

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-Analyses) 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-Analyses). 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

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cea 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.*

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 an 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-Analyses) methodology [12]. The scientific material was selected through a search in electronic databases as PubMed, Scopus, Clarivate Analytics, and Google Scholar. 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), sistematicreviews, 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 preztented in Table I.

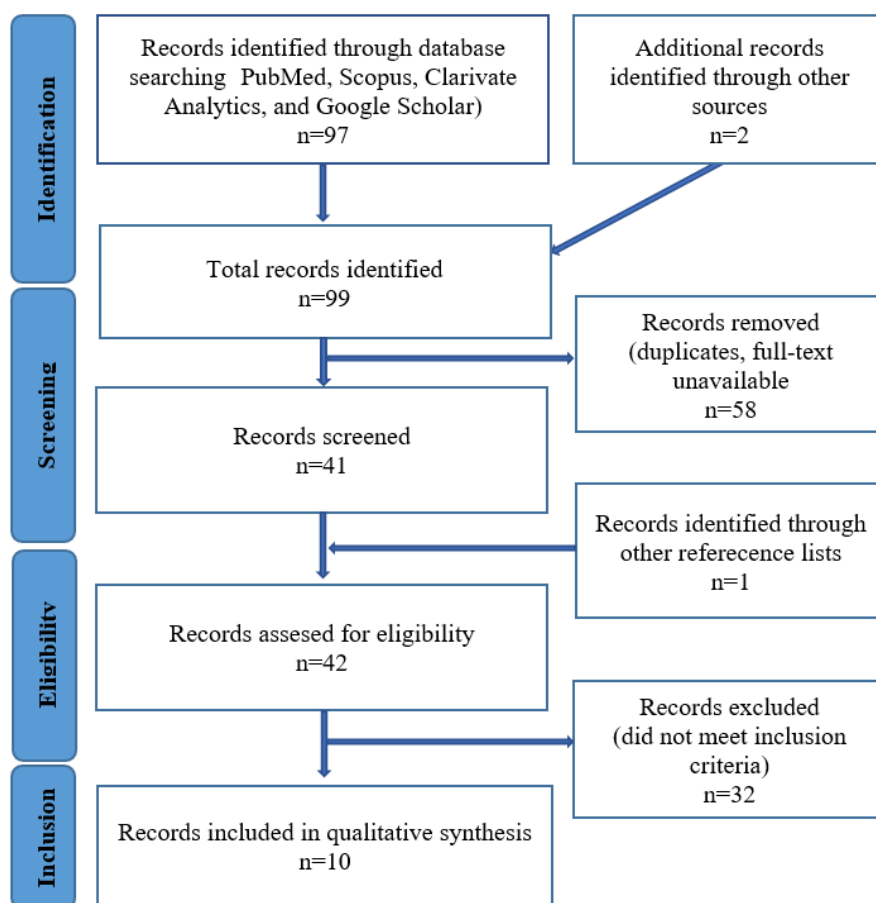


Figure 1. PRISMA flow chart demonstrating identification, screening and selection of included studies [12]

Table I. Main characteristics of the selected studies

Source (place of study - country)	Participants	Assessment methods <i>Assessment period(s)</i>	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) <i>Period: January-April 2020</i> <i>Baseline: work in office</i> <i>Follow-up: work at home</i>	- 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 <i>Period: NA</i>	- 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 <i>Period: April 2020</i>	- 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 <i>Period: 2020</i>	- 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.)	n1=192 (F: 38) age: 36.65±10.77yr. range: 19-63 yr.; n2=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 <i>Period of wave 1: April 2020</i> <i>Period of wave 2: May 2021</i>	- 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) <i>Period: November 2020</i>	- 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.) <i>Period: April-May 2020</i>	- 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 <i>Period: April- June, 2020</i>	- 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) <i>Period: July 2020</i>	- 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. <i>Period: April-June, 2020</i>	- 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 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 health 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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