

Changes in Smoking Behavior, Stress, and Sleep Duration Among Israeli Hospital Workers During the COVID-19 Pandemic: A Cross-sectional Study

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Abstract

Introduction: Being on the COVID-19 frontline could negatively impact healthcare workers mental health.

Aims and Methods: We examined smoking behavior changes and the association with changes in stress levels and sleeping patterns among hospital workers during the pandemic. An online survey was conducted among employees of a large tertiary medical center in Israel. Data collected included sociodemographic characteristics, smoking status, changes in smoking behavior (for smokers only), stress levels, and sleeping duration during the pandemic, perceptions of risk for COVID-19 infection and disease severity, presence of a chronic illness, COVID-19 exposure and infection status, and involvement in treating COVID-19 patients. Multinomial logistic regression modeling assessed the effects of covariates on smoking behavior change.

Results: Overall, 920 healthcare workers participated. More than half (59%) reported an increase in stress and 28% reported changes in sleep duration. Thirty-five percent of current smokers ($n = 132$), reported smoking more. Increased stress was associated with an increase in smoking (odds ratio [OR] = 3.45, 95% confidence interval [CI] 1.2–9.4, $p = .016$), and an increase in sleeping hours was significantly associated with a decrease in smoking (OR = 6.42, 95% CI 1.2–32, $p = .02$). Among smokers who reported perceived levels of stress to be the same or slightly higher than prepandemic, a strong inverse association was observed between sleep and smoking.

Conclusions: The mental health consequences of the pandemic, specifically for health workers, could lead to negative changes in smoking behaviors. Together with offering stress-management skills and coping strategies, mental health support should target smoking behaviors and sleep disturbances.

Implications: A high proportion of healthcare employees working in a large tertiary medical center in Israel reported increased stress levels during the COVID-19 pandemic. Among smokers, increased stress levels were associated with increased smoking, suggesting that smoking may be a coping mechanism for COVID-19-related stress. Offering stress-management skills and coping strategies can mitigate the negative impact on health workers' smoking behavior, and reduce stress-related increases in smoking behavior.

Introduction

The COVID-19 pandemic has drastically impacted people's lives, socially, economically, and health-wise.^{1,2} Several cross-sectional studies conducted during the initial COVID-19 period have shown that the pandemic has caused changes in smoking behavior among current smokers in two opposite directions—an increase in smoking in some people, and in others an increase in motivation to quit, quitting attempts, and smoking cessation.^{3–9} Intensification of smoking behavior has been suggested to be associated with traumatic events, mediated through psychological distress.¹⁰ Higher levels of self-reported stress (related to social isolation, financial strain and fear of infection, severe disease and death from the SARS-CoV-2 virus) have been observed during the COVID-19 pandemic, which may explain increases in smoking behavior.^{11,12} In a

longitudinal study among current smokers in Pakistan before and during COVID-19 ($n = 2062$), those who increased their smoking were more likely to be single and on average younger, with higher financial stability, and were less dependent on tobacco than the rest of the cohort; whereas participants who were financially worse-off, with higher motivation to quit, were more likely to quit smoking.⁶ A national cross-sectional study that was conducted during the first national lockdown in Israel among the general population (ages 20–64 years, $n = 1500$) found that 36% of smokers increased their smoking whereas 3% quit smoking.¹³ Increases of smoking behavior were more pronounced among women, ultra-orthodox Jews, persons living alone or without a partner, persons with a lower income or who anticipated a reduction in income, and in those who lived in a dwelling without a garden or balcony.¹⁴

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To date, most cross-sectional studies regarding changes in smoking behavior have focused on the general population.^{3–9} COVID-19 studies conducted specifically among healthcare workers during the pandemic have naturally focused on their mental health—reporting high rates of anxiety, depression, and stress.¹⁵ Healthcare workers have been in the frontline of the pandemic and experienced extreme changes to their work and lives.¹⁵ Previous studies have shown that stress is associated with increased odds of smoking across countries globally,¹⁶ and smoking has been found to alleviate stress psychologically and physiologically.¹⁷ Nicotine withdrawal symptoms can increase perceived stress, which is alleviated by smoking.¹⁸ Stress has also been shown to be a predictor for poor sleep quality^{19,20} which in turn is associated with smoking and with greater nicotine dependence.^{21–23}

This study aimed to examine changes in smoking behavior and the association with perceived changes in stress levels and sleep duration among Israeli hospital workers during the COVID-19 pandemic.

Methods

Design

An online cross-sectional survey was conducted during the period May 19–June 7, 2020 among medical and nonmedical employees of the Hadassah Medical Centre. Hadassah Medical Centre is one of the largest tertiary medical centers in Israel, with over 1000 beds, treating the population of the Jerusalem metropolitan. During the first COVID-19 lockdown in Israel (ending 19 April) Hadassah reduced elective work extensively and outpatient clinics transitioned to providing remote care (telemedicine) to the extent possible. However, at the time of the survey, Israel was in between lockdowns and Hadassah was working at normal pre-COVID-19 capacity (COVID-19 “routine” period).

Survey Instrument

The self-report survey was based on a similar questionnaire distributed among the general population in Israel,⁹ and asked about sociodemographic characteristics, smoking status, perceptions of risk for COVID-19 infection and disease severity if infected, presence of a chronic illness that might place the respondent at risk of a severe COVID-19 infection, current COVID-19 exposure and infection status and smoking patterns (for smokers only) during the COVID-19 pandemic.

For this survey of hospital workers, questions were added pertaining to involvement in treating COVID-19 suspected or confirmed patients, and changes in stress levels and sleep duration.

Sociodemographic characteristics included age, sex, professional role (physician, nurse, allied health professional such as physiotherapist, administrative personnel, and maintenance personnel), religion (Jewish, Christian, Muslim, other; recategorized to Jewish or other), marital status (single, married, widowed, divorced; recategorized to married or other), any children living at home, any smoker living at home, and anyone at high risk for COVID-19 infection complications living at home (defined as old age or with any chronic disease).

Smoking status was measured using two questions—(1) “In the beginning of the COVID-19 pandemic (February 2020) did you smoke cigarettes?” (yes, every day or on some days; no,

but I smoked in the past and quit prior to COVID-19; I have never smoked). Respondents who classified themselves as smokers in February 2020 were asked: (2) “Do you currently smoke?” (yes, every day; yes, on some days; no, I recently quit during the COVID-19 pandemic). In addition, participants were asked whether they currently use (yes or no) any other tobacco or smoking products (ie, electronic cigarettes, heated tobacco products, water pipe, or other).

Perception of COVID-19 infection risk was measured based on four questions: two questions assessed the participant’s perception of *personal* risk of infection and if infected, the risk of developing severe illness (both questions answered on a Likert scale from 1—no risk at all, to 10—very high risk), and two questions assessed the perception of a *smoker’s* risk (in general) of COVID-19 infection, and the risk to develop severe illness if infected (for both—a smoker’s risk is higher, the same, or lower compared with a nonsmoker). Respondents were asked to indicate whether or not they had each of the following *Underlying chronic illnesses* (as a measure of possible personal risk for severe illness): cardiovascular disease, chronic obstructive pulmonary disease, asthma, hypertension, diabetes, or other; recategorized to any or none. *COVID-19 exposure or infection status* was categorized as: not exposed to a confirmed case, exposed and currently in quarantine, past-exposure and quarantine, currently ill with the virus, past illness with the virus. Participants were asked whether they were involved at all in *treating confirmed or suspected COVID-19 patients* (yes or no).

Psychological stress was measured with two questions: (1) “Prior to the COVID-19 period, to what extent did you feel you were under psychological stress?” (very low, low, medium, high, very high), and (2) “To what extent do you feel that your psychological stress level has changed since the onset of the COVID-19 period?” (increased considerably, increased slightly, did not change, reduced slightly, reduced considerably). *Sleep duration* were measured with two questions: (1) “Prior to the COVID-19 period how many hours on average did you sleep at night (excluding nights you were on call)?” and (2) “Currently, during COVID-19, how many hours on average are you sleeping at night (excluding nights you are on call)? (for both—<5, 5–6, 6–7, >7). From the answers to these two questions a new variable was computed regarding changes in sleep duration during COVID-19 (sleeping more, the same, or less).

Smoking patterns were assessed among participants who smoked in February 2020. Participants were asked about the average number of cigarettes smoked daily before COVID-19 (<1, 1–10, 10–20, >20), recategorized into occasional smoker (<1) and regular smoker (at least 1 cigarette a day); time to first cigarette in the morning pre-COVID-19 (within 5 minutes of waking, 6–30 minutes, 31–60 minutes, more than 1 hour)²⁴; perceptions of motivation and self-efficacy to quit smoking prior to COVID-19 (Likert scale from low (1) to high (10)). For those who were still smoking at the time of the survey, additional questions assessed: changes in self-efficacy to quit during the COVID-19 period (increased considerably, increased slightly, no change, decreased slightly, decreased considerably); attempt to quit smoking since the beginning of the COVID-19 period (yes or no); and changes in smoking patterns during the COVID-19 period (I smoke more; the same; less than usual; the dependent variable for regression analysis).

Analysis

Statistical analyses were performed using R software, version 3.5.1 and Microsoft Excel. Basic participants' perceptions were summarized using means, medians, and interquartile ranges when appropriate. Due to the relatively small sample size, p value of .1 or less was considered statistically significant.²⁵ Categorical variables were summarized as counts and percentages and continuous variables as medians and interquartile range. Univariate analysis was performed using chi-squared test, Fisher's exact test, and t -test, as appropriate. Multinomial logistic regression was performed to assess the effect of changes in stress levels and sleep duration, and other factors, on changes in smoking behavior during COVID-19. Variable selection for the regression models was based on $p < .2$ in bivariate analysis.

Ethics

The study was approved by the Ethical Committee for Scientific Research on Human Subjects at the Hadassah Medical Centre (approval #0199-20-HMO).

Results

Overall, 920 Hadassah workers out of 4700 (20%) participated in our study. Of these, 659 were women (72%) and 253 were men (28%); 22% were physicians, 33% nurses, 19% allied health workers, 20% administrative workers, and 3% maintenance workers (Table 1). Of all respondents, 132 (14%) smoked in February 2020, 128 (14%) had smoked in the past and quit prior to COVID-19, and 660 (72%) never smoked. Very few participants used other tobacco or nicotine products (1.8% water pipe, 0.8% heated tobacco products, 0.2% electronic cigarettes, and 2.1% other).

Perception of COVID-19 Infection Risk, Underlying Chronic Illness, and Exposure Status to COVID-19

Table 2 presents the participants' perceptions of smokers' risk and of their own personal risk for COVID-19 infection and severe disease if infected. The proportion of participants who think that smoking increases the risk for COVID-19 infection and severe infection was higher among former and never smokers compared with smokers. However, mean perception of participants' own personal risk for infection and for severe disease was higher among smokers than former and never smokers. Of all workers, 1% were previously ill with COVID-19, 1% were previously exposed to a confirmed COVID-19 patient and quarantined, 13.5% were currently in quarantine due to being exposed to a confirmed COVID-19, and 85% were neither ill or exposed to COVID-19. In addition, 16% reported working in wards treating confirmed COVID-19 patients, and 26.5% working in wards for patients suspected with COVID-19.

Psychological Stress and Sleep Duration

More than half of the participants reported an increase in their stress levels—16% ($n = 148$) a considerable increase, and 43% ($n = 391$) a slight increase. One-third (33%, $n = 301$) reported no change in stress levels and 8% ($n = 76$) reported a decrease in their stress levels (Table 2). Most respondents reported no change in the number of sleeping hours ($n = 658$, 73%), while 14% ($n = 125$) reported an increase in the number of hours, and 14% ($n = 124$) reported a decrease.

Smoking Patterns

Of those who smoked in February 2020 ($n = 132$), 11 (8.3%) quit smoking before May 2020, and 8 (6%) attempted to quit. Less than a quarter (23%) smoked occasionally, 42% smoked up to 10 cigarettes a day, 25% between 11 and 20 cigarettes a day, and 10% smoked more than 20 cigarettes a day. Participants' self-reported levels of motivation and self-efficacy to quit prior to the COVID-19 pandemic were 5.16 (SD 3.10) and 5.68 (SD 2.68), respectively. Of the participants that were still smoking at the time of the survey ($n = 121$), one-third (35.3%) reported smoking more during the COVID-19 pandemic, 13% reported smoking less, and 52% reported no change (missing $n = 2$). More than half (59%) reported no change in their level of self-efficacy to quit, 19% reported an increase and 23% reported a decrease in their self-efficacy level (missing $n = 5$).

Factors Associated With Changes in Smoking Behaviors

Table 3 presents the results of the multinomial regression analysis examining the effect of changes in stress levels and sleep duration, and other factors, on changes in smoking behavior among smokers during COVID-19. An increase in stress was found to be associated with an increase in smoking (adjusted odds ratio [OR] = 3.45, 95% confidence interval [CI] 1.26–9.46; $p = .016$). In addition, an association was noted between an increase in sleeping hours and a decrease in smoking (adjusted OR = 6.42, 95% CI 1.28–32.1; $p = .023$). A visual description of the association between changes in sleep, stress, and smoking patterns is presented in Figure 1, which suggests there could be some interaction between changes in sleep and changes in stress: sleeping more among those who were much more stressed appears to be associated with smoking more, while sleeping more among those who were as stressed as before (or slightly more) appear to be associated with smoking less. This interaction, despite being visible, cannot be tested statistically in a proper significance level, due to the small number of participants who reported large increase in stress ($n < 30$). However, it can also be noted that none of the smokers who reported a considerable increase in stress, reported smoking less, regardless of changes in sleep duration.

Discussion

In this sample of hospital workers from a large tertiary hospital, during the COVID-19 "routine" period, 59% of participants experienced an increase in stress, and 28% experienced changes in their sleep duration. Among the participants who smoked in February 2020 (14%), 35% reported smoking more, 61% reported increased stress levels, and 33% reported changes in sleeping hours during the COVID-19 pandemic. A clear association was observed between increased stress levels and increased smoking behavior. In addition, among smokers whose levels of stress did not change or increased only slightly an association was observed between sleeping more and decreased smoking.

Similar to findings from this study, 43% of health workers in Italy reported increased smoking during the pandemic.²⁶ Studies among the Israeli general population have also found that approximately one-third of participants increased their smoking.^{9,13} Results of meta-analyses revealed a 45% prevalence of stress among health workers during the COVID-19

Table 1. Sociodemographic Characteristics Among Hospital Employees ($N = 920$) by Smoking Status, Israel, 2020

Sociodemographic characteristic	Smoking status in February 2020 (prior to COVID-19 emergence in Israel)			<i>p</i>	
	Total (<i>n</i> , %) <i>N</i> = 920	Smokers (<i>n</i> = 132, 14.3%)	Former smokers (<i>n</i> = 128, 13.9%)		Never smokers (<i>n</i> = 660, 71.7%)
Age (y), mean (SD)	46.2 (13.5)	44.4 (13.5)	51.0 (13.9)	45.6 (13.2)	<.001 ^a
Sex—female	659 (72.3%)	89 (68.5%)	83 (66.4%)	487 (84.1%)	.12
Profession					
Physician	203 (22.6%)	13 (10.2%)	28 (22.2%)	162 (25.2%)	<.001
Nurse	304 (33.9%)	55 (43.3%)	33 (26.2%)	216 (33.5%)	
Allied health profession	178 (19.8%)	13 (10.2%)	23 (18.3%)	142 (22.0%)	
Administration	187 (20.8%)	43 (33.9%)	38 (30.2%)	106 (16.5%)	
Maintenance	25 (2.8%)	3 (2.4%)	4 (3.2%)	18 (2.8%)	
Religion (missing <i>n</i> = 9)					
Jewish	839 (92.1%)	104 (81.3%)	121 (94.5%)	614 (93.7%)	<.001 ^c
Muslim	45 (4.9%)	13 (10.2%)	4 (3.1%)	28 (4.2%)	
Christian	15 (1.6%)	5 (3.9%)	2 (1.6%)	8 (1.2%)	
Other ^b	12 (1.4%)	6 (4.7%)	1 (0.8%)	5 (0.8%)	
Marital status (missing <i>n</i> = 8)					
Single	152 (16.7%)	28 (21.5%)	14 (11%)	110 (16.8%)	.001
Married	681 (74.7%)	83 (63.8%)	96 (75.6%)	502 (76.6%)	
Widower	8 (0.9%)	3 (2.3%)	0 (0.0%)	5 (0.8%)	
Divorced	71 (7.8%)	16 (12.3%)	17 (13.4%)	38 (5.8%)	
At least one child (under 18) living at home	617 (68.3%)	93 (71.5%)	80 (63.0%)	444 (68.6%)	.31
Any smoker living at home	165 (18.2%)	61 (46.6%)	22 (17.5%)	82 (12.6%)	<.001
Any high-risk individual for COVID-19 severe infection living at home	247 (27.0%)	45 (34.6%)	37 (28.9%)	165 (25.1%)	.07

p values per chi-square tests, unless otherwise noted. Missing: age, *n* = 21; sex, *n* = 8; profession, *n* = 23; religion, *n* = 9; marital status, *n* = 8; at least one child living at home, *n* = 16; any smoker living at home, *n* = 12; high-risk individual for COVID-19 living at home, *n* = 5.

^aOne-way ANOVA.

^bOther religions include—no religion/Atheist/Buddhist.

^cComparison for religion is between Jewish and all others combined.

Table 2. Risk Perceptions of COVID-19 Infection, and Changes in Stress and in Sleep Duration Among Hospital Employees (N = 920) by Smoking Status, Israel, 2020

	Smoking status in February 2020 (prior to COVID-19 emergence in Israel)				p
	Total (n, %) N = 920	Smokers (n = 132, 14.3%)	Former smokers (n = 128, 13.9%)	Never smokers (n = 660, 71.7%)	
Perception of smokers' risk (in general) of COVID-19 infection					
Higher than nonsmokers	470 (52.5%)	47 (36.2%)	72 (56.7%)	351 (54.9%)	<.001
Same as nonsmokers	382 (42.6%)	67 (51.5%)	49 (38.6%)	382 (42.6%)	
Lower than nonsmokers	44 (4.9%)	16 (12.3%)	6 (4.7%)	22 (3.4%)	
Perception of smokers' risk (in general) of severe disease if infected					
Higher than nonsmokers	802 (88.8%)	101 (77.1%)	114 (89.1%)	587 (91.1%)	NA
Same as nonsmokers	86 (9.5%)	28 (21.4%)	12 (9.4%)	46 (7.1%)	
Lower than nonsmokers	15 (1.7%)	2 (1.5%)	2 (1.6%)	11 (1.7%)	
Perception of personal risk for COVID-19 infection; mean (scale 1-5) (SD)	4.43 (1.98)	4.73 (2.07)	4.44 (1.99)	4.36 (1.96)	.14
Perception of personal risk for severe COVID-19 infection; mean (scale 1-5), (SD)	3.54 (2.15)	4.02 (2.17)	3.91 (2.33)	3.38 (2.08)	.001
Underlying chronic illness	189 (20.5%)	25 (18.9%)	40 (31.3%)	124 (18.8%)	.005
Perceived pre-COVID-19 stress levels					
Very low	180 (19.6%)	29 (22.3%)	29 (22.8%)	122 (18.5%)	NA
Low	334 (36.5%)	44 (33.8%)	46 (36.2%)	244 (37.1%)	
Medium	320 (34.9%)	45 (34.6%)	39 (30.7%)	236 (35.8%)	
High	61 (6.7%)	10 (7.7%)	10 (7.8%)	41 (6.2%)	
Very high	20 (2.2%)	2 (1.5%)	3 (2.4%)	15 (2.2%)	
Perceived change in stress levels during COVID-19					
Increased considerably	148 (16.2%)	25 (19.1%)	20 (15.7%)	103 (15.7%)	.66
Increased slightly	391 (42.7%)	55 (42.0%)	48 (37.8%)	288 (43.8%)	
Did not change	301 (32.9%)	44 (33.6%)	46 (36.2%)	211 (32.1%)	
Decreased slightly	48 (5.2%)	4 (3.1%)	10 (7.9%)	34 (5.2%)	
Decreased significantly	28 (3.1%)	3 (2.3%)	3 (2.4%)	22 (3.3%)	
Changes in sleep duration during COVID-19					
Sleeping more	125 (13.8%)	20 (15.4%)	13 (10.4%)	92 (14.1%)	.40
Sleeping the same	658 (72.5%)	87 (66.9%)	96 (76.8%)	475 (72.8%)	
Sleeping less	124 (13.6%)	23 (17.7%)	16 (12.8%)	85 (13.0%)	

p values per chi-square tests, unless otherwise noted. NA = not applicable due to small cell numbers. Missing: perception of smokers' risk of COVID-19 infection, n = 24; perception of smokers' risk of severe disease if infected, n = 17; perception of personal risk for COVID-19 infection, n = 15; perception of personal risk for severe COVID-19 infection, n = 14; perceived pre-COVID-19 stress levels, n = 5; perceived change in stress levels during COVID-19, n = 4; changes in sleep duration during COVID-19, n = 13.

Table 3. Multinomial Regression Analysis of Changes in Smoking Behavior During COVID-19, Among Current Smokers ($n = 121$)

	Dependent variable: change in smoking behavior	
	Increased smoking	Decreased smoking
Sleep duration		
More sleep	OR = 2.28 95% CI 0.55–9.37	OR = 6.42*** 95% CI 1.28–32.1
Less sleep	OR = 0.57 95% CI 0.18–1.79	OR = 0.35 95% CI 0.03–3.37
Stress ^a		
More stress	OR = 3.45* 95% CI 1.26–9.46	OR = 0.89 95% CI 0.24–3.33
Occasional smoker (cigarettes per day <1) prior to outbreak	OR = 0.66 95% CI 0.21–2.05	OR = 4.08** 95% CI 1.10–15.1
Children at home	OR = 0.42* 95% CI 0.15–1.16	OR = 0.27* 95% CI 0.07–1.05
Intercept	0.53	0.32*

CI = confidence interval; OR = odds ratio.

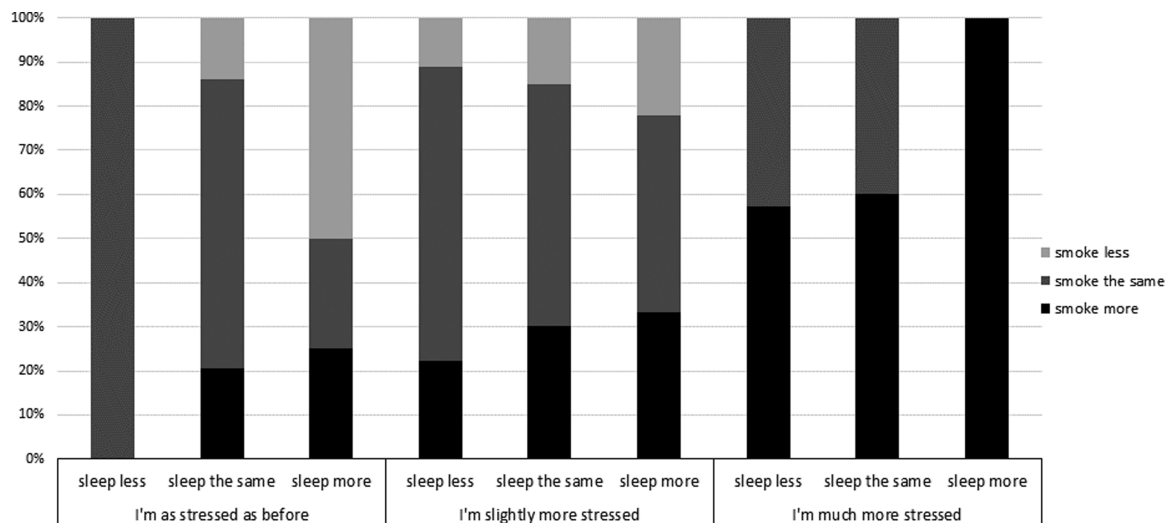
^aThe “Less Stress” category had a small sample size that did not allow for the calculation of a confidence interval and p value (a “complete separation” situation), thus it is not presented in the table.

(Variables that were included in the covariate selection process in the multivariate analysis [$p < .2$ in a bivariate regression]: marital status; children at home; COVID-19 exposure or infection status; involvement in treating confirmed or suspected COVID-19 patients; perception of participant’s personal risk of severe infection with COVID-19; change in sleep; change in stress; occasional smoker [cigarettes per day <1] prior to COVID-19; time to first cigarette in the morning pre-COVID-19; perceptions of self-efficacy to quit smoking prior to COVID-19; changes in self-efficacy to quit during the COVID-19 period.)

* $p < .1$.

** $p < .05$.

*** $p < .01$.

**Figure 1.** Proportion of smokers reporting “smoke less; the same; more” by change in stress and in sleep during COVID-19.

pandemic (95% CI 24.3%–67.5%; nine studies, $n = 3819$),²⁷ and that the prevalence of sleep disturbances among nurses was 34.8% (95% CI 24.8%–46.4%; six studies, $n = 3745$), and 41.6% among physicians (95% CI 27.7%–57%; five studies, $n = 2123$).²⁸ In the current study, a considerable increase in stress was associated only with increased smoking. Other studies among the general population found that COVID-19-related stress was associated with both increased and decreased smoking behaviors.^{29,30} This has been partially explained due to movement restrictions and social distancing that reduced work-related social smoking opportunities. Hospital workers, however, continued to work as usual or more, which might explain why we did not observe a similar pattern in our study.

Interestingly, a survey of health workers from 19 hospitals and health centers in Vietnam found that participants whose smoking level remained unchanged or increased had a greater likelihood of anxiety (adjusted OR = 3.46, 95% CI 2.12–5.66; $p < .001$), depression (adjusted OR = 3.11, 95% CI 1.99–4.84; $p < .001$), and lower health-related quality of life scores ($b = -4.72$; 95% CI -6.50 to -2.94 ; $p < .001$).³¹ However, when analyzing specifically the interaction with health workers involvement in the COVID-19 response, among those that were involved, smoking the same or more was strongly associated with a 67% lower likelihood of anxiety and depression.³¹ These findings, along with findings from our study, suggest that smoking might be used by health workers as a coping mechanism for COVID-19-related stress.

Psychological stress was found to be associated with a negative change in both sleep patterns and smoking behavior among Australian adults during the initial COVID-19 restrictions.³² Findings from our study also suggest a strong association between all three factors. However, the temporality of the association and causality cannot be ascertained due to the cross-sectional study design. The current study only assessed changes in sleep duration, and did not explore sleep quality per se, although both shorter and longer sleep duration have been associated with poor sleep quality.³³

The strengths of this study are the large overall sample size, the inclusion of hospital workers among both medical and nonmedical employees, and the collection of data during a period of COVID-19 “routine” when the burden of disease in Israel was relatively low. As many studies assessing smoking behaviors change focused on the immediate period during initial country lockdowns, including studies conducted in Israel,^{9,13} it is important to also understand the longer impact of the COVID-19 pandemic on smoking behavior. A major limitation is the cross-sectional design, limiting the understanding of the temporal nature of the associations between stress, sleep, and smoking behavior. The small sample size of participants who smoked prior to the pandemic prevented the exploration of the factors associated with quitting or quit attempts during this period. The low response rate of hospital employees is not unusual, although it limits the generalizability of the results to similar populations in Israel and other countries. Specifically, our sample had a higher proportion of Jewish participants compared with their corresponding proportion among all workers in Hadassah (79% Jewish, 15.6% Muslim, 5.4% other). However, the distribution of all Hadassah hospital employees with regard to profession, gender, and smoking status is similar to their distribution in our study (19% physicians, 34% nurses, and 47% others; 65.5% female; 13.2% smokers). Another limitation is that, to maintain brevity of the questionnaire whose main focus was changes in smoking behavior, changes in stress levels and sleep duration were not assessed with a validated survey instrument such as the Perceived Stress Scale and the Pittsburgh Sleep Quality Index.^{34–36} Specifically for changes in sleeping patterns, we assessed sleep duration but not sleep quality which has been previously found to be associated with smoking and smoking cessation.²¹ Consequently, findings need to be interpreted with caution and replicated with larger, more representative samples, using validated measures. In addition, the analysis plan for this manuscript was not preregistered and therefore the results should be considered exploratory.

The mental health effects of the pandemic, specifically for hospital workers, have long-lasting negative implications. Many countries, including Israel, offered mental health support to hospital workers as part of the pandemic response. Findings from this study suggest that such support should also target smoking behavior (among those who smoke) and sleep disturbances. Smoking cessation interventions that target health workers should incorporate alternative stress-coping mechanisms, and strategies to improve sleep quality. As many of the health workers may not be motivated to quit smoking, interventions might consider a harm-reduction approach, aiming to mitigate any negative changes in smoking behaviors, that may be mediated through stress and poor sleep quality. Specifically, offering stress-management skills and coping strategies may also have a direct impact on health workers smoking behavior, and reduce stress-related

increases in smoking behavior. Lessons learned from the current COVID-19 pandemic should guide us as the world prepares for a future health crisis.

Supplementary Material

A Contributorship Form detailing each author’s specific involvement with this content, as well as any supplementary data, are available online at <https://academic.oup.com/ntnr>.

Declaration of Interests

Yael Bar-Zeev has received fees for lectures from Pfizer Ltd, Novartis NCH, and GSK Consumer Health (distributors of smoking cessation pharmacotherapy in Israel) in the past (2012–July 2019). All other authors declare no conflict of interest.

Data Availability

The data underlying this article will be shared on reasonable request to the corresponding author.

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