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Investigation of Musculoskeletal Disorders among Pregnant Women Working in Education and Information Technology Sector during Homestay in COVID-19 Pandemic

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Abstract: The COVID-19 pandemic and lockdowns have disrupted physical activity levels, leading to adverse health consequences and decreased motivation to exercise. Prolonged sitting, poor ergonomics, and limited physical activity trigger musculoskeletal disorders. Pregnant women must prioritize proper ergonomics, take regular breaks, and seek professional guidance. The present work has investigated the advent of musculoskeletal disorders during a homestay in COVID-19 by the help of Modified Oswestry Disability Index. An analysis was conducted to assess the statistical correlation between the age (26.03±1.52) of pregnant women during the final phase of the third trimester and the calculated musculoskeletal disorders, yielding a p-value of .365552; however, since the result is not significant at $p < .05$, it indicates the absence of a statistically significant relationship between maternal age and musculoskeletal disorders. The assessment of the statistical strength of the relationship between musculoskeletal disorder and body mass index ($p<.00001$), nature of occupation ($p=.000024$), and sitting hours ($p=.000051$), conducted at $p < .05$, revealed a robust statistically significant relationship between musculoskeletal disorder and the respective parameters.

Keywords: COVID 19; Ergonomics; Musculoskeletal Disorders; Pregnant Women

1. Introduction

Since 2019, COVID-19 has been predicted to create a massacre, resulting in deaths of million people all over the globe[1)]. In an effort to end the spread of the disease, governments instituted numerous restrictions on public life, including curfews, the closing of businesses, and prohibitions on social gatherings and other large-scale activities[2)]. Although these steps helped to slow the spread of the virus, they did so at the cost of physical activity (PA) of the people. For instance, many organizations working as site for physical exercises were shut down during this time[3)]. As a result of the lockdown measures, daily routines were disturbed, and the social side of exercise was lost; this made it more difficult for individuals to find the motivation to remain active. At the same time, it's possible that the lockdown procedures led to an increase in sedentary behavior (SB), such as more time spent sitting and staring at screens. PA and SB are both areas of particular concern due to the huge amount of information demonstrating the importance of physical activity as an important factor for healthy well-being and the negative consequences that sedentary behavior can have[4)]. As science and technology advance, occupational diseases are being better managed, but there is a growing focus on musculoskeletal disorders (MSDs). MSDs, primarily caused by poor working posture, not only impact workers' health but also result in significant economic losses for countries. Alongside chemical, physical, and biological hazards in the workplace, other factors like manual lifting, static work, unreasonable working posture, and labor organization contribute to the development of MSDs[4)].

The impact of COVID-19 pandemic on pregnant women is witnessed in the form of increased susceptibility to severe illness and the risk of adverse pregnancy outcomes[2)]. Adequate antenatal care, vaccination, and adherence to infection prevention and control measures are vital for ensuring the well-being of pregnant women and their unborn babies. The pandemic has had detrimental effects on various aspects of women's lives, including their domestic experiences, health, employment, and financial well-being. Not only has it hindered women in the present, but it has also negatively impacted their future prospects[1)].

The COVID-19 epidemic has compelled a large number of people, particularly faculty members and professionals in the information technology (IT) sector, to move to remote work arrangements, most generally known as WFH[5)]. Although WFH offers flexibility and safety, it has also led to an increase in MSDs, which are caused by increased sitting time, poor ergonomics, and abating

physical activities[6]. Work from home demands much time spent on laptops, workstations or mobile devices[7]. Though required but it would be better to use the devices like mobile and laptops in leisure time rather than full time then it could lessen the intensity of MSDs among the users[7]. This results in less time spent moving around and more time spent on sitting. This sedentary behavior can contribute to multiple MSDs, including lower back pain, neck and shoulder discomfort, and joint stiffness. Sitting for extended periods without taking appropriate breaks or moving around can cause tension on the muscles and ligaments, leading to discomfort and possibly even permanent injury[8]. WFH setups lack the appropriate ergonomic equipment and furniture that is typically seen in office settings. Poor ergonomics and musculoskeletal difficulties can be caused by poor design chair height, back support, and casual positioning of the monitors[8]. This world of business has expressed its main concern in improving worker productivity while still ensuring their health and safety on the job[8]. Musculoskeletal diseases, injuries, and accidents are all caused by issues in the workplace such as difficult system design, adversarial atmosphere, ambiguous jobs, and unsynchronized employee competence in accordance with the task requirements. There is a good chance that the work-related injuries and the impairment that follows them can be avoided, and sufficient evidence supports the implementation of interventions aimed at reducing work-related disorders[6]. Evaluating the several methodological aspects of the interventions for workplace design needs to be done. Working professionals have seen a large rise in their total screen time as a result of the switch to WFH. Eye strain, dry eyes, headaches, and even a temporary blurring of vision can result from prolonged use of electronic screens, whether for educational or occupational purposes[7]. As a result of the transition to WFH, there are fewer opportunities for people to engage in activities that get them moving and exercise than before, such as during their commutes and breaks. The lack of access to fitness facilities or planned exercise routines has contributed to a sedentary lifestyle, which can cause muscles to become weaker, lose flexibility, and raise the chance of acquiring MSDs[9]. The harmful consequences on musculoskeletal health are further compounded by the lack of movement and physical activity that people engage in. As a result of the many physiological adjustments that occur throughout pregnancy, maintaining good musculoskeletal health is one of the primary concerns for women**.** Pregnant women working from home in the college and coaching sectors may experience challenges incorporating regular physical activity and movement into their routines[10]. Limited access to facilities, reduced opportunities for walking or commuting, and a sedentary work environment can contribute to a lack of physical activity, leading to muscular stiffness, reduced muscle strength, and increased risk of MSDs[11]. Pregnancy brings about various physiological and psychological changes that can disrupt sleep. Hormonal fluctuations, increased frequency of urination, physical discomfort, leg cramps, and anxiety contribute to sleep disturbances during pregnancy[11]. Sleep disturbances and insomnia are common among middle-aged women, impacting their overall well-being and quality of life. Exercise presents a non-pharmacological intervention that can improve sleep quality and alleviate insomnia symptoms. Regular physical activity, incorporating both aerobic and strength training exercises, has positively affected sleep quality, insomnia severity, and psychological well-being in middle-aged women[12]. Work-related MSDs are prevalent and impactful occupational health issues[13]. Implementing ergonomic assessments, education programs, appropriate workstation design, and supportive policies can create safer and more ergonomic work environments[14]. This study investigates the effects of WFH on the musculoskeletal health of faculty and IT sector staff during the COVID-19 pandemic, with a particular emphasis on pregnant women as the population of interest.

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2. Methodology

2.1 Study design and selection of participants

A cross sectional study for selecting participants based on certain criteria, like nature of occupation, work load during work from home and number of shifts in twenty four hours was conducted in Gorakhpur, Uttar Pradesh, India. The survey was done offline but most of the part was conducted online where other parts of India were covered remotely. As it was the lockdown scenario and as per the Indian Government norms, a safe distance had to be maintained from each other and very strictly in the case of patients, especially the pregnant women. The basic screening criteria were that the pregnant women must be primigravida, non-smokers, non-drinkers, must not have earlier complaints of chronic MSDs at a large scale and no past history of accident. Since the present work is based on investigating sedentary behavior, especially sitting position for prolonged time, the participants were chosen from the professions having the aforesaid nature. The participants were selected among the faculties coming from schools, colleges, coaching and IT sector professionals. The basis for selecting such candidates is their job nature requiring prolonged sitting hours. As the present work focuses on determining the trend in the variation of MSDs with the advent of the trimesters and body mass index, the participants in their first trimester phase were selected and the subsequent readings were taken with the advent of the trimesters.

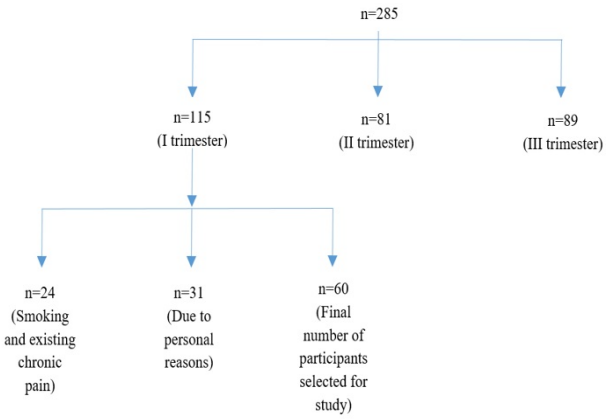

Fig.1: Flowchart of selection criteria.

As illustrated in Fig. 1, 285 participants were interviewed for further screening processes. One hundred fifteen participants were at first trimester stage and hence potential subjects to be worked upon. Out of these numbers, thirty one were not available due to vacations and other personal problems and other twenty four were screened out on the basis of smoking habit or chronic pain experiencing since a long time due to other medical problems. The rest of sixty participants were selected for the further study. It had also been taken care of the fact that no one was relying on pain killer unless and until instructed by doctors and also found within a healthy (body mass index) BMI range. Consent had been mandatory for participants to remain in contact throughout the entire gestation period, and they were assured that personal information, except for some demographic features, would be kept confidential.

2.2 Data collection

Regarding survey, an offline as well as online Google form consisting of demographic information and other required data to be collected was prepared. Since the participants were faculties and the IT professionals hence no or minimum efforts were made to explain the technicalities of the online information collection mode. Online video platforms like zoom and Google meet assisted in data collection and online interview of the participants to minimize the possibility of data inaccuracy. Doctors from different nursing homes and maternity homes were given the offline form for possible data collection as per their convenience.

2.3 Indicators of MSDs and its assessment

Intensity of MSDs was calculated by the help of Modified Oswestry Disability Index form[29]. Original questionnaire has the section on Sex life which has been replaced by employment/homemaking as the former one was used to be left blank by the participants. The survey comprises ten segments, each centering on distinct functional tasks like walking, sitting, standing, lifting, social engagement, personal care, pain intensity, travelling, employment/homemaking and sleeping. Within every segment, participants evaluate their degree of impairment on a scale from 0 to 5, where 0 represents no impairment and 5 signifies substantial impairment. The scores of each segment are aggregated to compute the total impairment score, which has a potential range of 0 to 50, and potentially beyond, if extra segments are considered. The disability could be measured on different scales varying from minimal to cripple via moderate and severe in chronological order of increasing severity. The impact on psychosocial factors due to lower back pain were measured through the questionnaire.

3. Results and Discussions

Demographic characteristics of the participants like age, BMI, average working hours and occupation are considered for the study. A statistical relationship was examined between age (26.03±1.52) and MSDs calculated during last phase of III trimester. The P-Value is .365552. The result is not significant at $p < .05$, which shows that there is no statistical significance relationship between the age of a pregnant woman during gestation period and the MSDs. Despite this observation, the age factor might not be ignored for a larger difference. With the advent of the age the tendency of muscles and ligaments to sustain the external load reduces. It is observed from Oswestry Disability Index that since the commencement of the gestation period till the last phase of III trimester, the pregnant women enter in the severe disability zone. Age during the gestation period can somewhat influence the risk of musculoskeletal disorders among pregnant women. However, it's important to note that while age is a factor, it interacts with other variables, such as overall health, pre-existing conditions, lifestyle factors, and the nature of the job, to determine the likelihood of developing musculoskeletal issues during pregnancy[19]. Younger pregnant women might generally have better musculoskeletal resilience due to their bodies being in a relatively healthier and more adaptable state. Their joints and muscles might have a higher capacity to cope with the physiological changes that occur during pregnancy[20]. On the other hand, older pregnant women might have a higher likelihood of having pre-existing musculoskeletal conditions or a history of wear and tear on their bodies, making them more susceptible to discomfort or pain during pregnancy[23].

BMI was taken at all the three trimesters as tabulated in Table 1.

Table 1. BMI and MSDs values for all the trimesters.

Trimester	BMI (Kg/m^2)	MSD (%)
I	22.16±2.91	13.5±2.93
II	25.95±3.77	35.33±3.72
III	29.30±3.63	48.68±3.57
Mean	25.80±3.43	32.50±3.40

An average BMI of all the trimesters along with MSDs has been taken for the same participants. It is seen that with the advent of the trimesters the Oswestry disability index increases, from minimal disability to moderate disability and then to severe disability till the last trimester. It could also be clearly observed from the Table 1 that BMI and MSDs disability index increases with the gestation period. The P-Value is calculated to be < .00001 and the result is significant at $p < .05$ which shows a strong statistical significance relationship between MSDs and BMI. During pregnancy, the BMI of a pregnant woman tends to increase gradually as the trimesters progress[14]. BMI during pregnancy is primarily attributed to the weight gained due to the growing fetus, increased blood volume, amniotic fluid, placenta, and additional maternal tissue[15]. During the first trimester, the increase in BMI is typically minimal or even negligible. Some women may experience slight weight loss or minimal weight gain due to factors such as morning sickness, changes in appetite, and hormonal fluctuations[16]. The second trimester is when the majority of weight gain occurs. This is the period of rapid fetal growth, and the pregnant woman's body accumulates more weight. The increase in BMI during this trimester is usually more noticeable compared to the first trimester[17]. Weight gain is typically gradual and varies among individuals. In the third trimester, the rate of weight gain may slow down slightly compared to the second trimester. However, BMI continues to increase as the baby grows and gains weight[18]. Some women may experience additional weight gain due to factors like increased fluid retention, larger breasts, and enlargement of the uterus. It is be noted that the change of BMI in accordance to the rate of weight gain varies among the pregnant women[19]. Factors such as pre-pregnancy BMI, individual metabolism, overall health, and lifestyle choices can influence the pattern of weight gain during pregnancy[20]. It is recommended that pregnant women consult with their healthcare provider to monitor their weight gain and ensure it falls within the healthy range for their pre-pregnancy BMI category. A healthy weight gain in a pregnant woman sounds healthy for baby and the mother. In the early stages of pregnancy, hormonal changes, particularly the increase in relaxin hormone, can lead to joint laxity and softening of ligaments. This can result in a higher risk of joint instability and discomfort, especially in the pelvic region[10]. As the pregnancy progresses, the additional weight and pressure from the growing fetus can lead to changes in posture and an increased load on the spine, potentially causing back pain and strain on the lower back muscles. Later in pregnancy, as the uterus expands and the baby grows, there can be changes in the center of gravity and an altered gait, which may further contribute to musculoskeletal discomfort and imbalances[11]. Additionally, the pressure on nerves and blood vessels can lead to issues like carpal tunnel syndrome or swollen ankles and feet[20]. It's important to note that not all pregnant women will experience musculoskeletal disorders, and the severity and type of discomfort can vary widely. Factors like pre-existing musculoskeletal conditions, physical activity levels, overall health, and individual anatomy also play a role[16].

Present work has also made an attempt to find the correlation between the MSDs and the nature of occupation. Fig. 2 shows the variance of MSDs with the nature of job and seen to have highest value for pregnant women giving coaching and working as IT professional. The statistical significance between the MSDs and the nature of occupation has been seen to be strongly significant as the P-Value is .000024. The result is significant at $p < .05$.

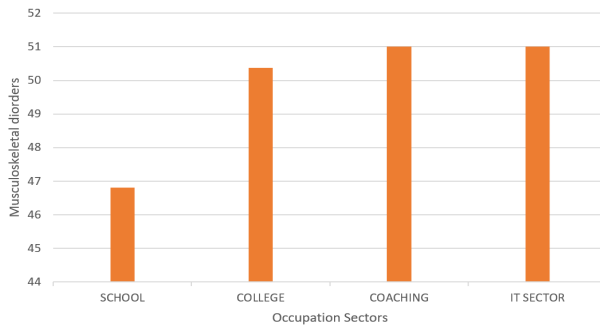

Fig.2: MSDs in different sectors.

An average of sitting hours has been taken and correlated with the average MSDs index obtained from Oswestry disability index. Fig. 3 establishes the relation between average sitting hours and average MSDs. The P-Value is .000051. The result is significant at $p < .05$ which shows that there is a statistical significance relationship between the MSDs and the duration of sitting hours.

In the school sector, pregnant teachers are often required to stand for long periods, which can strain their backs, necks, and shoulders. They may also be required to lift and carry heavy objects, which can further increase the risk of MSDs. In the IT sector, pregnant workers may be required to sit for long periods, which can strain their wrists, hands, and shoulders. They may also be required to use repetitive motions, which can increase the risk of carpal tunnel syndrome and other MSDs. It is found that pregnant women working from home in the school and IT sectors were more likely to report MSDs than pregnant women who were not working from home[5]. The study also found that the risk of MSDs was higher among pregnant women who worked longer hours and had less ergonomically-designed workspaces. Pregnant women in the IT sector may engage in tasks such as programming, data analysis, or virtual meetings[21]. These activities may require prolonged sitting or standing, frequent laptop or device use, and potential lifting or moving of equipment. Improper ergonomics or lack of breaks during these activities can contribute to MSDs[22]. Pregnant women who work fewer hours as in school sector, since the activities demanding physical exertions at school has now reduced during work from home may have the advantage

of reduced workload and more flexibility in managing their tasks. This can provide opportunities for breaks, rest, and the ability to prioritize self-care. With fewer working hours, there may be less exposure to prolonged sitting or repetitive tasks, which can reduce the risk of developing MSDs[23]. Pregnant women working for longer hours as IT professionals may face higher workloads and task demands. Extended periods of sitting, repetitive computer work, and increased stress levels can increase the risk of MSDs, such as back pain, neck and shoulder discomfort, and wrist or hand-related issues.

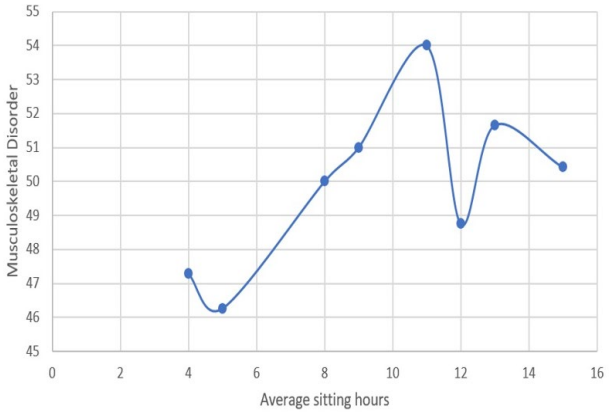

Fig.3: MSDs variation with seating time.

It is observed in Fig. 3 that despite the average time being more, the index of MSDs has shown a considerable decline. This can be attributed to the fact that pregnant women in the school sector may face challenges in creating an ergonomic workstation at home while IT professionals are accustomed to this work culture and also have an established workstation at home while working for prolonged time sitting at a place[6]. Faculties from schools may not have access to adjustable chairs, proper desks, or suitable equipment[4]. This can result in poor posture, inadequate back support, and increased strain on the musculoskeletal system[7]. Pregnant women in the IT sector may have an advantage when it comes to setting up an ergonomic workstation at home. They are likely to have experience with technology and may have access to adjustable chairs, ergonomic keyboards, and monitors, promoting better posture and reducing MSDs[24]. The home environment may not be optimized for work in the school sector. Pregnant women may face distractions, noise, or limited space, affecting their ability to maintain proper posture and focus on work[16]. These challenges can contribute to increased stress and musculoskeletal discomfort. Pregnant women in the IT sector may have a more controlled home environment, as they may be accustomed to working with minimal distractions[20]. However, factors such as inadequate lighting, poor ventilation, or an uncomfortable workspace can still impact their musculoskeletal health.

The COVID-19 pandemic has compelled many pregnant women in the college and coaching sectors to adapt to remote work from home. This transition has brought about unique challenges, including the potential risk of developing MSDs. Pregnant women in the college and coaching sectors may encounter difficulties in creating an ergonomic workstation at home. They might lack access to adjustable chairs, suitable desks, or ergonomic equipment, leading to poor posture, inadequate back support, and increased strain on the musculoskeletal system. Insufficient attention to ergonomics can contribute to the development of MSDs, such as back pain, neck and shoulder discomfort, and wrist or hand-related issues[25]. Pregnant women in the college sector may engage in activities such as online teaching, preparing materials, and administrative tasks. These tasks can involve prolonged sitting or standing, frequent use of laptops or devices, and potentially lifting or moving equipment[26]. Inadequate ergonomics or limited breaks during these activities can contribute to MSDs. In the coaching sector, pregnant women may be involved in virtual training sessions, creating lesson plans, and organizing activities. These tasks may require prolonged sitting, repetitive movements, and maintaining static postures, which can increase the risk of MSDs[27]. Prolonged sitting, especially in poor ergonomic conditions, can lead to various musculoskeletal issues such as lower back pain, hip discomfort, and neck strain[6]. During pregnancy, the body undergoes physiological changes that can amplify the impact of poor posture and prolonged sitting. The additional weight and altered center of gravity can further strain the spine, muscles, and joints[16]. The home environment might not be optimized for work in the college and coaching sectors. Pregnant women may face distractions, noise, or limited space, affecting their ability to maintain proper posture and focus on work. These challenges can contribute to increased stress and musculoskeletal discomfort. Pregnant women working from home in the college and coaching sectors may experience challenges incorporating regular physical activity and movement into their routines. Limited access to facilities, reduced opportunities for walking or commuting, and a sedentary work environment can contribute to a lack of physical activity, leading to muscular stiffness, reduced muscle strength, and increased risk of MSDs[28].

4. Conclusion

The COVID-19 pandemic and subsequent lockdowns have presented significant challenges for maintaining physical activity levels. The reduced movement and increased sedentary behavior have led to negative health consequences, while the psychological impact has affected motivation to exercise. Nevertheless, recognizing the importance of staying active during these times is crucial for overall well-being.

The shift to WFH during the COVID-19 pandemic has increased risk of MSDs for faculty and IT sector professionals. Results show that with the advent of

trimesters, the intensity of MSDs increases exponentially. This is attributed to the reason that body mass index of the women enhances with the gestation period. More the sitting hours, more is the probability of getting MSDs. Prolonged sitting, poor ergonomics, increased screen time, and limited physical activity have all contributed to the prevalence of MSDs. Pregnancy-related physiological changes, improper posture, and inadequate support can lead to discomfort, pain, and potential long-term MSDs. While these physiological changes are necessary for a healthy pregnancy and childbirth, they can make the body relatively weaker and more susceptible to strain and musculoskeletal issues. It is crucial for pregnant women to prioritize proper ergonomics, including the use of ergonomic chairs, taking regular breaks, maintaining good posture, and seeking professional guidance when needed. By implementing proactive measures, pregnant women can promote musculoskeletal health and enhance their overall well-being during this transformative period.

By adopting an active lifestyle, practicing good posture, and seeking professional guidance, pregnant women can minimize the negative impact of sedentary behavior on musculoskeletal health and promote overall well-being during pregnancy. It is important to note that individual factors, such as pre-existing musculoskeletal conditions, personal health, and adherence to ergonomic practices, can significantly influence the occurrence and severity of MSDs in pregnant women across different sectors.

To decrease MSDs in pregnant women during work from home the pregnant women must be encouraged to create a dedicated workspace at home with proper ergonomics. This includes using an adjustable chair, maintaining proper desk height, and positioning the computer monitor at eye level to promote good posture and reduce strain on the muscles and joints emphasizing the importance of taking frequent breaks to stretch and move around. Incorporating short walks or gentle exercises into their routine alleviates muscular tension and promote blood circulation. Providing guidelines on sitting with proper back support and maintaining neutral spine alignment make oneself reluctant to poor posture. Encouraging cushions or lumbar rolls supports the lower back and promotes a comfortable sitting position. Lumbar support equipped with thermal pads can potentially help pregnant women reduce back pain through a combination of mechanical support and heat therapy. Pregnancy often leads to changes in posture, weight distribution, and hormonal levels, which can contribute to back pain and discomfort. Providing access to ergonomic equipment, such as adjustable chairs, footrests, and ergonomic keyboards and mice enhances comfort and reduce the risk of MSDs. Providing resources for stress management, relaxation techniques, and mental health support helps pregnant women cope up with the challenges of working from home. Exploring options for flexible work schedules that allow pregnant women to take breaks or adjust their work hours helps them to accommodate their physical needs and energy levels during pregnancy. By implementing these strategies, employers can help create a supportive work environment that prioritizes the musculoskeletal health of pregnant women during work from home arrangements.

The present work has brought forth unprecedented challenges impacting the musculoskeletal health of pregnant women in unexpected ways. These challenges encompass altered healthcare access, reduced physical activity, increased stress, and changes in work environments. Healthcare systems strained by the pandemic might divert resources from routine prenatal care, affecting early detection and management of musculoskeletal issues. Pregnant women working remotely, especially in the IT sector, face ergonomic challenges contributing to discomfort and disorders like back pain and neck strain due to prolonged hours in suboptimal setups. The surge in freelancing and online teaching also poses similar risks, as these professionals lack ergonomic support and engage in repetitive tasks. Addressing these challenges is crucial to prevent musculoskeletal disorders and ensure the health of these professionals. Studying these issues during pregnancy within the pandemic context can offer insights into long-term consequences and strategies for future crises, shaping guidelines for effective maternal care.

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