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Association between smoking status and changes in health behaviours during the COVID-19 lockdown: a cross-sectional study in Israel

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ABSTRACT

Objectives To explore the association between smoking status (current vs former), changes in smoking habits (among current smokers only) and negative changes in dietary and physical activity habits during the initial COVID-19 lockdown in Israel.

Design A secondary analysis of an online cross-sectional study (6 April 2020 to 28 April 2020). Dependent variables included deteriorations in dietary habits score and odds of reporting worsening of physical activity habits during the first COVID-19 lockdown. The study analysed the association between these variables and 'smoking status' (current vs former) and, within smokers, changes in smoking habits, using multivariate logistic and linear regression models. For changes in physical activity habits, there was a significant interaction with baseline physical activity levels (p=0.04), therefore, analysis was stratified accordingly.

Setting Online data collection.

Participants 660 participants, current or former smokers in Israel, Hebrew speakers and ≥18 years old.

Primary outcomes Self-reported negative changes in dietary habits and physical activity during the first COVID-19 lockdown.

Results The sample (n=660) included 66.2% (n=437) current smokers and 33.8% (n=223) former smokers. Among current smokers, 43.5% (n=190) indicated an increase in their smoking habits. Of all respondents, 25% (n=170) reported a negative dietary change and 48% (n=192) spent less time engaging in physical activity, with 66% (n=437) reporting increased levels of stress. No significant association was found between smoking status and the dietary habits score in the multivariate linear regression (B=−0.046, CI −0.493 to 0.401, reference group: former smokers). This indicates that being a current smoker was associated with a non-significant 0.046 point decrease in the dietary habits score compared with former smokers. Similarly, no significant association was found between smoking status and odds of reporting worsening of physical activity, even after stratifying by baseline physical activity levels. Among participants who currently smoke, no significant association was found between changes in smoking habits and the dietary habits score (B=0.391, 95% CI −0.061 to 0.843, p=0.090, reference group: those who smoke the same or less) or with odds of reporting worsening of physical activity (OR=1.16, 95% CI 0.688 to 1.956, p=0.577, reference group: those who smoke the same or less).

Conclusion Among current and former smokers, high rates of negative health habit changes were found, emphasising the need for interventions during future crises. Smoking status and/or changes in smoking habits among current smokers were not associated with negative changes in dietary and physical activity habits.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The study used an online cross-sectional design, enabling quick data collection in multiple languages from a diverse sample.
⇒ Potential participation bias may have been introduced due to the exclusion of populations less likely to use online platforms, such as the Ultra-Orthodox Jewish community.
⇒ The study did not include never smokers, which limits our understanding of how dietary and physical activity habits differ across all smoking status groups.
⇒ The use of self-reported data may be subject to recall bias, potentially affecting the accuracy of reported changes in behaviours.
⇒ The reliance on a convenience sample recruited through social media may limit the representativeness of the study population.

INTRODUCTION

The COVID-19 pandemic has had a profound impact on the lives of people worldwide, physically, emotionally, socially and economically.[1] Most countries, including Israel, imposed lockdowns in the first few months of the pandemic.[2] In Israel, the first full lockdown (including closure of workplaces, schools and a general ban on leaving your home beyond a certain distance) was implemented between 19 March 2020 and 3 May 2020.[2]

The impact of the pandemic and lockdown policies on the mental health of the population, the economic situation, social distancing and perceptions of risk from the coronavirus are all factors that could affect the health habits of the population, such

as dietary habits, physical activity and smoking.[3–5] The pandemic, which led to increased access to stockpiled food and heightened stress from media exposure, has caused changes in dietary habits, including overeating of 'comfort' food.[6–8] This psychological response may also contribute to the development of eating disorders and emotional eating as people seek solace in food.[9–11] Reports of a decrease in physical activity are likely linked to restrictions on leaving the home, closure of fitness facilities and national and neighbourhood parks, a decrease in social, family and community interactions and job loss and mental stress.[12 13]

Negative physical activity habits occur in tandem with poor dietary habits, a correlation that existed both before and during the pandemic.[14–16] Therefore, although they have been described separately, it is important to consider synergistically the negative impact of a lack of physical activity and poor dietary habits on health, particularly when examining chronic metabolic and viral diseases. Several studies conducted in Israel during the first lockdown found that most residents reported reduced levels of physical activity and an increase in snack consumption and weight gain.[17 18]

Several risk factors are linked to changes in health behaviours during challenging times. Increased calorie and salty food consumption is more likely in individuals who are female, under 29 years old, in a relationship, confined to smaller spaces, living alone during the lockdown or having a history of psychiatric treatment.[19] Negative changes in health behaviours due to psychological distress, such as stress, anxiety and depression, are prevalent among women, individuals aged 18–45 years, those with low education and income, those without a partner and individuals with chronic diseases.[20] Dietary habits are influenced by factors like age, gender, geographic region, body mass index and job status. Overeating and reduced physical activity are predicted by concerns about economic hardship, poor health and gender (women), emphasising the need for tailored strategies to maintain a healthy lifestyle during challenging circumstances.

Similarly to dietary habits and physical activity, many studies reported changes in smoking behaviour.[21 22] In Israel, nearly half of the current smokers reported smoking more than usual during the COVID-19 pandemic.[22 23]

Research has shown that former smokers often exhibit better health behaviours than current smokers, including improved dietary habits and increased physical activity.[24] For example, in a study by Boyle *et al* in 2000, former smokers were found to consume more fruits and vegetables, engage in higher levels of physical activity and adopt healthier overall lifestyles compared with current smokers. Therefore, former smokers may demonstrate more resilience and healthier behavioural adaptations during stressful periods and crises. It is unclear whether smokers are more at risk regarding changes in other health habits, such as dietary habits and physical activity, and whether changes in smoking behaviour are also linked to changes in dietary habits and physical activity.

The aim of the current study is to examine the relationship between smoking status, changes in smoking habits and changes in dietary habits and physical activity during the first lockdown period of the COVID-19 pandemic. Specifically, we aimed to: (1) examine whether there is a difference in negative changes in dietary and physical activity habits between current smokers and former smokers and (2) assess among people who currently smoke whether there is a relationship between negative changes in smoking habits and negative changes in dietary and physical activity habits.

While our study focuses on the COVID-19 pandemic, it is important to note that future pandemics may also necessitate lockdowns or similar restrictive measures, making our findings potentially relevant for crisis situations beyond this pandemic. This broader perspective underscores the importance of understanding how health behaviours change during periods of confinement and stress, regardless of the specific cause.

MATERIALS AND METHODS

Design

Secondary data analysis from a cross-sectional study among current and former smokers during the first lockdown period in Israel was performed.[22] The original study aimed to explore changes in smoking behaviour and home-smoking rules during this period.

Participants

The participants were Hebrew-speaking Israeli residents who were current or former smokers over the age of 18 years. In total, 660 participants (identical to the original sample) took part in the study, of whom 437 were current smokers and 223 were former smokers. The survey was distributed online through social media platforms (Facebook and Instagram) using paid advertisements. No incentive was offered for participation or completion of the survey.

Data collection tool

The full survey (online supplemental file 1) included variables that were not part of the current study. In the Methods section, we only describe the variables that were included in the current analysis.

Sociodemographic variables

Sociodemographic characteristics included age, sex, education level (recategorised as having a bachelor's degree or higher vs those without an academic degree), religion (recategorised to Jewish vs other), marital status (recategorised to married or living with a partner vs single/widowed/divorced), employment status prior to the COVID-19 restrictions (full-time job, part-time permanent, part-time casual, self-employed, unemployed or retired), changes in employment status during COVID-19 restrictions (recategorised to no change, and reduced income/loss of job), number of children living

at home and age of the youngest child, anyone at high risk for COVID-19 complications living at home (defined as old age and/or with any chronic disease) and outdoor home environment (garden, balcony only or no garden or balcony).

COVID-19-related variables

COVID-19 exposure or infection status was recategorised as not exposed to a confirmed case at all/no past/current illness versus exposed/current illness/past illness. Perception of risk was measured based on four questions: two questions assessed the general perception of a smoker's risk of infection with the SARS-CoV-2 virus, and, if infected, the risk to develop severe illness (for both—smoker's risk is higher, the same or lower compared with non-smoker's risk), and two questions pertained to the perception of the participant's own personal risk of infection with the SARS-CoV-2 virus and, if infected, to develop severe illness (both using a Likert scale from 1 (no risk at all) to 10 (very high risk)). Underlying chronic illness (as a measure of possible personal risk for severe illness) was ascertained with a dichotomous (yes/no) question asking whether the participant had any chronic illnesses, including cardiovascular disease, chronic obstructive pulmonary disease, asthma, hypertension, diabetes or cancer. Perceived mental stress was measured with two questions: (1) 'Before the COVID-19 period, to what extent did you feel you were under mental stress?' (very low, low, medium, high, very high) and (2) 'Since the COVID-19 period, how much do you feel that your mental stress level has changed?' (recategorised to increased, no change and reduced).

Baseline health behaviour variables

Dietary habits prior to the pandemic included four yes/no questions assessing: (a) striving to eat regular meals every day, (b) striving to reduce salty and/or sweet snacks, (c) striving to reduce sugary drinks and (d) striving to eat at least five or more portions of fruit and vegetables a day. A combined variable of overall dietary habits prior to the pandemic was created from the sum of these four questions (range 0–4; 4 indicating healthy dietary habits and 0 indicating poor dietary habits). Physical activity levels prior to the COVID-19 pandemic were measured using the question 'In a normal week, prior to the COVID-19 pandemic period, how much cumulative time do you spend exercising?' (I do not devote any time to physical activity, up to 30 min a week, 30–90 min a week, 90–150 min and over 150 min).

Dependent variables

The dependent variables were 'worsening of physical activity habits during the COVID-19 period' and 'worsening of dietary habits during the COVID-19 period'. Changes in physical activity habits during the COVID-19 pandemic were assessed using the following question: 'Since the COVID-19 pandemic period in Israel began, has there been a reduction in the time you devote to physical activity?' (The answers no, it rose considerably; no, it rose slightly; has not changed, (all recategorised as no); yes, it dropped slightly and yes, it dropped significantly (all recategorised as yes)). Changes in dietary habits during the COVID-19 pandemic were measured using the sum score from four questions: 'Have there been any changes in your eating habits since the start of the COVID-19?' (a) Eating regular meals every day, (b) eating salty and/or sweet snacks, (c) drinking sugary drinks and (d) eating at least five or more portions of fruit and vegetables a day, with answers for each question being: it is worse now (score 3), no change (score 2) and it is better now (score 1) (range 4–12; 12 indicating worsening of all dietary habits and 4 indicating an improvement in all of their habits).

Explanatory variables

The explanatory variables were 'smoking status' and 'change in smoking habits'. Smoking status was measured using the question: (1) 'do you currently smoke?' (recategorised as Yes (I smoke every day and sometimes combined) vs No (I used to smoke, and I quit)). For current smokers only, participants were asked about the changes in smoking habits during the COVID-19 period (recategorised as I smoke more vs I smoke the same or less combined).

Statistical analysis

Descriptive analysis was conducted using frequencies (%) for categorical variables and mean SD for continuous variables. For each of the different dependent variables, a bivariate analysis was performed to examine the relationship between the outcome variable and the explanatory variables as well as between the explanatory variables and other covariates (sociodemographic variables, perceived mental stress and underlying chronic illness). The rationale for selecting covariates was grounded in established scientific literature concerning factors associated with changes in health and smoking behaviour. Categorical variables were analysed using the χ^2 test, normally distributed continuous variables were analysed using the t test and non-normally distributed continuous variables were analysed using the Mann-Whitney test. An independent variable that was significantly associated with or close to significance ($p \leq 0.1$) with the explanatory variable was suspected as a confounding variable in the tested association. Afterwards, each of the suspected covariates was separately entered into the regression model along with the explanatory variable, examining the change in the effect measure. For a variable that changed the effect measure by more than 15%, the additional effect of an interaction variable with the explanatory variable was tested. Variables that were found to be confounders (changed the effect measure by more than 15% and the interaction term was not significant) were included in the final regression model as confounders. For variables where the interaction term was significant, stratification was conducted. This method, drawing on statistical

Table 1 Sociodemographic characteristics, psychological distress, background illness and risk perceptions among all participants (n=660) and by smoking status, Israel, 2020

	Total (*N*, %)	Current smokers	Former smokers
	n=660	(n=437, 66.2%)	(n=223, 33.8%)
Age (mean, SD)*	40.2 (14.5)	38.6 (14.5)	43.2 (14.0)
Sex (n(%))*			
Male	261 (39.7%)	162 (37.2%)	99 (44.6%)
Education (n(%))*			
Did not have an academic degree	438 (67.0%)	319 (74.1%)	119 (53.4%)
Jewish (n(%))*	615 (94.5%)	406 (94.2%)	209 (95.0%)
Married/living with a partner (n(%))*	336 (51.1%)	203 (46.8%)	133 (59.6%)
Living with one or fewer adults (n(%))*	355 (58.5%)	223 (55.6%)	132 (64.1%)
Number of children (under the age of 18) living together with the respondent in the household (mean (SD))*	1.01 (1.2)	1.02 (1.2)	0.98 (1.2)
Age of youngest child living at home (mean (SD))*	7.96 (5.15)	8.30 (5.00)	7.19 (5.43)
High-risk individual for COVID-19 severe infection living at home (n(%))*	208 (31.8%)	138 (31.9%)	70 (31.7%)
Outdoor home space (n(%))*			
Garden	275 (42.3%)	163 (37.9%)	112 (50.9%)
Balcony	235 (36.2%)	166 (38.6%)	69 (31.4%)
No balcony or garden	140 (21.5%)	101 (23.5%)	39 (17.7%)
Employment status prior to COVID-19 restrictions (n(%))*			
Full-time job	310 (47.4%)	207 (48.0%)	103 (46.2%)
Part-time permanent	101 (15.4%)	71 (16.5%)	30 (13.5%)
Part-time casual	40 (6.1%)	41 (6.1%)	42 (6.1%)
Self-employed	64 (9.8%)	34 (7.9%)	30 (13.5%)
Not working/unemployed	96 (14.7%)	64 (14.8%)	32 (14.3%)
Retired	43 (6.6%)	22 (5.1%)	21 (9.4%)
Reduced income/loss of job during COVID-19 restrictions (n(%))*	293 (45.6%)	209 (48.8%)	84 (39.1%)
COVID-19 exposure or infection status (n(%))*			
Not exposed to a confirmed case at all/ no past/current illness	626 (95.4%)	412 (94.9%)	214 (96.4%)
Exposed/current illness/past illness	8 (1.2%)	2 (5.1%)	8 (3.6%)
Underlying chronic illness (n(%))*	157 (23.9%)	93 (21.4%)	64 (28.8%)
Perceived stress level prior to COVID-19 restrictions (n(%))*			
Very low	124 (18.9%)	77 (17.7%)	47 (21.2%)
Low	160 (24.4%)	104 (23.9%)	56 (25.2%)
Medium	192 (29.2%)	122 (28.0%)	70 (31.5%)
High	119 (18.1%)	86 (19.8%)	33 (14.9%)
Very High	62 (9.4%)	46 (10.6%)	16 (7.2%)
Perceived change in stress level during COVID-19 restrictions (n(%))*			
Decreased considerably	18 (2.7%)	9 (2.1%)	9 (4.0%)
Decreased slightly	33 (5.0%)	22 (5.1%)	11 (4.9%)
Did not change	168 (25.6%)	99 (22.9%)	69 (30.9%)
Increased slightly	271 (41.3%)	175 (40.4%)	96 (43.0%)
Increased considerably	166 (25.3%)	128 (29.6%)	38 (17%)
Perception of personal risk	4.67 (2.19)	4.66 (2.19)	4.69 (2.18)
Perception of personal risk for severe COVID-19 infection (mean (SD))*†	4.88 (2.47)	5.10 (2.47)	4.43 (2.43)

Continued

Table 1 Continued

	Total (*N*, %) n=660	Current smokers (n=437, 66.2%)	Former smokers (n=223, 33.8%)
Perception of smokers' risk for COVID-19 infection compared with non-smokers (n(%))*			
Higher risk	316 (47.9%)	205 (47.0%)	111 (49.8%)
Same or lower risk	343 (52.0%)	231 (53.0%)	112 (50.2%)
Perception of smokers' risk for severe COVID-19 infection compared with non-smokers (n(%))*			
Higher risk	535 (81.1%)	335 (77.2%)	200 (89.7%)
Same or lower risk	122 (18.5%)	99 (22.8%)	23 (10.3%)

Pearson χ^2 test, unless otherwise specified.
*Missing: age=22, gender=2, education=6, religion=9, marital status=3, number of adults (over 18) living with the respondent=53, number of children (under 18) living with the respondent=48, living with people who are at high risk of severe COVID-19 illness=6, outdoor home space=10, employment status prior to the COVID-19 outbreak=6, change in employment status due to COVID-19=17, exposure status to COVID-19=4, underlying chronic illnesses=3, level of pre-existing mental stress=3, change in mental stress since the outbreak of COVID-19=4, perception of personal risk for COVID-19 infection=5, perception of personal risk for severe COVID-19 infection=9, perception of smokers' risk for COVID-19 infection compared with non-smokers=1 and perception of smokers' risk for severe COVID-19 infection compared with non-smokers=3
†Measured on a scale of 1–10.
‡t test.
§Among those with children under 18 years of age, n=303

considerations, aimed to identify potential confounders and modifiers while avoiding potential multicollinearity.

In total, four different multivariable regression models were performed—two linear regressions for the dependent variable 'worsening in dietary habits score' with the explanatory variables 'smoking status' for the entire sample (n=660) and 'change in smoking habits' among current smokers only (n=437) and two logistic regressions for the dependent variable 'worsening in physical activity' with the same explanatory variables. For the latter two models, we excluded participants who answered that they did not engage in physical activity before the pandemic. A few participants (n=9) mentioned they did not engage in physical activity before the pandemic but did answer that they worsened their physical activity during the pandemic. For these participants, we re-coded their original answer to 'engaging in less than 30 min physical activity prior to the pandemic'. Therefore, the final models for 'changes in physical activity' included n=404 for the explanatory variable 'smoking status' and n=253 for the explanatory variable 'changes in smoking habits'.

A p value ≤0.05 was considered statistically significant. Analyses were performed using SPSS V.25 (IBM, Armonk, New York, USA).

Patient and public involvement

Patients and the public were not involved in the design, conduct, reporting or dissemination plans of our research.

RESULTS

Overall, n=660 participants answered the survey, with 66.2% (n=437) reporting currently smoking and 33.8% (n=223) reporting former smoking. Among former smokers, 7% (n=46) recently quit between 3 months and 12 months before the COVID-19 restrictions, and 26.8% (n=177) quit over a year before the restrictions. Within the subsample of smokers only (n=437), 43.5% (n=190) reported increasing their smoking, while 54.7% (n=239) did not change or decreased their smoking during the early stages of the pandemic.

Table 1 describes the sociodemographic characteristics, psychological distress, background illness, risk perception of all participants and according to smoking status. Of all respondents, 60.3% were women, and the average age was 40.2 (SD 14.5) years. The majority of respondents were Jewish, did not have an academic degree and were employed full-time. Almost all (95.4%) reported that they were not exposed to or infected with the coronavirus (at the time of the survey), and 76.1% did not have any chronic underlying diseases. Less than a third (27%) of the surveyed individuals reported that they were under high levels of stress prior to the pandemic, with 66% reporting an increase in their stress levels.

There were notable differences between participants who were current smokers and participants who were former smokers with regard to their sociodemographic characteristics (table 1). Compared with the participants who smoked in the past, participants who were currently smoking were younger (average age 38.6 years old vs 43.2 years old in the past smoking group), less educated (74% did not have an academic degree vs 53.4% among past smokers) and fewer were in a relationship (46.8% vs 59.6% of past smokers). Furthermore, participants who reported being current smokers reported their employment status changed less compared with past smokers (51.2% of current smokers experienced a change in employment status compared with 60.9% among past smokers). Current smokers reported having fewer chronic

Table 2 Dietary habits before and during the COVID-19 pandemic among all survey participants and according to smoking status (n=660), Israel, 2020

	Total (*N*, %) n=660	Current smokers (n=437, 66.2%)	Former smokers (n=223, 33.8%)	P value
Before the COVID-19 pandemic				
Striving to reduce salty and/or sweet snacks (n(%))*	373 (60.7%)	231 (56.2%)	142 (70.0%)	0.001
Striving to reduce sugary drinks (n(%))*	399 (64.8%)	245 (59.2%)	154 (76.2%)	<0.001
Striving to eat at least five or more portions of fruit and vegetables a day (n(%))*	253 (40.6%)	148 (35.6%)	105 (50.7%)	<0.001
Striving to eat regular meals every day (n(%))*	423 (65.7%)	262 (61.4%)	161 (74.2%)	<0.001
Overall dietary habits score prior to the pandemic (mean (SD))*†	2.30 (1.37)	2.11 (1.35)	2.69 (1.31)	0.001§
During the COVID-19 pandemic				
Eating regular meals (n(%))*				
Better	145 (22.2%)	96 (22.3%)	49 (22.1%)	0.712
No change	298 (45.7%)	192 (44.7%)	106 (47.7%)	
Worse	209 (32.1%)	142 (33.0%)	67 (30.2%)	
Eating salty and/or sweet snacks (n(%))*				
Better	102 (16.0%)	64 (15.2%)	38 (17.6%)	
No change	310 (48.6%)	206 (48.8%)	104 (48.1%)	0.717
Worse	226 (35.4%)	152 (36%)	74 (34.3%)	
Consuming sugary drinks (n(%))*				
Better	103 (16.2%)	69 (16.5%)	34 (15.7%)	0.012
No change	394 (62.0%)	245 (58.5%)	149 (69.0%)	
Worse	138 (21.7%)	105 (25.1%)	33 (15.3%)	
Eating at least five or more portions of fruit and vegetables a day (n(%))*				
Better	157 (24.6%)	110 (26.1%)	47 (21.7%)	
No change	375 (58.7%)	236 (55.9%)	139 (64.1%)	0.140
Worse	107 (16.7%)	76 (18.0%)	31 (14.3%)	
Overall dietary habits score during the pandemic (mean (SD))*‡	8.08 (2.14)	8.13 (2.20)	7.97 (2.03)	0.474§

Pearson χ^2 test, unless otherwise specified.
*Missing: striving to reduce salty and/or sweet snacks=46, striving to reduce sugary drinks=44, striving to eat at least five or more portions of fruit and vegetables a day=37, striving to eat regular meals every day=16, overall dietary habits prior to the pandemic=60, eating regular meal=8, eating salty and/or sweet snacks=22, consuming sugary drinks=25, eating at least five or more portions of fruit and vegetables a day=21, negative change in all their dietary habits=30 and overall dietary habits during the pandemic=4.
†Measured on a scale of 0–4, where 4 indicates adherence to healthy eating habits and 0 indicates no adherence.
‡Measured on a scale of 4–12, where 4 indicates that they improved all the examined dietary habits and 12 indicates that they worsened all the examined dietary habits.
§Mann-Whitney U.

diseases (78.6% among current smokers had no chronic diseases compared with 71.2% among former smokers) and reported an increase in their stress level (70% among the group of current smokers compared with 60% among former smokers).

Changes in dietary habits

Prior to the pandemic, 60.7% reported striving to reduce their consumption of snacks, 64.8% striving to reduce their consumption of sweetened beverages, 40.6% striving to consume at least five portions of fruits and vegetables daily and 65.7% striving to eat regular meals (table 2).

Former smokers reported a higher rate of striving to reduce their consumption of snacks (70% vs 56.2% among current smokers, p=0.001) and sweetened beverages (76.2% vs 59.2% among current smokers, p <0.001). In addition, former smokers reported a higher rate of striving to consume at least five portions of fruits and vegetables (50.7% vs 35.6% among current smokers, p<0.001) and of eating more regular meals compared with current smokers (74.2% vs 61.4%, respectively, p<0.001). Overall dietary habits score was higher among former smokers (2.69 vs 2.11 among current smokers, p<0.001) (table 2).

Table 3 Results of the Linear models examining the relationship between smoking status and negative changes in the dietary habits score and the relationship between change in smoking habits and negative changes in the dietary habits score during the pandemic period, Israel, 2020

Negative changes in the dietary habits score	B	Standardised coefficient beta	P value	95% CI
Smoking status*†	−0.046	0.010	0.839	(−0.493, 0.415)
Change in smoking habit‡§ (n=404)	0.391	0.088	0.090	(−0.061, 0.843)

*n=660, adjusted for age, gender, education, number of adults living in the household, level of change in psychological distress during COVID-19, the perceived likelihood of smokers developing severe COVID-19 disease compared with non-smokers, pre-COVID-19 overall dietary habits score and the time dedicated to physical activity before COVID-19.
†Reference group: former smokers.
‡n=404, adjusted for age, gender, perceived change in stress level during COVID-19 restrictions and number of children living in household.
§Reference group: those who smoked the same or less.

Less than half (45.7%) reported that they did not change their eating habits in terms of eating regular meals, 48.6% did not change their snacking habits, 62% did not change their consumption of sweetened beverages and 58.7% did not change their consumption of fruits and vegetables. Approximately 25% of the sample reported that they changed all four of their dietary habits, with no significant difference between the groups. The mean changes in the dietary habits score for the entire sample were 8.08 (SD 2.14). Comparing changes in dietary habits and physical activity between current and past smokers, the only significant difference found was that 25.1% of participants who were current smokers reported a negative change in reducing the consumption of sweetened beverages, compared with 15.3% in former smokers (p =0.012). In the final linear regression models, neither smoking status (B=−0.046, 95% CI −0.493 to 0.401, p =0.839, reference group: former smokers) nor changes in smoking habits (among current smokers only) (B=0.391, 95% CI −0.061 to 0.843, p =0.090, reference group: those who smoke the same or less) were significantly associated with changes in the dietary habits score during the early stages of the COVID-19 pandemic, after adjusting for confounding variables (table 3).

Changes in physical activity: prior to the pandemic, 58.8% of all respondents engaged in any physical activity. A little less than half of the current smokers (44.6%) did not engage in physical activity compared with 34.5% of former smokers (p =0.003). Overall, 48.1% (n=192) reported reducing their physical activity levels, with no differences between current or former smokers (table 4). For the outcome 'changes in physical activity habits during the COVID-19 pandemic', the variable 'cumulative time performing physical activity per week before the COVID-19 pandemic' was found to be an interaction variable (p =0.04). Therefore, we stratified the model according to this variable.

No statistically significant relationship was found between smoking status and odds of reporting worsening physical activity during the COVID-19 pandemic in any of the categories, after adjusting for all other confounders (table 5). Similarly, among current smokers only, no significant relationship was found between changes in smoking habits and odds of reporting worsening physical activity (OR=1.16, 95% CI 0.688 to 1.956, p=0.577, reference group: those who smoke the same or less) (table 5).

Table 4 Physical activity habits before and during the COVID-19 pandemic among all survey participants and according to smoking status (n=660), Israel, 2020

	Total (*N*, %) n=660	Current smokers (n=437, 66.2%)	Former smokers (n=223, 33.8%)	P value
Cumulative time performing physical activity per week before the COVID-19 pandemic (n(%))*				
Not devoting any time to physical activity	271 (41.2%)	194 (44.6%)	77 (34.5%)	0.003
Up to 30 min	109 (16.6%)	79 (18.2%)	30 (13.5%)	
30–90 min	117 (17.8%)	75 (17.2%)	42 (18.8%)	
90–150 min	76 (11.6%)	41 (9.4%)	35 (15.7%)	
Over 150 min	85 (12.9%)	46 (10.6%)	39 (17.5%)	
Worsened their physical activity habit during the COVID-19 pandemic (n=401) (n(%))*				
Yes	192 (48.1%)	116 (46.6%)	76 (50.7%)	0.429

Pearson χ^2 test.
*Missing: cumulative time performing physical activity per week=2 and worsened their physical activity habit=2.

Table 5 Results of the logistic regression models examining the relationship between smoking status and negative changes in physical activity habits and the relationship between change in smoking habits and negative changes in physical activity habits during the pandemic period, Israel, 2020

Negative changes in physical activity and smoking status*†							
Crude‡§				Adjusted‡‡			
B	Exp (B)	P value	95% CI	B	OR	P value	95% CI
Up to 30 min cumulative time performing physical activity per week, prior to the pandemic period							
−0.627	0.534	0.127	(0.239, 1.19)	0.734	0.480	*0.113*	(0.194, 1.189)
30–90 cumulative minutes performing physical activity per week, prior to the pandemic period							
0.134	1.134	0.729	(0.537, 2.434)	0.171	1.187	0.690	(0.511, 2.759)
90–150 cumulative minutes performing physical activity per week, prior to the pandemic period							
−0.080	0.923	0.866	(0.364, 2.339)	0.218	0.804	0.685	(0.281, 2.300)
Over 150 cumulative minutes performing physical activity per week, prior to the pandemic period							
0.298	1.348	0.498	(0.498, 1.348)	0.111	1.118	0.827	(0.412, 3.032)
Negative changes in physical activity and smoking habit‡§							
B		Standardised coefficient beta		P value		95% CI	
0.149		1.160		0.577		(0.688, 1.956)	

*n=404, adjusted in all models for underlying chronic illness, changes in employment status due to the pandemic and the assessment of the risk of smokers contracting severe illness compared with non-smokers.
†Reference group: former smokers.
‡n=245. Adjusted for age and gender.
§Reference group: those who smoked the same or less.

DISCUSSION

The aim of this study was to examine the relationship between smoking status, changes in smoking habits during the first lockdown period of the COVID-19 pandemic and changes in dietary and physical activity habits. The findings indicate that there were no differences between current smokers and former smokers in terms of changes in their dietary habits and physical activity. In addition, among current smokers only, there was no association between changes in smoking habits and changes in dietary habits and physical activity. Nonetheless, among all the study participants, a very high rate of negative changes in various health habits was found. Approximately 25% reported negative changes in all dietary habits together, 30% reported negative changes in the habit of eating regular meals, 35% reported higher consumption of snacks and sweets, 20% reported higher consumption of sweetened drinks and 15% reported lower consumption of fruits and vegetables. Regarding physical activity habits, approximately 48% spent less time on physical activity, and, additionally, about 66% reported an increase in their level of psychological distress.

Despite being a convenience sample, which might not be fully representative of current and former smokers in Israel, our findings regarding smoking behaviour changes were similar to a nationally representative sample, which found that 40% of people who currently smoke increased their smoking, and approximately 3% quit during the first lockdown.[18] Similarly, our findings on the changes in dietary and physical activity habits were also similar to those reported from other studies conducted in Israel during COVID-19.[17 23 25] The prolonged stay at home and the social disconnection from the environment, together with the sense of insecurity from the emergency situation, may cause negative changes in health habits.[17 18 25] These negative changes need to be taken into account by decision-makers and public health professionals when planning intervention programmes during emergency situations. Staying at home is an opportunity to encourage at-risk populations such as current or former smokers to maintain and even improve their health habits in a variety of ways. It may be possible to use various media such as television or the internet to disseminate recommendations for physical training, dietary guidelines or workshops to neutralise the sense of emergency and reduce anxiety or depression.

Nonetheless, our findings indicate that there was no difference between smokers or former smokers in regard to changes in dietary habits or physical activity. This indicates that smoking status may not need to be a primary consideration when evaluating the broader behavioural impacts of lockdown measures on public health, although further research may be warranted to confirm this across diverse populations and contexts, and specifically whether never smokers differ from current or former smokers. Similar to our findings, models from other research studies that aimed to predict those at risk for negative changes in diet or physical activity did not find smoking status as a predictor.[26 27] A study conducted in Spain[26] that examined physical activity habits before and during the lockdown among students (n=213) found that both smoking and non-smoking students dedicated more time

to physical activity after the pandemic outbreak, contrary to the study hypothesis. Another study from Spain by Casas *et al*,[27] which examined adherence to the Mediterranean diet and the degree of weight gain among adults in Europe during the lockdown (n=1268), found no difference in the risk of weight gain among smokers, former smokers and non-smokers. However, this study did find a link between the extent of smoking habits and weight gain. Among smokers, those who improved their smoking habits by quitting or smoking less had a 50% lower risk of weight gain, compared with those who smoked more.[26] In contrast to the current study, Casas *et al* examined the risk of weight gain and not the dietary or physical activity habits themselves.[26]

The online data collection method enabled rapid data collection during the lockdown, but it could have led to participation bias. Although 85% of adults in Israel reported using Facebook,[28] the survey conducted through social media may not fully represent the population of current and former smokers in Israel. Our sample was almost exclusively Jewish, with a higher proportion of women. More importantly, our sample did not include Ultra-Orthodox participants as they do not use social media.[29] The Ultra-Orthodox population (11% of the Israeli population) and the Arab population (20% of the Israeli population) both experienced several COVID-19 outbreaks during the first lockdown.[30] Future studies should consider including a more representative Israeli sample, including never-smokers, to provide a more comprehensive understanding of health behaviour changes across Israel's population during lockdowns. As the primary objective of the initial study was to focus on changes in smoking habits, questions regarding dietary and physical activity habits were relatively few and did not include longer validated surveys.[31–33] Hence, the potential for measurement bias may have affected our findings. For example, perceived stress levels might not accurately reflect true stress levels, and measured physical activity may not fully capture the actual effort or duration of activity performed. In valid questionnaires, the level of physical activity can be standardised by measuring various activities such as walking, running, weight training or studio exercises using one metabolic equivalent (MET) units. In this study, participants were asked how many minutes they devoted to physical activity before and after the pandemic outbreak. It is possible that participants did not change the time devoted to physical activity, and therefore no difference in physical activity level was expected. However, due to the pandemic restrictions that led to confinement at home, it is possible that the participants changed the quality of their physical activity and therefore performed fewer or more MET units per exercise compared with the prepandemic period. However, our study used similar questions used by other studies,[34] including a national representative, government-funded study in Israel.[23] All data collected in the study are based on self-reporting, which might have also introduced bias. Nonetheless, we assume there is no differential bias in regard to reporting on dietary and physical activity between people who are current smokers and former smokers. While we aimed to include a comprehensive range of demographic, psychosocial and behavioural variables based on the existing literature, it is possible that other factors may have influenced both smoking behaviours and health habit changes during lockdown, potentially affecting our results. Therefore, a limitation of our study is the potential presence of residual confounders that were not considered, such as social support networks and pre-existing mental health conditions.

Conclusions

In summary, no differences were found in the change of dietary and physical activity habits between current smokers and former smokers and between those who smoked more and those who smoked the same or less. However, the surveyed population as a whole worsened their dietary and physical activity habits following the outbreak of the pandemic. Findings from the current study support the need to invest efforts in preventing the exacerbation of negative dietary and physical activity habits during future crisis situations.

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Contributors YB-Z conceptualised the study. YB-Z collected the data. MC conducted the data cleaning and initial coding under the guidance of YBZ. MC analysed the data under YB-Z's supervision. MC prepared the first draft of the manuscript with input from YB-Z. MC wrote the paper under YB-Z's guidance. YB-Z supervised the entire data collection, analysis and writing process. All authors have read and agreed to the published version of the manuscript. YB-Z is the guarantor for this manuscript.

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Competing interests YB-Z 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 conflicts of interest.

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Ethics approval This study involves human participants and was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee for Scientific Research on Human Subjects at the Hebrew University-Hadassah Faculty of Medicine (approval #05042020). Participants gave informed consent to participate in the study before taking part.

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