Lista publicațiilor

1. Stîncel, O.R. & Oravițan, M. (2020) - Implications of forward head posture in computer users - A systematic review, Proceedings of the 6th International Education, Sports and Kinesiotherapy - Implications in quality of life, ISBN 979-12-80225-05-4, DOI: 10.26352/EY06-FEFSTIM2020;
2. Stîncel O.R. - Rehabilitation for a post-traumatic patella dislocation in a patient with hip dysplasia – a challenging combination for a physiotherapist, Revista Română de Kinetoterapie, vol. 27(46), 4-13 (indexată în DOAJ, EBSCO etc.)
3. Stîncel, O. R., Niţă, A., & Oraviţan, M. (2021) - The impact of home office setup due to COVID-19 pandemic on IT professionals′ physical health: a systematic review, Timisoara Physical Education and Rehabilitation Journal, 14(26), 7-16. DOI:10.2478/tperj-2021-0001
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Implications of Forward Head Posture in Computer Users – A Systematic Review

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Abstract

Todays' working population takes advantage of modern technology, especially of the utility of the computer, which enhances a sedentary behavior in the workplace, but also recreationally.
Many scientific studies have shown that prolonged computer use involves a series of risk factors, which consequently promote postural changes, the most common deficiency observed in computer users being forward head posture. The aim of this study was to conduct a systematic literature research of publications which have focused on the association between the implications of forward head posture in computer users and the prevalence of musculoskeletal pain. Scientific studies of which the primary outcome of interest was "forward head posture in computer users" were identified thorough a search in scientific databases such as PubMed, Scopus and Clarivate Analytics. A total of 28 studies published after 2010 met the inclusion criteria. Findings show that abnormal head position has a significant effect on the human body, forward head posture being highly correlated with improper muscle activity (creating postural imbalances), great repositioning error (due to reduced proprioceptive function) and a high prevalence of musculoskeletal disorders and presence of neck pain (especially among women).
The present study confirmed associations between non-neutral head postures (forward head posture) in computer users with a high prevalence of musculoskeletal disorders and an increased occurrence of neck pain.
Keywords: forward head posture, neck pain, computer use, musculoskeletal disorders, head posture

Introduction

In today's fast-paced society the usefulness of a computer is highly noted being ensured that this technology is used either at the workplace or at home.
Scientific studies have often found that prolonged computer use involves a series of risk factors due to the duration and frequency of the static activity involved. A professional computer user spends daily 7-8 hours and weekly an average of 40 hours in a static position leading to a sedentary behavior; this kind of activity now occupies around 60% of total working hours in general population [1-3]. Nowadays general risk factors which enhance a sedentary behavior include reduced periods of physical activity during means of transportation to the workplace (walking or cycling), promoting sedentary activities at home (computer use in a recreational manner), reduced manual work and promoting sedentary activities at the workplace [1]. Often risk factors that are associated with computer use are highlighted by prolonged sitting, repetitive movements, non-neutral body postures, static muscle loading, poor ergonomics at the workplace and few rest breaks [4].
Prolonged static postures and a sedentary behavior affect and cause modifications in all systems of the body. Sedentarism is one of the leading risk factors in the development of metabolic diseases, type 2 diabetes, obesity and cardiovascular diseases [5, 6]. Non-neutral body postures have a great impact on

the functionality of the upper body biomechanics; most often seen postural deficiency in computer users can be observed in a sagittal plane (forward head posture, rounded shoulders, exacerbated thoracic kyphosis, flattened lumbar curve and a posterior tilted pelvis) [7, 8], which consequently can affect the joint position sense, associated with reduced proprioception [9] and reduced respiratory function [10, 11].
Strong evidence was found that the most common observed postural change in computer users is forward head posture (FHP) defined as a forward displacement of the head on the cervical spine [12], significantly associated with holding the neck in a forward flexed posture for a prolonged period of time. (Fig.1)

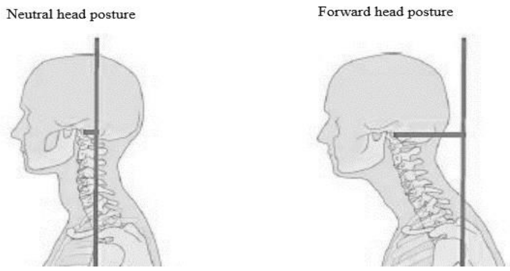

Fig. 1. Neutral head posture vs. forward head posture [13]

Objective

The aim of this study was to review recent research publications which have focused on the correlation between aspects of sagittal head posture (forward head posture), computer use and the prevalence of neck pain.

Material and methods

Records were identified through a thorough search in 3 electronic scientific databases PubMed, Scopus and Clarivate Analytics. Selection criteria was based on the publication date (only studies published between 2010-2020 were selected), their accessibility (full free text) and according to the key words used. The primary outcome of interest was “forward head posture observed in computer users”. Secondary outcomes include “neck pain”, “computer users”, “musculoskeletal disorders” and “head posture”. The search in selected databases provided a total of 89 studies. After screening the records found and removing duplicates our records number was 77 studies. When screening for full-text articles as well as their objectives and outcomes, a total of 28 studies were eligible to be included in this review.

Results

The concern regarding consequences of prolonged computer use at the workplace and the presence of musculoskeletal disorders has been consistent over several decades. One major postural change that was observed in computer users is the faulty position of the head – FHP, often associated with presence of pain.
Prolonged sitting and non-neutral head postures during occupational activity have been proven to be of a great risk to promote the occurrence of neck pain in people who use computers at the workplace [14].
Valide methods for measuring FHP have been described in scientific studies with the use of craniovertebral angle [12] or radiographic investigations [15]. After assessing head posture using X-rays, Sun et al., [15] confirmed that in people with spontaneous neck pain there is a significant association of pain with reduced cervical lordosis and FHP.
Measurement of changes in the thoracic spine and head position have also been linked with FHP. When measuring cervical and thoracic postures in computer users by measuring the craniovertebral and high-

[redacted]

thoracic angle [16], a significant relationship was found between abnormal postures of the head and cervicothoracic spine and presence of neck pain, but little evidence was proved to exist in the correlation of shoulder posture and neck pain. Later in 2015, Park et al., [18] stated that the evaluation and measurements of FHP requiers a more thorough assesement, appart from measuring the craniovertebral angle. Three methods – craniovertebral angle, head position angle and head tilt angle were compared in a study with 78 participants.

Subjects were organized in 3 groups of which 2 contained participants with FHP. Findings of the study show that subjects with smaller craniovertebral angle have more FHP, a larger head position angle was observed in participants with an exacerbated FHP and a larger head tilt angle was associated with the position of the head in extension relative to the cervical spine.

Significant correlation was found between FHP, neck pain and disability when measuring the craniovertebral angle [12]. Postural changes of the cervical spine as a consequence of sustained computer work have been observed through a modification of the upper cervical region and affects mostly cervical flexion range [18].

Compensatory postural actions have been seen in subjects with FHP, modifications in the curve of the cervical spine promote muscular imbalances which cause modifications in the scapulohumeral region (rounded shoulder posture) [19]. Also, findings of Shaghayegh et al., [20] demonstrated that subjects which present a forward posture of the head have a smaller craniovertebral angle, more noticeable in sitting rather than standing.

Muscle activity is proven to be affected in people with FHP due to changes in muscle length and a reduced ability to generate force. During a surface electromyography (EMG) measurement, Lee et al., [7] demonstrated a decreased activity of the splenii and sternocleidomastoids muscles in the FHP group during neck protraction (due to the shortening of these muscles in FHP) and weakness of cervical flexor muscles and scapular retractors (trapezius muscle). In a study that investigated thickness in cervical muscles (longus colli, sternocleidomastoid, semispinalis capitis, rectus capitis posterior and oblique capitis superior) in women with and without FHP, results presented a greater thickness of the sternocleidomastoid muscle in women with FHP associated with reduced activity of deep cervical flexor muscles [21]. FHP has a great impact on respiratory system caused by reducing muscle power in the neck muscles, consequently on the respiratory muscles and a reduced respiratory function [22].

The relationship between FHP and proprioceptive activity was investigated by Yong et al., [23] by assesing the value of the sense of position error (joint position error) using a digital inclinometer. Their results demonstrated a significant correlation between the severity of FHP and joint position error. Kang et al., [24] confirmed the association in subjects which present a relatively protruded head and neck posture with a change of the center of gravity in an anterior direction in static and dynamic situations, which affects the ability to maintain postural balance.

In a comparative study, Choi et al., [25] assesed the presence of fatigue in the cervical muscles due to non-neutral head postures. The results confirmed that between two types of monitors (regular fixed monitors and moving monitors), reduced neck fatigue was observed when using a moving monitor which contradicts findings of Yoo [8] who demonstrated that the use of a fixed workstation has proven to help prevent FHP. A profilactic point of view in postural imbalances like FHP should include ergonomic, individual and psychosocial modifications of the workload [26] and work environment [27], concurrently. [28-30] The association between reduced muscle activity, non-neutral head postures and musculoskeletal disorders has been demonstrated over the years to be more prevalent in computer users, especially among women [31]. In a cross-sectional survey which was addressed to 202 computer users in Estonia a high prevalence of musculoskeletal disorders was associated with at least one anatomical region, the most prevalent pain site being at the neck (51%) [32].

Differences in muscle activity and physical exposure have been observed in 117 office workers during a more complex design in method of measurement which included computer interactions, questionnaires, EMG of trapezius muscle and observation of shoulder, head, neck and torso posture while participants were performing computer work. Authors believed that each of these factors were

[redacted]

relevant in developing musculoskeletal disorders in computer users when performing the same tasks [33]. In a comparative study which observed the prevalence of self- reported musculoskeletal symptoms between computer users and non-computer users, demonstrated a higher risk for the computer users, influenced mostly by factors like age, gender and physical exposure time [34, 35]. Moreover, higher perceived exertion, perceived comfort and working technique were associated with an increased risk of developing musculoskeletal symptoms [36, 37]. Recommendations regarding an active workstation, taking more work-breaks and increasing physical activities have been proved to be efficient in reducing the prevalence of musculoskeletal disorders and improving quality of life among computer users [1, 6, 38].

Discussion

The results of this study confirm that prolonged duration of the computer use is consistently associated with non-neutral postures of the head, observed through forward head posture and musculoskeletal disorders of the neck and upper extremities. The results also confirm that forward head posture is associated with neck pain mostly caused by postural changes and amplitudes of the cervical spine observed with reduced cervical lordosis and reduced cervical flexion. These findings are similar with the results of Mahmoud et al., [39] who determined a correlation between FHP and neck pain.
When measuring the craniovertebral angle in subjects with FHP and neck pain results demonstrated a lesser angle in these subjects, which supports study findings of Singla & Veqar [40], also, modifications of the head position angle and head tilt angle have been associated with FHP, mostly noticeable in sitting rather than standing.
Modifications in the curve of the cervical spine promote muscular imbalances which consequently affect muscle activity and their ability to generate force, noticeable by the weakness of neck flexors muscle group and shortening of neck extensors muscle group.

Reduced muscle power in the neck muscles has a great impact on the respiratory muscles, reduced respiratory function often found in subjects with FHP. A significant change observed due to faulty head posture is in the anterior positioning of the center of gravity which affects muscular balance and sense of positioning, reducing proprioceptive activity. Results that uphold findings of Szczygieł et al., [41] in their review study.

Conclusions

Computer users are more prone to develop a forward head posture which can lead to an increased occurrence of neck pain. Forward head posture promotes improper muscular activities that negatively affect postural balance, consequently proprioceptive and respiratory function. A high prevalence of musculoskeletal disorders with a great impact on the neck region has been demonstrated among computer users, especially in female subjects.

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REHABILITATION FOR A POST-TRAUMATIC PATELLA DISLOCATIONIN A PATIENT WITH HIP DYSPLASIA – A CHALLENGING COMBINATION FOR A PHYSIOTHERAPIST

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Abstract

Introduction: Hip dysplasia is a well-known cause of hip pain and dysfunction characterizedby an increased mechanical load on the hip joint and soft tissues in this region. A common sign of atraumatic hip dysplasia is hyperlaxity caused by repetitive micro traumatic activities, genetic predisposition, or benign hypermobility syndrome. Patellar dislocation is a traumatic disruption of the patella from the femoral trochlear which can result in patellar instability, pain, recurrent dislocations, damage to the medial patellofemoral ligament, and patellofemoral osteoarthritis.

Case presentation: A 30-year-old male patient presents to our clinic with a history of patellar dislocation of the right knee after a traumatic event, a direct lateral blow by a car. After conducting a brief examination, we could observe that the patient revealed a painless dislocating hip issue on the right side, the peculiarity in the patient's medical history representing the justification of the study. The association between both pathologies limited exercise applicability of the rehabilitation protocol and, in order to follow the protocol's progressive stages, we adapted some of the weight-bearing exercises. The patient was asked to complete the Knee Injury and Osteoarthritis Outcome Score (KOOS) and the Hip disability and Osteoarthritis Outcome Score (HOOS) at the baseline of the first evaluation, and also after 1 and 2 months after beginning the rehabilitation program.

Results: After following The Gundersen Health System Rehabilitation Program and knee- hip targeted exercises to increase posterolateral hip musculature we obtained significant improvements in patient-reported outcomes (quality of life and pain) and functional performance (functionality, sports and recreational activities).

Conclusion: Our case highlights the importance of a thorough examination and proper rehabilitation program approach

to ensure full recovery. Thus, we can appreciate that a rehabilitation program which addresses the patients' hip dysplasia could cause a considerabledecrease in patella dislocation prevalence or recurrence. Using specific instruments as KOOS and HOOS questionnaires to assess patients' opinion about their social, physical, and associated problems helps us provide a better and more concise approach to conducting the rehabilitation program.

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Key words: *patella dislocation; hip dysplasia; hyperlaxity; knee injury; hip injury*

Rezumat

Introducere: Displazia de șold este o cauză cunoscută a durerii locale și a disfuncțieicaracterizate printr-o creștere a încărcării mecanice pe articulația șoldului și pe țesuturilemoi din această regiune. Un semn comun în displazia non-traumatică a șoldului este reprezentată de hiperlaxitatea cauzată de activități repetitive microtraumatice, predispoziția genetică sau de sindromul benign de hipermobilitate. Dislocarea patelară reprezintă deplasarea traumatică a patelei din trohleea femurală ceea ce determină instabilitate patelară, durere, dislocări recurente, deteriorarea ligamentului patelofemural medial, și artroză patelofemurală.

Prezentarea cazului: Un pacient de sex masculin în vârstă de 30 de ani se prezintă în cadrul clinicii noastre cu un istoric clinic de dislocare a rotulei drepte în urma unui incidenttraumatic, o lovitură din lateral cauzată de un accident rutier. În urma unei evaluări succinte, am observat că pacientul prezenta și o dislocare nedureroasă a șoldului drept, particularitatea istoricului medical reprezentând motivația studiului. Asocierea dintre cele două patologii a limitat

aplicabilitatea exercițiilor fizice din protocolul de recuperare și, pentru a urma etapeleprogresive ale protocolului, am adaptat unele dintre exercițiile cu încărcarea greutății corporale. Pacientul a fost rugat să completeze chestionarul Knee Injury and Osteoarthritis Outcome Score (KOOS) și Hip disability and Osteoarthritis Outcome Score (HOOS) la prima evaluare și de asemenea după 1 și 2 luni de la începerea programului de recuperare.
Rezultate: în urma aplicării programului de recuperare The Gundersen Health System și a exercițiilor specifice pentru dezvoltarea musculaturii posterolaterale a șoldului am obținut îmbunătățiri semnificative în rezultatele raportate de către pacient (cu privire la calitatea vieții și nivelul durerii) și performanța funcțională (funcționalitate, sporturi și activități recreative).
Concluzie: Acest caz evidențiază importanța unei examinări amănunțite și o abordare adecvată a unui program de recuperare pentru a asigura o recuperare completă. Astfel,putem aprecia că un program de recuperare care se adresează pacienților cu displazie de șoldpoate favoriza o scădere considerabilă a prevalenței și recurenței dislocării patelare. Folosindinstrumente specifice precum chestionarele KOOS și HOOS pentru a evalua opinia pacienților cu referire la probleme lor sociale, fizice și asociate, ne poate oferi o abordare mai potrivită și mai concisă în elaborarea programului de recuperare.

Cuvinte cheie: *luxație de rotulă; displazie de șold; hiperlaxitate; traumatism al genunchiului; traumatism al șoldului*

Introduction

Hip dysplasia, a well-known cause of hip pain and dysfunction is an orthopedic disordercharacterized by an increased mechanical load on the hip joint and soft tissues in this region due to a shallow coverage of the acetabulum [1, 2]. Hip dysplasia is more likely to occur during infancy, but it is also often discovered in adolescence or adulthood under the medical term "acetabular dysplasia" due to a shallow socket, the acetabulum, which does not support the ball, namely the femoral head. Poor congruency in the hip socket may increase stress on the labrum [3]. The acetabular labrum role in hip biomechanicsis to retain a layer of pressurized intra-articular fluid essential in load support, distribution, and stabilization against distractive forces in the hip joint and to better lubricate the joint [4, 5]. During hip dysplasia, the labrum is exposed to 10 times thenormal load [5], which exposes it to increased stress and leads to labral hypertrophy [1], degeneration, and tearing [5]. Most common structures implicated in the appearance of hip pain in patients with hip dysplasia are associated with degeneration and hypertrophy of the labrum and the ligamentum teres, increased stress in the cartilaginous surfaces [6], and a decreased function of the muscles surrounding the hip joint which participate in load transfer and hip stability [7]. A common sign of atraumatic hip dysplasia is hyperlaxity caused by repetitive microtraumatic activities (in sports like ballet or gymnastics), genetic predisposition, or benign hypermobility syndrome [8].

Patellar dislocation is a traumatic disruption of the patella from the femoral trochlear,sometimes referred to as primary patellar dislocation, which can result in patellar instability, pain, recurrent dislocations [9, 10], damage to the medial patellofemoral ligament [11], and patellofemoral osteoarthritis. It is considered the second most seen cause of knee hemarthrosis [12, 13]. Primary and recurrent patellar dislocations can be caused by predisposing factors as hyperlaxityof the knee ligaments, increased femoral anteversion, vastus medialis muscle hypotrophy, or genu valgus.

Case study

A 30-year-old male patient presents to our clinic with a history of patellar dislocation of the right knee after a traumatic event, a direct lateral blow by a car. After the incident, the patient was taken to the emergency room at the County Hospital of Timisoara, where the doctors applied a long-leg cylinder cast with the recommendations to keep the cast for four weeks. The patient did nothave a history of prior knee injury, surgery, or instability. After the removal of the cast, the patient continued to use a knee brace to help stabilize the kneecap. We conducted a brief physical examination and noticed that there was moderate effusion around the knee joint, tightness on the lateral retinaculum, tenderness along the iliotibial band, moderate atrophy of the quadriceps muscle,extension deficiency (knee blocked in flexion at about 10°) and passive knee flexion limited at 80°. During the adjoining joints' evaluation, we could observe that the patient revealed a painlessdislocating hip issue on the right side when conducting passive knee and hip flexion (beyond 30- 40°) in supine position. When assessing the patient from standing the lower limb posture presented overpronation at the feet level (more visible at the hind foot in the right leg than the left). Altered biomechanics have been obs[redacted]ring gait analysis showing a limping pattern with an external tibial torsion and overpronation more visible in the right leg as the patient was out-toeing during walking on a flat surface. The patient stated that he had increased pain with prolonged standing and difficulties when climbing/descending stairs.

An MRI conducted on the 9th of February 2021 stated that there was intra-articular hematic build-up as well as around the patellar bursae, a lateral subluxation of the patella, anosteochondral fracture on the medial condyle of the femur, osseous edema, a millimetric bone fragment detachment, medial patellar retinaculum avulsion in the patellar insertion, and mild edema at the insertion of the patellar tendon. At the beginning of the rehabilitation program the patient was using crutches and a knee brace.

The peculiarity in the patient's medical history, which described a hip dysplasia on the same side as the affected knee, represented the justification of this study. The association between both pathologies limited exercise applicability of the rehabilitation protocol that we use for patellar dislocations; to follow the protocol's progressive stages, we adapted some of the weight-bearing (closed kinetic chain and open kinetic chain) exercises.

The patient signed an informed consent regarding his participation in this study.

The patient was asked to complete the Knee Injury and Osteoarthritis Outcome Score [14] and the Hip disability and Osteoarthritis Outcome Score [15]. The Knee injury and Osteoarthritis Outcome Score (KOOS) was developed in the 1990s to evaluate the patients' knee symptoms and functionality. KOOS questionnaire consists of 5 subscales regarding pain, other symptoms, functionality in daily living, sports and recreation, and knee related quality of life [14, 16]. The Hip disability and Osteoarthritis Outcome Score (HOOS) assesses patients' hip symptoms and functionality according to their opinion in cases with or without osteoarthritis and consists of 5 subscales, just like KOOS. Both questionnaires can be used on a weekly or even yearly basis; a normalized score (100 indicating no symptoms and 0 indicating extreme symptoms) is calculated for each subscale for both questionnaires. We also conducted a general hypermobility test using the 9-point Beighton score [17, 18] in which a maximum score for ligament laxity is 9 and a score of 0 is tight. Our patient scored 5 out of 9, which indicates a generalized hypermobility of the joints.

The treatment plan was conducted in a conservative manner following objectives such as resolution of pain, swelling and inflammation, recovery of joint motion and flexibility, recovery of muscle strength, improve proprioception, motor patterns and coordination, and eventually return to sport activity.

As rehabilitation protocol we followed The Gundersen Health System Rehabilitation Program [19], which is an evidence-based and soft tissue healing dependent program. Following clinical practice guidelines recommended by Willy et al. (2019) [20], we also focused on including combined hip-knee targeted exercises as increasing strength on the posterolateral hip musculature inorder to improve patient-reported outcomes and functional performance.

Knee rehabilitation protocol (Table I) was described to the patient and structured on 6-8 weeks treatment plan. In the first 2 weeks, the primary objectives were to minimize knee joint effusion and to increase knee range of motion per tolerance. In this phase, the strength exercise program included quad sets, hip abduction with resistance from side-lying position to increase strength in the gluteal muscles, calf raises and balance exercises (standing on the affected leg) with wall/chair support. A significant aim of this phase was the normalization of gait pattern. In the second phase (weeks 2-4), the primary objectives were to return to full range of motion, and improve muscle strength, endurance and balance. The patient regained full weight-bearing normalized gait pattern by the 3rd week. In the last phase (4+ weeks),our major goals followed exercises which promoted muscle strength, endurance, balance activities, single leg stance progressions and cuing the patient to regain proper running pattern and reduce hip adduction while running.

[redacted]

Table I. Rehabilitation program [19]

Rehabilitation phase	Goals	Exercises
0-2 weeks (acute phase)	- Normalize gait pattern; - Minimize joint effusion; - Increase ROM pertolerance; - Therapeutic exercises for strengthening, stretchingand balance; - Improve and increase quadriceps function;	- Emphasis on return to full knee extension: prone hangexercise; - Restore quadriceps strength: single leg raises in all planes (with 1kg ankle weights, progressing to 1.5 kg by 2nd week); - Weight transfer exercises on single leg stance to challenge unilateral balance/proprioception and partial wall-squats bilateral and unilateral on the affected leg; - Flexibility and strengthening exercises for hamstrings (legcurls) and triceps surae muscle; - Multi-angle isometrics for quadriceps, hamstrings andiliopsoas (with resistance band); - Side-lying exercises to increase hip rotator muscles strength: clam shell exercises progressions and variations (withresistance band and/or ankle weights).
2-4 weeks (minimal protective phase)	- Regain full range ofmotion; - Increase muscle strength and endurance; - Improve single legbalance;	- Stretching exercises to promote full ROM using wall bars to support the affected leg; - Progression of strengthening exercises in closed kinetic chain:sumo squats (to avoid dislocating hip), partial lunges (with front leg supported on a stepper), hip thrusts (with resistance band above knees and hip externally rotated); - Balance and proprioception exercise: star excursion balance exercise using sliders, on flat surface and on balance board; - Standing glute exercises progressions and variations in closedand open kinetic chain (clam shells and fire hydrants with resistance band around ankles and/or above knees).
4-8 weeks (return to sportactivity)	- Progression to improve muscle strength, endurance and balance;	- Closed and open kinetic chain exercises to increase single leg strengthening: multiple directions lunges (with resistance band above knees), from partial squats to sumo squats (with resistance band above knees), step-ups variations (on flat surface and on wobble board); - Running progression – acceleration and deceleration, controlled change of direction, and basic agility drills (figure eight, carioca and shuttle run); - Impact activities started by 6th week – plyometric exercises (double and single leg directional hops on flat, even surface, 90° to 180° jump, and series jumping from/on height) (patient presented >75% strength compared to the unaffected leg).

In the acute phase, the patient exercised without knee brace, but continued wearing it throughout the day and night. Gait pattern without crutches was encouraged under supervision with progression to use 1 crutch by the end of 1st week and no crutches by the end of 2nd week. During exercises which promoted knee flexion patient was advised to be aware of his hip dislocation.

In the second phase of the program the patient continued to use the knee brace for long distance walks or prolonged standing daily activities; during all exercises in standing (closed and open kinetic chain manner), the patient was advised to control hip flexion in order to avoiddislocating the hip.

After 4 weeks into the rehabilitation program we used kinesiotaping during impact exercisesto stabilize the knee instead of the knee brace.

By the 8th week of the program we conducted a functional testing consisting of 5 items: balance, single hop in place, triple forward hop, jump/land, and single leg squat. The patient did not have any pain during testing and performed all movements with good control and balance (in all

[redacted]

planes of movement), no knee valgus in landing technique, and good trunk stability at contact with the floor. Only during single leg squat, when on the right leg, we did observe a painless mild dislocation of the hip at hip flexion past 60°.

Results

In order to assess and measure the outcomes of the individualized exercise protocol which we used with our patient, we analyzed the results of both KOOS and HOOS questionnaires. At the beginning of the rehabilitation program our patient presented a score of 15% after completing the KOOS questionnaire and a score of 89.4% after completing the HOOS questionnaire. After 1 monthof individualized exercise protocol for the knee and hip, the patient presented significant improvement in both questionnaires scoring a high of 66% for the KOOS and 95% for the HOOS questionnaire; after 2 months both scores reached a high of 91.1%, respectively 98.1% (Figure 1).

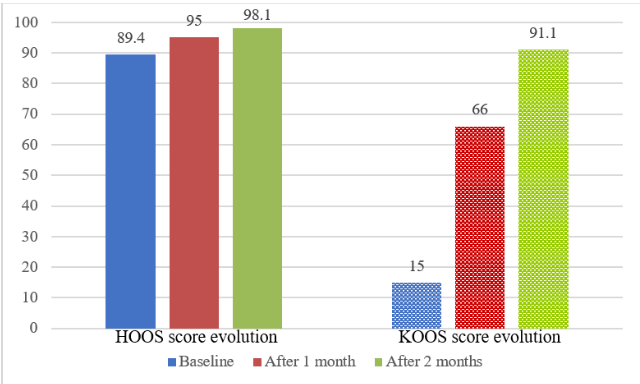


Figure 1. Evolution of KOOS and HOOS at baseline, after 1 month and 2 months of rehabilitation

Between February 22nd (at baseline) and after 2 months, significant improvements were noticed in the quality of life subscale and functionality, and sports and recreational activities subscale for the knee injury, both of them having improved by about 75%, respectively 85%. Pain and symptoms have subsided, and daily living activities improved significantly between baseline evaluation and the evaluation conducted after 2 months (Figure 2).

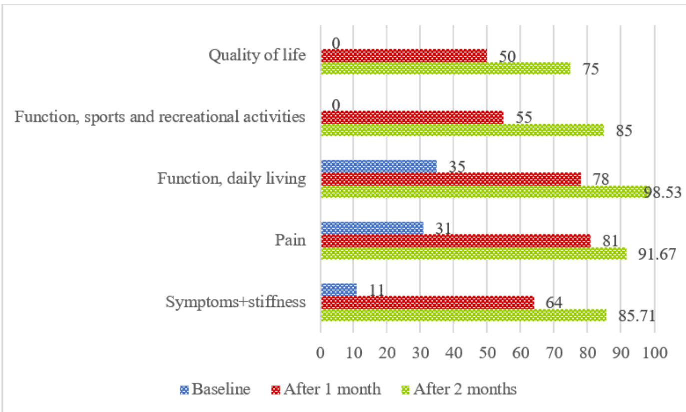
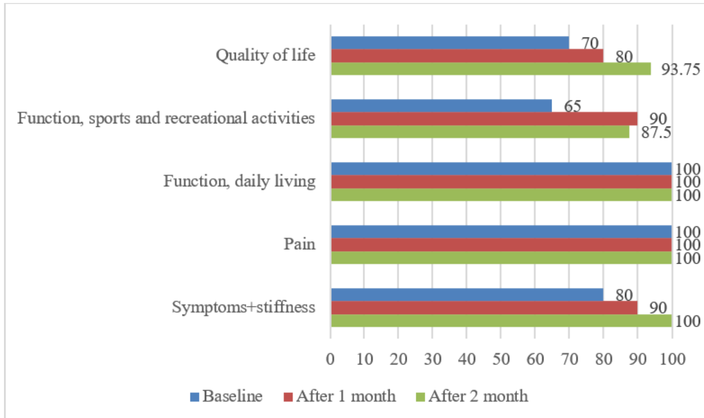


Figure 2. Subscales evolution for Knee injury and Osteoarthritis Outcome Score (KOOS)

[redacted]

Significant improvements were observed regarding the functionality, sports and recreational activities, and quality of life subscales between the first evaluation and after 2 months for the hip (Figure 3).

Figure 3. Subscales evolution for Hip disability and Osteoarthritis Outcome Score (HOOS)



Discussions

Li et al. (2013)[21] demonstrated in a study conducted on 75 patients with hip dysplasia that there are structural and biomechanical changes in their knees; it has been proven that the anterior femoral condylar angle of the femur and the groove angle was increased, and the trochlear groove was shallower in these patients. The lateral patella shift was also reduced, and the patellar tilt angle was increased in patients with dislocated hips compared with patients with normal hips. The authorsobserved that the extent of the mentioned changes differed with the degree of dislocation. Hu et al. (2019) [22] have also found patella alignment abnormality in 138 patients with developmental dysplasia of the hip; these patients' patellar instability was correlated with a more significant valgus angle of the lower limbs, a higher femoral neck torsion angle, quadriceps angle, and sulcus angle. Inthis context, even if the presented patient's patella dislocation was one of traumatic etiology, we must note that hip dysplasia may be a predisposing factor for such pathology of the knee.

We consider that a noticeable fact that made the rehabilitation easier and functionality improve for the patient was the hypermobility score that the patient presents, but at the same time, looking at the findings by Enix et al. (2015) [11], a predisposing factor in patients with a higher riskof patellar dislocations occurrence is hypermobility, especially in the knee region, as well as a mal- positioning of the patella.

Depending on the MRI findings and the evaluation of the supporting structures of the knee, after a displaced patella is reduced, a period of immobilization is preferred in a cast. A study conducted by Mäenpää and Lehto (1997) [23] suggested that by limiting the period of immobilization to three weeks, they could avoid and reduce muscle atrophy, knee joint restrictions, and retro-patellar crepitation. Although our patient was immobilized for four weeks in a long-leg cylinder cast and presented moderate muscle atrophy, especially on the quadriceps muscle (adifference of 2.5 cm between both thighs at the baseline evaluation), after two months from the baseline evaluation when measuring the thigh at the proximal third, we observed only a 1.5 cm difference between limbs. Several studies conducted by Powers et al. (2003) [24], Sillanpää and Mäenpää (2012) [25], and Van Gemert et al. (2012) [26] that followed patients with patellar dislocations cases, show return to full activity 8-12 weeks from the time of injury. When assessing the patient after eight weeks from the baseline evaluation, the KOOS score improved significantly, especially regarding function and daily activities subscale (from 35% to 98.53%) and functionality, sports and recreational activities (from 0 to 85%).

Conclusions

Our case highlights the importance of conducting a brief examination in order to elaborate the rehabilitation program approach and to ensure full recovery and a secondary prevention program.

Conducting a thorough clinical examination and discussing the patient's medical history is essential in creating an individualized exercise protocol. We followed clinical practice guidelines recommended for the pathology and diagnosis accordingly, but clinical outcomes as per the examination required minor modifications and variations of the protocol exercises. Thus, we can appreciate that a rehabilitation program which addresses the patients' hip dysplasia could cause a considerable decrease in patella dislocation prevalence or recurrence.

Using specific instruments as KOOS and HOOS questionnaires to assess patients' opinion about their social, physical, and associated problems helps us provide a better and more concise approach to conduct the rehabilitation program.

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The impact of home office setup due to COVID-19 pandemic on IT professionals′ physical health: a systematic review

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Abstract

Introduction: The COVID-19 pandemic represented a great reset in terms of how we work; it affected all organizational levels and brought up unexpected challenges, forcing a lot of workers to shift into working from home. A home office may not be suitable for IT professionals as it is not usually designed ergonomically for long-term use. This study *aimed* to explore the effects of the COVID-19 pandemic on IT professionals' physical health who hypothetically deal with non-ergonomic workstations at home and with modified workloads. *Material and method:* The research was conducted based on PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyzes) methodology. The scientific material was selected through a search in PubMed, Scopus, Clarivate Analytics, and Google Scholar databases; the eligible studies were published in 2020 and 2021, involved IT professionals who shifted to home office due to the COVID-19 pandemic and analysed the physical health issues related to these changes. *Results:* Physical health outcomes as neck pain and other musculoskeletal complaints, along with increased stress and anxiety, as mental issues, were reported in most of the participants interviewed in the selected studies; the musculoskeletal complaints were strongly influenced by the unexpected changes that came along with working from home in terms of workload and workstations. On the other hand, having a room dedicated to professional activities, an ergonomic workstation, knowing how to adjust the workstation, and increased satisfaction with indoor environmental quality factors in the workspaces were associated with a lower chance of developing new health problems during this period. *Conclusion:* The present study confirms that in the case of IT professionals there is a strong association between working from home, poor ergonomic workstations and high prevalence of musculoskeletal complaints, and, especially, an increased occurrence of neck pain.

***Key words**: IT professionals, COVID-19, work from home, ergonomics, musculoskeletal complaints, neck pain.*

Rezumat

Introducere: Pandemia determinată de COVID-19 a produs mari schimbări ale modului în care muncim; a afectat toate nivelurile organizaționale și a adus provocări neașteptate, forțând mulți angajați să lucreze de acasă. Pentru profesioniștii din domeniul IT, aceasta s-ar putea să nu fie cea mai potrivită variantă, având în vedere că spațiul de lucru de acasă nu îndeplinește, de obicei, principiile ergonomice potrivite pentru o folosire îndelungată. Acest studiu a avut ca *scop* investigarea efectelor pandemiei asupra sănătății fizice a specialiștilor din domeniul IT, care ipotetic, nu beneficiază acasă de spații de lucru ergonomice și au solicitări profesionale modificate. *Material și metodă:* Cercetarea s-a realizat conform metodologiei PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyzes). Materialul științific a fost selectat prin accesarea bazelor de date PubMed, Scopus, Clarivate Analytics și Google Scholar; studiile eligibile au fost publicate în 2020 și 2021, au inclus ca participanți profesioniști din domeniul IT care au trecut la munca de acasă și au analizat problemele de sănătate fizică care s- au asociat pandemiei de COVID-19. *Rezultate:* O mare parte din participanții intervievați în studiile selectate au raportat probleme de sănătate fizică cum ar fi durerile cervicale sau alte manifestări musculo-scheletale, alături de creșterea anxietății și stressului – ca probleme psihologice; manifestările musculo-scheletale au fost puternic influențate de schimbările neașteptate în ceea ce privește spațiul de lucru și sarcinile specifice muncii de acasă. Pe de altă parte, existența în casă a unei încăperi dedicate activităților profesionale, cu un spațiu de lucru ergonomic, cunoașterea modalităților de ajustare a acestuia, precum și un grad crescut de satisfacție în ceea ce privește calitatea factorilor de mediu din spațiul de lucru au fost asociate cu un risc scăzut de apariție a unor noi probleme de sănătate în această perioadă. *Concluzie:* Acest studiu confirmă faptul că, în cazul profesioniștilor din domeniul IT, există o legătură puternică între munca de acasă, spațiul de lucru neergonomic și prevalența crescută a tulburărilor musculo-scheletale și, în mod special, a durerilor cervicale.

Key words: *profesioniști din domeniul IT, COVID-19, muncă de acasă, ergonomie, tulburări musculo-scheletale, dureri cervicale.*

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Introduction

The beginning of the year 2020 represented a big challenge not only for the health system around the world but also for the working system. The COVID-19 pandemic represented a great reset in terms of how we work, represented by a forced modernization affecting all organizational levels and bringing up unexpected challenges, forcing a lot of workers to shift into working from home. Telework or telecommuting was fundamental during the pandemic in order to allow social distancing in the workplaces [1,2], in many companies the shift to full remote work being highly encouraged, and several protocols for the implementation of telework have been published [3].

Working remote, mostly from home, due to pandemic times brought up different working strategies. The idea of telework was developed in the 1970s [4] being more favourable in terms of saving time and money spent on commuting. According to Bouziri et al., in the late March 2020, 84 countries adopted temporarily teleworking – working from home [5]. Even before pandemic times, an increased number of people working from home (from 19% - in 2003 to 24% - in 2015) has been reported by the U.S. Bureau of Labour statistics [4]. Due to COVID-19 pandemic, in 2020, about 81% of the worldwide workforce has been affected and shifted to remote working [6]. In Italy, the number of remote workers increased by 69% [6], while in Switzerland, around 50% of the working community shifted to home office [7]. In a survey conducted by OWL Labs and Global Workplace Analytics almost 70% of full time workers in the United States were working from home during COVID-19 [8]. Working from home facilitates flexibility and provides workers a lot of advantages. In the case of technologically skilled workers, such as IT professionals, it provides the opportunity to engage with a globally distributed team, offers them schedule flexibility - regarding how and when to work, giving them autonomy over their working hours [2,9]. According to Bao et al., when employees can work from home, they are more able to manage work and life responsibilities [10].

Even though remote work gives the ability to work from anywhere, pandemic times forced a lot of workers to shift into home office, which brought up a lot of challenges, even for IT professionals. According to Ford et al., the most frequently reported challenges were lack of childcare (58%), poor ergonomics in the home based workstation (52%) and not enough physical activity (51%) [2]. An article in the Wall Street Journal, written by Aaron Zitner (May 13, 2020) discussed the association between working from home and the high incidence of neck and back pain, mostly due to poor working conditions - improper workstation ergonomics [11].

Many of the challenges with working from home were associated with reduced productivity due to more interruptions, lack of motivation, poor work environment, less time to complete work, difficulty communicating with colleagues and lack of a routine [2].

This transition to telework has become the new normal, regardless of where work is completed IT professionals engage in more screen time than ever before, in home offices that may not fit them ergonomically. Most of them had to set up an office using furniture, like dining tables and chairs which resulted in rapid onset of discomfort in the body that lead to stiffness, soreness, back and neck pain [4].

According to OWL Labs State of Remote Work 2020, the most frequent locations used to work from during home office were the dining room, the couch and the bedroom, as well as the kitchen table or on the floor. Evidently, none of these current home workstations are suitable from and ergonomic perspective [4]. A home office may not be suitable for IT professionals as it is not usually designed ergonomically for long-term use [8].

This study *aimed* to explore the effects of the COVID-19 pandemic on IT professionals' physical health who hypothetically deal with non-ergonomic workstations at home and with modified workloads.

Materials and Methods

The research was conducted based on PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyzes) methodology [12]. The scientific material was selected through a search in electronic databases as PubMed, Scopus, Clarivate Analytics, and Google Scholar.

[redacted]

Selection criteria was based on the publication date, only studies published between 2020-2021 being selected according to the key words used. The primary outcome of interest involved IT professionals (named also IT specialists, software engineers, software developer, programmers) who shifted to home office due to the COVID-19 pandemic and the secondary outcome involved ”ergonomics”, ”musculo-skeletal complaints”, ”pain” and also physical health issues related to ergonomic changes. Exclusion criteria was based on items as: workplace that was not shifted at home, publication language (other than english), publication year (before 2020/before COVID-19 pandemic), sistematic reviews, meta-analysis, or studies that observed other types of office workers The selection process is presented in Figure 1.

Results

We identified our records through database search (PubMed, Scopus, Clarivate Analytics and Google Scholar) and found 97 studies. 2 records were found in other sources (newspaper articles), giving us initially 99 records. After removing the duplicates, the articles that did not have the full-text available, we screened the remained records for eligibility and removed the articles that did not meet our inclusion criteria. Ten records were included in our qualitative synthesis. Almost all of them are transversal, cross-observational studies, one is a two-wave longitudinal study, and one has an experimental study design. The main characteristics of the studies are prezented in Table I.

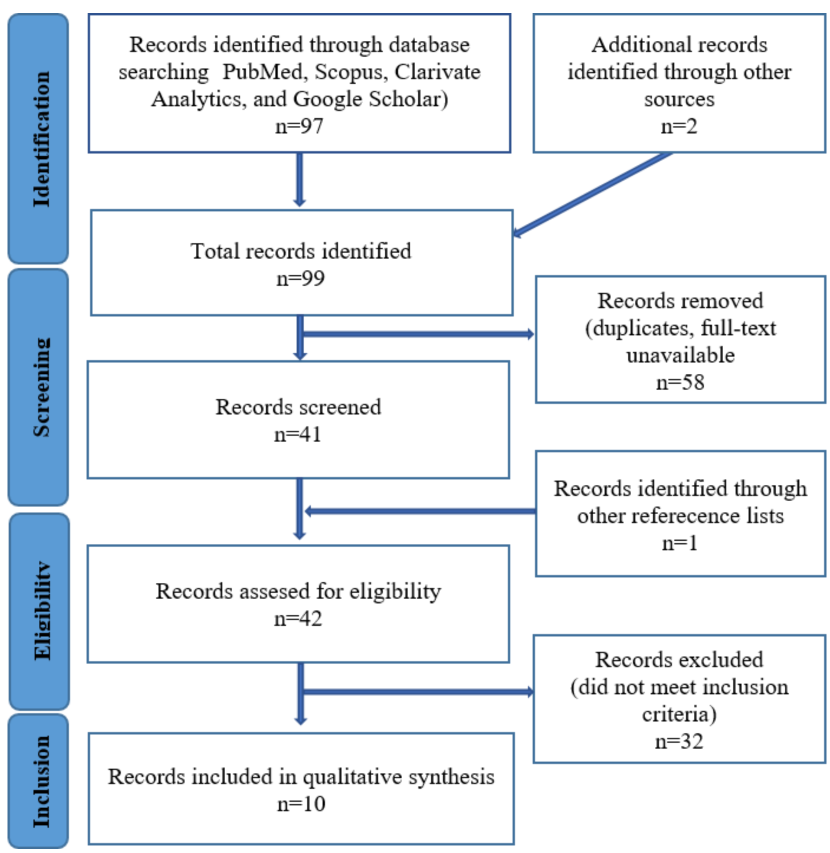

Figure 1. PRISMA flow chart demonstrating identification, screening and selection of included studies [12]

Table I. Main characteristics of the selected studies

Source (place of study - country)	**Participants**	**Assessment methods** ***Assessment period(s)***	**Results**
Aegerter et al., 2021 [7] (Switzerland)	n=69 (F: 71.01%) age: 42.2±9 yr.	- Neck pain (NRS) - Neck Disability Index - Workstation ergonomics (NRS) *Period: January-April 2020* *Baseline: work in office* *Follow-up: work at home*	- each working hour at the computer increased neck pain intensity by 0.36 points (95% CI: 0.09 to 0.62) (strong evidence); - each work break taken reduced neck disability by 2.30 points (95% CI: − 4.18 to − 0.42, evidence), but not pain level; - there is very strong evidence that workstation ergonomics was poorer at home.
Anand et al., 2020 [13] (India)	n=40 age: 31.7 ± 6.63 yr.	- pilot study - VAS pain scale - intervention: ergonomic guideline and neck and shoulder stretching program for 2 weeks *Period: NA*	- pain relief and reduced risk of developing MSD after 2 weeks; - VAS for neck pain was reduced from 4.82 ± 1.48 to 3.75 ± 0.95 (p=0.00023); - VAS for shoulder pain was reduced from 3.45 ± 1.57 to 2.75 ± 1.15 (p=0.0172).
Ralph et al., 2020[14] (53 countries)	n=2225 (F:18%) range: 30-34 yr.	- a questionnaire survey - Emotional Wellbeing (WHO-5) - WHO′s Health and Work Performance Questionnaire (HPQ) - Disaster Preparedness (DP) - The Bracha-Burkle Fear and Resilience (FR) - Ergonomics: six-point Likert scale - Organizational Support *Period: April 2020*	- poor home ergonomic workstation is a main predictor for risk of productivity and wellbeing reduction (after structural equation model regressions).
Redivo & Olivier, 2021[15] (South Africa)	n=136 MSD group n=68; F:45.6% Control group n=68, F:39.7%	- NMQ - The Effort-Reward Imbalance Model and Over-commitment Questionnaire - ROSA checklist *Period: 2020*	- MSD group experienced a mean score for multi-site MSD of 2.6 ±1.4.; - mean ROSA score (post-test) for MSD group was 4.5 ± 1.0 and for the control group 4.3 ± 0.8 (p=0.102); - most common pain site was the neck (69.1%).
Russo et al., 2021[16] (USA, UK, Portugal, Poland, Italy etc.)	n_1=192 (F: 38) age: 36.65±10.77yr. range: 19-63 yr.; n_2=184	- two-wave longitudinal study - Satisfaction with Life Scale - Office set-up (ergonomics): 7-point Likert scale; - Physical activity: Leisure Time Exercise Questionnaire (3-item); - Diet: 7-point Likert scale *Period of wave 1: April 2020* *Period of wave 2: May 2021*	- longitudinal analyses did not provide evidence that any predictor variable causal explained variance in well-being and productivity. - lighting, temperature, chair comfort, and overall ergonomics are more closely associated with office-setup, which was positive but not significantly associated with well- being and perceived work productivity. - quality of sleep: significant positive predictor for well-being in wave 2.

***Legend**: n: number of participants; yr.: years; F: female; NRS: Numeric Rating Scale; MSD: musculoskeletal disorders; NA: not available.*

Table I. *(continued)*

Source (place of study - country)	**Participants**	**Assessment methods** ***Assessment period(s)***	**Results**
Shah & Desai, 2021[17] (India)	n=129 (F: 34) age: 18-30 yr. = 37.2% 31-40 yr. = 55.8% >40 yr. = 7% range: 18-65 yr.	- Google survey (work place, ergonomics knowledge, pain) - Neck disability index (NDI) - Oswestry low back pain (ODI) *Period: November 2020*	- Place of work (office/study/dining table: 48.8%; bed/sofa/comfort chair: 42.6%); - Ergonomics knowledge: none – 59.14%; may be – 9.08%; yes – 31.78%; - Pain: neck + upper back – 30.23%; lower back + legs – 25.58%; neck + back + legs – 11.63%; - NDI: no disability – 30.2%; mild disability – 41.9%, moderate disability – 24.8%; severe disability – 3.1%; - ODI: minimal disability - 67.4%; moderate disability - 31.8%; severe disability 0.8%.
Shaikh & Kadrekad, 2020[18] (India)	n=778 (F: 43.7%) age: 20-25 yr. = 31.3% 26-30 yr. = 25 % 31-35 yr.= 12.5 % 36-40 yr.= 12.5 % 41-45 yr. = 6.3 % >45 yr. = 12.5%	- online survey of total 23 questions using Google form (working hours, posture, pain, methods used to alleviate pain etc.) - *Period: April-May 2020*	- high prevalence of MSD: shoulder pain/trapezius pain, elbow pain, wrist pain and back pain; - significant increase in percentage of headaches, eye strains; - poor workstations ergonomics at home – only 43.6% had enough space to move around, 76.2% had to lean in front on the table/laptop, 32.1% had the table at waist level, 16.1% had elbow support; - only 46% of the participants took frequent breaks and exercises for pain reduction.
Varshney et al., 2021[19] (India)	n=434 (F: 41.24%) range: 18-45 yr.	- Neck Outcome Score Questionnaire *Period: April- June, 2020*	- 52% of the participants reported increased neck pain due to prolonged computer use during COVID-19 lockdown.
Widianawati et al., 2020[20] (Indonesia)	n=50 age, gender: NA	- quantitative design study about ergonomics design of WFH and its implications for musculoskeletal, work time, and stress) *Period: July 2020* -	- 28% had MSD, out of which all of them experienced neck pain; - the design of the ergonomic work facility and MSD affect the rest time by 48.5% ($p<0.05$); - the ergonomic design of the workstation is strongly associated with the risk of developing MSD ($p<0.05$).
Xiao et al., 2021[21] (USA)	n=988 age: 40.9 yr. gender: NA	- anonymous questionnaire about: 1. lifestyle factors 2. occupational environment 3. home office environment 4. physical and mental well-being All factors were assessed using a 5-point Likert scale. - *Period: April-June, 2020*	- although 11% of the participants reported that they had proper workstation setup and knew how to adjust it they were at higher risk of increased body pain or to develop other physical health conditions; - participants reported to be less productive, with lower job satisfaction and increased neck pain.

***Legend**: n: number of participants; yr.: years; F: female; NRS: Numeric Rating Scale; MSD: musculoskeletal disorders; NA: not available.*

Discussions

Although some software professionals used to work from home before the COVID-19 pandemic, it is essential to note that remote work in the pandemic is not the same as traditional remote work. During this period, many new challenges appeared [22].

Transition to working from home decreased mental and physical wellbeing and had an important impact on mental and physical health, including decreased physical activity and increased junk food intake [21]. A study made in Microsoft Corporation [2] showed that home remoting had some disadvantages on their employees′ physical and mental health (reduced social interactions – 83%, a disrupted work-life balance – 78%, non-ergonomic home environment – 70%, less physical activity – 65%), but also several benefits (reduced health risks – 72%, more physical activity – 34%, closer to families – 81%). A part of the respondents appreciated more working from home because their environment is more quiet, spacious, private, has a better natural light or closer bathroom, assures better personal comfort (as lounge clothing, no make-up). On the other hand, many IT specialists confirmed that their furniture at home was not as ergonomic as their furniture at work (e.g., small desk space, no standup desk, less ergonomic keyboards). In this regard, Microsoft provided recommendations and financial support to sustain the adjustments of home workspaces of their employees in an ergonomic way [2]. After Ralph et al. (2020), 41.4% of the investigated IT professionals stated that they consider that it is or it would be helpful if their organizations offer them home exercise programs, while 15.8% are following such programs [14].

Butler & Jaffe (2021), based on 4,641 nightly reflection diaries, found that one of the challenges for IT professionals in this period is the increasing physical and mental health issues (worries related to COVID-19, headaches, overtired, sore back from lack of ergo furniture) [23]. Research of home working was made even before Covid 19 pandemic. In a review published in 2020 by Ciolfi et al., it was demonstrated that the duration of actual work performed at home is longer than the duration of work performed in the office being task-based instead of clock-based [9].

Russo et al. (2021) published a study that covered an extensive set of 51 predictors for the well-being and productivity of software professionals in the COVID- 19 pandemic. Nine of them were reliably associated with well-being and productivity, one being workplace ergonomics. However, the longitudinal analysis between data collected in April 2020 and May 2021 did not provide evidence that any predictor variable causal explained variance in well-being and productivity [16]. Similarly, a structural equation regressions model was made by Ralph et al. (2020). It indicates the relative strength and directions of the relationships between change in well-being, fear (of bio event), home office ergonomics, disaster preparedness, and change in perceived productivity. The best predictor for software developers' well-being working from home was ergonomics, followed by COVID status, fear, age, and disaster preparedness. For perceived work productivity, also ergonomics was the best predictor, followed by disaster preparedness, adult cohabitants, disability, age, and fear [14]. The relation between poor ergonomics and physical health issues, especially musculoskeletal disorders (MSD), in IT professionals, is well known and confirmed by numerous researches [24-26]. However, it must be mentioned that, even before the pandemic, many studies confirmed that no or minimum attention was paid to ergonomics in the majority of the home offices, with a lack of ergonomically designed and adjustable furniture and equipment [27, 28]. Some relevant studies reconfirmed that ergonomically poor designed workstation has a high impact on the body posture and increases risks of developing MSD in the neck and upper back [7, 29]; there was a significant association between MSD and laptop users, rather than normal computer station users [29].

Moretti et al. (2020) [6] found that: most workers (58%) have had some type of office chair (not good enough), dining chairs (27%), and non-chairs like a bed or couch (15%); 54.9% of seats have not adjustable height; 56.9% of chairs have four legs, not wheels; the back of the seats are flat (no concave) in 54.9%, and 68.6% had no back inclination; the majority sits at a desk (88%), while a small portion sits at a dining table (7%); 86.3% had a table with adjustable height. Auxiliary computer accessories are highly relevant in workstation ergonomics according to their type. Laptop keyboard (54%) and external keyboard (46%); 47% of the external keyboard users have a laptop as a secondary input; laptop touchpad or input devices were used by 46%; external mouse was used by 54%; more than half of the external mouse users (55%) used the touchpad of the laptop for an input device. Monitor types were divided into four groups: laptop (29%), external monitor only (17%), the combination of laptop and external monitor (39%), and multiple monitors (10%) [6].

Regarding the relation between workplace ergonomics and the cohabitants′ number, it seems that people who live alone have more ergonomic home offices [14].

Moretti et al. [6] even recommend the Mayo Foundation for Medical Education and Research – Office Ergonomics Guide [30], after observing that the majority of their participants used an ordinary kitchen chair and table which were not adjustable in height and laptops that did not have any

[redacted]

height- adjustable support.

Shah & Desai (2021) found that 59.14% of professional computer users haven't any ergonomic knowledge [17].

A study conducted by Moretti et al. [6] reported that 70.5% of participants reported musculoskeletal pain after shifting to working from home, most frequently at the low back (41.2%) or neck (23.5%), and 23.5% in multiple sites. Increased intensity of pain was reported in the neck area, during daily activities, compared to lower back pain, according to a higher mean score on the Fear Avoidance Beliefs Questionnaire (FABQ) – work component [6]. Redivo & Olivier [15] observed in most of their participants more than five sites of pain after reviewing NMQ results and concluded that there is a high need for chronic pain interventions in professional computer users.

Aegerter et al. (2021) found a 0.68-point reduction of the neck pain on the NRS but declared it not sensitive enough and added more information for analysis (such as; frequency, duration, quality and location of pain). They have also used NDI to assess neck functionality, finding that some ergonomic measures, such as taking more work breaks improve NDI but not pain intensity on NRS [7].

Data from the selected studies were enforced by the findings of other similar studies [4,23,29,31] who also reported severe discomfort in the back, eyes, head, and neck.

"Pandemic posture" is a term increasingly used by health professionals as a suitable expression for the non-ergonomic posture adopted by those who work from home; it has as main consequences pain in the neck and back [32-34]; the cumulative effects of musculoskeletal stress are felt more and more now, after a more extended period of work at home.

In the studies screened for this review, physical health and, especially the MSD of IT professionals, was investigated with Nordic Musculoskeletal Questionnaire [15, 35], Modified Nordic Questionnaire [29], Neck Disability Index [7], Emotional Well-being and Health and Work Performance Questionnaire [14], Neck Outcome Score Questionnaire [19]. Shaikh & Kadrekad (2020) have used an online survey of total 23 questions (working hours, posture, pains, methods used to alleviate pain etc.) using Google form [18]; Xiao et al. used a 5-point Likert scale that evaluated 4 categories: 1. lifestyle factors (overall physical activity, food intake); 2. occupational environment (level of communication, work duration, changes in workload expectations and distractions); 3. home office environment (visual, thermal, air quality, noise); 4. physical and mental well-being [21].

Even the home office ergonomics is an essential factor for the IT specialists' physical health, well- being, and work productivity, a valid scale for evaluating this element is hard to find [36]. Ralph et al. (2020) used a simple six-item, six-point Likert scale concerning distractions, noise, lighting, temperature, chair comfort, and overall ergonomics [14]. Panchal et al. [29] and Redivo & Olivier [15] applied the Rapid Office Strain Assessment checklist (ROSA) to identify and quantify the ergonomic risks when working on a computer. Aegerter et al. used a numeric rating scale scored from 1 (very good ergonomics) to 5 (very poor ergonomics) for evaluation of breaks during work, hours worked per day, self-rated quality of workstation [7].

Moretti et al. (2020) analyze the workplace ergonomics related to current regulations and the national standards for office work chairs, office furniture, and lighting [6].

Many recent studies estimate that working from home will be more common after the pandemic than in the pre-pandemic period [37-40]; in all probability, this aspect will also be found among IT professionals [16]. It could be the reason why attention to all the elements incriminated in maintaining physical health in such situations will be viewed from another perspective - one in which the professional has greater control and, consequently, a more significant impact than in the pre-pandemic period. The elements we are referring to are: workplace ergonomics, diet, physical activity, sleep, and the management of work-life balance. Lopez- Leon et al. (2021) centralized some specific recommendations for working from home to preserve the quality of life in all its aspects; they mainly refer to creating a daily routine, organizing a proper home office, maintaining the balance between work and the rest of the daily activities, avoiding multitasking, facilitating communication, and networking [41].

We consider that this research has a few limitations:

1. although many studies were dedicated to working from home during the pandemic, a relatively limited number of them refer specifically to the participants'

physical [redacted] problems, focusing more on psychological impairment and the impact on work productivity;

2. of the population categories investigated related to the impact of the pandemic on their activity and on their health, IT specialists represented only a relatively small part, given that an overwhelming percentage of the world's population has carried out online activities during this period;

3. the majority of surveys were online submitted, without explanations or questions, details for participants, and the evaluated parameters (ergonomics, MSD, physical and mental health) have been self-reported, which revealed a subjective aspect;

4. the studies selected for analysis are highly different in terms of assessment methods (questionnaires, scores for health-related problems or ergonomics of the workplace), so a meta-analysis was difficult to perform.

Conclusions

The COVID-19 pandemic induced some unique conditions for many IT specialists too. Some were good for health, but others induced or aggravated pre-existing pathological conditions. The changes were different from those considered typical, even for those who usually work from home; we refer in particular to the impact of the decrease in physical activity imposed by the epidemiological situation and the additional stress factors that have just appeared (risks of infection, change in the daily routine of the whole family or cohabitants, travel restrictions, isolation). In addition, the ergonomics of the workspace – deficient in many cases, was a significant factor in declining well-being, work perceived productivity and the appearance or aggravation of some health problems. The present study confirms that there is a strong association between working from home, poor ergonomic workstations and high prevalence of musculoskeletal complaints, and, especially, an increased occurrence of back and neck pain in the case of IT professionals.

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ANALYSIS OF HIGH-SPEED RUNNING AND SPRINT RUNNING IN ELITE FEMALE FOOTBALL COMPETITIONS

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Abstract

Introduction: Although football is recognized as the fastest growing sport globally, scientific literature on female football is still limited. Available published data in understanding the physical demands of female football players have described the necessity of a high level of physical conditioning during matches with average heart rates of 84-86% maximum heart rate and an average of 9.1-11.9 km in total distance covered in the running. The most commonly utilized physical performance measures reported are high-speed running (19 km/h-23 km/h) and sprinting (>23 km/h). A better understanding of football's physical, technical and tactical demands has resulted from investigations of both training and matches by wearing a global positioning system unit.
Objective: This study aimed to assess the running speed and the proportions of different types of running during official competitions in elite female football players.
Material and Method: A total of 22 female players (16 seniors and six juniors) that are part of a Romanian First League female football team - Politehnica Timisoara, have been monitored for running speed and covered distance in 6 official matches, which represent a quarter of the championship period. The assessment period was ten weeks (August-October 2021). The monitored parameters (total distance, distance/minute, low speed running, high speed running, sprint running, and maximum speed) were obtained using K-Sport GPS with a high sampling rate of 50 Hz.
Results: During the six analyzed matches the following average values were found: total covered distance - 7906.33 ± 1176.68 m, distance/minute - 90.83 ± 3.72 m/min, low-speed running distance - 7598.50 ± 1102.16 m, high-speed running distance - 308 ± 101.31 m, sprint running distance - 69.50 ± 28.54 m, and maximum speed - 25.13 ± 0.84 km/h.
Conclusion: Regarding the monitored parameters (total distance, average speed, proportion of different speed running, maximum speed), we observed a constancy between different matches. During female football matches, high-speed running and sprinting covered 4.77% of the total distance. Based on this data, a future training objective would be the enhancement of this percentage in order to optimize the key moments of the matches.

Keywords: high-speed running, sprint running, female football, match analysis, gps tracking system.

1. Introduction

Although football is recognized as the fastest growing sport globally, scientific literature on female football is still limited. Physical and physiological characteristics of female football players during trainings and matches started to have a growing interest in scientific investigations. In 2015 Women's Football World Cup in Canada presented a growing popularity of this sport. Nowadays number of female football leagues continue to grow. The Fédération Internationale de Football Association (FIFA) presented a report in 2018 in which they predicted that by 2026 women's participation rates will double to 60 million worldwide (Griffin et al., 2020).
There is a disparity in published scientific literature that evaluates running speed and different types of running in female football players. Football involves explosive linear and multidirectional actions that require the players to be physically prepared for high- intensity bouts of running, repeated changes of direction, sprint running, acceleration/deceleration in demanding actions – technical and tactical components (Izzo et al., 2019; Sprouse et al., 2020).
Several scientific studies demonstrated that the total distance covered by an elite female football player during an official match is up to 8-12 km (Altavilla et al., 2017; Datson et al., 2014; Mara et al., 2015) while for men is 10-13 km (Bangsbo, 2014). Important periods during matches that distinguishes elite player from those at a lower level are high-speed running (19-23 km/h) periods and sprint running (>23 km/h). The key component of performance in football game is the ability to perform these types of intense actions

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that are observed in an elite level through a higher number of intense runs (Datson et al., 2014; Izzo et al., 2020). Factors that influence the distance covered in a game include not only the physical capacity of the athlete but also technical qualities, playing position, tactical qualities, opponent's level and the importance of the game (Bangsbo, 2014).

Valid indicators of the training status and physical performance level is defined by high-speed running and high-speed distance (distance during high speed runs) (De Silva et al., 2018). Studies conducted on elite female football players competing in the European Champions League demonstrated that the distance covered in high-speed running is less when comparing it to male football players from the same level (Bangsbo, 2014; Bradley & Vescovi, 2015). Also a difference in high-speed running distance is observed between playing positions, according to Datson et al. (2014) midfielders cover a greater distance than attackers or defenders, whereas in sprint running midfielders cover less distance than attackers and defenders.

Bradley and Vescovi demonstrated in 2015 that female football player covered only 718 m of the total distance in high-speed running during a game while male players covered 986 m of the total distance. When analyzing sprint running, they found out that women cover only 59 m of the total distance during a game while male players covered 200 m.

Sprinting ability is considered a very important factor in football games making a great difference between elite and sub-elite athletes. According to Datson et al. (2014) when comparing international elite female players to moderate-level female players it was observed that elite athletes performed 28% more high-intensity running and 24% more sprinting during official games. Vescovi (2012) and Mara et al. (2015) reported that sprinting actions are performed in short periods of 2 -6 s during matches. Other essential variables in the football game are abilities like acceleration, deceleration and change of direction.

Player movement tracking is targeted nowadays when using tools like global positioning systems (GPS), enhancing the accuracy of the physical characteristics of each athlete providing immediate responses to the coaches and professional analyst performance (Altavilla et al., 2017; Izzo et al., 2020). This observational method helps monitoring the progress or evolution or a team or an athlete both in matches as well as in trainings. A study conducted by Trewin et al. (2018), reported that FIFA has allowed the use of these kind of tracking systems. In the recent scientific literature there is limited data regarding the use of these systems in female football games.

K-Sport technology (K-Sport.Tech, 2021) offers reliable information related to physical parameters, is validated by the Technical University of Munich and is certified for in-game use by FIFA. K50 wearable tech consists of a GPS, an ultra-wide band, an accelerometer, a gyroscope and a magnetometer. It measures directly the heart rate (HR) by a smart vest with a HR belt and offers real-time analysis on a customized multi-platform.

This study aimed to assess the running speed and the proportions of different types of running during official competitions in elite female football players.

2. Materials and Methods

22 female football players – 16 seniors (>18 years old) and 6 juniors (14-18 years old) that are part of a Romanian First League female football team – Politehnica Timisoara were monitored during 6 official games. The assessment period lasted ten weeks – from August until October 2021, that represents a quarter of the championship period.

The collected data were obtained following 6 official games played at a national level with opponents from the same league. All activites during this time were monitored using K-Sport GPS with a sampling frequency of 50Hz. All GPS units have been placed inside the smart vest that have been worn by the athletes during the games. Data collected have been downloaded to a laptop and the results were analysed with Microsoft Excel 2016.

All athletes have been informed about the study and written consent was obtained prior to participation. Only outfield players were included in the current study from the following playing positions: forward, midfield, fullback and centre back.

3. Findings

Mean values and standard deviation of each parameter monitored during all 6 official matches were calculated and presented in Table 1.

Table 1. The mean values of the monitored parameters during 6 official games

	Total distance (m)	**Distance/minute (m/min)**	**Low-speed running (<19 km/h) (m)**	**High-speed running (19-23km/h) (m)**	**Sprint running (>23 km/h) (m)**	**Maximum speed (km/h)**	**Game outcome and score**
Game 1	8576	89	8241	336	80	26.1	lost 3-1
Game 2	6252	86	6032	220	50	25	won 4-1
Game 3	9682	98	9164	518	128	26	lost 4-1
Game 4	8690	92	8459	231	43	23.6	won 4-1
Game 5	7359	91	7074	285	60	25.3	lost 4-1
Game 6	6879	89	6621	258	56	24.8	lost 3-1
Mean	7906.33	90.83	7598.50	308.00	69.50	25.13	
Standard deviation	1176.68	3.72	1102.16	101.31	28.54	0.84	

Figure 1 presents the total distances covered in all 6 official games, there are visible differences from game to game mostly due to the opponents` level. It was found that the average total distance covered was 7906.33 ± 1176.68 m.

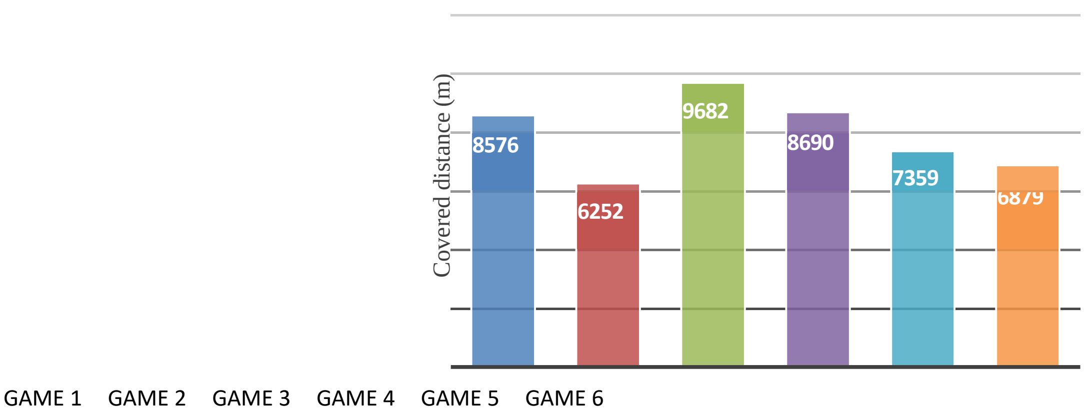

Fig. 1. Total distance covered in 6 games

Figure 2 shows distance/minute covered in each of the 6 games played. Average distance/minute was 90.83 ± 3.72 m/min (5.45 ± 0.33 km/h).

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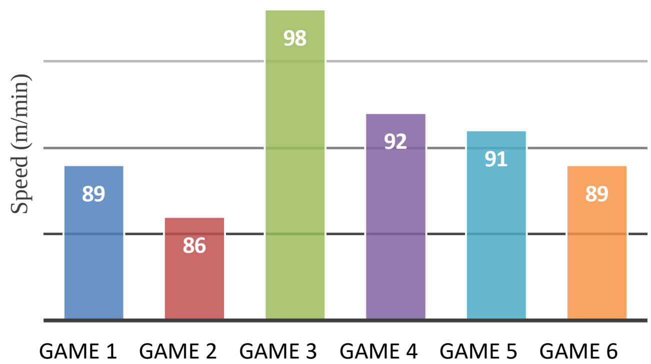

Fig. 2. Distance/minute covered in all 6 games

Figure 3 shows results of low-speed running (>19km//h) distance. Average low-speed running distance was 7598.50 ± 1102.16 m.

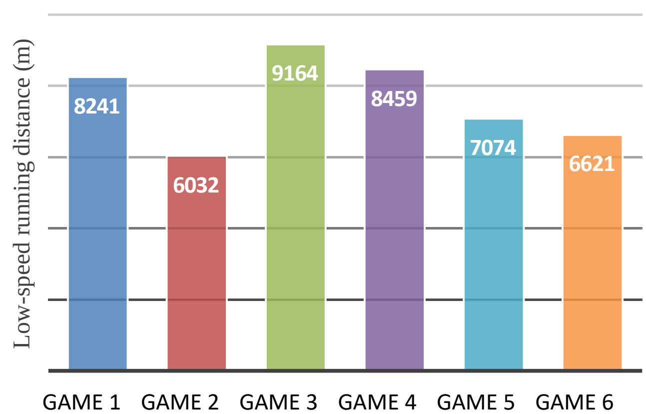

Fig. 3. Low-speed running values in all 6 games

Figure 4 presents results of high-speed running (19km/h-23km/h) distance. Average high-speed running distance was 308 ± 101.31 m.

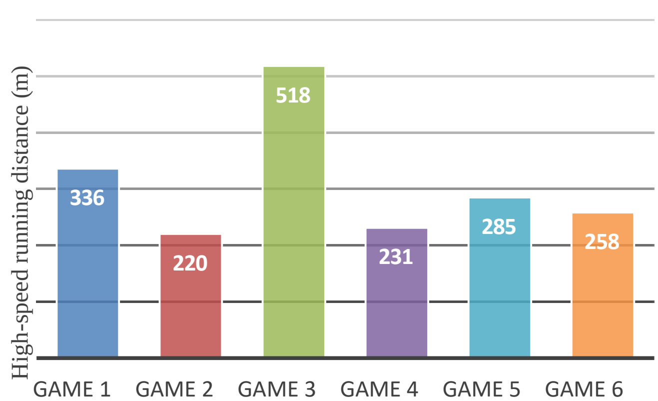

Fig. 4. High-speed running values in all 6 games

Figure 5 presents results of sprint running (>23 km/h) distance. Average sprint speed distance was 69.50 ± 28.54 m.

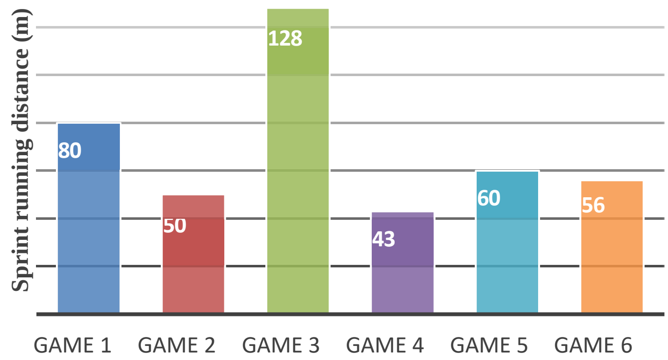

Fig. 5. Sprint running values covered in 6 games

Figure 6 presents results obtained at maximum speed. Average maximum speed covered was 25.13 ± 0.84 km/h.

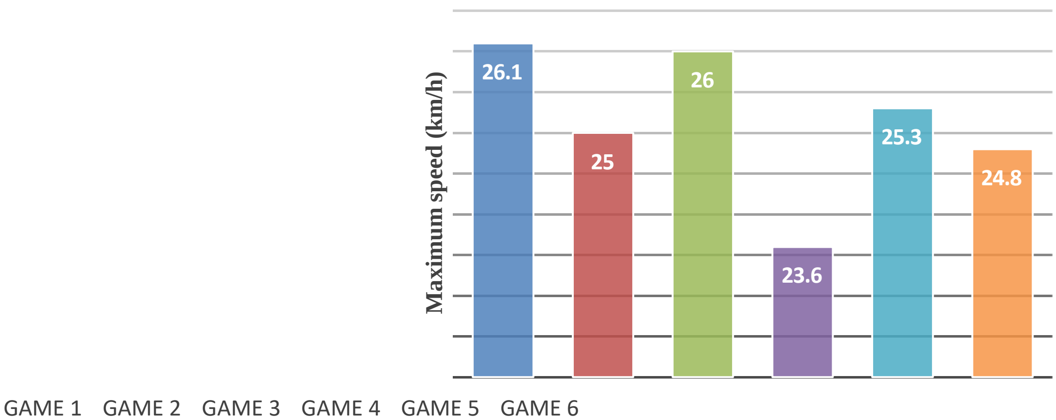

Fig. 6. Maximum speed values covered in 6 games

4. Discussion

To our knowledge this is the first study to assess the running speed and the proportions of different types of running with the use of K-Sport Tech 50Hz during official competitions in a Romanian elite female football team.

Differences observed between game outcomes strengthen the results of the measured parameters. The greatest difference in the total distance covered (Figure 1) was between the 2nd game played (6252m) which was won and 3rd (9682m) which was lost. Regarding the distance covered per minute (Figure 2) differences were observed between the 2nd game played - 86 m/min (5.16 km/h), and the 3rd game - 98 m/min (5.88 km/h) as well as with results of low-speed running distance (Figure 3) - 2nd game 6032m, respectively 3rd game 9164 m.

When measuring high-speed running distance and sprint-running distance, we observed that there are visible differences between games that were lost (the longest distance covered) compared with the ones that were won (Figure 4, Figure 5). Greatest difference of high-speed running distance was between the 2nd game (won) 220 m, and the 3rd game (lost) 518 m, although in sprint running it was between the 4th game (won) 43 m and the 3rd game 128 m (lost).

Also when measuring maximum speed (Figure 6) we observed that the highest results were obtained in a losing game, 1st game 26.1 km/h (lost) compared with the 4th game (won) 23.6 km/h.

We observed that there is a relation between physical performance parameters measured and match outcomes. Similar observations have been made by Modric et al. in 2019 who also concluded that in a winning game there are less high-intensity activities. Andrzejewski et al. (2018) attributed these observations to the fact that the style of play differs when in need of a goal.

We consider that a limitation of our study was due to the small number of analysed games which made difficult a more detailed statistical analysis. Further research will be taken into consideration by monitoring and analysing the specific physical performance parameters for the entire championship.

5. Conclusions

Monitoring physical parameters as high-speed running, sprint running or maximum speed is an optimal performance management in training load and in minimizing risk of injuries. The technology used has led to these detailed results in many aspects of the game from which we observed a constancy in between matches, with only 4.77% of the total distance covered in high-speed running and sprinting. A more elaborate approach is needed to establish if there is a correlation between these parameters and the games' outcomes in order to optimize the key moments of games.

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Monitoring forward head posture in IT professionals – case study

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Abstract

Introduction: Computer use in professional activity, especially for IT professionals, typically involves sustained and frequent periods of sitting behind monitors that promotes forward head posture (FHP) during work. Maintaining an excessive anterior posture of the head can lead to changes between the spine and the line of gravity, involving a shift of the center of gravity. Measuring the craniovertebral angle (CVA) is a reliable method when assessing head and neck posture, this angle is significantly smaller in subjects with forward head posture and implies a greater level of disability.
Objective: Our study aimed to evaluate the degree of forward head posture by measuring the craniovertebral angle in the case of a IT professional.
Material and Method: We observed a 31 years old male IT professional (development and operations engineer) with 10 years experience in IT domain. We monitored our subject for 5 working days. Videos and photos from saggital view in the usual working sitting position of the participant have been taken in key moments of the day – in the morning, before lunch brake and at the end of the shift. We evaluated forward head posture in our subject by measuring the craniovertebral angle using the Kinovea software 0.8.15 and analyzed data using Excel. Neck Disability Index questionnaire has been used in order to measure patient-reported disability. Exposure to risk factors in office work environment have been evaluated with the help of ROSA checklist.
Results: The analysis showed a significant difference ($p<0.05$) between the craniovertebral angle measured at the beginning of the working day and at the end of the same day, as well between the first working day of the week and the last ($p<0.001$).
Conclusion: Our study highlights major changes of head posture when measuring CVA in the case of a professional computer user during a period of 5 work-days. An easy approach and non-invase method when measuring FHP is the use of Kinovea software that provides concise data of the CVA. More data are necessary for a better accurancy and validity of results and to better describe if these changes happen randomly or habitually.

Key words: *forward head posture, craniovertebral angle, neck disability index, IT professional, computer use.*

Introduction

Computer use in professional activity, especially for IT professionals, typically involves sustained and frequent sitting periods behind monitors that promote forward head posture (FHP) during work. Maintaining an excessive anterior posture of the head can lead to changes between the spine and the line of gravity, involving a shift of the center of gravity and an increased weight on the neck (Jain & Sharma, 2018; Kim & Kim, 2016). Static prolonged sitting postures while heavy use of a computer as a professional activity represents a great risk of neck pain occurrence, especially in the presence of FHP. Changes in posture cause overload on muscles and connective tissues, consequently leading to modified biomechanical movements of the neck and upper body as well as muscular imbalances (Kim et al., 2018). Functional activity of the muscles in FHP is highly altered, especially in the craniocervical area observed through tightness on the extensor muscles (posterior cervical region) and lengthening of the flexion muscles (anterior cervical region) (Kim et al., 2018; Subbarayalu, 2016).

When assessing FHP clinically, the position of the head should be observed relative to other anatomical landmarks – the seventh cervical vertebrae (C7), from a sagittal view, and the external auditory meatus (tragus) (Contractor et al., 2018; Salahzadeh et al., 2014; Subbarayalu, 2016). Also, a highly reliable indicator in FHP measurement is the angle formed by C7, tragus of the ear, and a horizontal line, clinically known as the craniovertebral angle (CVA) (Figure 1) (Salahzadeh et al., 2014; Silva et al., 2010). According to the findings of Shaghayeghfard et al. (2016) and Mani et al. (2017), CVA measurements indicate FHP severity, subjectively classified as normal, slight and severe. It is generally accepted that smaller CVA indicates a greater FHP (Abbasi et al., 2016; Kim et al., 2018; Salahzadeh et al., 2014). According to the findings of Abbasi et al. (2016), a CVA value less than 50° is considered as mild FHP, while values that fall below 30° are considered as severe FHP.

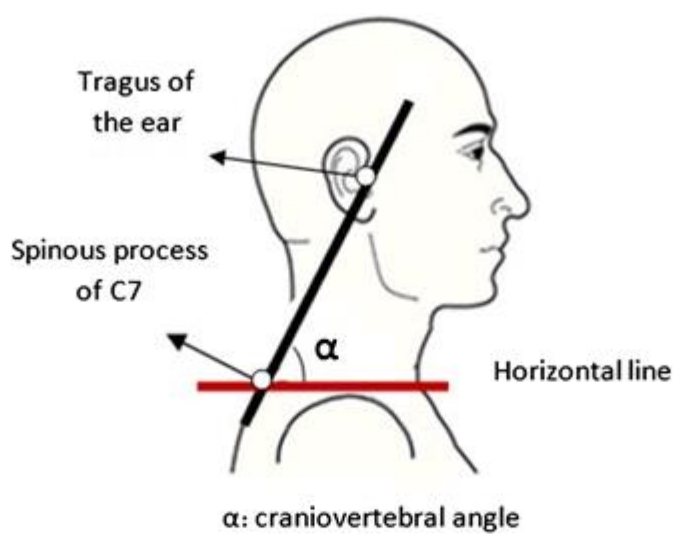

Figure 1. Craniovertebral angle (Shaghayeghfard et al., 2016)

Several techniques are mentioned in the literature in evaluating FHP and measuring CVA, but a non-invasive and low-cost approach can be done with the use of Kinovea software (Fernández-González et al., 2020; Puig-Divi et al., 2019; Sharifnezhad et al., 2021). This technology is a free motion analysis software used in three main fields: sport, clinical analysis, and when comparing the reliability of other new technologies. According to Puig-Divi et al. (2019) and Sharifnezhad et al. (2021), Kinovea software is a reliable and valid approach in assessing different body angles. It enables the analysis of distance coordinates and spatio-temporal parameters either by using video recordings or photos. This type of assessment of CVA was also adopted by Talati et al. (2018) through photogrammetry technique in evaluating head and neck postures in standing position, even though findings of Shaghayeghfard et al. (2016) admit that it is not clear which position is more relevant in evaluating FHP - sitting or standing. In several studies that adopted this method of measuring the camera was placed at a distance of 1.5-1.6 m away and at a height that was adjusted according to the subject's shoulder level (Elwardany et al., 2015; Hidzir Pauzi et al., 2020; Sharifnezhad et al., 2021; Talati et al., 2018).

A highly reliable and commonly used tool developed to evaluate neck disorders is Neck Disability Index (NDI) (Hoving et al., 2003), originally published in 1991 in the Journal of Manipulative and Physiological Therapeutics. It consists of a six-point scale with ten questions; subjects rate their pain from 0 – no pain to 5 – worst pain, answers are then summed up and the total score indicates if there are activity limitations related to subjective symptoms (AlAbdulwahab et al., 2017; Hung et al., 2019; Shin et al., 2017). Values of NDI score reach a highest of 50 and imply more significant limitations in daily activities (AlAbdulwahab et al., 2017; Ghamkhar & Kahlaee, 2019).

According to the findings of Panchal et al. (2020), Redivo & Olivier (2021) and Rodrigues et al. (2017) a good evaluation tool of ergonomic risk factors in computer workstations and equipment assessment is considered the Rapid Office Strain Assessment (ROSA). It is an observational method and consists in assessing the chair, the monitor, mouse and keyboard, the subject's posture, and the time spent per day while using these devices. A ROSA score of 5 or higher indicates a high risk of discomfort (Bagheri & Ghaljahi, 2019; Sonne & Andrews, 2011).

Objective

Our study aimed to evaluate the degree of forward head posture by measuring the craniovertebral angle in the case of an IT professional.

Case presentation

We observed a 31 years old male IT professional (development and operations engineer) with ten years of experience in the IT domain. Our subject spends daily 6-8 hours in front of the computer in his home office during professional activity, five days a week. In addition, on an average of 2-3 times/month, the subject plays volleyball in an amateur way. After a brief physical examination we observed that the subject presented mild muscular spasm along with the left Trapezius muscle without any other medical history of surgery or injury. Written and signed informed consent for participation in the study was obtained from the subject.

Material and Methods

We monitored our subject for five working days. Videos and photos have been taken with a mobile phone from a sagittal view with the subject sitting. The mobile device was placed on a tripod stand at 1.5 m away from the subject and the height was adjusted according to the subjects′ shoulder level. Anatomical landmarks used were: C7 spinous process, tragus of the ear, and the shoulder joint's tip. All landmarks have been highlighted with the use of adhesive stickers.

All photos and videos recorded have been transferred to the laptop and opened in the Kinovea application. With Kinovea software 0.8.15 we measured the CVA in key moments of the working days: in the morning, at noon before lunch break, and at the end of the shift. To find CVA, we connected two lines – one that was drawn from the spinous process of C7 to the tragus of the ear and a second one, a horizontal line that passes through the C7 vertebrae. All survey data has been collected and analyzed with Microsoft Excel 2016.

The subject was asked to complete the NDI questionnaire which was submitted online, and in order to identify an appropriate ROSA score, we observed the workstation and completed the [redacted]list. Risk factors were grouped by sections: chair, monitor, keyboard, and mouse. NDI scores are divided into 0-4 points if there was no disability, 5-14 points if there is mild disability, 15-24 points if there is a moderate disability, 25-34 points for severe disability, and 35 points for total disability. Workstation and individual posture are scored individually according to the ROSA checklist, and a score between 0-10 is obtained. A score higher than 4 is considered as high risk, which denotes an ergonomic hazard of the workstation.

Results

We monitored and measured the subject for five working days in key moments – morning, noon, and end of the shift. All results are presented in Figure 2.

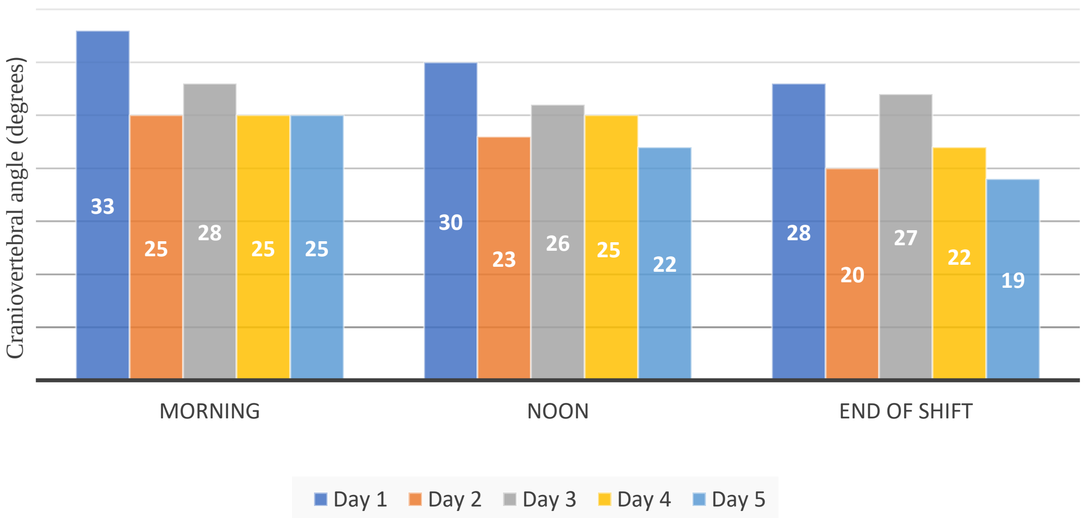

Figure 2. Evolution of CVA of the subject on the key moments of the monitored work-days

Mean values and standard deviation of CVA were calculated. Table 1 shows the mean values and standard deviation of CVA for a period of 5 working days. Extremely significant differences ($p<0.001$) have been observed between the first working day of the week and the last, when assessing CVA every hour (Figure 3). Also, when comparing early morning values of CVA with those corresponding to the end of the same day, we found significant differences ($p<0.05$).

Table 1. The main values of the craniovertebral angle (CVA) of the subject during the monitored period

Key moments of the day	**Craniovertebral angle (CVA)**				
	Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**
Morning	33	25	28	25	25
Noon	30	23	26	25	22
End of shift	28	20	27	22	19
Mean	**30.33**	**22.67**	**27**	**24**	**22**
Standard deviation	**2.05**	**2.05**	**0.82**	**1.41**	**2.45**

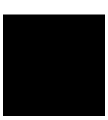

Figure 3. CVA value comparison between day 1 and day 5

Due to pandemic times, our subject has changed to a home office for more than a year; in this case, the workspace is deficient from an ergonomic point of view. Therefore, after a brief observation of the workstation, we completed the ROSA checklist. The workstation in relation to the subjects′ posture has been scored in different sections – chair and computer peripheral devices. Final scores indicate risk level and are scored between 0 and 10 (0-3 low-risk level, 3-5 safety warning level, >5 need for ergonomic intervention).

The first section of the checklist observes the chair components: the seat pan height and depth, the armrest, and the back support. Because the seat pan is too low (knee angle is <90°), there is insufficient space under the desk; the chair is non-adjustable in height and pan length, so the seat pan score was 6. The armrest and the back support area score was 3 because the chair does not have lumbar support, arms are not supported, and the chair is non-adjustable. Therefore, the chair section's total score, according to ROSA scoring instructions, is 5 (Table 2).

When assessing the monitor, we gave this area a score of 1 because the screen was too far away and for the phone area a score of 0 because the subject does not interact with it during working hours. In this case, the monitor section's total score was 1 (Table 2). When using the peripheral devices, we observed based on the subject′s equipment and work techniques that the palm is placed in front of the mouse and is gripping on it and that the keyboard platform is non-adjustable, giving this section a score of 3 (Table 2).

An observation of the monitor in relation to the peripheral devices resulted in a score of 3.

In order to obtain the total ROSA score we analysed the monitor and peripheral devices score in relation with the chair score. The final ROSA score highlighted in the table below is 5, which is a high-risk level.

[redacted]

Table 2. ROSA scores for the studied subject

Sections	Components	Subscores	Scores/section
A. Chair	Seat pan height/depth	6	5
	Arm rest and back support	3	
B. Monitor and phone	Monitor	1	1
	Phone	0	

C. Mouse and keyboard	Keyboard	2	3
	Mouse	3	
Total ROSA score			**5**

Neck disability index score was 3/50 (6%); the subject reported that he has mild pain in the neck at the moment, he can read as much as he wants with slight neck pain, and that he can engage in all his recreational activities with some pain in his neck.

Discussions

The purpose of this study was to evaluate the degree of forward head posture in the case of an IT professional by measuring the craniovertebral angle. To our knowledge, this is the first study that observes CVA changes in professional computer users with the help of Kinovea software. Furthermore, we consider that a strong point in our study is the non-invasive method applied in measuring the subject – no perturbations have been made to the subject's posture; in this case, the evaluation has been made in optimal conditions.

Our results sustain the findings of Guan et al. (2016) and Ramalingam & Subramaniam (2019), who concluded that a prolonged time spent using the computer has a major impact on the head posture through a high prevalence of forward head posture, therefore a decrease in the craniovertebral angle.

We consider that measuring CVA using Kinovea software is a highly reliable method in obtaining objective data, in this case sustaining the results of Hidzir Pauzi et al. (2020).

Even though findings of Sun et al. (2014) and Mahmoud et al. (2019) present a high correlation between neck pain and FHP in professional computer users, we consider that these negative outcomes can be influenced positively when maintaining a physically active lifestyle. When assessing FHP, an important point of view that should be taken into consideration is the physical activity level and other associated pathologies. Our findings show a small NDI score because our subject is young and physically active. Therefore, the assessment of CVA can predict the occurrence of neck pain in those with FHP.

A significant impact on head posture during computer use was the ergonomic factor. Our findings sustain the results of Redivo & Olivier (2021), who also considered the ROSA checklist to be precise when evaluating computer use in the workplace. Also, we agree with the findings of Machado-Matos & Arezes (2016) that the equipment influences a high exposure to risk factors.

Strengths and limitations

Throughout our study, we used only validated and non-invasive methods and measurements. Nevertheless, we consider our results reliable since we did not interfere with the subject's posture during measurements using Kinovea software to analyze CVA.

A limitation observed during the study period was the twisted posture that the subject adopted sometimes that may influence the value of the CVA; in this case, a more elaborate approach is needed.

Conclusion

Our study highlights major changes of head posture when measuring CVA in the case of a professional computer user during a period of 5 work-days. An easy approach and non-invasive method when measuring FHP is the use of Kinovea software that provides concise data of the CVA.

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Assessment of Forward Head Posture and Ergonomicsin Young IT Professionals – Reasons to Worry?

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KEYWORDS: Neck disability; craniovertebral angle; musculoskeletal disorders; workspace ergonomics; soft-ware engineers; COVID-19 pandemic

ABSTRACT

Background: *Prolonged computer use and poor ergonomics among IT professionals are considered risk factors for musculoskeletal disorders. This research aims to analyze the degree of forward head posture and workplace ergonomics in young IT professionals to assess the risk for a neck disability.* **Methods:** *A prospective study was carried out by assessing the sitting posture at work, neck disability in the cervical region, quality of life, physical activity, and ergonomics of the workspace in 73 young IT professionals (32.56±5.46 years).* **Results:** *The score for the cervical functional disability index (NDI) showed a mild neck disability (8.19±7.51). The craniovertebral angle has an average value of 32.01±11.46, corresponding to a light forward head posture, and it positively correlated with age and work experience and negatively correlated with ROSA (r=0.24, p<0.05). The NDI positively correlated with physical activity (r =00.32 p<0.05) and with ROSA (r= 0.24, p<0.05).* **Conclusions:** *In IT professionals, neck disability is associated with the lack of workspace ergonomics and the amount of physical activity. Forward head posture correlated with age, work experience, and poor workspace ergonomics. According to our findings, there are real concerns about the influence of head posture and workplace ergonomics on health among IT professionals. We consider that it is necessary to adopt preventive measures to address neck disability and improve workspace ergonomics.*

1. INTRODUCTION

Prolonged use of computers for professional pur-poses often involves frequent and extended periodsat the workplace that are not always ergonomi-cally designed. Moreover, among IT professionals, sedentary activity due to long static periods at the computer affects all body systems [1]. Due to the COVID-19 pandemic, all professional activities have been affected, many of them resorting to tel-eworking. However, in the case of IT profession- als, these changes proved to be unfavorable, being a determining factor in the prevalence of muscu- loskeletal disorders and cervical pain [2]. Essential aspects in managing and preventing work-related musculoskeletal disorders in the case of IT profes- sionals include postural assessments, workstation ergonomic interventions, and work-break time frames [3, 4].

In the literature, studies of professional computerusers show that these static postures seriously im- pact the functionality of the upper torso and the cervical region, implicitly often identified in pos- ture changes in the sagittal plane [5]. The most

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commonly identified posture in computer users is described by the anterior projection of the head, de-fined as the anterior position of the head relative to the gravitational line – recognized in the scientific literature as forward head posture [6]. In addition, forward head posture is considered one of the mainrisk factors in developing musculoskeletal disorders among IT professionals [7, 8].

According to the literature, head posture assess- ment among computer users is often performed sagittally due to the positioning of the computer workstation (the monitor and auxiliary devices) in the frontal plane [6]. From a clinical point of view, the assessment of postural deficiencies of the head and neck from the sagittal plane should be per- formed by measuring angles such as the craniover- tebral angle (CVA), head positioning angle, head tiltangle, and cranial rotation angle [9].

Recent scientific work considers that the primarymethod for analyzing the anterior projection of the head is the determination of the craniovertebral an-gle through photogrammetry [6, 10], which can be evaluated with the help of Posture Screen Mobile software [11, 12].

The means for assessing the workspace ergonom-ics described in the literature involve various obser-vational methods such as the Rapid Office Strain Assessment (ROSA) checklist [13]. In the scien- tific literature, several types of questionnaires assess cervical musculoskeletal disorders using patient-reported instruments, the Neck Disability Index (NDI) being the most commonly used for measur- ing the status of neck pain and the level of disability secondary to pain [14, 15].

This research aims to analyze the degree of for- ward head posture and the ergonomics of the work-place in young IT professionals to assess the risk fora neck disability.

2. MetHODs

Informed consent was obtained from all par- ticipants involved in the study. We conducted this prospective study between November 15, 2021, andFebruary 15, 2021, in the context of the COVID-19pandemic.

2.1. Participants

We invited twelve IT companies to participate inthe current research by contacting their human re- sources department; nine of them accepted our invi-tation. One hundred fifty-two employees received aletter of invitation and the study protocol. Inclusioncriteria were:

- Professional activity in the field of IT;
- At least two years of relevant work experience in the field of IT;
- Minimum age of 23 years;
- Written confirmation for participation in the study.

Exclusion criteria were:

- Any history of cervical pathologies independently of the profession, present before the initiation to the study: diagnosed degenerative and inflamma-tory disorders of the cervical spine (such as spon-dylosis, ankylosing spondylitis), cervical traumas, and surgical interventions in the cervical area;
- Absence to any of the stages of the study (regard-less of the reason).

All volunteers signed informed consent to par- ticipate in the study. The local ethics committee approved the study protocol, which respected the Helsinki Declaration.

2.2. Study Protocol

The study protocol was divided into three stages:Stage I – which consisted of a 20 min survey, fol- lowed by Stage II – an objective assessment of the sitting posture at work, and Stage III – the evalua- tion of the workspace ergonomics.

2.2.1. Stage I - Survey Implementation

The survey comprised four sections: (i) demo- graphic data and details about the professional ac- tivity; (ii) neck disability assessment; (iii) quality oflife; (iv) physical activity assessment.

1. *Demographic data* (gender, age, height, weight, dominant hand) and *details about the professional ac-tivity* (work experience, duration of weekly working days, and the average number of hours spent on the computer, place of professional activity – at the office

(within the company) or home (remotely), number and duration of daily breaks, information about the alternation of office position and data about the cur-rent state of health).

2. *The neck disability assessment* was performed us-ing the Neck Disability Index (NDI) questionnaire – it contains ten items that refer to neck pain (inten-sity) and the level of ability to manage daily living activities (personal care, reading, lifting, headache, work, concentration, driving, sleep and recreation) [14]. The NDI score is interpreted as 0-4=no dis- ability, 5-14=mild disability, 15-24=moderate dis-ability, 25-34=severe disability, and over 34= total disability, where a score of 50 converted to percen-tiles represents 100% [15]. According to Kumariet al., the NDI score is calculated as follows: total score/total possible score, transformed to percentagemultiplied by 100=% points [16].

3. *The quality of life* was evaluated by applying the SF-36 quality of life questionnaire composed of 8 scales (36 questions): physical functioning, bodily pain, role limitations due to physical health prob-lems, role limitations due to personal or emotional problems, general mental health, social functioning, energy/fatigue or vitality, and general health per-ceptions [17]. The results can vary between 0 and 100, with a higher score representing a better gen-eral state of health [18]. The SF-36 questionnaire is frequently used as a valuable tool in determining health status [19].

4. *Physical activity assessment*: the participants' type, frequency, and volume of physical activity.

2.2.2. Stage II - Evaluation of the Sitting Postureat Work

Head and neck posture assessments were per- formed at the workstation of each participant, eitherat their home office setup or within the company of-fice by an independent investigator. All images were taken with the same camera placed on a tripod 1.5 m away from the participant and adjusted at shoul- der level. The camera recorded a 60 minutes video of the participant during the work time activity. In or-der to reduce potential false working postures, par- ticipants were asked to continue their professional activity while the camera was recording. The video analysis was performed by a second investigator who selected a frame of the most relevant posture (the posture maintained by the participants for the most extended period).

The photographic analysis was done in the sec- ond part of the first working day of the week (or im-mediately after a holiday) to obtain relevant resultsand implicitly reduce the bias. In addition, we usedthe Posture Screen Mobile Software (PSM) [11] to obtain accurate and more detailed measurements ofthe craniovertebral angle and to analyze the head's position.

After selecting the images of all participants,these were uploaded into the PSM software. The height and weight were entered into the PSM soft- ware after creating a record of each participant. The digitization process involves specific landmarks that were placed on the lateral view in the follow-ing points: the top part of the monitor, the bottom part of the monitor, the lateral canthus of the eye, the correct interior of the external acoustic meatus, the center base of the neck at the cervicothoracic junction, spinous process of the C7 vertebrae, sev- enth thoracic vertebrae, the center of the thorax – approximately at T6-T8 level, the center of the mid-lower torso at T10-L1 level, elbow, wrist, hand(center of distal metacarpals), the center of the hip - great trochanter, knee - lateral of the tibiofemoral joint and ankle - the center of the malleolus (Figure1). All points were marked using reflective stickersplaced according to the above body landmarks.

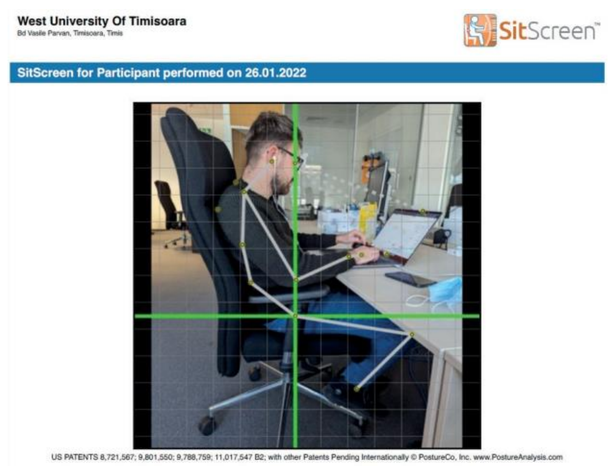

Figure 1. Anatomical landmarks, digitisation process in PSM.

The craniovertebral angle was analyzed with two anatomical landmarks (the spinous process of the C7 cervical vertebrae and the outer part of the ear- tragus). This angle is formed by the horizontal line passing through the seventh cervical (C7) vertebra'sspinous process and the line between the C7 verte- bra's spinous process and the ear's tragus [20]. Ac-cording to Shaghayegh Fard et al., values <48-50° of the craniovertebral angle imply a greater rate of occurrence of forward head posture [21]. Therefore, the craniovertebral angle is considered normal whenhigher than 50°, light when it is between 30°-50°, and severe when it is below 30° [22].

During the process of digitization, the PSM software measures the craniovertebral angle (CVA),head-neck angle (neck flexion angle), head-tilt an- gle (relative to horizontal), gaze angle, high thoracic angle, neck posture angle, elbow angle, wrist angle,trunk-thigh angle, thigh angle, and lower leg an- gle. The results obtained using the PSM software present the relation between the sitting posture of the participant and workspace ergonomics.

2.2.3. Stage III - Assessment of the Workspace Ergonomics

The workspace was assessed using an independ- ent investigator's Rapid Office Strain Assessment (ROSA) checklist, blind to the previous evaluation stages. ROSA is an observational method that as- sesses chair height, pan depth, armrest, back sup- port, duration of sitting, and postures when using the telephone, monitor, keyboard, and mouse, all results producing an overall score that will be ana- lyzed with a scoring chart. A final score higher than5 implies an increased ergonomic risk factor anda high level of discomfort [13]. Statistical analysis was performed using SPSS Version 26. A bivariate(1-tailed) Pearson correlation test was used to ob- serve the relation between the measured parameters.

3. Results

From the 105 IT specialists recruited in the study, we enrolled 73 (39 men and 34 women). Eight participants were excluded due to medical condi- tions mentioned in the exclusion criteria, and 24 participants dropped out after the first stage of the study protocol. The demographic characteristics of the group are shown in Table 1.

Due to the COVID-19 pandemic, 33 (45.21%) participants adopted a remote work style and, in some cases, a hybrid mode (remote work combinedwith office work). Many participants spend, on aver- age, 6-8 hours/day at the computer (n=31, 42.47%).Many participants (n=33, 45.21%) also reported that they work from home (remotely), followed bya large number who adopted a hybrid mode (n=28, 38.36%), whereas only 16.44% (n=12) conducted their professional activity at the office. Among those adopting a hybrid regime, 12.3% worked 1-2 days from home/week, 23.2% worked 2-4 days from home, whereas 47.9% worked 4-6 days a week from home.

Break frequency during a working day was rela- tively high, with 36.9% stating that they take 3-4 breaks/day, each lasting about 5-10 minutes long (61.6% of the participants).

According to the Occupational Safety and Health Administration (OSHA), sitting still for prolonged periods when working at the computer isunhealthy, and they recommend changing this posi-tion frequently.

Sources of information about office ergonomics vary widely. Most participants (n=53, 72.6%) know workspace ergonomics, obtained through online research, specialized courses, ergonomic specialists,friends, colleagues, or social media. The most com- monly used device among the IT professionals in our research is the laptop (n=67, 91.78%), with onlya few using a computer (n=6, 8.10%). For most of their professional activity, 54.7% (n=40) of the par-ticipants used two monitors.

In terms of physical activity, a large number of participants (n=35, 47.9%) stated that they join in physical activities several times a week, and only a

Table 1. Characteristics of the study group.

Parameter	Mean±Standard deviation (n=73)
Age (yrs.)	32.56±5.46
Body Mass Index (kg/m^2)	23.52±3.56
Professional experience (yrs.)	9.32±5.56

few participants (n=4, 5.48%) from the entire groupdo not join any physical activities. 42.47% (n=31) of the participants stated that they endorse physicalactivities several times a week with a frequency of 3-4 workouts/week, followed by 27.4% (n=20) witha frequency of 1-2 workouts/week. 15.07% (n=11) of the entire group is sedentary, and 5.48% (n=4) practice high-performance sports. 9.59% (n=7) of the participants have daily physical activities such as walking or cycling to work. For statistical analysis,physical activity was coded with 1 – daily physical activity, 2 – physical activity several times a week, 3 –physical activity several times a month, 4 – physical activity several times a year, and 5 – never.

The correlations between the measured param- eters are presented in Table 2. The mean value of the cervical functional disability index (NDI) is8.19±7.51 (Table 2), which, according to Vernon, represents a mild disability score [15]. The mean craniovertebral angle measured using the Posture Screen Mobile software has an average value of 32.01±11.46 (Table 2).

The craniovertebral angle was positively corre- lated with age (r=0.28, p<0.01) and work experi- ence (r=0.23, p<0.05) and negatively correlated with ROSA (r=0.24, p<0.05). The head-neck angle was negatively correlated with age (r=-0.26, p<0.05) and with work experience (r=-0.21, p<0.05) and positively correlated with ROSA (r=0.29, p<0.01). The gaze angle was negatively correlated with workexperience (r=-0.21, p<0.05) and the device used – laptop/computer (r=-0.22, p<0.05), and positively correlated with ROSA (r=0.21, p<0.05). Finally, theNDI was positively correlated with physical activity(r =0.32 p<0.05) and with ROSA (r=0.24, p<0.05).

4. DIsCussION

Our study aimed to assess the level of cervical dis- ability among young IT specialists by assessing therelationship between cervical spine posture during professional activities, age, work experience, level of physical activity, and the impact of workspace er- gonomics. The results obtained provide valuable in- formation on these topics. In addition, Lamba et al.also confirmed the development of neck and upper limb disabilities among IT specialists using com- puters more than 40 hours per week [23].

Aegerter et al. noticed that the number of daily breaks and workstation ergonomics could influencethe level of neck disability [24]. Therefore, they con- ducted a longitudinal study starting from 2 hypoth-eses – neck pain prevalence is influenced by working from home, and workstation ergonomics, break timeduring computer use.The total amount of time spentat the computer could increase neck pain intensity

Table 2. Descriptive Statistics and 1-Tailed Bivariate Pearson Correlations for Manifest Variables.

	Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	CVA	-										
2	Head Neck Angle	-0.94**	-									
3	Gaze Angle	-0.35**	0.32**	-								
4	Thorax Angle	-0.06	0.12	0.00	-							
5	Age	0.28**	-0.26*	-0.19	0.04	-						
6	Neck Disability Index	-0.06	0.13	0.19	0.06	-0.15	-					
7	Work Experience	0.23*	-0.21*	-0.21*	0.10	0.87**	-0.08	-				
8	Gender	-0.10	0.13	0.02	0.00	-0.05	0.02	0.02	-			
9	Physical Activity	-0.13	0.06	0.04	-0.02	-0.05	0.32*	-0.09	0.11	-		
10	Device Type	-0.13	0.10	-0.22*	-0.01	0.06	-0.09	0.09	0.14	0.13	-	
11	ROSA	-0.24*	0.29**	0.21*	0.00	0.01	0.24*	0.00	-0.11	0.04	.17	-
	Mean	32.01	57.02	19.49	157.99	32.56	8.19	9.32	1.53	2.32	1.06	3.37
	SD	11.46	11.57	11.15	15.37	5.46	7.51	5.56	.50	.87	.25	.87

*M=mean; SD=standard deviations; *=p<0.05; **=p<0.01.*

and neck disability. For their study, they collected data before the COVID-19 pandemic started and made a follow-up during the lockdown. The find- ings of their study show that a higher number of breaks during computer use could reduce the degreeof a neck disability and that there is an association between neck pain intensity and the number of hours spent at the computer.

We have chosen to evaluate the forward head posture by measuring the craniovertebral angle as per the findings of Kim & Kim, who stated thatthis method is reliable when investigating the func-tionality of the neck region [25]. In addition, re- cent scientific work considers the primary method for analyzing the anterior projection of the head by determining the craniovertebral angle using pho- togrammetry as a validated, reliable, and objective method [6, 10, 20]. Following the posture's photo- graphic analysis, the craniovertebral angle measure- ment can be done with the help of Posture Screen Mobile [11, 12], a non-invasive, easy-to-use, and portable way that allows optimal assessment and does not require experience in obtaining accurate and reliable measurements.

According to the study by Szucs & Brown, the Posture Screen Mobile software has strong reliabil-ity and validity in scientific research and for clinicalpurposes [12]. Natural numbers with finite decimalsrepresent the result of the measured craniovertebralangle when using the Posture Screen Mobile app. Astudy by Boland et al. showed that postural assess- ments analyzed with the PSM software are clinically relevant, especially when diagnosing the forward head posture [11]. Other scientific studies assessing poor postures among computer users, implicitly theforward head posture, by measuring the craniover- tebral angle, concluded that the photogrammetrytechnique analysis using the PSM software is reli- able and conclusive [26, 27]. The equipment chosen and the assessment method applied were consid- ered unobtrusive/non-invasive and feasible in the COVID-19 pandemic context.

Even though the mean age of the studied group indicated a relatively young group (32.56±5.46 years), we noticed that the CVA degree is positively correlated with age and work experience, consist- ently with the findings of Sun et al. [28]. Implicitly, some misalignments can be noticed with a poor posture, such as an anterior projected head. According to Hansraj, as the weight of the head is shifted anteriorly in the forward head pos- ture, not only the craniovertebral angle worsens/is affected, but it also changes and can be seen in the gaze angle, dropping below the horizontal line – which is considered to represent a level of comfort.Our study has identified significant results when correlating parameters such as the CVA, gaze angle,and head-neck flexion angle [29].

Nejati et al. conducted a study regarding the re- lationship between poor postures (forward head posture) and the prevalence of cervical pain, respec- tively the degree of cervical disability, in two groups of participants (a symptomatic group with cervical pain and an asymptomatic group without cervi- cal pain)[30]. Following the measurements of the craniovertebral angle, the differences between the symptomatic and asymptomatic groups were mi- nor (UCV=23.00±0.70 in the symptomatic group, respectively UCV=28.40±12.40 in the asympto- matic one). The study concludes that the value of the craniovertebral angle does not directly influencethe degree of cervical disability and, implicitly, by the degree of forward head posture.

In compiling the online survey, we chose both theNeck Disability Index and SF-36 as per the results of Pontes et al., which show that these are reliable and valid tools for evaluating disability and neck pain [31]. In addition, a review conducted by Boboset al. demonstrated that the Neck Disability Index questionnaire has from moderate to excellent level of reliability in test-retest and is supported by the qualitative results of the content [32]. Although theNeck Disability Index was published first in 1991 by Vernon et al., the only change that has been madewas the word "neck" that was added to the term "pain" to specify that the question referred to the "neck pain" of the individual taking the survey. The scientific literature regarding ways of treating and preventing neck pain, and, all the more, neck dis- ability, highly recommend specific exercises that fol- low outcomes, such as strengthening or stretching the involved region. In our study group, participantsmore involved in physical activities had a lower level of neck disability, the NDI being correlated to phys-ical activity.

According to Lindegård et al. [33] and Jun et al.[34], the NDI can be influenced by multifactorialcauses, such as ergonomic risk factors, psychosocialfactors, and individual factors. A specific method ofassessing ergonomic workplace risk factors amongcomputer users is the Rapid Office Strain Assess-ment (ROSA) checklist published by Sonne & An-drews [13], and according to the findings of Panchalet al., it is highly applicable among IT specialists [7].Our results support Sonne et al., who dem- onstrated a relationship between the level of dis-comfort and a higher ROSA score; in our study,significant correlations were noticed between theROSA score and NDI [35]. Our conclusions are also consistent with the findings of Aegerter et al.,i.e., that neck disability can be positively influencedby increasing the number of breaks during computeruse and when physically active [24], and with thoseof Barkhordarzadeh et al., suggesting that great fo-cus should be oriented towards an ergonomic in-tervention, to reduce work-related musculoskeletal disorders and cervical disability [36].

The use of the questionnaire method is consid- ered an appropriate approach in scientific research because it allows the collection of a large amount ofinformation by obtaining accurate and easily meas-urable data in the shortest possible time and with the least possible need for resources; however, there are disadvantages such as a low response rate and ahigh level of subjectivity on the part of the partici- pants. Nowadays, the vast majority of IT specialistsare working remotely, which, according to scientific literature findings, can harm them. Out of 73 par- ticipants, only a small number do not know if they change their position (13.6%) or do not change it during a working day.

Strengths and Limitations

To our knowledge, this is the first study thatuses the Posture Screen Mobile software to assess the craniovertebral angle in IT specialists. We con- sider our method to be not only non-invasive but also highly applicable in the case of remote workers.

Furthermore, we consider our survey to be original in its approach, as we did not find any other study analyzing the correlation between neck disability, quality of life, and workspace ergonomics.

The study has the following limitations: the self-reported data obtained in the first stage of the studyprotocol cannot be independently verified; in the second stage of the study protocol, the participants'posture could have been influenced by the aware- ness that they were video-recorded. Also, we con- sider that recording the posture during work time for a more extended period, in different timeframesof the working day and the week, would lead to more relevant results.

5. CONCLUSION

In IT professionals, the degree of neck disabilityis associated with the lack of workspace ergonom- ics and the amount of physical activity. The forward head posture positively correlates with age, work ex- perience, and poor workspace ergonomics. Accord-ing to our findings, there are real concerns about theinfluence of head posture and workplace ergonom- ics on health among IT professionals. We consider that it is necessary to adopt preventive measuresto address neck disability and improve workspace ergonomics.

INSTITUTIONAL REVIEW BOARD STATEMENT: The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by approved by The Scientific Council of University Research and Creation by West University of Timisoara (approval number: 62876/ November 11, 2021).

INFORMED CONSENT STATEMENT: Informed consent was obtained from all subjects involved in the study.

DECLARATION OF INTEREST: The authors declare no conflict of interest.

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