



# The Association Between Healthy Lifestyle Behaviours and Coronavirus Protective Behaviours

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## Abstract

**Background** Based on models of cross-behavioural associations and the role of past behaviour in predicting behaviour, an association was hypothesized between healthy lifestyle behaviours prior to the COVID-19 pandemic and adherence to coronavirus protective behaviours. Self-assessed health was also examined as a potential moderator.

**Methods** A cross-sectional sample ( $N=463$ ) completed online questionnaires during a COVID-19-related lockdown that measured engagement in healthy lifestyle behaviours (e.g., exercising and eating fruits and vegetables), adherence to coronavirus protective behaviours (e.g., wearing a face mask and practicing social distancing), and self-assessed health (subjective evaluation of overall health).

**Results** As predicted, higher engagement in healthy lifestyle behaviours prior to the pandemic was significantly correlated with higher adherence to coronavirus protective behaviours (Pearson  $r(459)=.308, p<.001$ ). Adherence levels were higher than engagement in healthy lifestyle behaviours, and self-assessed health was related to the latter but not to the former. Moderation was examined using model 1 in PROCESS for SPSS; as expected, the association was stronger among individuals with higher levels of self-assessed health (coefficient 95% CI [.04, .20]).

**Conclusions** The findings highlight cross-behavioural facilitating processes, specifically between lifestyle behaviours and adherence to recommended protective behaviours during the pandemic. They also draw attention to the need to address individuals whose poorer evaluations of their general health might prevent them from implementing their behavioural intentions.

**Keywords** Healthy lifestyle behaviours · Adherence to behavioural recommendations · Coronavirus · Cross-behaviour associations · Self-assessed health · Self-rated health

## Introduction

A novel coronavirus has caused the COVID-19 global pandemic [1]. With no vaccine to prevent the highly contagious disease, people around the world have been instructed to mitigate its transmission by adopting behavioural measures ranging from frequent hand washing to strict self-isolation. While these protective behaviours are currently the public's only weapon against the pandemic [2], not everybody adheres to them to the same extent. The present study was undertaken to examine the effects of regular healthy lifestyle

behaviours and self-assessed health status on differences in adherence to COVID-19 protective behaviours.

## Predicting Current Health Behaviours From Past Behaviours

Research points to the tendency of health behaviours to have high temporal stability, making past behaviours among the strongest predictors of present health behaviour [e.g., 3, 4, 5, 6]. This might reflect implicit or nonconscious processes that affect behaviour, such as behavioural scripts [7] or routines [8, 9]. However, the coronavirus pandemic is new and most people have had no prior experience with such an occurrence. Nevertheless, there might be a relationship between the new recommended coronavirus-related protective behaviours and healthy lifestyle behaviours. Indeed, numerous studies have suggested that engaging in one health behaviour might result in a higher likelihood of engaging in other health behaviours

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[10–15]. For example, smoking was found to predict alcohol consumption [16], and engaging in physical activity was found to promote healthy nutritional habits [17].

Such cross-behavioural associations have been attributed to goal facilitation among behaviours [18, 19], a general health orientation [20], shared underlying motivations [21], and cross-behaviour cognitions that enable transfer of resources and strategies between behaviours [22]. Regardless of the precise mechanism enabling cross-behaviour associations, they imply that regular performance of health behaviours prior to the pandemic may predict adherence to coronavirus protective behaviours.

In addition, we expected that adherence to coronavirus protective behaviours would be higher than engagement in healthy lifestyle behaviours, which are known to be practiced at inadequate levels [e.g., 23]. The rationale for this prediction is based on important differences between the two sets of behaviours. Ease of performance, one of the key dimensions of health behaviour representations [24], seems to differ considerably between maintaining a healthy lifestyle and adhering to coronavirus protective behaviours. After all, strict adherence to a healthy diet and engagement in adequate physical activity [25] require more effort than wearing a face-mask and washing hands frequently with soap and water [26]. Moreover, unlike lifestyle behaviours, for which health outcomes are expected to materialize at some point in the future, coronavirus protective behaviours represent urgent measures that must be taken immediately to thwart an imminent threat to one's health and the health of close others. In line with the Construal Level Theory of psychological distance [27], there is evidence that psychological proximity to threatening outcomes predicts higher levels of risk perceptions and willingness to engage in protective behaviours [28, 29]. Therefore, we expected the concrete threat generated by the coronavirus pandemic to prompt higher levels of adherence to protective behaviours.

## Health Behaviours and Self-Assessed Health

Self-assessed health is a widespread measure of overall subjective health [30]. It was found associated with objective measures of health, such as disability ratings, number of physician visits, hospitalization, diagnoses, medications and physical functioning [31–33]. Higher levels of self-assessed health were also found associated with greater engagement in healthy lifestyle behaviours [34–36], and this positive association was expected to be found in the present study as well. However, self-assessed health was not predicted to correlate with adherence to coronavirus protective behaviours since the health outcomes of such behaviours are unknown as of now and therefore not expected to be associated with present health assessments.

Nevertheless, we hypothesized that self-assessed health would moderate the association between engagement in healthy lifestyle

behaviours and adherence to coronavirus protective behaviours. Higher well-being and better perceived health outcomes related to engagement in health behaviours were suggested as mechanisms that facilitate cross-behavioural associations [21, 37]. Therefore, we decided to test this proposition by using self-assessed health as a measure of well-being and better-perceived health outcomes [32, 38, 39]. We predicted that the association between healthy lifestyle behaviours and coronavirus protective behaviours would be stronger among individuals with higher, compared with lower, self-assessed health. This hypothesis was compatible with our previous predictions, in that individuals with poorer self-assessed health may be less able to perform certain health behaviours due to their limited mental and/or physical functioning when higher levels of effort are required. On the other hand, limited functioning is not expected to impede the performance of health behaviours among individuals with better self-assessed health, resulting in stronger predicted associations between healthy lifestyle behaviours and coronavirus protective behaviours.

To sum up, the research hypotheses were as follows:

Hypothesis 1: Higher engagement in healthy lifestyle behaviours would be related to higher adherence to coronavirus protective behaviours.

Hypothesis 2: Adherence to coronavirus protective behaviours would be higher on average than engagement in healthy lifestyle behaviours.

Hypothesis 3: Self-assessed health would be related more to engagement in healthy lifestyle behaviours than to adherence to coronavirus protective behaviours.

Hypothesis 4: Self-assessed health would moderate the relationship between healthy lifestyle behaviours and coronavirus protective behaviours: the relationship would be stronger among individuals with higher self-assessed health.

## Method

### Participants

The initial dataset included a representative sample of 537 participants. However, due to quality control procedures,<sup>1</sup> the final number of individuals in the analyses was 463, of which 243 were women (52.5%). This sample size was

<sup>1</sup> Fifteen participants had duplicate IP addresses; 11 completed the survey in an unreasonably short time, defined as three times the Semi-Quarterlies Range lower than the Mean time; 13 reported having contracted COVID-19 (which may have influenced their engagement in protective behaviors); 35 reported that Hebrew was not their first language, which may have caused difficulty in understanding the survey. Nevertheless, similar results were found when participants with COVID-19 and those whose first language was not Hebrew were included in the analysis ( $N=511$ ).

**Table 1** Means, SDs, and Correlations among the Study Variables

	Gender <sup>a</sup>	Age	Education	Healthy lifestyle behaviours	Self-assessed health	Coronavirus protective behaviours
<i>M</i>	0.52	40.01	14.45	4.41	5.65	5.39
<i>SD</i>	0.50	14.90	2.41	1.06	0.97	1.07
Age	-.06					
Education	-.02	.18***				
Healthy lifestyle behaviours	.15**	.13**	.13**			
Self-assessed health	.04	-.28***	.02	.13**		
Coronavirus protective behaviours	.18***	.11*	-.01	.34***	.02	

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

$N = 463$ , except for Education where  $N = 451$

<sup>a</sup>Women = 1, men = 0

adequate for our purposes: minimum sample size, based on prior research [11, 12, 17] and calculated using G\*Power 3.1 [40], was 359 ( $\alpha = 0.05$ ,  $1 - \beta = 0.90$ ,  $f^2 = 0.04$ ). Age ranged between 18 and 70 years ( $M = 40.01$ ,  $SD = 14.90$ ). Education ranged between 8 and 29 school years ( $M = 14.45$ ,  $SD = 2.41$ ), with 12 participants unreported (2.6%).

## Measures

**Coronavirus Protective Behaviours.** A list of 17 behavioural recommendations aimed at preventing and containing the COVID-19 pandemic was compiled (see Appendix 1), based on official guidelines [41]. The list included behaviours such as wearing a face mask and washing hands frequently with soap and water. Participants were instructed to indicate the degree to which they adhere to each recommendation on a 7-point scale (1 = not at all and 7 = complete adherence). An average was calculated across items to represent overall adherence to coronavirus protective behaviours, with higher scores indicating higher adherence (Cronbach's  $\alpha = 0.88$ ).

**Healthy Lifestyle Behaviours.** A list of 12 healthy lifestyle behaviours was developed (see Appendix 1) that included items such as eating at least five fruits and vegetables a day and engaging in at least 150 min of moderate-intensity aerobic physical activity or 75 min of vigorous-intensity aerobic physical activity throughout the week [25]. The items on the list represented all behavioural clusters according to the Health Behaviour Taxonomy, a cognitive schema of lay people's perceptions of health behaviours [42]. Participants were instructed to refer to their health habits in general, prior to the coronavirus situation, and asked to indicate the extent to which they perform each behaviour on a 7-point scale (1 = not at all and 7 = to a very great extent). An average was calculated across the behaviours to represent overall engagement in healthy lifestyle

behaviours, with higher scores indicating higher engagement (Cronbach's  $\alpha = 0.76$ ).

**Self-Assessed Health.** Participants were asked the following question: "How do you assess your health in general?" Responses were marked on a 7-point scale (1 = *poor* and 7 = *excellent*).

**Demographic Variables.** Participants reported their age, gender, formal education completed (in years), first language (Hebrew/other), and whether they had been infected with COVID-19 (yes/no).

## Procedure

The study was approved by Tel Aviv University's Institutional Review Board. It was part of a larger project that included additional measures related to the pandemic.<sup>2</sup> Data were collected between April 21 and 24, 2020, when Israel was under lockdown due to COVID-19. The study was conducted online using the Qualtrics platform and distributed by a well-known survey company<sup>3</sup> aiming at collecting a representative sample of the population. Participants first read an explanation about the study and were assured that participation was anonymous. After checking for eligibility (age over 18 years), participants who expressed their consent were presented with the study measures in the following order: demographic variables, self-assessed health, coronavirus protective behaviours, and healthy lifestyle behaviours. Participants were reimbursed with a nominal sum of about \$2. The data supporting the findings of this study are openly available at <https://osf.io/4dtmw/>.

<sup>2</sup> The goal of the larger project was to examine various perceptions, coping styles, and behaviours related to COVID-19. It included measures of coronavirus representations, perceived threat, coping strategies, anxiety, and trust in authorities.

<sup>3</sup> <https://www.panel4all.co.il>

**Table 2** Results of Bootstrap Moderation Test Predicting Adherence to Coronavirus Protective Behaviours

	Coefficient	SE	LL	UL
Healthy lifestyle behaviours	.31**	.04	.22	.40
Self-assessed health	.01	.05	-.09	.11
Healthy lifestyle behaviours $\times$ Self-assessed health	.12**	.04	.04	.20
Age	.01	.00	-.00	.01
Gender	.30**	.09	.12	.48

Healthy lifestyle behaviours were the predicting variable; self-assessed health was the moderating variable; age and gender were entered as covariates. Predictors were centred prior to analysis

SE standard error, LL lower limit of 95% confidence interval, UL upper limit of 95% confidence interval

\*\* $p < 0.01$

$N = 463$

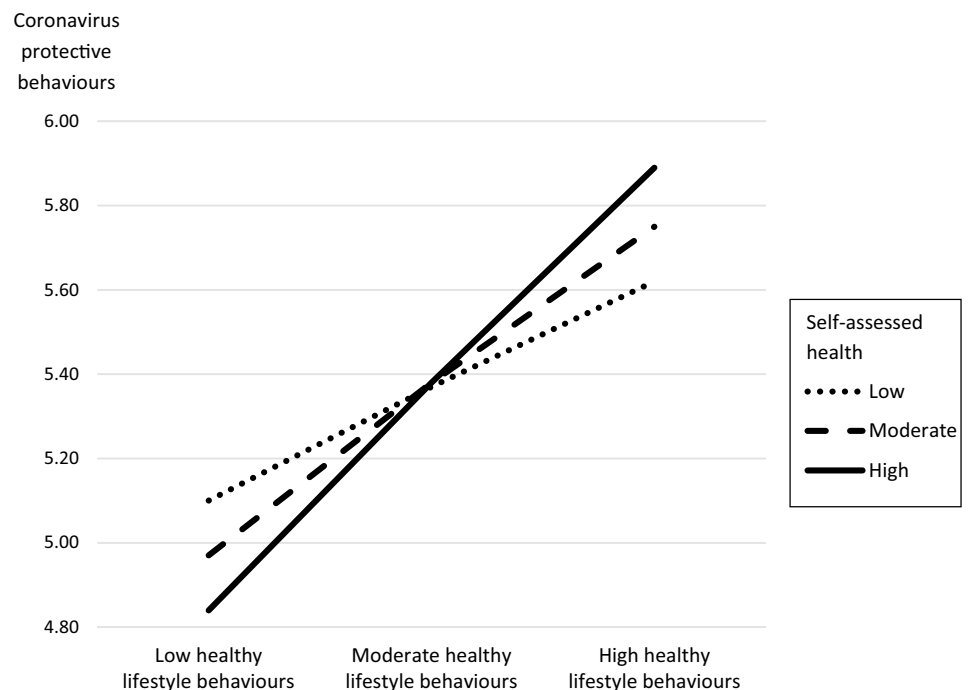
## Results

Table 1 presents means, standard deviations, and bivariate correlations among study variables. Age and gender were significantly correlated with adherence to coronavirus protective behaviours: older participants and women displayed higher levels of adherence to protective behaviours than younger participants and men. Consequently, these variables were statistically controlled for in all subsequent analyses.

Consistent with hypothesis 1, there was a significant positive correlation between healthy lifestyle behaviours and coronavirus protective behaviours,  $r(459) = .31$ ,  $p < .001$ . The correlation was of medium effect size [43], and the highest of all the correlations among study variables. Moreover, sensitivity analysis wherein familiar behaviours were removed from the calculation of the coronavirus protective behaviour score resulted in the same correlation (see Appendix 1). Hypothesis 2 was also supported: the average adherence to coronavirus protective behaviours was significantly higher than the average engagement in healthy lifestyle behaviours,  $F(1, 460) = 30.70$ ,  $MSE = .75$ ,  $p < .001$ , partial  $\eta^2 = .06$  (Table 1). Consistent with hypothesis 3, self-assessed health was positively and significantly correlated with healthy lifestyle behaviours,  $r(459) = .17$ ,  $p < .001$ , but not with coronavirus protective behaviours,  $r(459) = .05$ ,  $p > .05$ , and the difference between the two correlations was significant,  $Z = 2.24$ ,  $p < .05$ , Cohen's  $q = .12$  [44].

To test hypothesis 4, a moderation effect was examined using Model 1 in the PROCESS macros for SPSS v3.0 [45], with number of bootstrap samples set to 5000 and confidence intervals at 95%. Healthy lifestyle behaviours were entered as the predictor, behaviours to reduce coronavirus transmission as the predicted variable, self-assessed health as the moderator, and age and gender as covariates. The model was significant,  $F(5, 457) = 16.19$ ,  $MSE = 0.98$ ,  $p < 0.001$ ,  $R^2 = .15$ . As expected, self-assessed

**Fig. 1** Adherence to coronavirus protective behaviours as a function of engagement in healthy lifestyle behaviours, with a stronger effect in higher levels of self-assessed health



Note.  $N = 463$ . Self-assessed health values are the 16th, 50th, and 84th percentiles, respectively.

health was a significant moderator of the relationship (Table 2): higher levels of self-assessed health corresponded to a stronger association between healthy lifestyle behaviours and adherence to coronavirus protective behaviours (Fig. 1).

## Discussion

The goal of the current study was to examine potential sources of the variance in adherence to protective behaviours aimed at reducing COVID-19 transmission. As expected, engagement in healthy lifestyle behaviours prior to the outbreak of the pandemic was found related to adherence to coronavirus protective behaviours. In addition, adherence to coronavirus protective behaviours was higher than engagement in healthy lifestyle behaviours; and the latter, but not the former, was associated with self-assessed health. Moreover, in line with our fourth hypothesis, the association between healthy lifestyle behaviours and coronavirus protective behaviours was stronger among people with higher, compared with lower, self-assessed health.

### Healthy Lifestyle Behaviours as Predictors of Coronavirus Protective Behaviours

To the best of our knowledge, this is the first empirical evidence of cross-behavioural effects between healthy lifestyle behaviours and situationally unique behaviours demanded as a protection from a pandemic. The findings are consistent with prior reports on cross-behaviour associations [10, 13], and support the importance of considering the interconnectedness among health-related behaviours [11]. Several explanations have been offered to account for cross-behaviour effects, some even leading to contradictory predictions. For example, in one study, engagement in a particular health behaviour was expected to facilitate engagement in other behaviours through shared cognitions [17]. In another, engagement in a health behaviour was expected to hinder engagement in other behaviours due to compensatory health beliefs whereby the negative effects of an unhealthy behaviour can be compensated for by engaging in a healthy behaviour [46]. This could have been reflected in the current context as higher engagement in healthy lifestyle behaviours associated with less adherence to coronavirus protective behaviours, perhaps due to a belief that the health benefits related to lifestyle behaviours decrease the severity of COVID-19 or even create a sense of perceived invulnerability [47, 48]. However, consistent with previous findings [49], our results indicate that engagement in healthy lifestyle behaviours is positively related to adherence to protective behaviours against the new health threat.

Observations that actions can be initiated and carried out even without conscious goals [50] underscore the importance of exploring nonconscious mechanisms and constructs that may facilitate cross-behaviour associations over time such as shared motivations, strategies, and implicit attitudes towards a behaviour [21, 51, 52]. Consequently, common social-cognitive models [53] may benefit from including measures addressing past-behaviour effects, such as the Self-Report Habit Index [54] or a component multiplying frequency of past behaviour by the stability of the context of behavioural performance [e.g., 55], as well as constructs related to cross-behaviour influences on engagement in a given behaviour, such as measuring the effects carried over from changes in other behaviours [56].

### Self-Assessed Health and Health Behaviours

The present study considered self-assessed health as the sum of health-related experiences, outcomes and evaluations [32, 38]. Although a positive relationship was found between past healthy lifestyle behaviours and current adherence to coronavirus protective behaviours, it was stronger for people with higher subjective health ratings. This is consistent with the theoretical prediction that higher well-being and better perceived health outcomes related to health behaviours serve as facilitating mechanisms for cross-behaviour carryover effects [21].

Another explanation for the moderating role of self-assessed health on the association between healthy lifestyle behaviours and coronavirus protective behaviours may be related to perceived differences in their ease of performance [24] and in their outcome timeframe: long-term vs. immediate [57–59]. The relative ease of performing the coronavirus protective behaviours, combined with the immediate short-term consequences of not performing them, may mobilize people to engage in them regardless of their subjective perceived health condition. This partly explains the higher adherence to protective behaviours compared with healthy lifestyle behaviours, as well as the lack of association between the former and self-assessed health. However, people with low self-assessed health who do adhere to coronavirus protective behaviours might have found it difficult to engage in some healthy lifestyle behaviours. In addition, when individuals are coping with poor health and maintain an enduring unhealthy self-concept [60], all efforts may focus on the health conditions involved, leaving little energy or attention to engage in other preventive lifestyle behaviours. Such individuals may still be acutely aware of the COVID-19 situation and take preventive measures, regardless of their overall lifestyle. Moreover, the long-term consequences of lifestyle behaviours, which may occur decades after engagement or nonengagement in them (e.g., from smoking), might not

be a strong enough incentive to overcome existing health constraints and bring people in poor health to implement their health intentions. Consequently, people with low self-assessed health might display weaker cross-behavioural associations.

Finally, the relationship between self-assessed health and healthy lifestyle behaviours is often presented as causal, wherein less engagement in health behaviours predicts lower health status (e.g., [61]). The current findings suggest a possible bi-directional causality: although engagement in health behaviours is beneficial for one's health, individuals with lower self-assessed health may have limitations that cause less engagement in healthy lifestyle behaviours. Consequently, the magnitude of the effect of lifestyle behaviours on illness, disability, and mortality should be adjusted to account for the variability in people's baseline health status.

### Limitations and Future Directions

Caution is advised in generalizing from the current findings. Since there are differences between, and even within, countries in health behaviours [62], replications are warranted, both within the studied population and across cultures. Because of the abrupt nature of the global coronavirus pandemic, both healthy lifestyle behaviours and coronavirus protective behaviours were measured simultaneously, precluding the possibility to properly determine causality [63]. Future studies should try to assess engagement in healthy lifestyle behaviours during normal times, as a benchmark, prior to investigating protective behaviour during a pandemic or similar crisis.

Self-assessed health is often measured by a single scale [30], as in our study. However, since some health dimensions may be more important than others when assessing subjective health [64], it is recommended that identification of the specific aspects of self-assessed health that moderate the relationship between healthy lifestyle behaviours and coronavirus protective behaviours includes more specific health-related measures, such as fatigue assessment [65] and objective biomarkers [66]. Moreover, since individuals with higher levels of self-assessed health base their overall health evaluations on health behaviours more than individuals with lower levels of health [67], higher self-assessed health may also make the cross-behavioural associations more evident.

Finally, this study focused on the roles of healthy lifestyle behaviours and self-assessed health in explaining coronavirus protective behaviours. It is advisable to also examine the relationship between these factors and other theoretical constructs that predict engagement in health behaviours and may potentially act as psychological mechanisms that link both clusters of behaviours, such as anticipated regret and attitudes towards the behaviours [68, 69], behaviour-specific risk perception, and perceived

susceptibility to the threat [70, 71]. Ease of performance may also be strongly correlated with habit strength of a behaviour [72], and both constructs should be examined as possible explanations for the study's findings.

### Conclusions

The novel coronavirus has become a global threat, and the only means currently available to contain it is behavioural [2, 26]. Understanding individual differences in adherence to recommended protective behaviours is essential for communicating recommendations to the public, tailoring interventions for specific sub-groups, and modifying these behaviours. Consistent with the formation of implicit and explicit cognitions and motivations to achieve health goals [5, 10, 50], this study revealed that leading a healthy lifestyle prior to the pandemic was associated with adherence to coronavirus protective behaviours, especially among people with high self-assessments of their health. These findings suggest that investing efforts in enhancing the population's engagement in healthy lifestyle behaviours does not only have direct benefits, but it also might potentially increase adherence to behavioural instructions during the next global health crisis.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s12529-021-09960-6>.

**Data Availability** The data that support the findings of this study will be openly available in Open Science Framework upon the acceptance of the manuscript.

### Declarations

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

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