JSSF (10) (2) (2024)

Journal of Sport Sciences and Fitness

http://journal.unnes.ac.id/sju/index.php/jssf

Correlation between Arm Position, Craniovertebral Angle, and Non-Specific Neck Pain in College Students

Melya Rossa[1]✉, Afif Dwi Nugraha[2], Muhamad Fauzi Antoni[3], Laily Mita Andriana[4] , Dani Pramuno Putra[5], Dewangga Yudhistira[6]

Airlangga University[1,5], Universitas Negeri Surabaya[2,3,4,6]
melya.rossa@vokasi.unair.ac.id[1], afifnugraha@unesa.ac.id[2], muhamadantoni@unesa.ac.id[3], lailyandriana@unesa.ac.id[4], dany.pramuno@vokasi.unair.ac.id[5], dewanggayudhistira@unesa.ac.id[6]

Article's Info

Article's History:

Received December 2024

Accepted February 2025

Published May 2025

Keywords:
Arm position, craniovertebral angle, forward head posture, neck pain

Abstract

Students, especially intensive users of visual devices such as computers, are at risk of postural disorders such as Forward Head Posture (FHP) and non-specific neck pain (NSNP). The static position of the arm is thought to contribute to this disorder. This study used a cross-sectional design with 47 female participants aged 18-25 years. FHP is measured by Craniovetebral Angle (CVA), static position of the arm with Forward Shoulder Angle (FSA), and neck pain with Neck Disability Index (NDI). Data analysis was carried out by Pearson correlation test. The results showed that there was no significant relationship between CVA and FSA ($r=0.182$; $p>0.05$), but there was a significant negative relationship between FSA and NDI ($r=-0.315$; $p<0.05$). The conclusion was that there was no association between FHP and static arm position, but there was an association between static arm position and non-specific neck pain.

Correspondence E-mai✉l: melyarossa@vokasi.unair.ac.id

ISSN 2252-6528

INTRODUCTION

Ideal posture plays an important role in maintaining body balance as well as preventing excessive stress on musculoskeletal structures (Markopoulos et al., 2020). Daily activities such as sitting for long periods of time with poor posture, especially when using visual devices such as computers, laptops, and gadgets, have been identified as a major factor causing posture changes, including forward head posture (FHP) (Gandolfi et al., 2023). Forward head posture (FHP), which is characterized by a head position that is more advanced than the normal posture line, can disrupt neck biomechanics and cause disorders such as non-specific neck pain (Kee, 2023).

Non-specific neck pain is one of the most common musculoskeletal complaints among college students (Amioka et al., 2021). Research shows that the prevalence of NSNP in physiotherapy students reaches 52.9%, with 26.5% of cases related to musculoskeletal disorders influenced by lecture activities, the use of visual devices, and stress levels (Schmid et al., 2021). Static arm positions, such as in the use of gadgets, have been known to increase the risk of posture disorders such as forward head posture (FHP) (Yoon et al., 2020).

Biomechanical mechanisms suggest that arm positions with shoulder abduction of 30° and elbow flexion of less than 90° can lead to unbalanced muscle tension, angular changes in the shoulders, and biomechanical compensation in the neck (Prudenzano, 2024). This strain can worsen the condition of the fhp as well as increase the risk of NSNP (Almeida et al., 2024). Although previous studies have explored the relationship between the duration of visual device use and fhp and neck pain, the specific relationship between static arm position and craniovertebral angle and nsnp is still rarely studied, especially in the student population (Beneka et al., 2024).

Non-specific neck pain is a condition of discomfort or pain in the neck area in the absence of an obvious medical cause, such as a serious injury or certain diseases (Markopoulos et al., 2020). Although often considered a trivial issue, this condition can affect various aspects of an individual's life, both physically, functionally, and psychologically (Kee, 2023).

Physically, people with non-specific neck pain often feel stiffness or limitation of movement in the neck. Simple activities such as turning your head, looking down, or looking up can be difficult and painful (Yoon et al., 2020). This pain also often spreads to other areas, such as the shoulders, upper back, and head, which can lead to additional symptoms such as tension headaches. In addition, the muscles around the neck will usually be tense or tired, which can further exacerbate the discomfort (Prudenzano, 2024).

From a functional perspective, neck pain can interfere with a person's ability to perform daily activities. Tasks that require long sitting, such as working in front of a computer, become difficult (Debucean et al., 2023). Sleep can also be disrupted by difficulty finding a comfortable position, which leads to prolonged fatigue. In addition, reduced mobility due to pain makes people tend to avoid physical activities that require neck movement (Figas et al., 2024).

From a psychological perspective, non-specific neck pain can affect an individual's mood and mental health. Long-lasting pain often causes stress, frustration, or anxiety about their physical condition (Alotaibi et al., 2022). In some cases, individuals may feel like they are losing control over their health, which can negatively impact their self-confidence. Not infrequently, this condition also

causes social isolation, because a person is reluctant to participate in social activities or recreation due to pain (Debucean et al., 2023).

If not treated properly, this neck pain can become a chronic problem in the long term and can potentially lead to other complications, such as poor posture or pain in other parts of the body (Cezar-Vaz et al., 2023). Therefore, it is important for individuals experiencing non-specific neck pain to immediately take treatment measures, such as performing stretching exercises, maintaining good posture, or consulting a medical professional, such as a physiotherapist, to prevent more serious impacts (Grondin et al., 2022).

Based on this explanation, this study contains several novelty elements, namely the combination of biomechanical analysis (arm position and craniovertebral angle) with clinical symptoms (non-specific neck pain). This approach offers a more holistic view than focusing on just one factor (Bryndal et al., 2022). The study highlights college students as a population that often faces the risk of poor posture due to habits such as using digital devices and sitting for too long (Lind et al., 2023). Thus, this study contributes to filling the data gap in this group (Smith et al., 2020). This topic is especially relevant in today's world, where activities such as online learning and the use of technology have become very common (Akhter et al., 2024).

It is also the basis for the development of ergonomic interventions in the academic environment (Alqhtani et al., 2023). The relationship between arm position (often overlooked) and craniovertebral angle to neck pain offers a new approach in understanding the biomechanical risks associated with musculoskeletal disorders (Debucean et al., 2023). This research opens up opportunities to develop an ergonomics or exercise program aimed at students, based on the relationships found (Figas et al., 2024). In addition, this study may provide new insights into the literature regarding non-specific neck pain, which is generally difficult to identify causes (Grondin et al., 2022).

This novelty of this research has the potential to be an important reference in the field of health and ergonomics, especially in the context of the prevention and management of non-specific neck pain among college students. Therefore, this study aims to explore the relationship between static arm position, forward head posture (FHP), and non-specific neck pain (NSNP) in students of Airlangga University. This research is expected to contribute to the ergonomics literature and help in the prevention of musculoskeletal disorders in young populations (Kim et al., 2015).

METHOD

This study uses a cross-sectional analytical design, aiming to analyze the relationship between static arm position, Forward Head Posture (FHP), and non-specific neck pain (NSNP). The population and research sample consisted of 47 female students of the Physiotherapy Study Program, Airlangga University, aged 18-25 years. The sample was selected using the purposive sampling technique by considering the inclusion and exclusion criteria. Inclusion Criteria: Female students aged 18-25 years, have no history of trauma to the neck, shoulder, or spine, are not currently undergoing physiotherapy treatment for musculoskeletal disorders, are willing to participate in the study and sign informed consent. Exclusion criteria, having congenital structural abnormalities of the spine, experiencing acute neck pain requiring immediate medical intervention, unable to maintain normal posture during the measurement process.

Measurement Procedure, measurements are performed to assess FHP, static arm position, and neck pain level with the following steps:

1. Craniovetebral Angle (CVA), The angle between the ear tragus and the C7 processus spinosus was measured using Kinovea software from a lateral photo of the subject taken in a comfortable sitting position. The camera is placed parallel to the acromion at a distance of 1.5 meters. CVA is used to determine the level of FHP; an angle below 48° indicates FHP.
2. Forward Shoulder Angle (FSA), The angle between the C7 spinosus processus and the acromion is measured from the same image. The FSA indicates a static arm position, with a smaller angle indicating a more advanced shoulder position.
3. Neck Disability Index (NDI), Subjects were asked to fill out an NDI questionnaire, which consisted of 10 questions related to the impact of neck pain on daily activities. The NDI score is calculated to determine the level of NSNP.

Data Analysis, the data collected was tested for normality using the Shapiro-Wilk test. The relationship between the variables was analyzed using the Pearson correlation test with a significance level of $p<0.05$.

RESULT AND DISCUSSION

Table 1. Descriptive Data of Research Sample

Data	N	Min	Max	Mean ±SD
Age	47	18	21	19,81±0,68
Heigh	47	150	172	160,87±5,24
Weigh	47	45	72	57,15±8,10
IMT	47	18	26	22,06±2,38
VAS	47	1	4	1,91±0,78

The table shows that the research subjects totaled 47 female physiotherapy students. The distribution of characteristics of research subjects based on age is divided into 2, namely 18-20 years old as many as 41 female physiotherapy students (87.24%) and 21-25 years old as many as 6 female physiotherapy students (12.76%). The distribution of research subjects based on BMI was obtained by normal BMI as many as 29 female physiotherapy students (61.70%) and overweight BMI as many as 18 people (38.30%). The distribution of Non-specific Neck Pain felt by the research subjects based on the Visual Analog Scale (VAS) above was 15 female physiotherapy students who felt no pain, 22 female physiotherapy students who felt mild pain and 10 female physiotherapy students who felt moderate pain, with an average VAS of 1.91 and a minimum of scale 1 and a maximum of 4.

Table 2. The description of Craniovetebral Angle (CVA) forward shoulder angle (FSA), & neck disability index

Measurements	**Average & Standart Deviation**
Craniovertebaral angle (CVA)	47.6° ± 0.21
Forward Shoulder Angle (FSA)	55.8° ± 0.19
Neck Disability Index (NDI)	18.9% ± 0.31

Description: Craniovertebral angle <50° falls into the category of poor posture (head forward, thus causing muscle tension and pain). Forwar Shoulder Angle (FSA) <60° is included in the medium posture category (still within reasonable limits, but needs attention). The neck disability index shows a moderate disability category (disorders that are quite significant in daily activities, may need treatment or physical therapy.

Table 3. Pearson Correlation Test between Craniovetebral Angle (CVA) dan Forward Shoulder Angle (FSA)

		CVA	FSA
CVA	Pearson Correlation	1	0,18
	Sig. (2-tailed)		0,22
	N	47	47
FSA	Pearson Correlation	0,18	1
	Sig. (2-tailed)	0,22	
	N	47	47

The results of the table above show a Pearson correlation coefficient value of 0.18, so it can be concluded that there is a statistically weak and positive relationship (positive corlation) between CVA and FSA because it is close to the

value of 0. Meanwhile, the significance value of p=0.22 (p>0.05) can be concluded if there is no relationship between FHP and the static position of the arm.

Table 4. Pearson Correlation Test between Neck Disability Index (NDI) dan Forward Shoulder Angle (FSA)

	NDI	FSA	
NDI	Pearson Correlation	1	-0,32*
	Sig. (2-tailed)		0,03
	N	47	47
FSA	Pearson Correlation	-0,32*	1
	Sig. (2-tailed)	0,03	
	N	47	47

The results of the Pearson correlation test based on the table above, namely the value of the Pearson correlation coefficient of -0.32 and close to -1, it can be concluded that the relationship between NDI and FSA is close and negative (negative correlation) The significance value of p=0.03 (p<0.05) can be concluded that there is a non-specific relationship between neck pain and the static position of the arm

The relationship between Static Arm Position and Forward Head Posture (FHP), the results of the study showed that there was no significant relationship between static arm position measured using Forward Shoulder Angle (FSA) and Forward Head Posture (FHP) measured through Craniovetebral Angle (CVA) (r=0.182; p>0.05). This shows that the change in angle in the position of the arm does not affect the angle of the craniovertebra in the students who are the research subjects (Oka et al., 2024).

This finding contradicts a previous study by (Atia et al., 2023), which stated that the position of the arm with shoulder abduction tends to increase the biomechanical load on the neck, causing adaptive postural changes such as FHP. Most likely, other factors such as exposure duration and daily posture habits were more influential than static arm position in this study population (Llamas-Ramos et al., 2023).

The relationship between Static Arm Position and Non-Specific Neck Pain (NSNP), this study found a significant negative relationship between FSA and Neck Disability Index (NDI) (r=-0.315; p<0.05). That is, the smaller the FSA (more advanced shoulder), the higher the NDI score, which reflects an increase in neck pain levels. These results are in line with (David et al., 2021) research which showed that muscle tension in the shoulder due to unergonomic arm position can affect the neck muscles, including the trapezius muscle and levator scapulae, thereby increasing the risk of pain. Activities such as the constant use of visual devices trigger the body's biomechanical adaptations that can increase the risk of neck pain (Alotaibi et al., 2022).

Prevalence of neck pain in college students, the prevalence of NSNP in physiotherapy students involved in this study reached 52.9%, consistent with previous research by (Javdaneh et al., 2021). This high prevalence can be associated with lecture activities that involve the use of visual devices for a long time and high levels of stress during studies (Moreira et al., 2021). In addition, postural imbalances triggered by physical activity that can affect metabolism and regulation of hormones such as irisin, which play a role in energy regulation and muscle health as well as daily habits such as sitting for long periods with a hunched position also contribute to neck pain complaints (Alshehre et al., 2023).

These findings suggest that the angle of the arm in static conditions does not directly affect the angle of the craniovertebral (Cezar-Vaz et al., 2023). This means that more advanced head posture (FHP) is most likely influenced by other factors, such as

overall posture habits, sitting patterns, or biomechanical factors in other body segments (Warda et al., 2023). Although the position of the static arm is not ergonomic, it does not directly cause a change in the angle of the craniovertebra that reflects FHP (Alhakami et al., 2022). The disconnect between the position of the arm and the angle of the craniovertebra can be understood through the complexity of the overall postural interactions (Park et al., 2021). For example, other factors such as muscle strength, flexibility, length of static positions, as well as posture habits also need to be taken into account for a more in-depth analysis (Prieto-González et al., 2021).

This study provides new insights that although static arm position does not have a direct impact on craniovertebral angle, this factor can still significantly affect neck pain complaints (Sbardella et al., 2021). This emphasizes the importance of a thorough ergonomic approach to prevent musculoskeletal problems among students. The lack of a significant relationship between static arm position and Forward Head Posture (FHP) suggests that arm angle does not directly affect craniovertebral angle (Lutz et al., 2022). This can be explained by several reasons, including that posture is the result of complex interactions (Butera et al., 2024).

FHP is affected by a variety of biomechanical factors, including posture habits, neck muscle strength, spinal flexibility, and overall posture styling (Roldan et al., 2023). The position of the arms may not have a direct effect on the angle of the craniovertebrae because changes in the position of the head and neck have more to do with general posture habits than the specific position of the arms (Farì et al., 2023). For example, factors such as sitting position, workplace settings, or long-term screen viewing habits may have a greater effect on FHP than arm position (Batatolis et al., 2023).

Indirect Muscle Load, a static arm position can cause strain on the shoulder and upper back muscles (Markova et al., 2024). However, this tension may not be strong enough to directly affect the position of the head (Diaz-Saez et al., 2022). This sense of tension is more pronounced in the proximal muscles (such as trapezius) and has less effect on the neck muscles that regulate the craniovertebral angle (Pardos-Aguilella et al., 2023). Posture Compensation Flexibility, the human body is able to adapt and compensate for uneven loads (Story et al., 2021). When the arm position is in an unergonomic static state, the body can adjust the distribution of the load in the rest of the body without changing the position of the head or the angle of the craniovertebra (Khoja et al., 2024). Duration and Intensity of Static Arm Position, if the duration or intensity of the static arm position is not significant enough, the effect on posture may not be directly noticeable (Popa et al., 2023). Forward Head posture usually arises due to long-term repetitive postural habits, so the temporary position of the arm will not have a direct impact on the angle of the craniovertebra (Sbardella et al., 2021). The angle of the craniovertebra is more related to the activity of the anterior and posterior muscles of the neck (e.g., sternocleidomastoid muscles and splenius capitis) than the position of the arm (Park et al., 2021). Therefore, the position of the arms may not sufficiently affect the mechanical arrangement of the head and neck.musculoskeletaldu in anatomy and posture habits, every individual has a variation in anatomy and posture habits (Cezar-Vaz et al., 2023).

Students who are the subjects of the study may have differences in the way they sit, look at a screen, or set their posture. This variation can obscure the relationship between the position of the arm and the angle of the craniovertebra (Warda et al., 2023). The disassociation between static arm position and FHP suggests that the biomechanical

factors of posture are multifactorial (Paleta et al., 2024). Although the position of the arm may contribute to muscle tension in the shoulder and neck areas, its impact on the craniovertebral angle may be minor or mediated by other, more dominant factors (Moreira et al., 2021). These findings underscore the importance of overall posture analysis in understanding musculoskeletal disorders such as FHP (Javdaneh et al., 2021).

Implications and limitations of the study, the results of this study emphasize the importance of considering ergonomic positions during daily activities to prevent posture disorders and neck pain. Ergonomics interventions and education about ideal posture, especially in college students, can help lower the risk of NSNP (Alotaibi et al., 2022). However, this study has limitations on a relatively small sample size and focuses only on female students. Further studies are needed to confirm these findings in a larger and more diverse population, including male college students.

CONCLUSION

This study showed that there was no significant relationship between static arm position and Forward Head Posture (FHP), which suggests that arm angle does not directly affect craniovertebral angle. However, there was a significant negative association between static arm position and non-specific neck pain (NSNP), suggesting that unergonomic arm position contributed to an increase in neck pain complaints. The high prevalence of NSNP in physiotherapy students of Universitas Airlangga indicates the importance of education regarding ergonomics and correct posture during daily activities to prevent musculoskeletal disorders. This research contributes to understanding the importance of the relationship between posture, visual device usage habits, and musculoskeletal health in young population.

REFERENCES

Akhter, S., Zafar, H., Ahmad, A., & Farooqui, W. A. (2024). Effects Of Integrating Jaw Opening and Closing Movements with Active Neck Exercises in The Management of Chronic Non-Specific Neck Pain: A Randomized Controlled Trial. *Medicina*, *60* (9), 1437. Https://Doi.Org/10.3390/Medicina60091437

Alhakami, A. M., Madkhli, A., Ghareeb, M., Faqih, A., Abu-Shamla, I., Batt, T., Refaei, F., Sahely, A., Qassim, B., Shami, A. M., & Alhazmi, A. H. (2022). The Prevalence and Associated Factors of Neck Pain Among Ministry of Health Office Workers in Saudi Arabia: A Cross Sectional Study. *Healthcare (Switzerland)*, *10* (7). Https://Doi.Org/10.3390/Healthcare10071320.

Almeida, M. B. De, Moreira, M., Miranda-Oliveira, P., Moreira, J., Família, C., Vaz, J. R., Moleirinho-Alves, P., & Oliveira, R. (2024). Evolving Dynamics of Neck Muscle Activation Patterns in Dental Students: A Longitudinal Study. *Sensors*, *24*(17). Https://Doi.Org/10.3390/S24175689

Alotaibi, M. S., Fox, M., Coman, R., Ratan, Z. A., & Hosseinzadeh, H. (2022). Smartphone Addiction Prevalence and Its Association on Academic Performance, Physical Health, And Mental Well-Being Among University Students In Umm Al-Qura University (Uqu), Saudi Arabia. *International Journal of Environmental Research and Public Health*, *19*(6). Https://Doi.Org/10.3390/Ijerph19063710

Alqhtani, R. S., Ahmed, H., Alshahrani, A., Khan, A. R., & Khan, A. (2023). Effects Of Whole-

Body Stretching Exercise During Lunch Break for Reducing Musculoskeletal Pain and Physical Exertion Among Healthcare Professionals. *Medicina (Lithuania)*, *59*(5). Https://Doi.Org/10.3390/Medicina59050910

Alshehre, Y. M., Pakkir Mohamed, S. H., Nambi, G., Almutairi, S. M., & Alharazi, A. A. (2023). Effectiveness Of Physical Exercise on Pain, Disability, Job Stress, And Quality of Life In Office Workers With Chronic Non-Specific Neck Pain: A Randomized Controlled Trial. *Healthcare (Switzerland)*, *11*(16). Https://Doi.Org/10.3390/Healthcare11162286

Amioka, N., Nakamura, K., Kimura, T., Ohta-Ogo, K., Tanaka, T., Toji, T., Akagi, S., Nakagawa, K., Toh, N., Yoshida, M., Miyoshi, T., Nishii, N., Watanabe, A., Asano, R., Ogo, T., Nakaoka, Y., Morita, H., Yanai, H., & Ito, H. (2021). Pathological And Clinical Effects of Interleukin-6 On Human Myocarditis. *Journal Of Cardiology*, *78*(2), 157–165. Https://Doi.Org/10.1016/J.Jjcc.2021.03.003

Atia, D. T., Elsayed, N. I., Abdelmonem, A. F., Mahmoud, S. M. S., Mahmoud, M. M. M., Mohamed, K. E. S., Turky, K. T. Y., Rashad, U. M., & Abdel Karim, A. E. (2023). Prevalence Of Musculoskeletal Disorders Among General and Technical Secondary School Students in Egypt. *International Journal of Environmental Research and Public Health*, *20*(2). Https://Doi.Org/10.3390/Ijerph20021465

Batatolis, C., Karatrantou, K., Gymnopoulos, V., & Gerodimos, V. (2023). Functional Capacity Profile of The Cervical Joint in Young Adults: Sex-Related Differences. *Applied Sciences (Switzerland)*, *13*(20). Https://Doi.Org/10.3390/App132011326

Beneka, A., Sakellari, P., Daskalaki, K., Malliou, P., & Konstantinidis, T. (2024). The Effectiveness of a Specific Exercise Program In Alleviating Work-Related Neck And Upper Back Pain And Improving Mood State In Various Occupational Populations—A Randomized Controlled Trial. *Medicina*, *60*(12), 2002. Https://Doi.Org/10.3390/Medicina60122002

Bryndal, A., Glowinski, S., & Grochulska, A. (2022). Influence Of Occupation on The Prevalence Of Spinal Pain Among Physiotherapists And Nurses. *Journal Of Clinical Medicine*, *11*(19). Https://Doi.Org/10.3390/Jcm11195600

Butera, A., Maiorani, C., Fantozzi, G., Bergamante, F., Castaldi, M., Grassi, R., Leuter, C., Scribante, A., & Nardi, G. M. (2024). Musculoskeletal Disorders in The Clinical Practice of Dental Hygienists And Dentists, Prevention And Awareness Among Italian Professionals: Focus On Enlarging Systems. *Clinics And Practice*, *14*(5), 1898–1910. Https://Doi.Org/10.3390/Clinpract14050150

Cezar-Vaz, M. R., Xavier, D. M., Bonow, C. A., Vaz, J. C., Cardoso, L. S., Sant'anna, C. F., Da Costa, V. Z., Nery, C. H. C., Alves, A. S., Vettorello, J. S., De Souza, J. L., & Loureiro, H. M. A. M. (2023). Musculoskeletal Pain In The Neck And Lower Back Regions Among Phc Workers: Association Between Workload, Mental Disorders, And Strategies To Manage Pain. *Healthcare (Switzerland)*, *11*(3). Https://Doi.Org/10.3390/Healthcare11030365

David, D., Giannini, C., Chiarelli, F., Mohn, A., Tchounwou, B., & Bozzola, E. (2021). Text Neck Syndrome in Children and Adolescents. *Int. J. Environ. Res. Public Health*, *18*, 1565. Https://Doi.Org/10.3390/Ijerph18

Debucean, D., Mihaiu, J., Maghiar, A. M., Marcu, F., & Marcu, O. A. (2023). A Multidisciplinary Approach to Swallowing Rehabilitation in Patients with Forward Head Posture. *Medicina (Lithuania)*, *59*(9). Https://Doi.Org/10.3390/Medicina59091580

Diaz-Saez, M. C., Navarro-Fernández, G., Fernandez-Carnero, J., Garrigós-Pedrón, M., Muñoz, J. P. R., & Beltran-Alacreu, H. (2022). Conventional Cervical Exercises Compared with A Mixed-Reality-Based Game in Asymptomatic Subjects: An Exploratory Crossover Pilot Study. *Applied Sciences (Switzerland)*, *12*(7). Https://Doi.Org/10.3390/App12073657

Farì, G., Latino, F., Tafuri, F., Dell'anna, L., Raele, M. V., Fai, A., De Serio, C., Intonti, G., De Salvo, A. L., Ricci, V., Saraiello, E., Bonavolontà, V., Bernetti, A., Fiore, S., Megna, M., & Ranieri, M. (2023). Shoulder Pain Biomechanics, Rehabilitation and Prevention in Wheelchair Basketball Players: A Narrative Review. In *Biomechanics (Switzerland)* (Vol. 3, Issue 3, Pp. 362–376). Multidisciplinary Digital Publishing Institute (Mdpi). Https://Doi.Org/10.3390/Biomechanics3030030

Figas, G., Kostka, J., Pikala, M., Kujawa, J. E., & Adamczewski, T. (2024). Analysis Of Clinical Pattern of Musculoskeletal Disorders in The Cervical and Cervico—Thoracic Regions of The Spine. *Journal Of Clinical Medicine*, *13*(3). Https://Doi.Org/10.3390/Jcm13030840

Gandolfi, M. G., Zamparini, F., Spinelli, A., & Prati, C. (2023). Āsana For Neck, Shoulders, And Wrists to Prevent Musculoskeletal Disorders Among Dental Professionals: In-Office Yóga Protocol. *Journal Of Functional Morphology and Kinesiology*, *8*(1). Https://Doi.Org/10.3390/Jfmk8010026

Grondin, F., Freppel, S., Jull, G., Gérard, T., Caderby, T., & Peyrot, N. (2022). Fat Infiltration of Multifidus Muscle Is Correlated with Neck Disability in Patients with Non-Specific Chronic Neck Pain. *Journal Of Clinical Medicine*, *11*(19). Https://Doi.Org/10.3390/Jcm11195522

Javdaneh, N., Saeterbakken, A. H., Shams, A., & Barati, A. H. (2021). Pain Neuroscience Education Combined with Therapeutic Exercises Provides Added Benefit in The Treatment of Chronic Neck Pain. *International Journal of Environmental Research and Public Health*, *18*(16). Https://Doi.Org/10.3390/Ijerph18168848

Kee, D. (2023). Characteristics Of Work-Related Musculoskeletal Disorders in Korea. *International Journal of Environmental Research and Public Health*, *20*(2). Https://Doi.Org/10.3390/Ijerph20021024

Khoja, L., Zoulfikar, M., Hak, L., Yousif, S., Aljebori, M., Stiffler, M., Tariq, M., Burgard, S., Fleischer, N. L., Wallner, L. P., & Pearce, C. L. (2024). Overcoming Cultural Barriers and Building Healthcare Trust: A Mixed Methods Study on Cervical Cancer Prevention Among Arab American Women Across Major U.S. Cities. *Cancers*, *17*(1), 5. Https://Doi.Org/10.3390/Cancers17010005

Lind, C. M., Abtahi, F., & Forsman, M. (2023). Wearable Motion Capture Devices for The Prevention of Work-Related Musculoskeletal Disorders in Ergonomics—An Overview of Current Applications, Challenges, And Future Opportunities. In *Sensors* (Vol. 23, Issue 9). Mdpi. Https://Doi.Org/10.3390/S23094259

Llamas-Ramos, R., Barrero-Santiago, L., Llamas-Ramos, I., & Montero-Cuadrado, F. (2023). Effects Of a Family Caregiver Care Programme in Musculoskeletal Pain And Disability In The Shoulder-Neck Region—A Randomised Clinical Trial. *International Journal of Environmental Research and Public Health*, *20*(1). Https://Doi.Org/10.3390/Ijerph20010376

Lutz, K., Jünger, S. T., & Messing-Jünger, M. (2022). *Essential Management of Pediatric Brain Tumors*. Https://Doi.Org/10.3390/Children

Markopoulos, P., Shen, X., Wang, Q., & Timmermans, A. (2020). Neckio: Motivating Neck Exercises in Computer Workers. *Sensors (Switzerland)*, *20*(17), 1–15. Https://Doi.Org/10.3390/S20174928

Markova, V., Ganchev, T., Filkova, S., & Markov, M. (2024). Mmd-Msd: A Multimodal Multisensory Dataset in Support of Research and Technology Development for Musculoskeletal Disorders. *Algorithms*, *17*(5). Https://Doi.Org/10.3390/A17050187

Moreira, S., Ferreira, M. S., Criado, M. B., Machado, J., Mesquita, C., Lopes, S., & Santos, P. C. (2021). Occupational Health: Does Compliance with Physical Activity Recommendations Have a Preventive Effect on Musculoskeletal Symptoms in Computer Workers? A Cross-Sectional Study. *International Journal of Environmental Research and Public Health*, *18*(14). Https://Doi.Org/10.3390/Ijerph18147604

Oka, Y., Wachi, M., & Kida, N. (2024). Physical Therapist-Led Initiatives for The Prevention and Improvement of Chronic Pain Among Workers: A Case Study of Hosting Workshops Based on Survey Results in A Corporate Setting. *International Journal of Environmental Research and Public Health*, *21*(12), 1709. Https://Doi.Org/10.3390/Ijerph21121709

Paleta, D., Karanasios, S., Diamantopoulos, N., Martzoukos, N., Zampetakis, N., Moutzouri, M., & Gioftsos, G. (2024). Associations Of Treatment Outcome Expectations and Pain Sensitivity After Cervical Spine Manipulation in Patients With Chronic Non-Specific Neck Pain: A Cohort Study. *Healthcare (Switzerland)*, *12*(17). Https://Doi.Org/10.3390/Healthcare12171702

Pardos-Aguilella, P., Ceballos-Laita, L., Cabanillas-Barea, S., Pérez-Guillén, S., Ciuffreda, G., Jiménez-Del-Barrio, S., & Carrasco-Uribarren, A. (2023). Correlation Between Neck Muscle Endurance Tests, Ultrasonography, And Self-Reported Outcomes in Women with Low Cervical Disability and Neck Pain. *Applied Sciences (Switzerland)*, *13*(18). Https://Doi.Org/10.3390/App131810106

Park, G. W., An, J., Kim, S. W., & Lee, B. H. (2021). Effects Of Sling-Based Thoracic Active Exercise on Pain and Function and Quality of Life in Female Patients With Neck Pain: A Randomized Controlled Trial. *Healthcare (Switzerland)*, *9*(11). Https://Doi.Org/10.3390/Healthcare9111514

Popa, Ştefan, Ciongradi, C. I., Sârbu, I., Bîcă, O., Popa, I. P., & Bulgaru-Iliescu, D. (2023). Traffic Accidents in Children and Adolescents: A Complex Orthopedic and Medico-Legal Approach. In *Children* (Vol. 10, Issue 9). Multidisciplinary Digital Publishing Institute (Mdpi). Https://Doi.Org/10.3390/Children10091446

Prieto-González, P., Šutvajová, M., Lesňáková, A., Bartík, P., Bul'áková, K., & Friediger, T.

(2021). Back Pain Prevalence, Intensity, And Associated Risk Factors Among Female Teachers in Slovakia During the Covid-19 Pandemic: A Cross-Sectional Study. *Healthcare (Switzerland)*, *9*(7). Https://Doi.Org/10.3390/Healthcare9070860

Prudenzano, M. P. (2024). Botulinum Toxin and Migraine: Goals and Perspectives. *Toxins*, *16*(12), 530. Https://Doi.Org/10.3390/Toxins16120530

Roldan, C. J., Rosenthal, D. I., Koyyalagunta, D., Feng, L., & Warner, K. (2023). Methylene Blue for The Treatment of Radiation-Induced Oral Mucositis During Head and Neck Cancer Treatment: An Uncontrolled Cohort. *Cancers*, *15*(15). Https://Doi.Org/10.3390/Cancers15153994

Sbardella, S., La Russa, C., Bernetti, A., Mangone, M., Guarnera, A., Pezzi, L., Paoloni, M., Agostini, F., Santilli, V., Saggini, R., & Paolucci, T. (2021). Muscle Energy Technique in The Rehabilitative Treatment for Acute and Chronic Non-Specific Neck Pain: A Systematic Review. In *Healthcare (Switzerland)* (Vol. 9, Issue 6). Mdpi Ag. Https://Doi.Org/10.3390/Healthcare9060746

Schmid, P. M., Bauer, C. M., Ernst, M. J., Sommer, B., Lünenburger, L., & Weisenhorn, M. (2021). A Two Joint Neck Model to Identify Malposition of The Head Relative to The Thorax. *Sensors*, *21*(9). Https://Doi.Org/10.3390/S21093297

Smith, T. D., Balogun, A. O., Yu, Z., & Mullins-Jaime, C. (2020). Health, Physical Activity and Musculoskeletal Symptoms Among Stone, Sand, And Gravel Mine Workers: Implications for Enhancing and Sustaining Worker Health and Safety. *Safety*, *6*(4). Https://Doi.Org/10.3390/Safety6040052

Story, M. R., Haussler, K. K., Nout-Lomas, Y. S., Aboellail, T. A., Kawcak, C. E., Barrett, M. F., Frisbie, D. D., & Wayne Mcilwraith, C. (2021). Equine Cervical Pain and Dysfunction: Pathology, Diagnosis and Treatment. In *Animals* (Vol. 11, Issue 2, Pp. 1–21). Mdpi Ag. Https://Doi.Org/10.3390/Ani11020422

Warda, D. G., Nwakibu, U., & Nourbakhsh, A. (2023). Neck And Upper Extremity Musculoskeletal Symptoms Secondary to Maladaptive Postures Caused by Cell Phones and Backpacks in School-Aged Children And Adolescents. In *Healthcare (Switzerland)* (Vol. 11, Issue 6). Mdpi. Https://Doi.Org/10.3390/Healthcare11060819

Yoon, T. L., Min, J. H., & Kim, H. N. (2020). Effect Of Using An 8-Figure Shoulder Brace on Posture and Muscle Activities During the Performance of Dental Hygiene Procedures. *International Journal of Environmental Research and Public Health*, *17*(22), 1–8. Https://Doi.Org/10.3390/Ijerph17228494