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The association between smoking and changes in dietary habits and physical activity during COVID-19 in Israel

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Abstract

Objective to explore the association between smoking status (current vs former), and 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 (April 6-28, 2020). Dependent variables included deteriorations in dietary and physical activity habits during the firstCOVID-19 lockdown. The study analyzed 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=), therefore analysis was stratified accordingly.

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

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, 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 worsening of dietary habits in the multivariate linear regression (B=-0.046, CI -0.493-0.401) or worsening of physical activity smokers in the multivariate linear regression, stratified by baseline physical activity levels. Among participants who currently smoke, no significant association was found between changes in smoking habits and worsening of dietary habits (B=0.391, 95% CI -0.061-0.843, p=0.090) or worsening of physical activity (OR=1.16, 95% CI 0.688-1.956, p=0.577)..

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

1. STRENGTHS AND LIMITATIONS OF THIS STUDY

- The study examined the relationship between changes in three distinct health habits—diet, physical activity, and smoking—during the early months of the COVID-19 pandemic.
- The study employed an online cross-sectional design, potentially introducing participation bias. Specifically, the sample was skewed and did not encompass the Ultra-Orthodox population, who generally do not use social media.
- We did not include never smokers, which may be different in their changes of dietary and physical activity habits compared to current or former smokers.

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 March 19 and May 3 , 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, national and neighborhood parks, a decrease in social, family, and community interactions, as well as 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 snacks consumption and weight gain (17,18).

Several risk factors are linked to changes in health behaviors 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 behaviors due to psychological distress, such as stress, anxiety, and depression, are prevalent among women, individuals aged 18-45, 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, BMI, and job status. Overeating and reduced physical activity are predicted by concerns about economic hardship, poor health, and gender (women), emphasizing 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 behavior (21,22). In Israel , nearly half of current smokers reported smoking more than usual during the pandemic (22,23). However, 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 behavior 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 and 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.

Materials and Methods

Design: Secondary data analysis from a cross-sectional study aimed to assess changes in smoking habits during the first lockdown period in Israel (22). The participants were Hebrew-speaking Israeli residents who were current or former smokers over the age of 18. In total, 660 participants 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 is presented in supplementary file 1. Participants were asked about their sociodemographic characteristics, current Covid-19 exposure and infection status, perception of risks for potential complications from Covid-19 infection, perceived stress levels, dietary habits before and during the COVID-19 pandemic, physical activity habits before and during the COVID -19 pandemic, smoking status, and smoking habits (among current smokers only). Sociodemographic characteristics included age, sex, education level (re-categorized as having a bachelor degree or higher vs those without an academic degree), religion (re-categorized to Jewish vs other), marital status (re-categorized 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 (re-categorized to no change , and reduced income/loss of job), number of children living at home and age of 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 exposure or infection status was re-categorized as not exposed to a confirmed case at all/ no past/current illness vs 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 to non-smoker's risk), and two questions pertained to

the perception of 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) to10 (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?" (recategorized to increased, no change, and reduced). Dietary habits prior to the pandemic included 4 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 5 or more portions of fruit and vegetables a day. A combined variable of overall dietary habits prior the pandemic was created from the sum of these 4 questions (range 0-4; 4 indicating healthy dietary habits, and 0 indicating poor dietary habits). Physical activity levels prior the COVID-19 pandemic was measured using the question "In a normal week, prior 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 minutes a week, 30-90 minutes a week, 90-150 minutes, over 150 minutes).

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 was 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 yes, it rose considerably; yes, it rose slightly; has not changed, [all recategorized as no]; yes, it dropped slightly; and yes, it dropped significantly [all re-categorized 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 5 or more portions of fruit and vegetables a day, with answers for each question - it's worse now (score 3), no change (score 2), it's better now (score 1) (range 4-12; 12 indicating worsening of all dietary habits, and 4 indicating an improvement in all of their habits).

The explanatory variables were 'Smoking status' and 'Change in smoking habits'. Smoking status was measured using the question: (1) "Do you currently smoke?" (re-categorized 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 (re-categorized as I smoke more, vs I smoke the same or less combined).

Statistical Analysis: Descriptive analysis was conducted using frequencies (%) for categorial variables and mean standard deviation (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 additional independent variables (sociodemographic variables, psychological stress characteristics, and underlying disease). Categorical variables were analyzed using the Chi-Square test, normally distributed continuous variables were analyzed using T-Test, and non-normally distributed continuous variables were analyzed using the Mann-Whitney test. An independent variable that was significantly associated or close to significance ($p \leq 0.1$) was suspected as a confounding variable in the tested association. Afterwards, each of the suspected independent variables 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 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.

In total, four different multi-variable regression models were performed – two linear regressions for the dependent variable 'worsening in dietary habit' with the explanatory variables ‘smoking status’ for the entire sample (n=660) and ‘change is smoking habits’ among smokers only (n=437); and two logistic regression 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 minutes 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 v25 (IBM, Armonk, NY, USA). Ethics: The study was approved by the Ethical Committee for Scientific Research on Human Subjects at the Hebrew University-Hadassah Faculty of Medicine (approval#05042020)

Results

Overall, n= 660 participants answered the survey, with 66.2% (n=437) reporting currently smoking and 33.8% (n=223) reporting past smoking. Within the sub-sample 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). 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 that were current smokers to participants that were former smokers in regard to their socio-demographics characteristics (Table 1). Compared to 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, p<000.1), less educated (74% did not have an academic degree vs 53.4% among past smokers, p<0.001), fewer were in relationships (46.8% vs 59.6% of past smokers, p=0.002). Furthermore, participants who reported being current smokers, reported their employment status changed less compared to past smokers (51.2% of current smokers experienced a change in employment status compared to 60.9% among past smokers, p<0.019). Current smokers reported having fewer chronic diseases (78.6% among current smokers had no chronic diseases compared to 71.2% among former smokers, p=0.034) and reported an increase in their stress level (70% among the group of current smokers compared to 60% among former smokers, p=0.004).

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

	Total (*n*, %) N = 660	**Current Smokers (*n* = 437, 66.2%)**	**Former Smokers (n = 223, 33.8%)**	***p*-Value**
Age §, (mean, SD)	40.2 (14.5)	38.6 (14.5)	43.2 (14.0)	<0.001^
Sex (n(%)) §				
Male	261 (39.7%)	162 (37.2%)	99 (44.6%)	0.065
Education (n(%))§				
Did not have an academic degree	438 (67.0%)	319 (74.1%)	119 (53.4%)	<0.001
Bachelor's degree/Master's degree or higher	216 (33%)	112 (26%)	104 (46.6%)	
Jewish (n(%))§	615 (94.5%)	406 (94.2%)	209 (95.0%)	0.673
Married/Living with a partner (n(%))§	336 (51.1%)	203 (46.8%)	133 (59.6%)	0.002
Living with one or fewer adults (n(%))§	355 (58.5%)	223 (55.6%)	132 (64.1%)	0.045
Number of children (under the age 18) living together with the respondent in the household (mean (SD))§	1.01 (1.2)	1.02 (1.2)	0.98 (1.2)	0.715^
Age of youngest child living at home (mean (SD))§	7.96 (5.15)	8.30 (5.00)	7.19 (5.43)	0.084^

High risk individual forCOVID-19 severe infection living at home (n(%))§	208 (31.8%)	138 (31.9%)	70 (31.7%)	0.959
Outdoor home space (n(%))§				
Garden	275 (42.3%)	163 (37.9%)	112 (50.9%)	0.006
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%)	0.012
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%)	0.019
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%)	0.395
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%)	0.034
Perceived stress level prior to COVID-19 restrictions (n(%))§				
Very low	124 (18.9%)	77 (17.7%)	47 (21.2%)	0.251
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%)	0.004
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 for COVID-19 infection (mean (SD))§*	4.67 (2.19)	4.66 (2.19)	4.69 (2.18)	0.864^
Perception of personal risk for severe COVID-19 infection (mean (SD))§*	4.88 (2.47)	5.10 (2.47)	4.43 (2.43)	0.001^
Perception of smokers' risk for COVID-19 infection compare to non-smokers compared to non-smokers (n(%))§				
Higher risk	316 (47.9%)	205 (47.0%)	111 (49.8%)	0.503
Same or lower risk	343 (52.0%)	231 (53.0%)	112 (50.2%)	
Perception of smokers' risk for severe COVID-19 infection compared to non-smokers (n(%))§				
Higher risk	535 (81.1%)	335 (77.2%)	200 (89.7%)	<0.001
Same or lower risk	122 (18.5%)	99 (22.8%)	23 (10.3%)	

Pearson Chi-Square test, unless otherwise specified.

^ T- Test.

*Measured on a scale of 1-10

**Among those with children under 18, n=303

§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 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 compare to non-smokers compared to non-smokers = 1, perception of smokers' risk for severe COVID-19 infection compared to non-smokers = 3

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 5 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 5 portions of fruits and vegetables (50.7% vs 35.6% among current smokers, p<0.001), and of eating more regular meals compared to 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).

Less than a 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 sum changes in dietary habits score for the entire sample was 8.08 (SD 2.14). Comparing changes in dietary habits and physical activity between current and past smokers, only one significant difference was found - 25.1% of participants who were current smokers reported a negative change in reducing the consumption of sweetened beverages, compared to 15.3% in former smokers (p=0.012). In the final linear regression models, neither smoking status (B=-0.046, 95% CI -0.493-0.401, p=0.839) or changes in smoking habits (among current smokers only) (B=0.391, 95% CI -0.061-0.843, p=0.090), were significantly associated with changes in dietary habits during the early stages of the COVID-19 pandemic, after adjusting for confounding variables (Table 3).

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 5 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 prior 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%)	
No change	298 (45.7%)	192 (44.7%)	106 (47.7%)	0.712
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%)	
No change	394 (62.0%)	245 (58.5%)	149 (69.0%)	0.012
Worse	138 (21.7%)	105 (25.1%)	33 (15.3%)	
Eating at least 5 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 during the pandemic (mean (SD))§**	8.08 (2.14)	8.13 (2.20)	7.97 (2.03)	0.474^^

Pearson Chi-Square test, unless otherwise specified.

^^ Mann-Whitney U.

* 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.

§Missing: Striving to reduce salty and / or sweet snacks = 46, striving to reduce sugary drinks = 44, striving to eat at least 5 or more portions of fruit and vegetables a day =37, striving to eat regular meals every day = 16, overall Dietary habits prior the pandemic = 60, eating regular meal = 8, eating salty and / or sweet snacks =22, consuming Sugary drinks = 25, Eating at least 5 or more portions of fruit and vegetables a day = 21, Negative change in all their dietary habits = 30, Overall Dietary habits during the pandemic = 4.

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

Negative Changes in Dietary Habits	**B**	**Standardized Coefficients Beta**	***p*-Value**	***95% CI***
*Smoking status**	0.043	0.010	0.821	(-0.329, 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 to non-smokers, pre-COVID-19 overall dietary habits score, and the time dedicated to physical activity before COVID-19

** n=404, adjusted for age, gender, perceived change in stress level during COVID-19 restrictions, number of children living in household.

Changes in physical activity: Prior to the pandemic, 58.8% of all respondents engaged in any physical activity. A little less than half of current smokers (44.6%) did not engage in physical activity compared to 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 COIVD-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 worsening in physical activity habits 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 worsening in physical activity habits (OR=1.16, 95% CI 0.688-1.956, p=0.577) (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%)	
Up to 30 minutes	109 (16.6%)	79 (18.2%)	30 (13.5%)	
30-90 minutes	117 (17.8%)	75 (17.2%)	42 (18.8%)	0.003
90-150 minutes	76 (11.6%)	41 (9.4%)	35 (15.7%)	
Over 150 minutes	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 Chi-Square test.

* Measured on a scale of 0-4, where 4 indicates adherence to healthy eating habits and 0 indicates no adherence

§Missing: Cumulative time performing physical activity per week = 2, 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 minutes cumulative time performing physical activity per week, prior 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 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 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 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	**Standardized Coefficients 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 to non-smokers.

‡*n*=245. Adjusted for age and gender

Discussion

The aim of this study was to examine the relationship between smoking status and 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 were 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.

Our findings are similar to those found from a study among a nationally representative Israeli sample (23) as well as other studies in Israel (24) (17).

The prolonged stay at home and the social disconnection from the environment, together with the sense of insecurity from the emergency situation, may cause a negative changes in health habits (17,18,24). These negative changes need to be taken into account by decision-makers and public health professionals when planning intervention programs during emergency situations. Staying at home is an opportunity to encourage at-risk populations such as the sample population 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 neutralize 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. Similarly, models that aimed to predict those at risk for negative changes in diet or physical activity did not find smoking status as a predictor (25,26) A study

conducted in Spain (25) 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 Cases et al (26) 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 to 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 (27), 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 (28). 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 (29). Another limitation is the exclusion of individuals who had never smoked. 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 (30–32). In valid questionnaires, the level of physical activity can be standardized by measuring various activities such as walking, running, weight training, or studio exercises using 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 to the pre-pandemic period. However, our study used similar questions used by other studies (33), including a national representative government funded study in Israel (23). All data collected in the study is based on self-reporting, which might have also introduced bias. None-the-less, 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.

Conclusions

In summary, no differences were found in the change of dietary and physical activity habits between current smokers compared to former smokers, and between those who smoked more compared to 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.

Supplementary Materials: The following are available online at https://www.mdpi.com/1660-4601/18/4/1931/s1, File S1: Full survey questionnaire.

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Institutional Review Board Statement: The study 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).

Informed Consent Statement: Online completion of the survey was deemed as informed consent.

Data Availability Statement: Data are available upon reasonable request from the corresponding author.

Conflicts of Interest: Y.B.-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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The Association Between Smoking Status and Changes in Health Behaviors During a 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 (April 6-28, 2020). Dependent variables included deteriorations in dietary and physical activity habits during the first COVID-19 lockdown. The study analyzed 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 from current or former smokers in Israel, over 18 years old.
Participants N= 660 participants, current or former smokers, 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, 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 worsening of dietary habits in the multivariate linear regression (B=-0.046, CI -0.493-0.401, reference group: former smokers) or worsening of physical activity smokers in the multivariate linear regression, stratified by baseline physical activity levels. Among participants who currently smoke, no significant association was found between changes in smoking habits and worsening of dietary habits (B=0.391, 95% CI -0.061-0.843, p=0.090, reference group: those who smoke the same or less) or worsening of physical activity (OR=1.16, 95% CI 0.688-1.956, 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, emphasizing 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.

1. STRENGTHS AND LIMITATIONS OF THIS STUDY

- .
- The study utilized an online cross-sectional design to examine changes in dietary habits, physical activity, and smoking behaviors during the early months of the COVID-19 pandemic

- The online survey method allowed for quick data collection in multiple languages, accommodating various demographic groups.
- 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.

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 March 19 and May 3, 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, national and neighborhood parks, a decrease in social, family, and community interactions, as well as 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 snacks consumption and weight gain [17,18].

Several risk factors are linked to changes in health behaviors 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 behaviors due to psychological distress, such as stress, anxiety, and depression, are prevalent among women, individuals aged 18-45, 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, BMI, and job status. Overeating and reduced physical activity are predicted

by concerns about economic hardship, poor health, and gender (women), emphasizing 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 behavior [21,22]. In Israel , nearly half of current smokers reported smoking more than usual during the COVID-19 pandemic [22,23].

Research has shown that former smokers often exhibit better health behaviors 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 to current smokers. Therefore, former smokers may demonstrate more resilience and healthier behavioral 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 behavior 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 behaviors 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 [22]. The original study aimed to explore changes in smoking behavior 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. 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 (supplementary 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 (re-categorized as having a bachelor degree or higher vs those without an academic degree), religion (re-categorized to Jewish vs other), marital status (re-categorized 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 (re-categorized to no change , and reduced income/loss of job), number of children living at home and age of 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 re-categorized as not exposed to a confirmed case at all/ no past/current illness vs 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 to non-smoker's risk), and two questions pertained to the perception of 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) to10 (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?" (recategorized to increased, no change, and reduced).

Baseline Health Behavior Variables: Dietary habits prior to the pandemic included 4 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 5 or more portions of fruit and vegetables a day. A combined variable of overall dietary habits prior the pandemic was created from the sum of these 4

questions (range 0-4; 4 indicating healthy dietary habits, and 0 indicating poor dietary habits). Physical activity levels prior the COVID-19 pandemic was measured using the question "In a normal week, prior 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 minutes a week, 30-90 minutes a week, 90-150 minutes, over 150 minutes).

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 was 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 recategorized as no]; yes, it dropped slightly; and yes, it dropped significantly [all re-categorized 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 5 or more portions of fruit and vegetables a day, with answers for each question - it's worse now (score 3), no change (score 2), it's 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?" (re-categorized 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 (re-categorized as I smoke more, vs I smoke the same or less combined).

Statistical Analysis: Descriptive analysis was conducted using frequencies (%) for categorial variables and mean standard deviation (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 co-variates (sociodemographic variables, perceived mental stress, and underlying chronic illness). Categorical variables were analyzed using the Chi-Square test, normally distributed continuous variables were analyzed using T-Test, and non-normally distributed continuous variables were analyzed using the Mann-Whitney test. An independent variable that was significantly associated 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 co-variates 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 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.

In total, four different multi-variable regression models were performed – two linear regressions for the dependent variable 'worsening in dietary habit' with the explanatory variables ‘smoking status’ for the entire sample (n=660) and ‘change is 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 minutes 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 v25 (IBM, Armonk, NY, USA).

Ethics: The study was approved by the Ethical Committee for Scientific Research on Human Subjects at the Hebrew University-Hadassah Faculty of Medicine (approval#05042020).

Patient and Public Involvement: Patients and the public were not involved in the design, or conduct, or 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 to 12 months before the COVID-19 restrictions, and 26.8% (n=177) quit over a year before the restrictions. Within the sub-sample 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). 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 that were current smokers to participants that were former smokers in regard to their socio-demographics characteristics (Table 1). Compared to 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 to past smokers (51.2% of current smokers experienced a change in employment status compared to 60.9% among past smokers). Current smokers reported having fewer chronic diseases (78.6% among current smokers had no chronic diseases compared to 71.2% among former smokers) and reported an increase in their stress level (70% among the group of current smokers compared to 60% among former smokers).

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

	Total (*n*, %) N = 660	**Current Smokers (*n* = 437, 66.2%)**	**Former Smokers (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 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 forCOVID-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 for COVID-19 infection (mean (SD))§*	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)
Perception of smokers' risk for COVID-19 infection compare to non-smokers compared to 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 to 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 Chi-Square test, unless otherwise specified.

^ T- Test.

*Measured on a scale of 1-10

**Among those with children under 18, n=303

§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 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 compare to non-smokers compared to non-smokers = 1, perception of smokers' risk for severe COVID-19 infection compared to non-smokers = 3

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 5 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 5 portions of fruits and vegetables (50.7% vs 35.6% among current smokers, p<0.001), and of eating more regular meals compared to 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).

Less than a 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 was 8.08 (SD 2.14). Comparing changes in dietary habits and physical activity between current and past smokers, only one significant difference was found - 25.1% of participants who were current smokers reported a negative change in reducing the consumption of sweetened beverages, compared to 15.3% in former smokers (p=0.012). In the final linear regression models, neither smoking status (B=-0.046, 95% CI -0.493-0.401, p=0.839, reference group: former smokers) or changes in smoking habits (among current smokers only) (B=0.391, 95% CI -0.061-0.843, p=0.090, reference group: those who smoke the same or less), were significantly associated with changes in dietary habits during the early stages of the COVID-19 pandemic, after adjusting for confounding variables (Table 3).

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 5 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 prior 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%)	
No change	394 (62.0%)	245 (58.5%)	149 (69.0%)	0.012
Worse	138 (21.7%)	105 (25.1%)	33 (15.3%)	
Eating at least 5 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 during the pandemic (mean (SD))§**	8.08 (2.14)	8.13 (2.20)	7.97 (2.03)	0.474^^

Pearson Chi-Square test, unless otherwise specified.

^^ Mann-Whitney U.

* 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.

§Missing: Striving to reduce salty and / or sweet snacks = 46, striving to reduce sugary drinks = 44, striving to eat at least 5 or more portions of fruit and vegetables a day =37, striving to eat regular meals every day = 16, overall Dietary habits prior the pandemic = 60, eating regular meal = 8, eating salty and / or sweet snacks =22, consuming Sugary drinks = 25, Eating at least 5 or more portions of fruit and vegetables a day = 21, Negative change in all their dietary habits = 30, Overall Dietary habits during the pandemic = 4.

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

Negative Changes in Dietary Habits	**B**	**Standardized Coefficients 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 to non-smokers, pre-COVID-19 overall dietary habits score, and the time dedicated to physical activity before COVID-19

** n=404, adjusted for age, gender, perceived change in stress level during COVID-19 restrictions, number of children living in household.

^Reference group: Former smokers.

^^ Reference group: Those who smoked the same or less.

Changes in physical activity: Prior to the pandemic, 58.8% of all respondents engaged in any physical activity. A little less than half of current smokers (44.6%) did not engage in physical activity compared to 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 COIVD-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 worsening in physical activity habits 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 worsening in physical activity habits (OR=1.16, 95% CI 0.688-1.956, 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%)	
Up to 30 minutes	109 (16.6%)	79 (18.2%)	30 (13.5%)	
30-90 minutes	117 (17.8%)	75 (17.2%)	42 (18.8%)	0.003
90-150 minutes	76 (11.6%)	41 (9.4%)	35 (15.7%)	
Over 150 minutes	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 Chi-Square test.

* Measured on a scale of 0-4, where 4 indicates adherence to healthy eating habits and 0 indicates no adherence

§Missing: Cumulative time performing physical activity per week = 2, 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 minutes cumulative time performing physical activity per week, prior 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 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 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 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	**Standardized Coefficients 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 to non-smokers.
‡*n*=245. Adjusted for age and gender.
$ Reference group: Former smokers.
$$ 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 were 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 behavior 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 a 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 programs 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 neutralize 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 behavioral 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 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 Cases 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 to 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 behavior 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 standardized by measuring various activities such as walking, running, weight training, or studio exercises using 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 to the pre-

pandemic 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 is based on self-reporting, which might have also introduced bias. None-the-less, 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 behavioral variables based on existing literature, it is possible that other factors may have influenced both smoking behaviors 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 compared to former smokers, and between those who smoked more compared to 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.

Authors Contribution:

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

Supplementary Materials: The following are available online at https://www.mdpi.com/1660-4601/18/4/1931/s1, File S1: Full survey questionnaire.

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Institutional Review Board Statement: The study 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).

Informed Consent Statement: Online completion of the survey was deemed as informed consent.

Data Availability Statement: Data are available upon reasonable request from the corresponding author.

Conflicts of Interest: Y.B.-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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<u>Supplemental file 1:</u> Full survey questionnaire (translated from Hebrew to English)

For the exact wording used in Hebrew please email the corresponding author

Greetings,

We are conducting a survey exploring the changes in smoking habits and other health habits among current and former smokers during the COVID-19 pandemic period. This is an anonymous survey filled out through an electronic questionnaire. We, the researchers, do not have access to any personal data about the participants. You are free to decide not to answer any of the questions in the questionnaire and to stop answering the questionnaire at any time. The duration of the questionnaire is approximately 20 minutes.

Answering the questionnaire constitutes informed consent on your part to participate in the survey. For any questions or problems related to filling out this questionnaire, please contact the Chief Investigator, Dr. Yael Bar-Zeev, at Yael.Bar-Zeev@mail.huji.ac.il

Thank you for your cooperation,

Dr. Yael Bar Zeev

Public Health Physician and Senior Lecturer

School of Public Health

Hebrew University – Hadassah

Do you agree to participate in this survey? Yes / No (end survey)

1. Do you currently smoke cigarettes?
   a) Yes, every day (move to question 3)
   b) Yes, but only occasionally (move to question 3)
   c) No, but I smoked in the past and quit (move to question 2)
   d) No, I have never smoked (end survey)

2. (If they answered "c" for question 1): When did you quit smoking?
(afterwards, skip to question 17)
   a) Since the COVID-19 pandemic period began
   b) 3-12 months ago (before the COVID-19 pandemic period began, but less than a year ago)
   c) I have never smoked (end survey)

3. (If they answered "a" or "b" for question 1): **Before** the COVID-19 pandemic period in Israel, on average, how many cigarettes did you smoke a day? _____

4. Before the beginning of the COVID-19 pandemic period in the Israel, how long did it take you from the time you woke up in the morning until you smoked your first cigarette?
   a) Within 5 minutes
   b) 6-30 minutes
   c) 31-60 minutes
   d) Over an hour

5. In your opinion, since the COVID-19 pandemic period began in Israel:
   a) I smoke more than usual
   b) I smoke the same amount as usual
   c) I smoke less than usual

6. Since the COVID-19 pandemic period began in Israel, how many cigarettes do you smoke on average per day? _____

7. **Before** the beginning of the COVID-19 pandemic period in Israel, how do you estimate your level of motivation to quit smoking was, from 1-10 (1-did not want to quit smoking at all; 10-very much wanted to quit smoking)

1 2 3 4 5 6 7 8 9 10

8. In your opinion, has your motivation to quit smoking changed since the COVID-19 pandemic began in Israel?
   a) Yes, it rose considerably
   b) Yes, it rose slightly
   c) No, it remained exactly the same
   d) Yes, it dropped slightly
   e) Yes, it dropped significantly

9. **Before** the beginning of the COVID-19 pandemic period in Israel, how much do you estimate that you felt you were able to quit smoking from 1-10 (1-did not feel able to quit at all; 10 felt very able to quit)

1 2 3 4 5 6 7 8 9 10

10. In your opinion, has the feeling of being able to quit smoking changed since the COVID-19 pandemic period began in Israel?

a) Yes, it rose considerably
b) Yes, it rose slightly
c) No, it remained exactly the same
d) Yes, it dropped slightly
e) Yes, it dropped significantly

11. Do you feel that since the beginning of the COVID-19 pandemic period in Israel, the frequency of urges to smoke has increased (i.e. the number of times you feel during the day that you want to smoke)?

a) Yes, it rose considerably
b) Yes, it rose slightly
c) No, it remained exactly the same
d) Yes, it dropped slightly
e) Yes, it dropped significantly

12. Do you feel that since the beginning of the COVID-19 pandemic period in Israel, the strength of the urges to smoke has increased?

a) Yes, it rose considerably
b) Yes, it rose slightly
c) No, it remained exactly the same
d) Yes, it dropped slightly
e) Yes, it dropped significantly

13. Have you made any attempts to quit smoking since the COVID-19 pandemic period began in Israel?

Yes / No

14. How many of these attempts have lasted more than 24 hours? _____

15. What is the longest amount of time you have been able to quit smoking and remain abstinent since the COVID-19 pandemic period began?

a) Less than 24 hours
b) 1-3 days
c) 4-7 days
d) 8-14 days
e) Over two weeks

16. During the COVID-19 pandemic period, did you use any of the following measures to support a smoking cessation attempt? (All correct answers can be marked)

a) Telephone consultation through HMO / national Ministry of Health quit-line — Yes / No
b) Family doctor support — Yes / No
c) Prescription medication treatment — Yes / No
d) Over-the-counter medication treatment — Yes/ No
e) Other: _____ — Yes / No
f) I did not use any means of smoking cessation support — Yes / No

17. **Before** the COVID-19 pandemic period, what were your home rules regarding smoking?

a) Smoking is allowed throughout the house
b) Smoking is only allowed in some rooms
c) Smoking is only allowed in one particular room
d) Smoking is only allowed on the balcony
e) Smoking is not allowed anywhere

18. Now, during the COVID-19 pandemic period, what are the rules in your home regarding smoking?

a) Smoking is allowed throughout the house
b) Smoking is only allowed in some rooms
c) Smoking is only allowed in one particular room
d) Smoking is only allowed on the balcony
e) Smoking is not allowed anywhere

19. Do you smoke and / or use any other tobacco and / or smoking products?

a) Electronic cigarette — Yes / No
b) Heated tobacco products such as iQOS — Yes / No
c) Hookah — Yes / No
d) Other: _____ — Yes / No

20. Do you suffer from any chronic diseases (including heart disease / chronic obstructive pulmonary disease such as bronchitis or emphysema / asthma / hypertension / diabetes / cancer)? Yes / No

21. In your opinion, is the risk of smokers getting infected with the COVID-19 virus different from the risk of non-smokers?

a) No, smokers and non-smokers have the same risk of contracting the COVID-19 virus
b) Yes, the risk of smokers being infected with the COVID-19 virus is **higher**
c) Yes, the risk of smokers being infected with the COVID-19 virus is **lower**

22. In your opinion, is the risk of smokers experiencing a more severe case of COVID-19 (if infected) different from the risk of people who do not smoke?

a) No, smokers and non-smokers have the same risk of experiencing a more severe case of COVID-19 (if infected)
b) Yes, smokers' risk of experiencing a more severe case of COVID-19 (if infected) is **higher** than non-smokers.

c) Yes, smokers' risk of experiencing a more severe case of COVID-19 (if infected) is **lower** than non-smokers.

23. How much do you estimate your risk of being infected with the corona virus from 1-10, with 1 being not likely to be infected at all and 10 being sure to be infected with the COVID-19 virus.

1 2 3 4 5 6 7 8 9 10

24. How much do you estimate your risk experiencing a more severe case of COVID-19 (if infected) from 1-10, with 1 being not likely to experience a more severe case and 10 being sure I will experience a more severe case.

1 2 3 4 5 6 7 8 9 10

25. In a normal week, **before** the COVID-19 pandemic period, how much cumulative time do you spend exercising?

a) I do not devote any time to physical activity
b) Up to 30 minutes a week
c) 30-90 minutes a week
d) 90-150 minutes
e) Over 150 minutes

26. Since the COVID-19 pandemic period in Israel began, has there been a change in the time you devote to physical activity?

a) Yes, it rose considerably
b) Yes, it rose slightly
c) Has not changed
d) Yes, it dropped slightly
e) Yes, it dropped significantly

27. What is true about your eating habits **before** the COVID-19 pandemic period? (You can answer more than one answer)

a) Trying to eat regular meals every day Yes / No
b) Trying to reduce salty and / or sweet snacks Yes / No
c) Trying to reduce sugary drinks Yes / No
d) Trying to eat at least 5 or more portions of fruit and vegetables a day Yes / No

28. Has there been any change in your eating habits since the COVID-19 pandemic period began in Israel?

a) Eating regular meals has not changed / less good now / better now
b) Eating salty and / or sweet snacks has not changed / less good now / better now
c) Sugary drinks has not changed / less good now / better now
d) Eating fruits and vegetables has not changed / less good now / better now

29. **Before** the COVID-19 pandemic period, to what extent did you feel mentally stressed?

a) To a very small extent
b) To a small extent
c) Moderate
d) To a large extent
e) To a very large extent

30. Since the COVID-19 pandemic period began, to what extent do you feel that your degree of mental stress has changed?
    a) Rose considerably
    b) Rose slightly
    c) Has not changed
    d) Decreased slightly
    e) Significantly decreased

31. **Before** the COVID-19 pandemic period, what was your employment status?
    a) Full-time employee
    b) Permanent part-time employee
    c) Temporary employee (for example by hours)
    d) Self-employed
    e) Not working (including unemployed)
    f) Retired

32. Has your employment status changed as a result of the COVID-19 pandemic?
    a) No
    b) Yes, I lost my job
    c) Yes, I was placed on unpaid leave
    d) Yes, I was fired
    e) Yes, my income as self-employed has been significantly cut

33. What is your gender? Male / Female

34. Year of birth: _____

35. What is your level of education?
    a) Less than 12 years of schooling
    b) I completed 12 years of schooling
    c) Bachelor's degree
    d) Master's degree or higher

36. Religion:
    a) Jewish
    b) Muslim
    c) Christian
    d) Other _____

37. Marital status:
    a) Single
    b) Living with a partner
    c) Married
    d) Widower
    e) Divorced

38. How many adults (over the age of 18) live with you at home? _____

39. How many children (under the age of 18) live with you at home? _____

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40. What is the age of the youngest child living with you at home? _____ years

41. Are there any other smokers living with you in the house? Yes / No

42. If so, how many other smokers live with you at home? _____

43. Are any of the people living with you at home at high risk of experiencing a more severe case of COVID-19 (if infected) (old age or have an underlying chronic illness)? Yes / No

44. What type of residence do you currently reside in?
    a) House with a garden
    b) Apartment with a balcony
    c) Apartment without a balcony
    d) Other: _____

45. What is your current situation regarding the COVID-19 virus?
    a) I was not infected with the COVID-19 virus and to the best of my knowledge was not exposed to someone with COVID-19
    b) I was not infected with the COVID-19 virus, but I was exposed to someone with COVID-19 and I am now in quarantine
    c) I was not infected with the COVID-19 virus, but I was exposed to someone with COVID-19, was in quarantine and am already out of quarantine
    d) I was infected with the COVID-19 virus and I am currently hospitalized
    e) I was infected with the COVID-19 virus and I am currently in isolation in a hotel or at home
    f) I was infected with the COVID-19 virus and was previously hospitalized or in isolation

Thank you for participating in this survey.
If you are interested, you can contact free smoking cessation support at the Ministry of Health's national quit line - *6800.
For any questions or problems related to completing this questionnaire, you can contact the Principal Investigator:
Dr. Yael Bar-Zeev
Email- Yael.Bar-Zeev@mail.huji.ac.il

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The Association Between Smoking Status and Changes in Health Behaviors During a 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 (April 6-28, 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 analyzed 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 N= 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, 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 -0.493-0.401, 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 to 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 -0.061-0.843, 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 0.688-1.956, 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, emphasizing 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.

1. STRENGTHS AND LIMITATIONS OF THIS STUDY

- The study utilized 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 behaviors.
- 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 March 19 and May 3, 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, national and neighborhood parks, a decrease in social, family, and community interactions, as well as 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 snacks consumption and weight gain [17,18].

Several risk factors are linked to changes in health behaviors 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 behaviors due to psychological distress, such as stress, anxiety, and depression, are prevalent among women, individuals aged 18-45, 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, BMI, and job status. Overeating and reduced physical activity are predicted by concerns about economic hardship, poor health, and gender (women), emphasizing 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 behavior [21,22]. In Israel , nearly half of current smokers reported smoking more than usual during the COVID-19 pandemic [22,23].

Research has shown that former smokers often exhibit better health behaviors 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 to current smokers. Therefore, former smokers may demonstrate more resilience and healthier behavioral 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 behavior 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 behaviors 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 [22]. The original study aimed to explore changes in smoking behavior 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. 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 (supplementary 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 (re-categorized as having a bachelor degree or higher vs those without an academic degree), religion (re-categorized to Jewish vs other), marital status (re-categorized 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 (re-categorized to no change , and reduced income/loss of job), number of children living at home and age of 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 re-categorized as not exposed to a confirmed case at all/ no past/current illness vs 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 to non-smoker's risk), and two questions pertained to the perception of 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?" (recategorized to increased, no change, and reduced).

Baseline Health Behavior Variables: Dietary habits prior to the pandemic included 4 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 5 or more portions of fruit and vegetables a day. A combined variable of overall dietary habits prior the pandemic was created from the sum of these 4

questions (range 0-4; 4 indicating healthy dietary habits, and 0 indicating poor dietary habits). Physical activity levels prior the COVID-19 pandemic was measured using the question "In a normal week, prior 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 minutes a week, 30-90 minutes a week, 90-150 minutes, over 150 minutes).

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 was 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 recategorized as no]; yes, it dropped slightly; and yes, it dropped significantly [all re-categorized 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 5 or more portions of fruit and vegetables a day, with answers for each question - it's worse now (score 3), no change (score 2), it's 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?" (re-categorized 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 (re-categorized as I smoke more, vs I smoke the same or less combined).

Statistical Analysis: Descriptive analysis was conducted using frequencies (%) for categorial variables and mean standard deviation (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 co-variates (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 behavior. Categorical variables were analyzed using the Chi-Square test, normally distributed continuous variables were analyzed using T-Test, and non-normally distributed continuous variables were analyzed using the Mann-Whitney test. An independent variable that was significantly associated 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 co-variates 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 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 considerations, aimed to identify potential confounders and modifiers while avoiding potential multicollinearity.

In total, four different multi-variable 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 is 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 minutes 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 v25 (IBM, Armonk, NY, USA).

Ethics: The study was approved by the Ethical Committee for Scientific Research on Human Subjects at the Hebrew University-Hadassah Faculty of Medicine (approval#05042020).

Patient and Public Involvement: Patients and the public were not involved in the design, or conduct, or 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 to 12 months before the COVID-19 restrictions, and 26.8% (n=177) quit over a year before the restrictions. Within the sub-sample 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). 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 that were current smokers to participants that were former smokers in regard to their socio-demographics characteristics (Table 1). Compared to 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 to past smokers (51.2% of current smokers experienced a change in employment status compared to 60.9% among past smokers). Current smokers reported having fewer chronic diseases (78.6% among current smokers had no chronic diseases compared to 71.2% among former smokers) and reported an increase in their stress level (70% among the group of current smokers compared to 60% among former smokers).

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

	Total (*n*, %) N = 660	**Current Smokers (*n* = 437, 66.2%)**	**Former Smokers (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 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 forCOVID-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 for COVID-19 infection (mean (SD))§*	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)
Perception of smokers' risk for COVID-19 infection compared to 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 to 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 Chi-Square test, unless otherwise specified.

^ T- Test.

*Measured on a scale of 1-10

**Among those with children under 18, n=303

§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 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 to non-smokers = 1, Perception of smokers' risk for severe COVID-19 infection compared to non-smokers = 3

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 5 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 5 portions of fruits and vegetables (50.7% vs 35.6% among current smokers, p<0.001), and of eating more regular meals compared to 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).

Less than a 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 was 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 to 15.3% in former smokers (p=0.012). In the final linear regression models, neither smoking status (B=-0.046, 95% CI -0.493-0.401, p=0.839, reference group: former smokers) or changes in smoking habits (among current smokers only) (B=0.391, 95% CI -0.061-0.843, 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).

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 5 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 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%)	
No change	298 (45.7%)	192 (44.7%)	106 (47.7%)	0.712
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%)	
No change	394 (62.0%)	245 (58.5%)	149 (69.0%)	0.012
Worse	138 (21.7%)	105 (25.1%)	33 (15.3%)	
Eating at least 5 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 Chi-Square test, unless otherwise specified.

^^ Mann-Whitney U.

* 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.

§Missing: Striving to reduce salty and / or sweet snacks = 46, Striving to reduce sugary drinks = 44, Striving to eat at least 5 or more portions of fruit and vegetables a day =37, Striving to eat regular meals every day = 16, Overall dietary habits prior the pandemic = 60, Eating regular meal = 8, Eating salty and / or sweet snacks =22, Consuming sugary drinks = 25, Eating at least 5 or more portions of fruit and vegetables a day = 21, Negative change in all their dietary habits = 30, Overall dietary habits during the pandemic = 4.

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**	**Standardized Coefficients 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 to non-smokers, pre-COVID-19 overall dietary habits score, and the time dedicated to physical activity before COVID-19

** n=404, adjusted for age, gender, perceived change in stress level during COVID-19 restrictions, number of children living in household.

^Reference group: Former smokers.
^^ Reference group: Those who smoked the same or less.

Changes in physical activity: Prior to the pandemic, 58.8% of all respondents engaged in any physical activity. A little less than half of current smokers (44.6%) did not engage in physical activity compared to 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 COIVD-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 0.688-1.956, 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%)	
Up to 30 minutes	109 (16.6%)	79 (18.2%)	30 (13.5%)	
30-90 minutes	117 (17.8%)	75 (17.2%)	42 (18.8%)	0.003
90-150 minutes	76 (11.6%)	41 (9.4%)	35 (15.7%)	
Over 150 minutes	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 Chi-Square test.
§Missing: Cumulative time performing physical activity per week = 2, 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 minutes cumulative time performing physical activity per week, prior 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 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 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 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	**Standardized Coefficients 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 to non-smokers.

[‡]*n*=245. Adjusted for age and gender.

[$] Reference group: Former smokers.

[$$] 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 were 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 behavior 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 a 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 programs 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 neutralize 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 behavioral 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 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 Cases 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 to 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 behavior 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 standardized by measuring various activities such as walking, running, weight training, or studio exercises using 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 to the pre-pandemic 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 is based on self-reporting, which might have also introduced bias. None-the-less, 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 behavioral variables based on existing literature, it is possible that other factors may have influenced both smoking behaviors 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 compared to former smokers, and between those who smoked more compared to 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.

Authors Contribution:

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

Supplementary Materials: The following are available online at https://www.mdpi.com/1660-4601/18/4/1931/s1, File S1: Full survey questionnaire.

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Institutional Review Board Statement: The study 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).

Informed Consent Statement: Online completion of the survey was deemed as informed consent.

Data Availability Statement: Data are available upon reasonable request from the corresponding author.

Conflicts of Interest: Y.B.-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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<u>Supplemental file 1:</u> Full survey questionnaire (translated from Hebrew to English)

For the exact wording used in Hebrew please email the corresponding author

Greetings,

We are conducting a survey exploring the changes in smoking habits and other health habits among current and former smokers during the COVID-19 pandemic period. This is an anonymous survey filled out through an electronic questionnaire. We, the researchers, do not have access to any personal data about the participants. You are free to decide not to answer any of the questions in the questionnaire and to stop answering the questionnaire at any time. The duration of the questionnaire is approximately 20 minutes.

Answering the questionnaire constitutes informed consent on your part to participate in the survey. For any questions or problems related to filling out this questionnaire, please contact the Chief Investigator, Dr. Yael Bar-Zeev, at Yael.Bar-Zeev@mail.huji.ac.il

Thank you for your cooperation,

Dr. Yael Bar Zeev

Public Health Physician and Senior Lecturer

School of Public Health

Hebrew University – Hadassah

Do you agree to participate in this survey? Yes / No (end survey)

1. Do you currently smoke cigarettes?
   a) Yes, every day (move to question 3)
   b) Yes, but only occasionally (move to question 3)
   c) No, but I smoked in the past and quit (move to question 2)
   d) No, I have never smoked (end survey)

2. (If they answered "c" for question 1): When did you quit smoking?
(afterwards, skip to question 17)
   a) Since the COVID-19 pandemic period began
   b) 3-12 months ago (before the COVID-19 pandemic period began, but less than a year ago)
   c) I have never smoked (end survey)

3. (If they answered "a" or "b" for question 1): **Before** the COVID-19 pandemic period in Israel, on average, how many cigarettes did you smoke a day? _____

4. Before the beginning of the COVID-19 pandemic period in the Israel, how long did it take you from the time you woke up in the morning until you smoked your first cigarette?
   a) Within 5 minutes
   b) 6-30 minutes
   c) 31-60 minutes
   d) Over an hour

5. In your opinion, since the COVID-19 pandemic period began in Israel:
   a) I smoke more than usual
   b) I smoke the same amount as usual
   c) I smoke less than usual

6. Since the COVID-19 pandemic period began in Israel, how many cigarettes do you smoke on average per day? _____

7. **Before** the beginning of the COVID-19 pandemic period in Israel, how do you estimate your level of motivation to quit smoking was, from 1-10 (1-did not want to quit smoking at all; 10-very much wanted to quit smoking)

1 2 3 4 5 6 7 8 9 10

8. In your opinion, has your motivation to quit smoking changed since the COVID-19 pandemic began in Israel?
   a) Yes, it rose considerably
   b) Yes, it rose slightly
   c) No, it remained exactly the same
   d) Yes, it dropped slightly
   e) Yes, it dropped significantly

9. **Before** the beginning of the COVID-19 pandemic period in Israel, how much do you estimate that you felt you were able to quit smoking from 1-10 (1-did not feel able to quit at all; 10 felt very able to quit)

1 2 3 4 5 6 7 8 9 10

10. In your opinion, has the feeling of being able to quit smoking changed since the COVID-19 pandemic period began in Israel?

a) Yes, it rose considerably
b) Yes, it rose slightly
c) No, it remained exactly the same
d) Yes, it dropped slightly
e) Yes, it dropped significantly

11. Do you feel that since the beginning of the COVID-19 pandemic period in Israel, the frequency of urges to smoke has increased (i.e. the number of times you feel during the day that you want to smoke)?

a) Yes, it rose considerably
b) Yes, it rose slightly
c) No, it remained exactly the same
d) Yes, it dropped slightly
e) Yes, it dropped significantly

12. Do you feel that since the beginning of the COVID-19 pandemic period in Israel, the strength of the urges to smoke has increased?

a) Yes, it rose considerably
b) Yes, it rose slightly
c) No, it remained exactly the same
d) Yes, it dropped slightly
e) Yes, it dropped significantly

13. Have you made any attempts to quit smoking since the COVID-19 pandemic period began in Israel?

Yes / No

14. How many of these attempts have lasted more than 24 hours? _____

15. What is the longest amount of time you have been able to quit smoking and remain abstinent since the COVID-19 pandemic period began?

a) Less than 24 hours
b) 1-3 days
c) 4-7 days
d) 8-14 days
e) Over two weeks

16. During the COVID-19 pandemic period, did you use any of the following measures to support a smoking cessation attempt? (All correct answers can be marked)

a) Telephone consultation through HMO / national Ministry of Health quit-line — Yes / No
b) Family doctor support — Yes / No
c) Prescription medication treatment — Yes / No
d) Over-the-counter medication treatment — Yes/ No
e) Other: _____ — Yes / No
f) I did not use any means of smoking cessation support — Yes / No

17. **Before** the COVID-19 pandemic period, what were your home rules regarding smoking?

a) Smoking is allowed throughout the house
b) Smoking is only allowed in some rooms
c) Smoking is only allowed in one particular room
d) Smoking is only allowed on the balcony
e) Smoking is not allowed anywhere

18. Now, during the COVID-19 pandemic period, what are the rules in your home regarding smoking?

a) Smoking is allowed throughout the house
b) Smoking is only allowed in some rooms
c) Smoking is only allowed in one particular room
d) Smoking is only allowed on the balcony
e) Smoking is not allowed anywhere

19. Do you smoke and / or use any other tobacco and / or smoking products?

a) Electronic cigarette — Yes / No
b) Heated tobacco products such as iQOS — Yes / No
c) Hookah — Yes / No
d) Other: _____ — Yes / No

20. Do you suffer from any chronic diseases (including heart disease / chronic obstructive pulmonary disease such as bronchitis or emphysema / asthma / hypertension / diabetes / cancer)? Yes / No

21. In your opinion, is the risk of smokers getting infected with the COVID-19 virus different from the risk of non-smokers?

a) No, smokers and non-smokers have the same risk of contracting the COVID-19 virus
b) Yes, the risk of smokers being infected with the COVID-19 virus is **higher**
c) Yes, the risk of smokers being infected with the COVID-19 virus is **lower**

22. In your opinion, is the risk of smokers experiencing a more severe case of COVID-19 (if infected) different from the risk of people who do not smoke?

a) No, smokers and non-smokers have the same risk of experiencing a more severe case of COVID-19 (if infected)
b) Yes, smokers' risk of experiencing a more severe case of COVID-19 (if infected) is **higher** than non-smokers.

c) Yes, smokers' risk of experiencing a more severe case of COVID-19 (if infected) is **lower** than non-smokers.

23. How much do you estimate your risk of being infected with the corona virus from 1-10, with 1 being not likely to be infected at all and 10 being sure to be infected with the COVID-19 virus.

1 2 3 4 5 6 7 8 9 10

24. How much do you estimate your risk experiencing a more severe case of COVID-19 (if infected) from 1-10, with 1 being not likely to experience a more severe case and 10 being sure I will experience a more severe case.

1 2 3 4 5 6 7 8 9 10

25. In a normal week, **before** the COVID-19 pandemic period, how much cumulative time do you spend exercising?

a) I do not devote any time to physical activity
b) Up to 30 minutes a week
c) 30-90 minutes a week
d) 90-150 minutes
e) Over 150 minutes

26. Since the COVID-19 pandemic period in Israel began, has there been a change in the time you devote to physical activity?

a) Yes, it rose considerably
b) Yes, it rose slightly
c) Has not changed
d) Yes, it dropped slightly
e) Yes, it dropped significantly

27. What is true about your eating habits **before** the COVID-19 pandemic period? (You can answer more than one answer)

a) Trying to eat regular meals every day Yes / No
b) Trying to reduce salty and / or sweet snacks Yes / No
c) Trying to reduce sugary drinks Yes / No
d) Trying to eat at least 5 or more portions of fruit and vegetables a day Yes / No

28. Has there been any change in your eating habits since the COVID-19 pandemic period began in Israel?

a) Eating regular meals has not changed / less good now / better now
b) Eating salty and / or sweet snacks has not changed / less good now / better now
c) Sugary drinks has not changed / less good now / better now
d) Eating fruits and vegetables has not changed / less good now / better now

29. **Before** the COVID-19 pandemic period, to what extent did you feel mentally stressed?

a) To a very small extent
b) To a small extent
c) Moderate
d) To a large extent
e) To a very large extent

30. Since the COVID-19 pandemic period began, to what extent do you feel that your degree of mental stress has changed?
    a) Rose considerably
    b) Rose slightly
    c) Has not changed
    d) Decreased slightly
    e) Significantly decreased

31. **Before** the COVID-19 pandemic period, what was your employment status?
    a) Full-time employee
    b) Permanent part-time employee
    c) Temporary employee (for example by hours)
    d) Self-employed
    e) Not working (including unemployed)
    f) Retired

32. Has your employment status changed as a result of the COVID-19 pandemic?
    a) No
    b) Yes, I lost my job
    c) Yes, I was placed on unpaid leave
    d) Yes, I was fired
    e) Yes, my income as self-employed has been significantly cut

33. What is your gender? Male / Female

34. Year of birth: _____

35. What is your level of education?
    a) Less than 12 years of schooling
    b) I completed 12 years of schooling
    c) Bachelor's degree
    d) Master's degree or higher

36. Religion:
    a) Jewish
    b) Muslim
    c) Christian
    d) Other _____

37. Marital status:
    a) Single
    b) Living with a partner
    c) Married
    d) Widower
    e) Divorced

38. How many adults (over the age of 18) live with you at home? _____

39. How many children (under the age of 18) live with you at home? _____

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40. What is the age of the youngest child living with you at home? _____ years

41. Are there any other smokers living with you in the house? Yes / No

42. If so, how many other smokers live with you at home? _____

43. Are any of the people living with you at home at high risk of experiencing a more severe case of COVID-19 (if infected) (old age or have an underlying chronic illness)? Yes / No

44. What type of residence do you currently reside in?
    a) House with a garden
    b) Apartment with a balcony
    c) Apartment without a balcony
    d) Other: _____

45. What is your current situation regarding the COVID-19 virus?
    a) I was not infected with the COVID-19 virus and to the best of my knowledge was not exposed to someone with COVID-19
    b) I was not infected with the COVID-19 virus, but I was exposed to someone with COVID-19 and I am now in quarantine
    c) I was not infected with the COVID-19 virus, but I was exposed to someone with COVID-19, was in quarantine and am already out of quarantine
    d) I was infected with the COVID-19 virus and I am currently hospitalized
    e) I was infected with the COVID-19 virus and I am currently in isolation in a hotel or at home
    f) I was infected with the COVID-19 virus and was previously hospitalized or in isolation

Thank you for participating in this survey.
If you are interested, you can contact free smoking cessation support at the Ministry of Health's national quit line - *6800.
For any questions or problems related to completing this questionnaire, you can contact the Principal Investigator:
Dr. Yael Bar-Zeev
Email- Yael.Bar-Zeev@mail.huji.ac.il