my car at all because of neck pain.

SECTION 9 – SLEEPING

- ❑ I have no trouble sleeping.
- ❑ My sleep is slightly disturbed for less than 1 hour.
- ❑ My sleep is mildly disturbed for up to 1-2 hours.
- ❑ My sleep is moderately disturbed for up to 2-3 hours.
- ❑ My sleep is greatly disturbed for up to 3-5 hours.
- ❑ My sleep is completely disturbed for up to 5-7 hours.

SECTION 10 – RECREATION

- ❑ I am able to engage in all my recreational activities with no neck pain at all.
- ❑ I am able to engage in all my recreational activities with some neck pain.
- ❑ I am able to engage in most, but not all of my recreational activities because of pain in my neck.
- ❑ I am able to engage in only a few of my recreational activities because of neck pain.
- ❑ I can hardly do recreational activities due to neck pain.
- ❑ I can't do any recreational activities due to neck pain.

PATIENT NAME _____ DATE _____

SCORE _____ [50]

Appendix C: McGill Quality of Life questionnaire

STUDY IDENTIFICATION #:_____ DATE: _____

Instructions

The questions in this questionnaire begin with a statement followed by two opposite answers. Numbers extend from one extreme answer to its opposite.
Please circle the number between 0 and 10 which is most true for you.
There are no right or wrong answers.
Completely honest answers will be most helpful.

EXAMPLE:
I am hungry:

not at all 0 1 2 3 4 5 6 7 8 9 10 **extremely**

- If you are not even a little bit hungry, you would circle 0.
- If you are a little hungry (you just finished a meal but still have room for dessert), you might circle a 1, 2, or 3.
- If you are feeling moderately hungry (because mealtime is approaching), you might circle a 4, 5, or 6.
- If you are very hungry (because you haven't eaten all day), you might circle a 7, 8, or 9.
- If you are extremely hungry, you would circle 10.

BEGIN HERE:

IT IS VERY IMPORTANT THAT YOU ANSWER ALL QUESTIONS FOR HOW YOU HAVE BEEN FEELING *JUST IN THE PAST TWO (2) DAYS*.

PART A

Considering all parts of my life - physical, emotional, social, spiritual, and financial -

very bad 0 1 2 3 4 5 6 7 8 9 10 **excellent**

Please continue on the next page...

5. PART B: Physical Symptoms or Physical Problems

(1) For the questions in Part "B", please list the **PHYSICAL SYMPTOMS OR PROBLEMS** *which have been the biggest problem for you over the past* **two (2)** *days. (Some examples are: pain, tiredness, weakness, nausea, vomiting, constipation, diarrhea, trouble sleeping, shortness of breath, lack of appetite, sweating, immobility. Feel free to refer to others if necessary).*

(2) Circle the number which best shows how big a problem each one has been for you ***6. OVER THE PAST TWO (2) DAYS.***

(3) *If, over the past two (2) days, you had* **NO** *physical symptoms or problems, or only one or two, answer for each of the ones you have had and write "none" for the extra questions in Part B, then continue with Part C.*

1. Over the past two (2) days,
one troublesome symptom has been:_____.
7. (write symptom)

no problem 0 1 2 3 4 5 6 7 8 9 10 **tremendous 8. problem**

2. Over the past two (2) days,
another troublesome symptom has been:_____.
9. (write symptom)

no problem 0 1 2 3 4 5 6 7 8 9 10 **tremendous 10. problem**

3. Over the past two (2) days,
a third troublesome symptom has been:_____.
11. (write symptom)

no problem 0 1 2 3 4 5 6 7 8 9 10 **tremendous 12. problem**

Please continue on the next page...

4. Over the past two (2) days I have felt:

physically terrible	0	1	2	3	4	5	6	7	8	9	10	**physically well**

PART C *Please choose the number which best describes your feelings and thoughts* ***OVER THE PAST TWO (2) DAYS.***

13. Over the past two (2) days, I have been depressed:

not at all	0	1	2	3	4	5	6	7	8	9	10	**extremely**

14. Over the past two (2) days, I have been nervous or worried:

not at all	0	1	2	3	4	5	6	7	8	9	10	**extremely**

15. Over the past two (2) days, how much of the time did you feel sad?

never	0	1	2	3	4	5	6	7	8	9	10	**always**

16. Over the past two (2) days, when I thought of the future, I was:

not afraid	0	1	2	3	4	5	6	7	8	9	10	**terrified**

17. Over the past two (2) days, my life has been:

utterly meaningless and without purpose	0	1	2	3	4	5	6	7	8	9	10	**very purposeful and meaningful**

18. Over the past two (2) days, when I thought about my whole life, I felt that in achieving life goals I have:

made no progress	0	1	2	3	4	5	6	7	8	9	10	**progressed to complete whatsoever fulfillment**

19.

Please continue on the next page...

11. Over the past two (2) days, when I thought about my life, I felt that my life to this point has been:

completely worthless	0	1	2	3	4	5	6	7	8	9	10	**very worthwhile**

12. Over the past two (2) days, I have felt that I have:

no control over my life	0	1	2	3	4	5	6	7	8	9	10	**complete control over my life**

13. Over the past two (2) days, I felt good about myself as a person.

completely disagree	0	1	2	3	4	5	6	7	8	9	10	**completely agree**

14. To me, the past two (2) days were:

a burden	0	1	2	3	4	5	6	7	8	9	10	**a gift**

15. Over the past two (2) days, the world has been:

an impersonal unfeeling place	0	1	2	3	4	5	6	7	8	9	10	**caring and responsive to my needs**

16. Over the past two (2) days, I have felt supported:

not at all	0	1	2	3	4	5	6	7	8	9	10	**completely**

Please continue on the next page...

20. PART D

Please list or describe the things which had the greatest effect on your quality of life inthe past two (2) days. Please tell us whether each thing you list made your quality of life better or worse during this time. If you need more space, please continue on the back of this page.

Appendix D: Numerical Rating Scale of Pain

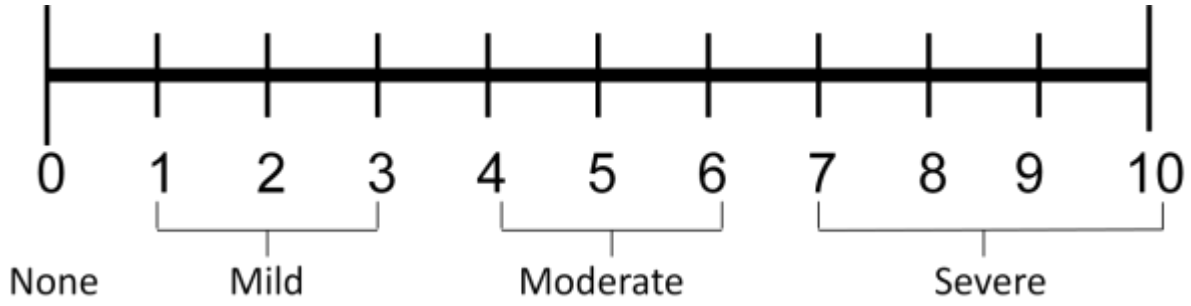
The Numeric Pain Rating Scale Instructions

General Information:

- The patient is asked to make three pain ratings, corresponding to current, best and worst pain experienced over the past 24 hours.
- The average of the 3 ratings was used to represent the patient's level of pain over the previous 24 hours.

Patient Instructions (adopted from (McCaffery, Beebe et al. 1989):

"Please indicate the intensity of current, best, and worst pain levels over the past 24 hours on a scale of 0 (no pain) to 10 (worst pain imaginable)"



Reference:

McCaffery, M., Beebe, A., et al. (1989). Pain: Clinical manual for nursing practice, Mosby St. Louis, MO.

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Thesis: **The effect of manual therapy and therapeutic exercise on patients with chronic neck pain, to improve function, activity, and participation level in accordance with international classification of functioning, disability and health**

I certify that I am the sole author of this thesis and that no part of it has been submitted or published in whole or in part for publication. I certify that the intellectual content of this thesis is the result of my own effort and that all assistance and resources used in the preparation of this thesis are acknowledged.

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Kosovo Chamber of Physiotherapists

The Commission of Ethical Issues of Kosovo Chamber of Physiotherapy, in accordance with Article 9 paragraph 1 subparagraph 1.6, Article 35 paragraph 1 subparagraph 1.1 and Article 36 of Law on Chambers of Health Professionals no. 04/L-150, Article 15 paragraph 1 subparagraph 1.6, Article 47 of the Statute of the Kosovo Chamber of Physiotherapy, Article 10 of the Regulation on the Scope and Powers of the Commission for Ethical Issues no. 622 dated 23.12.2021 on 18.05.2023 has given this:

DECISION

I. Approval of the request of **Arbnore Ibrahimaj Gashi** no.protocol 472 dated 18.05.2023 for permission for scientific research on the topic: "The Effect of Manual Therapy and Therapeutic Exercise on Patients with Chronic Neck Pain to Improve Function, Activity and Participation Level in Accordance with International Classification of Functioning, Disability and Health".
II. The topic of the research from the previous paragraph is in accordance with the Kosovo Chamber of Physiotherapy (KCHPT) legislation.
III. The member is obliged to respect the Code of Ethics and Deontology of KCHPT and the Declaration of Helsinky.
IV. This decision takes effect immediately.

Reasoning - The Commission for Ethical Issues, after examining the above-mentioned request in the enacting clause of this decision dated 18.05.2023, has determined that the submitted request meets all the requirements set out in the regulation on the scope and powers of the Commission for Ethical Issues of KCHPT. Based on the presented factual situation and the abovementioned legal provisions, the Ethics Committee decided as in the enacting clause of this decision.
***Note**: The Code of Ethics and Deontology of Physiotherapists and the Declaration of Helsinky must be respected throughout the research process.*

To be sent to:
The applicant
The President of KCHPT
Ethical Council of KCHPT
Administrative Service of KCHPT

Vice Chairman of the Ethics Committee of the KCHPT
Faton Shalimi

Pristina, 18.05.2023

Decision number: **2/2023-24**
Date: 14 Mar 24

Based on Article 22.b of the Statute of Alma Mater Europaea – European Center, Maribor (Alma Mater or AMEU) dated 18 Dec 12 and in accordance with the decision of the Ethics Committee of Alma Mater Europaea – European Center, Maribor (Committee for Academic Affairs) on 14 March 24, the following decision is issued by the President of the Ethics Committee

Decision

The Ethics Committee concludes that the proposed clinical study on the effectiveness of manual therapy and therapeutic exercise on patients with chronic neck pain in improving function, activity, and participation in accordance with the model of the International Classification of Functioning, Disability and Health, of the candidate Arbnora Ibrahimaj Gashi, student of the doctoral program in Physiotherapy is ethically appropriate.

Explanation:

Arbnore Ibrahimaj Gashi, a student of the doctoral program Physiotherapy, applied for an assessment of the ethical relevance of the research to the Ethics Committee of Alma Mater – ECM. The student will conduct a clinical study examining the effectiveness of manual therapy and therapeutic exercise on patients with chronic neck pain on improving function, activities and participation in accordance with the model of the International Classification of Functioning, Disability and Health. The study will take place in a private physiotherapy clinical setting in Kosovo. To conduct the research according to the ethical medical standards, ethical permission has been obtained from the Ethical Commission of the Kosovo Chamber of Physiotherapy and an ethical permission from the institutions where the research will take place. There will be approximately 150 patients included in the research. The study group will receive a new multimodal physiotherapy program according to the physiotherapy evidence: thermotherapy, TENS, dynamic exercises, deep tissue massage and passive stretching. The control group will receive relaxation massage, isometric exercise, active range of motion, thermotherapy, IF and hydrotherapy. All patients will receive 10 treatments. The measuring instruments used only before the treatment will be the Flex-rotation test (FRT), the Spurling test (ST) and deep neck flexor endurance test (DNFET). The measurement instruments that will be used before and after treatment are the Numerical Pain Scale (NPRS), Active Range of Motion (AT*ROM), Neck Disability Index (NDI), Patient Specific Functional Scale (PSFS) and the McGill Quality of Life Questionnaire (MQOL). The data will be analyzed with the statistical program SPSS, version 22. The student attached a statement of consent, agreed and signed by the participant before starting the research, and at the same time allowing to withdraw from the research at any time without reason.
After reviewing the application, the Committee members concluded that the documentation is submitted in full, and the proposed research is suitable for implementation. The student will carry out the research at the physical therapy clinic Fizio-Ana in Prishtina and in the Physical Therapy and Rehabilitation Hospital ONIX SPA LLC, Prishtina.

The members of the commission decided based on the submitted documentation, as follows from the pronouncement of the decision.

Legal precept:
An appeal against this decision is admissible within 8 days of receipt. The complaint should be sent to the address Alma Mater Europaea – European Center, Maribor, Slovenska ulica 17, Maribor. The Senate of Alma Mater Europaea will decide on it.

Legal precept:
President of the AMEU-ECM Ethics Commission
Pred. dr. Jelka Reberšek Gorišek