

Research Article

An Assessment of Cardiovascular Health Risks in People Working from Home During the Pandemic Period: PANDEV-KALP Study

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Abstract

Objective: The COVID-19 pandemic resulted in people working from home (WFH), which is associated with negative mental and social effects. However, the cardiovascular effects are not well established. We aimed to assess the effects of WFH on cardiovascular risk factors and health behaviors during the COVID-19 pandemic.

Methods: Companies that employ WFH were invited to study via occupational health specialists. WFH employees were sent an online self-reported questionnaire, which included demographics, WFH conditions, medical history, new-onset complaints, and health behaviors. Participants were asked to provide data on blood pressure, glucose, and lipid levels before and during the pandemic.

Results: 208 participants completed the questionnaire, and 61 provided biological data. 72 participants reported to have undergone training for WFH conditions, and 87 were able to provide regular breaks. Weekly working hours have increased by 6 hours during the pandemic (49.6 ± 13.8 vs. 43.8 ± 12.1 , $p=0.001$). Participants reported a median 7.5/10 satisfaction regarding WFH. 112 (53.8%) participants had a new complaint; the most common complaints were body weight gain/increased appetite (35.1%), insomnia/anxiety (27.9%), and physical inactivity/musculoskeletal pain (18.3%). 120 (57.6%) participants had a weight increase. Most participants did not have changes in tobacco or alcohol consumption or exercise habits during the pandemic. Data from the biological data subgroup did not show significant changes in blood pressure, blood glucose, or lipid levels.

Conclusion: WFH adversely affected modifiable cardiovascular risk factors and was associated with weight gain, increased work hours, a lack of workload planning, and increased anxiety. Although risk factors are adversely affected by WFH conditions, workers were satisfied with WFH. The training rate regarding WFH conditions was low; training about WFH should be provided to related employees, and occupational health specialists should focus on reducing specific risk factors that exist during WFH.

Keywords: COVID-19 Pandemic, Stay at home orders, Cardiovascular risk

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INTRODUCTION

The precautions to slow down the spread of the COVID-19 virus during the pandemic have shifted the classical way of working from “workplace” to “work-from-home” (WFH). Implementing this adaptable work model has been characterized as a deliberate decision necessitating a phase of planning, preparation, and adjustment to enable firms to effectively enhance employee productivity and promote a superior work-life balance. However, the COVID-19 pandemic has caused firms to implement remote work practices, frequently without equipping staff with the essential tools and skills for such arrangements [1,2].

Various studies have investigated the impact of WFH on work productivity and mental well-being [1,3,4]. Working from home has been demonstrated to elevate the likelihood of sleep disturbances and insomnia due to stressors and a deficiency of positive stimuli. Prior research has established the correlation between lockdowns and adverse psychological effects, including elevated stress levels [5-7]. However, the WFH’s impact on cardiovascular disease and its risk factors is not well established. Since studies demonstrated COVID-19-related decreased physical activity, increased sedentary lifestyle, and reduced well-being, it can be argued that COVID-19 may have been associated with increased cardiovascular risk in addition to increased inflammatory and thrombotic states [8-10]. However, these findings may not capture the whole cardiovascular risks associated with the COVID-19 pandemic and associated WFH due to the fact that several traditional risk factors [11], including blood pressure, blood glucose and cholesterol levels, smoking, alcohol, etc., may have changed during this period.

In this study, we aimed to investigate the cardiovascular risk factors that can be attributed to the pandemic-related work-from-home conditions.

METHODOLOGY

Study Population

This descriptive survey study included adult volunteers who were part-time or full-time employees working from home (WFH). The universe of the study comprised the white-collar employees of the seven companies served by two different commercial joint health and safety units. After the study protocol was approved by the Clinical Research Ethics Committee, we sent a video

advertisement about the project to the participating companies whose human resources departments shared this invitation and the respective secure link for participation with their white-collar employees.

Data Collection

The data collection process for this study took place from February 2022 to July 2022. Participants’ responses to survey questions and their data were collected through a dedicated secure online web-based platform. The data collected included sociodemographic characteristics (age, gender, education, and living conditions), past medical history including comorbidities and medications, presence of newly emerged medical complaints during the pandemic, changes in working conditions due to the pandemic, lifestyle habits (exercise, alcohol consumption, and smoking), and body mass index (BMI). The level of satisfaction with WFH was rated on a 10-point Likert scale (no satisfaction of 0 to complete satisfaction of 10). Participants were also asked to enter data on the most recent blood pressure office measurements (mmHg), blood glucose (mg/dL), and cholesterol levels (mg/dL), if available, within six months prior to and during the pandemic, meaning retrospective recall was used to estimate “before-pandemic” data.

Statistical Analysis

The study data was analyzed using SPSS 25.0 software and GraphPad Prism 6.0. Descriptive data was expressed as numbers (percentages) for categorical parameters and as mean ($\pm$ standard deviation) or median (Q1-Q3) for continuous parameters. Categorical parameters were compared using a chi-square test, while continuous parameters were compared using a paired t-test or Wilcoxon signed-rank test, according to their normality. The association of the change in BMI to the other study parameters was analyzed using multivariable linear regression. The odds ratio with a 95% confidence interval (CI) was calculated, and an overall Type-1 error level of 5% was used to infer statistical significance.

RESULTS

Overall Participant Characteristics

Among 245 participants who visited the link for the invitation to the survey, 208 volunteers agreed to provide written informed consent and completed the survey (response rate: 84.9%). The median age of the study population was 40 (23-66) years; males

constituted 60.6% of the study population, and 82.6% had a university or higher degree. Only 1 in 10 participants lived alone; two-thirds lived with their partners. Sixty-seven participants had one child, twenty had two, and four had three children. Nearly half of the participants had a chronic disease, the most common being cardiovascular conditions, and 60 (28.8%) had a history of regular medication use. Table 1 demonstrates the baseline characteristics in detail.

Table 1. Overall characteristics of the participants

Characteristics		Study population (n=208)
Age		40 (23-66) years
Gender	Male	126 (60.6%)
	Female	82 (39.4%)
Education	High school	36 (17.3%)
	University	120 (57.7%)
	Higher education	52 (25%)
Living conditions	Alone	24 (11.5%)
	Partner	138 (66.3%)
	Parents	37 (17.7%)
	Newborn to preschooler	44 (21.1%)
	School-aged child	43 (20.7%)
	High schooler	17 (8.2%)
	University aged child	15 (7.2%)
Comorbidities	Any comorbid condition	96 (46.2%)
	Hypertension	27 (13%)
	Diabetes mellitus	25 (12%)
	Musculoskeletal disorders	25 (12%)
	Migraine	23 (11.1%)
	Hypercholesterolemia	22 (10.6%)
	Myocardial infarction	15 (7.2%)
	Depression	7 (3.4%)
Medications	Any medication	60 (28.8%)
	Antihypertensives	29 (13.9%)
	Statins	12 (5.7%)
	Antidiabetics	12 (5.7%)
	Antithrombotics	11 (5.2%)
	Anxiolytics and antidepressants	10 (4.8%)
	Levothyroxine	7 (3.3%)
	Others	7 (3.3%)

Regarding COVID-19 infection history, 79 (37.9%) had been infected with COVID-19 previously, 95 (45.7%) had someone who had been infected with COVID-19 within the household, and 165 (79.3%) had a relative infected with COVID-19.

Changes in Working Conditions and Workload

Of the 208 participants, 140 (67.3%) reported appropriate WFH conditions, such as a home office or a private computer dedicated to work. Seventy-two participants (34.6%) had reported completing at least one introductory training module regarding WFH conditions (i.e., knowledge and skills for WFH planning

or WFH and healthy lifestyle). Eighty-seven participants (41.8%) reported being able to provide regular breaks during WFH. The participants reported a 6-hour increase in mean total weekly working hours (49.6 ± 13.6 hours vs. 43.8 ± 12.1 hours, $p=0.001$) and a 25-hour increase to mean WFH working hours (43.7 ± 20.3 hours vs. 17.9 ± 17 hours, $p=0.001$). Figure 1 depicts working hours prior to and during the pandemic. The median satisfaction with WFH conditions was 7.5 (5-9) on a 10-point Likert scale.

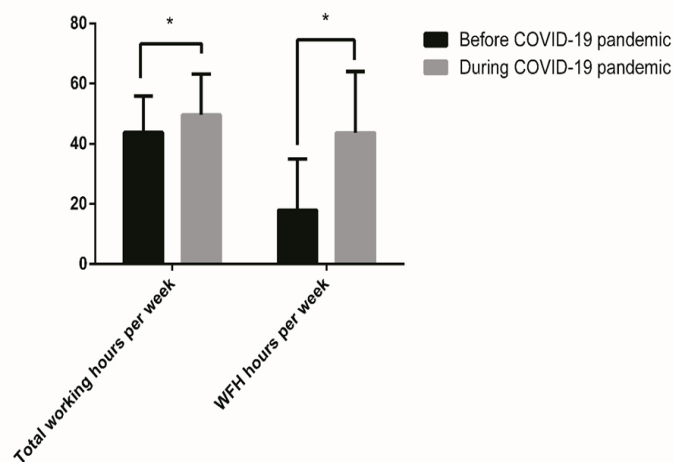


Figure 1. Both mean total working hours and mean working from home (WFH) hours per week significantly increased during the COVID-19 pandemic. * $p=0.001$, paired-samples t-test.

Changes in Healthy Lifestyle Habits During WFH

Seventy-two participants (34.6%) reported regular exercise during the COVID-19 pandemic, of whom 53 participants (73.6% of regular exercisers) exercised more than an hour each week. Thirty-one participants out of 72 (43%) adopted regular exercise during the COVID-19 pandemic, whilst other participants reported no change to their exercise frequency or access to exercise.

More than half of the participants never smoked tobacco, and 40% never used alcohol. During the pandemic, the percentage of participants with increased or decreased tobacco use was similar, whereas a decrease in alcohol consumption was apparent compared to increased alcohol consumption. Figure 2 presents the changes in tobacco and alcohol use.

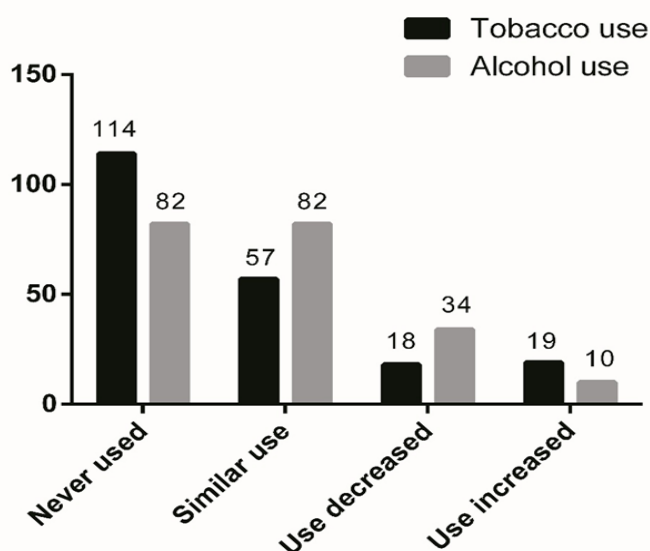


Figure 2. Changes in tobacco and alcohol use during the COVID-19 pandemic.

Development of New Complaints During WFH

Over half of the participants reported the development of a new health complaint during the COVID-19 pandemic. One-third of the study group most commonly reported an increase in appetite or body weight during WFH. Self-reported anxiety affected more than one-fourth of the study group. Other reported complaints were musculoskeletal complaints (e.g., back pain, shoulder pain, stiffness, etc.), palpitations, headache, and sexual dysfunction (e.g., desire or arousal disorders). Table 2 shows the distribution of newly emerged medical complaints during the pandemic in detail.

Table 2. Distribution of newly emerged medical complaints during the pandemic

Complaint	Frequency
Any complaint	112 (53.8%)
Weight gain or increased appetite	73 (35.1%)
Anxiety	58 (27.9%)
Musculoskeletal complaints	38 (18.3%)
Palpitation	22 (10.6%)
Headache	4 (1.9%)
Sexual function disorders	6 (2.9%)

Of the 208 participants, 199 reported their weight before and during the COVID-19 pandemic. Of them, 120 (60.3%) reported an increase, 59 (29.7%) reported a decrease, and 20 (10%) reported no changes to their weight and BMI. Median BMI before the COVID-19 pandemic was 24.8 kg/m² (21.9-28.1), which increased to 25.4 kg/m² (23.0-28.1) during the COVID-19 pandemic ($p=0.001$). When compared categorically, an increase in frequency in overweight participants and a decrease in the frequency of normal weight were

observed ($p=0.001$). Table 3 illustrates the comparison of body mass index categories among participants before and during the pandemic in detail.

Table 3. Comparison of body mass index categories of participants before and during the pandemic

BMI Categories	Before Pandemic	During Pandemic
Underweight (BMI <18.5 kg/m ²)	5 (2.5%)	2 (1%)
Normal weight (BMI 18.5-24.9 kg/m ²)	96 (48.2%)	88 (44.2%)
Overweight (BMI 25.0-29.9 kg/m ²)	68 (34.2%)	79 (39.7%)
Obesity Class I (BMI 30.0-34.9 kg/m ²)	24 (12.1%)	24 (12.1%)
Obesity Class II (BMI 35.0-39.9 kg/m ²)	4 (2%)	5 (2.5%)
Obesity Class III (BMI ≥40 kg/m ²)	2 (1%)	1 (0.5%)

BMI: body mass index.

Multivariate linear regression analyses showed that the female gender was an independent predictor for increased risk of an increase in BMI by 2.5 times. A five-percent risk increase per working hour was demonstrated, whereas regular exercises reduced the risk by 58%. Table 4 demonstrates the relationship between independent variables and an increase in BMI in detail.

Table 4. The relationship between independent variables and an increase in BMI: regression analysis

	Univariate OR (95% CI)	P value	Multivariate OR (95% CI)	P value
Female gender	2.5 (1.23-5.06)	0.011	2.59 (1.17-5.71)	0.018
Living with partner	0.55 (0.3-1.02)	0.053	NS	-
Living with parents	0.45 (0.19-1.02)	0.058	NS	-
Working hour during pandemic	1.05 (1.02-1.09)	0.001	1.05 (1.02-1.09)	0.002
WFH hour during pandemic	1.02 (1.00-1.04)	0.019	NS	-
Regular breaks	0.49 (0.26-0.95)	0.036	NS	-
Regular exercise	0.29 (0.15-0.58)	0.001	0.42 (0.19-0.92)	0.031

OR: odds ratio, CI: confidence interval, NS: not significant, WFH: working from home.

Changes in Biological Parameters During WFH

Self-reported data on blood pressure, blood glucose, and lipid levels before and during the pandemic had substantial missing values. The maximum data available was for blood pressure ($n=108$), followed by blood glucose ($n=61$) and lipid levels ($n=42$). When analyzed in subgroups, data from the biological data subgroup did not show any significant changes in blood pressure, blood glucose, or lipid levels (all $p>0.05$). Table 5 demonstrates the self-reported blood pressure, blood

glucose, and lipid levels of participant just before and during the pandemic in detail.

Table 5. Self-reported blood pressure, blood glucose, and lipid levels of participants before and during the pandemic

	Before Pandemic	During Pandemic
Systolic BP (n=108)	120 (85-190)	120 (85-190)
Diastolic BP (n=108)	80 (50-140)	80 (50-140)
Blood glucose (n=61)	96 (61-600)	95 (69-200)
Total cholesterol (n=42)	199 (100-342)	203 (74-365)
HDL cholesterol (n=42)	46 (26-109)	49 (19-195)
LDL cholesterol (n=42)	128 (65-228)	131 (49-300)
Triglyceride (n=42)	119 (37-388)	122 (42-399)

BP: blood pressure, HDL: high-density lipoprotein, LDL: low-density lipoprotein.

DISCUSSION

This research has demonstrated that rapid transition to WFH conditions may have adversely impacted both cardiovascular risk factors and health behaviors. Moreover, WHF conditions increased time spent on working by 7 hours, meaning one more workday. Working from home caused an increase in BMI. This change can be explained primarily by less movement, working continuously, and an inadequate diet. This finding is consistent with evidence from a comprehensive narrative review that examined multiple mechanisms through which remote work arrangements adversely affect weight management and metabolic health, including reduced daily physical activity, prolonged sedentary periods, accessibility to convenient but energy-dense foods, and the psychological strain of work-life boundary dissolution that may promote compensatory eating behaviors [12]. Since it is well demonstrated that BMI is correlated with increased cardiovascular morbidity and mortality [13], people working from home, especially those working alone, should be encouraged to pay more attention to their diets, and support should be increased in this regard to eliminate this risk factor. Pre-pandemic evidence from a scoping review of telework arrangements similarly documented that prolonged sitting, extended work hours without structured breaks, and inadequate ergonomic infrastructure were consistent risk factors for weight gain and metabolic dysfunction regardless of pandemic circumstances, suggesting that the adverse effects of remote work on health behaviors represent an inherent occupational concern rather than a temporary pandemic phenomenon [14].

It is noteworthy that approximately half of the

participants did not have a private study space, and only around 20% of the participants had their work-from-home equipment provided by their companies. Recent prospective cohort data from occupational populations in developed economies demonstrated that workers lacking adequate workstation infrastructure and ergonomic resources during remote work arrangements faced substantially elevated risk for incident coronary heart disease, even among initially low-risk white-collar employees, highlighting the importance of employer investment in appropriate work-from-home equipment and workspace design as a cardiovascular disease prevention strategy [15]. Furthermore, it was stated that there was very little training support regarding working from home. These problems may be partly due to the rapid transition to working from home as a necessity during the pandemic. However, due to both economic and health-ergonomic concerns, all parties must make rapid efforts to establish and improve the relevant work infrastructure and healthy working conditions. During the work-from-home era, work schedules appear flexible and uncertain. This situation manifests itself in working up to an extra workday per week, as shown in the study. Avoiding working excessively and without rest breaks is crucial for preventing potential health problems, since long work hours are associated with negative cardiovascular outcomes [16]. Professional guidelines from the American Heart Association emphasize that workplace wellness programs targeting modifiable cardiovascular risk factors, including weight management, structured exercise, and stress reduction, should be systematically incorporated into occupational health policy and practice, with remote work settings requiring adapted delivery models to ensure equitable access to such preventive interventions for all employees regardless of work location [17].

The low number of people experiencing difficulty accessing healthcare services when needed can be explained by factors such as our country's healthcare infrastructure, especially the dedication of healthcare professionals, the education level of the individuals in the study population, and the fact that the study group had private health insurance, which enabled them to access private practice. It has been shown that patient satisfaction is superior at private hospitals compared to public ones [18,19].

The satisfaction with working from home can be explained by the circumstances of the time. During the height of the pandemic, when vaccines were unavailable, staying home was, despite everything, the

safest way for self-protection from illness and death. On the other hand, working from home in major cities may have provided personal satisfaction by eliminating time spent in transportation and traffic. It would be of immense benefit to utilize this time by developing and implementing healthy and constructive lifestyle tools and behaviors. Evidence from pandemic lockdown studies indicated that approximately 55% of confined populations experienced weight gain during extended home isolation, with those who engaged in structured digital exercise programs experiencing significantly better metabolic outcomes, suggesting that deliberately repurposing commute time through accessible, technology-enabled fitness interventions may effectively mitigate sedentary behavior and weight gain risks inherent to remote work arrangements [17]. This is a task that all related parties should be in coordination.

We acknowledge our study's main limitation, that is, the self-report design. It may have affected the outcomes, mainly the blood pressure, blood glucose, and cholesterol data. This design may reduce the reliability, specifically the blood pressure, since it is known that rounding is common during blood pressure measurements, even when measured by health professionals [20]. Lack of difference in biological data may be explained by this significant limitation. The second limitation is the fact that we assessed longitudinal changes via cross-sectional questionnaire, which relied on participants' memories. Finally, the number of biological data subgroups is minimal and may lack power to detect small changes.

In conclusion, the PANDEV-KALP project has revealed evidence that working from home poses risks that could have lasting consequences. Although working from home has become widespread due to the COVID-19 pandemic, it is expected to become widespread and permanent due to information technology and economic reasons. Working from home, by changing the traditional social work environment and reducing mobility, requires us to develop different approaches to nutrition, rest, and movement. Key issues in occupational health and safety in the coming period will include organizing, improving, and monitoring the work-from-home environment and working hours in a healthy way from biological, ergonomic, and social perspectives. The psychological stress and anxiety documented in more than one-quarter of our study population may contribute to cardiovascular risk through multiple mechanistic pathways, including sympathetic nervous system activation, inflammation, and thrombotic state alterations; accordingly, comprehensive remote work

health interventions should integrate evidence-based psychological support and stress management alongside traditional physical health monitoring and lifestyle counseling [21]. From now on, there is a greater need for all stakeholders in this field to be transparent and work in coordination to improve health.

Article Information Form

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Conflict of interest: *All authors of this study declare no conflict of interest related to this work*

Ethics: *The survey was performed via an online platform that was developed for and dedicated to PANDEV-KALP Study. Each patient in the study was assigned an anonymous identification number to protect confidentiality. Written informed consent was obtained prior to the study inclusion. The study complies with the principles outlined in the Declaration of Helsinki, and this study protocol was approved by the Clinical Research Ethics Committee of Marmara University (Approval No: 09.2021.646).*

Author contribution: *Conceptualization: GT, VA, GKA, BD, EA, EK, ART, BK, AG, TE, ATG, AA, ASF; Data curation: GT, VA, GKA, BD, EA, EK, ART, BK, AG, TE, AA, ASF; Formal Analysis: GT, VA, ATG, AA, ASF; Funding acquisition: AA, ASF; Investigation: GT, VA, GKA, BD, EA, EK, ART, BK, AG, TE, BA, SÇD, MT, AA, ASF; Methodology: GT, VA, GKA, BD, EA, EK, ART, BK, AG, TE, BA, SÇD, MT, AA, ASF; Project administration: GT, VA, GKA, BD, EA, EK, ART, BK, AG, TE, BA, SÇD, MT, AA, ASF; Resources: GT, VA, GKA, BD, EA, EK, ART, BK, AG, TE, BA, SÇD, MT, AA, ASF; Software: VA, GKA, BD, EA, EK, ART, BK, AG, TE, BA, SÇD, MT, AA, ASF; Supervision: GT, BA, SÇD, MT, AA, ASF; Validation: GT, BA, SÇD, MT, AA, ASF; Visualization: GT, ATG, ASF;*

Writing – original draft: GT, ATG; Writing – review & editing: GT, ATG, AA, ASF

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