Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Effect of Covid-19 lockdown/ compulsory work from home (WFH) situation on musculoskeletal disorders in India

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ABSTRACT

Objective: To estimate self-reported musculoskeletal disorders among Indian population in work from home COVID-19 lockdown and its association on various socio-demographic and occupational factors among them.

Methods: The present cross-sectional study was conducted on working Indian professionals, through an online self-reported survey during the COVID-19 work from the home situation. Details about the perceived musculoskeletal discomforts, weight gain or loss, physical activity profile, number of working hours, total sedentary time, and satisfaction perceived with working from home were recorded from the participant responses and thereafter analyzed.

Results: A total of 281 responses were analyzed. 47.6% of respondents reported musculoskeletal disorders before lockdown, whereas 53.6% reported them during the lockdown period. 10% of respondents reported declination in physical activity. Finding of the chi-square for association and Spearman's rho correlation analysis suggested that gender, pre-existing musculoskeletal discomforts, current sedentary time, and long working hours are significantly associated with musculoskeletal discomforts during work from home COVID-19 lockdown.

Conclusion: This study concluded the increment in the self-reported musculoskeletal disorders among working Indian professionals during work from home COVID-19 lockdown. The study also found the significant association between MSD and gender, working hours, sedentary time and pre-existing musculoskeletal discomforts.

1. Introduction

The COVID-19 pandemic has posed a global challenge to several facets of our lives, from personal to professional. Unlike earlier crises, the fate of this pandemic is uncertain. The recommendations from WHO and the Government of India focus primarily on maintaining safety, hygiene, and social distancing as measures to curb the spread of the COVID-19 infection (Ministry of Health and Family Welfare, 2020)(WHO, 2020). Furthermore, the declaration of a complete nationwide lockdown in India on March 24, 2020, provided limited time for individuals to brace(UN News, 2020). All businesses, organizations, universities, schools, and public and government offices were compelled to close as a consequence of the impromptu lockdown. This situation resulted in a spike in "work from home" (WFH) prospects.

Work from home is not a new phenomenon; it was developed to respond to the 1970s oil crisis. Although terms like teleworking, remote working, home-working, mobile-working, and telecommuting are used interchangeably, "Work from Home" continues to remain a popular term among Indians (Eraso and Garcés, 2020) (Tavares, 2016). Until March 2020, WFH was not a popular alternative for most Indian organizations. However, the circumstance emerged as a result of the COVID-19 pandemic, making it our only reasonable option (Kanda, 2013).

Although WFH prevents the spread of the COVID-19 virus, it poses a lot of barriers. For instance, the flexibility of convenient work from home timings modifies the discipline in a daily work routine(Heathfield, 2020). Prolonged working hours restrict joint mobility and contribute to postural discomforts owing to a lack of

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ergonomically optimal workstations at home. A cross-sectional study found that an inadequate home environment had a significant impact on perceived job satisfaction, productivity level, work-related stress, and musculoskeletal issues among COVID-19 work from home participants (Moretti et al., 2020). The latest evidence focuses on the detrimental impact of WFH, which contributes to decreased physical activity, increased screen time, a decline in cognitive functioning, and an overall loss in quality of life among adults due to COVID-19 (Brink et al., 2018) (Hammami et al., 2020)(Shariat et al., 2020) (Sharma and Vaish, 2020). There is a lack of major infrastructure support for the sustainable application of WFH in developing countries such as India (Sanchez et al., 2020). Furthermore, the possible health consequences of WFH given required infrastructure demands are largely unknown in the Indian context. The present study aimed to estimate self-reported musculoskeletal disorders among the Indian population in work from home COVID-19 lockdown and its association with various socio-demographic and occupational factors.

2. Methods

Study design and setting: This cross-sectional online survey study (Fig. 1) was conducted and reported in accordance with "The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)" guidelines (von Elm et al., 2007). The approval for the study was obtained from the Institutional Ethics Committee (IEC No. 623/2020) and thereafter study was registered under the Clinical Trial Registry of India (CTRI/2020/11/029142). The information was gathered using an online survey form that clearly defined the goal of the study and its objectives. Participants that consented to participate continued to fill out the online survey form. The data were collected between November 24, 2020, and January 18, 2021.

Participants: The sample size was calculated using a formula $n = \hat{p} \times (1 - \hat{p}) \times z^2/MOE^2$(Machin et al., 2008). Where n: sample size, $\hat{p}$: sample proportion, z: found by using a z-score table, MOE: margin of error. The estimation of the sample size for this cross-sectional survey was based on the 47% prevalence of MSD among desk job workers in India (Rajalaxmi et al., 2019). With a margin of error of ±0.05% and an expected sample proportion of 0.47, the sample size was calculated to be 268.

The study participants were Indian working professionals aged between 18 and 60 years. Investigator excluded the responses from participants who were diagnosed positive with COVID-19.

Data collection: The online Google survey form comprised of 44 questions which collected the following details from study participants: (Q1-Q8) demographic details, (Q9-Q13) changes in body weight in lockdown, (Q14-Q19) regarding COVID-19 status. (Q20-Q24) and (Q41-Q44) enquired about the status of WFH such as the previous experience of WFH, the number of working hours, a technical device used during WFH, perceived productivity during WFH, work satisfaction level, and participants opinion to continue WFH. (Q25-Q26) addressed sedentary time. (Q27-Q36) enquired about physical activity/exercise habits before and after lockdown. (Q37-Q40) explored the musculoskeletal discomforts among ten body regions (neck, shoulder, elbow, wrist, upper back, lower back, hip, knee, ankle, and heel). The questions were aimed to elicit patterns of musculoskeletal discomfort before and after the lockdown began. Participants were allowed to provide short responses to obtain a better understanding of a few questions. (Supplementary file 1)

Six subject experts validated the questionnaire for face and content before it was circulated. Pre-testing for readability, understanding, and typing errors was performed on seven participants. According to expert and participant feedback, corrections were made, and three subject experts again reviewed the final questionnaire. The survey was expansively promoted on various social media and professional network sites.

The primary study outcome was to determine the self-reported musculoskeletal discomfort before and after the nationwide lockdown due to the COVID-19 pandemic. MSD was measured at ten different body parts (Q37, Q40). Respondents were asked to report their MSD before lockdown and a month prior to responding the survey.

The details about physical activity/exercise trends included type of activity; time spent per day, and the number of days per week activity was performed. Based on the description of the "the talk test" provided in the questionnaire for classifying the intensity of physical activity, participants provided their responses (Webster and Aznar-Laín, 2008).

To avoid multiple reporting, the online survey settings allowed only one response per login. To avoid over or understatement of MSD, personal identifiers like name and email address were non-mandatory questions. Also, to avoid self-bias, the framing of questions was either close-ended or multiple-choice, or multiple checkboxes.

Data Analysis: Responses were substantiated and downloaded

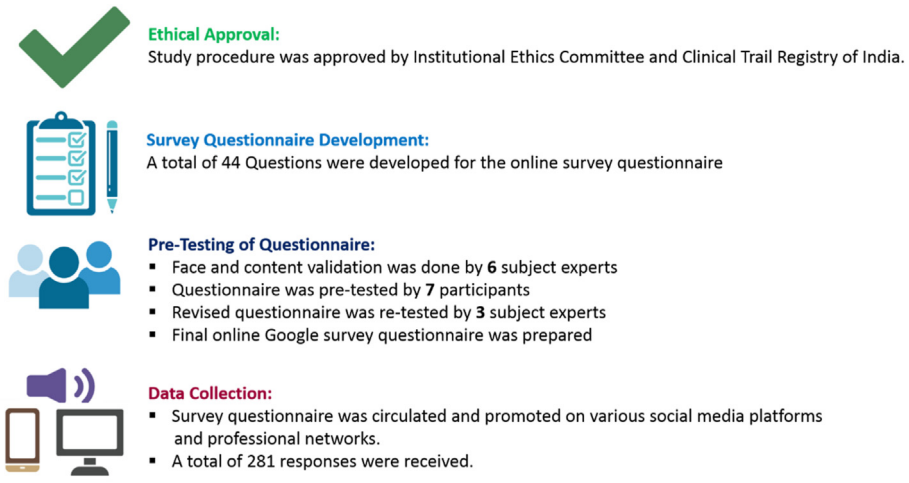

Fig. 1. Illustrative diagram of Study design and data collection.

in Microsoft excel. The data was then exported to ERZ software for analysis. (Kanda, 2013) Data analysis was done for summarizing the demographic details, weight change trend, profile for working hours, sedentary time, use of the technical device, living situation during the lockdown, Covid-19 status, and prior experience of WFH. Continuous variables were analyzed using descriptive statistics and reported as mean and standard deviation (SD). Frequency and percentage values were calculated for categorical variables. Chi-square analysis for categorical variables and Spearman's rho (r_s) correlation for continuous variables was done. As the chi-square test does not measure strength as an association, Phi and Cramer's V effect size statistics are used to find the strength of association between categorical variables (Akoglu, 2018). The level of confidence was set at 95% and the alpha was set at ≤ 0.05.

3. Results

Participants: Online Google survey was circulated among working Indian professionals from varied working sectors.

Descriptive data: A total of 281 responses with 119 females and 162 male respondents; from 17 Indian states were received. The majority of respondents were right-hand dominant (267 out of 281). Mean age (years), height (centimetres), weight (kilograms) and BMI (kilogram/meter^2) of respondents were 34.99 ± 7.84, 167.32 ± 10.56, 71.87 ± 14.04 and 25.71 ± 5.05 respectively. The information technology sector (46%) and education and training sector (20%) contributed major responses. Other profiles included responses from service, health care, business, human resources, government, and public administration sectors. 84% of the respondents reported using a laptop as a technical device used for WFH. The majority of respondents reported having sitting (59.43%) and mental planning (26.69%) as their "nature of the occupation." Only 33.80% had previous experience of working from home, rest 66.19% were experiencing it for the first time. (Table 1), (See Figs. 2 and 3)

53.02% respondents reported weight gain; no weight gain was reported by 41.99% respondents, whereas 4.98% were not aware of any weight gain during WFH. 30.96% respondents reported weight

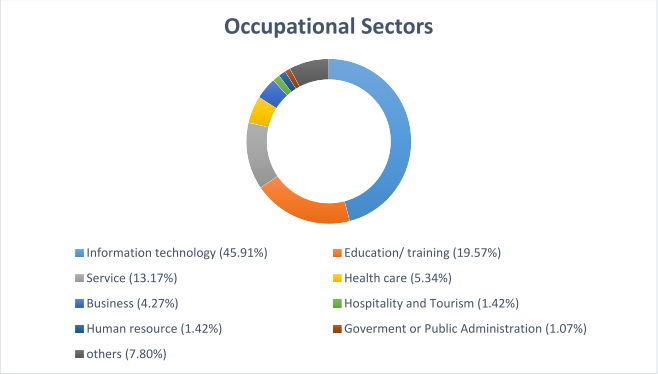

Fig. 2. Distribution of occupation sectors of respondents.

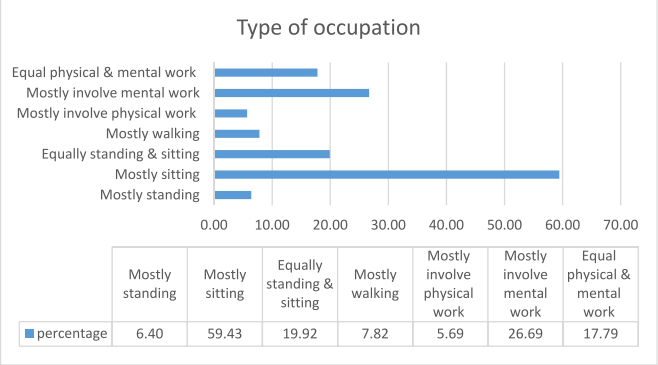

Fig. 3. Nature of occupation of respondents.

Table 1
Socio-demographic and occupational characteristics of the respondents.

Demographic Characteristics	Mean ± SD		
Age (years)	34.99 ± 7.84		
Height (centi-meters)	167.3 ± 10.56		
Weight-before lockdown (Kilograms)	71.87 ± 14.04		
Body mass index (kg/m^2)	25.71 ± 5.05		
Office/working hours Before lockdown (hours)	8.55 ± 1.56		
Office/Working Hours during WFH (hours)	9.32 ± 2.94		
Sedentary time sitting- before lockdown (hours)	3.76 ± 2.68		
Sedentary time sitting-during compulsory WFH (hours)	5.28 ± 4.11		
		Frequency (n)	**Percent (%)**
Gender	Males	162	57.65
	Females	119	42.34
Handedness	Right-handed	267	95.01
	Left-handed	14	4.98
Technical device used	Laptop	235	83.62
	Desktop	19	6.76
	Mobile	27	9.60
The living situation during lockdown	Living with family	245	87.18
	Stayed away from family	36	12.81
Tested positive with Covid-19	Yes	11	3.91
	No	270	96.08
Prior experience with WFH	Yes	95	33.80
	No	186	66.19
Weight gain trend during lockdown	No weight gain	118	41.99
	Weight gained	149	53.02
	Not aware	14	4.98
Weight loss trend in lockdown	No weight loss	179	63.70
	Lost weight	87	30.96
	Not aware	15	5.33

loss; no weight loss was reported by 63.70% respondents, whereas 5.33% were not aware of any weight loss during the period of WFH (Table 1).

Information on physical activity (PA) and exercise profile were collected. We found that, before lockdown, 70.46% of respondents were involved in some or other form of PA, while it was only 61.20% in the COVID-19 lockdown situation. Before lockdown out of 198 (70.46%) of respondents who reported being involved in some kind of exercise or PA, 82% were fulfilling the 150 min of moderate to vigorous physical activity per week, and 18% of respondents had a PA less than 150 min per week. In the current WFH situation, out of 172 (61.20%) who reported being involved in some exercise or PA, 59% are completing a minimum of 150 min of moderate to vigorous PA per week, and 41% have PA less than 150 min per week. Complete physical activity status of respondents before lockdown and during the WFH situation is illustrated in Fig. 4. Mean working hours; before lockdown and during WFH were 8.56 ± 1.56 and 9.32 ± 2.95, respectively. There was an increase in sedentary time during WFH. It increased from 3.77 ± 2.67 h before lockdown to 5.28 ± 4.11 h during WFH (Table 1). 76% of professionals were satisfied, and 24% were dissatisfied with their current work setup, i.e., WFH and 52% wanted to continue working from home. 82% perceived that they were productively contributing to their work.

3.1. Self-perceived musculoskeletal discomfort among COVID-19 positive respondents

Out of a total of 281 responses, 11 respondents survived COVID-19. Out of those 11 participants, five reported multiple body region MSD in their post- COVID-19, WFH situation. To avoid post-COVID-19 related musculoskeletal discomforts, data from these five COVID-19 survivor respondents were not considered while synthesizing MSD due to compulsory WFH.

3.2. Overall self-perceived musculoskeletal discomfort among non-Covid-19 respondents

Self-reported MSD was reported for “before lockdown” status and for the current WFH situation. For the period “before lockdown,” 134 (47.68%) respondents reported having MSD, and 148 (53.62%) respondents reported overall MSD during the current WFH situation. Neck, shoulders, lower back, knees, and upper back were the most affected body regions at both time points (See Fig. 5).

3.3. Regional status of self-perceived musculoskeletal discomfort among respondents

Neck pain: Neck pain was the most common musculoskeletal discomfort we found among respondents before lockdown and the current WFH situation. Before lockdown, 25% of respondents were suffering from neck pain. The percentage increased to 29% in the current WFH.

Shoulder pain: Shoulder pain was found among 18% of the respondents before lockdown. In the current situation, 20% are suffering from the same.

Upper back pain: Upper back pain percentage has raised 4% due to the WFH situation. Among respondents, 5% were complaining the upper back pain before lockdown. In the current scenario, it has reached 9%.

Lower back pain: Low back pain has risen from 17% to 19% due to WFH.

MSD of the lower limb: The survey found that the percentage of lower limb MSD has not been impacted much due to WFH. However, the percentage of knee pain has reduced due to WFH among respondents (see Fig. 6).

A Chi-square test of independence was done to explore the association between MSD during WFH and the following categorical variable-gender, weight gain and weight loss, physical activity status before and during the WFH, type of technical device used, previous experience of WFH, and pre-existing MSD.

Results of the Chi-square showed that there is a significant association between the gender (X^2 (1, N = 276) = 8.97, p = .003) and pre-existing MSD with current MSD during WFH (X^2 (1, N = 276) = 88.99, p = .001). strength of association from Phi and Cramer's V effect size statistics is found to be strong for gender and very strong for pre-existing MSD. Results of the other variables

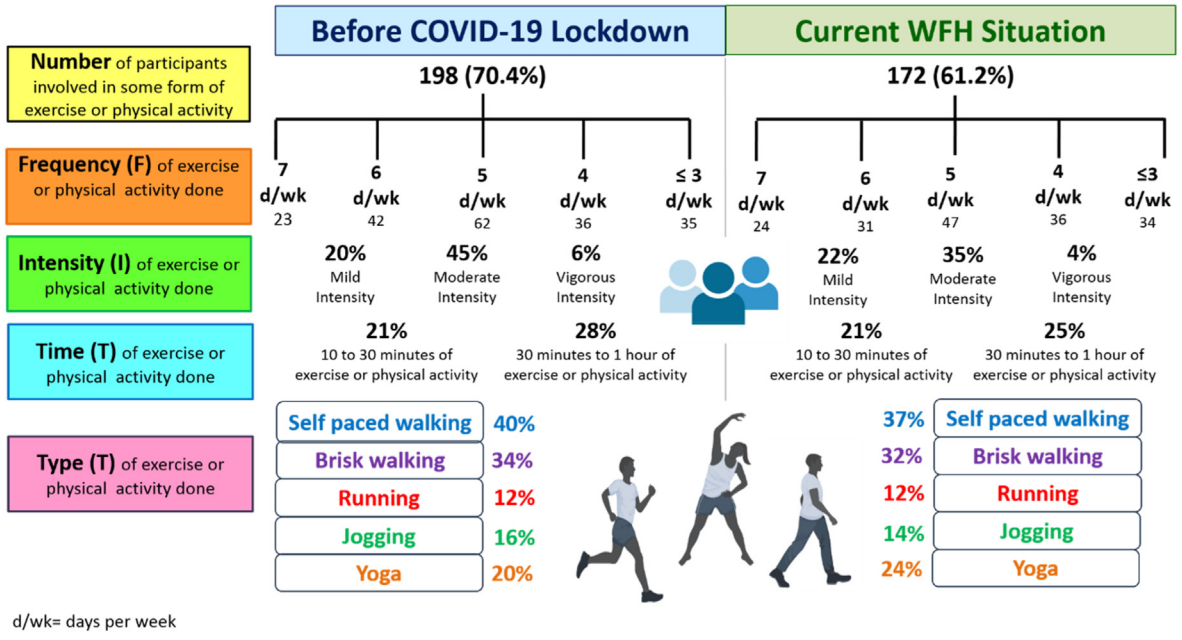

Fig. 4. Physical activity status of respondents before lockdown and during the work from home situation.

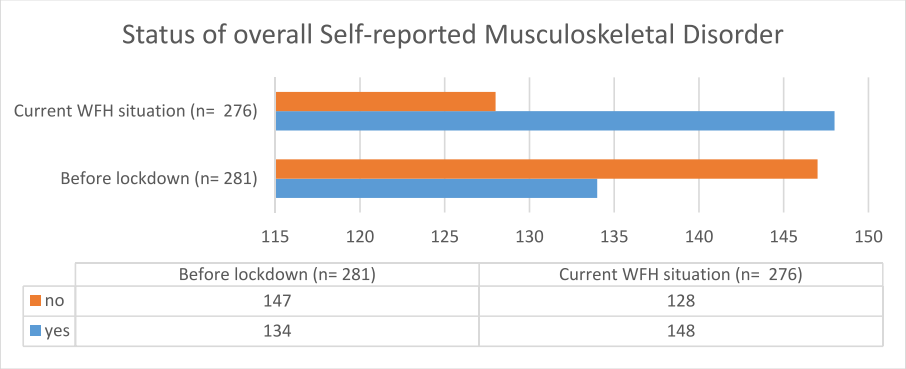

Fig. 5. Self-reported Musculoskeletal disorder status of respondents before lockdown and during the work from home situation.

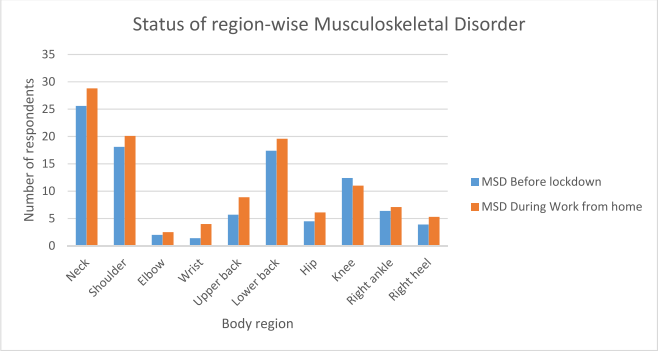

Fig. 6. Status of the regional self-reported musculoskeletal disorder among respondents.

analyzed for the chi-square test of independence showed no significant association (Table 2).

Spearman's rho (r_s) correlation analysis was computed to assess the relationship between MSD during WFH and the following continuous variable-age, working hours during WFH, and sedentary time. There was a significant positive correlation found between MSD during WFH current sedentary time ($r = 0.15$, $p = .02$) and working hours ($r = 0.20$, $p = .001$). Other variables (age, previous sedentary time) do not have a relationship with MSD during WFH (Table 3).

4. Discussion

The cross-sectional study analyzed the self-reported MSD and its association with various socio demographic and occupational factors like age, gender, weight gain, weight loss, physical activity status, sedentary time, a technical device used, and pre-existing MSD. The survey consisted of 44 close-ended questions. A total of 281 responses from different working Indian professions during work from home COVID-19 pandemic were received. The main findings indicated that, self-reported MSD had increased by 6% (from 47.68% to 53.62%) during the COVID-19 WFH situation. Along with weight gain, increased working hours, and increased sedentary time, a 10% drop in physical activity profile was observed. The significant factors associated with MSD among working Indian professionals were gender, pre-existing MSD, working hours and sedentary time.

The COVID-19 pandemic has impacted the globe in many ways, one of which is that many companies and governments are embracing WFH as a long-term adaptation. Few companies are implementing permanent WFH for their staff, while others are experimenting with various WFH models. WFH will thus be the next working trend. WFH or teleworking has its advantages and disadvantages. It offers flexible working hours, but a lack of workplace discipline causes working hours to extend into the late evenings and weekends (Tavares, 2016). Its effects on health range from increased anxiety and exhaustion to decreased quality of life. As a result, in order to gain the most out of the WFH circumstance, modifications in current working practice are required. The results of the present study are suggestive of the respondents (more than 50%) willing to continue WFH. As a result, it is critical to raise awareness about the musculoskeletal discomforts that can result from it.

The importance of regular physical activity is well established (Rhodes et al., 2017). Even though working Indian professionals retain an active physical activity profile, fifty-four percent of them reported MSD during the WFH COVID-19 lockdown. Our results observed three major modifiable factors (working hours, current sedentary time, and pre-existing MSDs) and one non-modifiable factor (gender) associated with MSD during WFH. All these factors must be equally considered while promoting optimal ergonomic health.

Our findings imply that long working hours and increased sedentary time have a deleterious impact on MSD during WFH. The majority of working professionals who responded to the current

Table 2
The strength of association for the presence of MSD during WFH with gender, weight change trend, physical activity status, use of technical devices, previous experience of WFH, and pre-existing MSD.

Variable	Chi-square value	Degree of freedom	Length of significance (p-value)	Phi & Cramer's V Value	Significance of association
Gender	8.97	1	.003	.18	Strong association
Weight gain during WFH	5.64	2	.06	.14	No association
Weight loss during WFH	.34	2	.84	.04	No association
Status of Physical activity before WFH started	.57	1	.45	.05	No association
Status of Physical activity during WFH	2.27	1	.13	.09	No association
Type of technical device used during WFH	4.55	2	.10	.13	No association
Previous experience of WFH	2.37	1	.12	.09	No association
Pre-existing MSD	88.99	1	.001	.57	Very strong association

Table 3
The relationship between the presence of MSD during WFH with age, sedentary time, and working hours.

			MSD current	Current Sedentary time	Before lockdown sedentary time	Working Hours during WFH	Age
Spearman's rho	MSD current	Correlation Coefficient	1.00	.15[a]	.04	.20[b]	−.02
		Sig. (2-tailed)		.02	.53	.001	.77
	Current Sedentary time	Correlation Coefficient		1.00	.59[b]	.01	−.11
		Sig. (2-tailed)			.001	.88	.08
	Before lockdown sedentary time	Correlation Coefficient			1.00	.02	.04
		Sig. (2-tailed)				.69	.47
	Working Hours during WFH	Correlation Coefficient				1.00	.03
		Sig. (2-tailed)					.67
	Age	Correlation Coefficient					1.00
		Sig. (2-tailed)					.

[a] Correlation is significant at the 0.05 level (2-tailed).
[b] Correlation is significant at the 0.01 level (2-tailed).

study stated that their job required long periods of sitting. Recent meta-analyses of extended working hours have found that they have a negative impact on occupational health (Wong et al., 2019). The current study's findings are consistent with prior research, which identified prolonged working hours and sedentary time as a significant risk factor for developing adverse health issues and orthopaedic discomfort. (Wong et al., 2019); (Kang et al., 2020)

Previous evidence suggests that replacing only 10 min of sedentary behavior with moderate physical activity results in positive health benefits(Ryan et al., 2017).

MSD has a tendency to recur and become chronic (El-Tallawy et al., 2021). Previous MSDs are well-known "individual risk factors" for the development of new MSDs (McCauley Bush, 2011), and our findings indicate a very substantial connection between MSD during WFH and any existing discomforts. As a result, if a person suffering from any MSD decides to pursue WFH, they should be aware of this strong relationship and seek expert assistance and ergonomic advice as soon as possible to alleviate their discomfort.

As gender is a non-modifiable risk factor, the formulation of a disciplined work schedule even during WFH will help to combat the other three risk factors. Avoidance of long sitting hours both while working and during leisure time is also crucial. With continued practice of regular physical activity, "active breaks" would help evade the disadvantages of long sitting hours. Self-monitoring of weight would help to stay conscious of personal health.

Limitations: Our study results are confined to working Indian professionals, their generalizability is thus not recommended. Moreover, our conclusions are drawn upon self-reported measures which were best suited for this study considering the COVID-19 pandemic, thus the probability of self-exaggeration or personal bias remains undeniable.

Future studies: Future research could look into the role of domestic physical activity (DPA) or leisure time physical activity (LTPA) for different types of working professionals, as well as the role of behavioural theory techniques in employing optimal ergonomic solutions for WFH practice across gender.

4.1. Clinical relevance

- In this era of COVID-19, most companies and governments have adopted WFH practice for their employees.
- Our results suggest that only maintaining an active physical activity profile is not enough. However, "appropriate scheduling of working hours" and "short regular active breaks" are critical.
- Furthermore, strategies largely aimed at targeting and improving health literacy among the general population on the deleterious effects of long sitting hours have paramount importance.

5. Conclusion

The present study found that WFH had increased the percentage of MSD among working Indian professionals with major associated factors of gender, increased working hours, increased sedentary hours, and presence of pre-existing MSD.

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CRediT authorship contribution statement

Garima Gupta: Conceptualization, Methodology, Investigation, Writing – original draft. **Radhika Aditya Jadhav:** Methodology, Investigation, Formal analysis, Writing – review & editing. **Megha Nataraj:** Methodology, Investigation, Writing – review & editing. **G Arun Maiya:** Supervision, Resources, Methodology, Writing – review & editing.

Declaration of competing interest

Authors declare that there is no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbmt.2022.09.019.

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