



# How did the COVID-19 pandemic influence health-related behaviour? An online survey on food choice, physical activity and changes in body weight among Swiss adults

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## ABSTRACT

The COVID-19 pandemic has affected all aspects of our everyday lives. To investigate these behaviour changes, an online survey was conducted with 1'028 individuals (51% female) in Switzerland between June and July 2020. The questions referred in particular to the lockdown in spring 2020. We put specific focus on the pandemic's impact on health-related behaviour, which includes food choice, physical activity and body weight management. For instance, participants reported whether and how their consumption of different foods changed during the lockdown. As a measure of healthy food choice, we chose consumption of *vegetables and salad* and in contrast, *sweet snacks* and *alcohol* consumption was used as a measure for unhealthy food choice. For physical activity and body weight, participants indicated whether it decreased, increased or did not change during the lockdown as compared before. In a next step, we investigated the influence of various predictors on health-related behaviour using multinomial logistic regression models. We find that the possibility to work remotely led to healthier food choices, that is, a reported increase in vegetable consumption and decrease in sweet snack consumption, but also to more unhealthy food choices and lifestyles, that is, a reported increase in alcohol consumption as well as an increase in sweet snack consumption. For weight change, the data indicated that individuals who worked remotely were more likely to gain or lose weight than individuals working from the office. Our findings demonstrate how individuals are affected differently by the pandemic and how complex the whole picture is. Further, these results are crucial in developing health recommendations for possible future lockdowns or health crises in general.

## 1. Introduction

In 2019, when the first cases of infection with the newly identified novel coronavirus were reported in China (Wang et al., 2020), COVID-19 was initially considered a health-related shock, but over time evolved into a long-term shock to multiple systems (Fanzo, 2021, p. 57). All aspects of the population's daily life were affected by the policy measures to contain the pandemic and its effects on food and health systems, in particular health-related behaviour such as dietary habits and lifestyle factors (Molina-Montes et al., 2021) but also people's wellbeing and mental health (Pfefferbaum & North, 2020; Serafini et al., 2020; Usher et al., 2020). Following the recommendations of the World Health Organisation that proposed various measures such as physical distancing to contain the spread of the virus (World Health Organization, 2020b), national and regional governments pronounced

containment measures such as remote work or curfews at national or regional level. These measures can ultimately cause anxiety, depression and stress (Rajkumar, 2020). In terms of behaviour, panic buying (e.g., Kassas & Nayga, 2021), stockpiling (Ritzel et al., manuscript submitted) and a sharp increase in online grocery shopping were observed (Leatherby & Gelles, 2020). People changed their individual health-related behaviour, including food and beverage consumption as well as changes in physical activity and body weight management. It is important for policy makers to draw the right conclusions from this pandemic to develop targeted measures to improve society's resilience to pandemics in the future.

### 1.1. COVID-19, food choice and alcohol consumption

The pandemic affected food choices in various ways. Data from Asia,

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Africa and Europe showed that snacking and unhealthy eating habits increased during confinement (Ammar et al., 2020). Similarly, self-reported data from Italy indicated that consumption of comfort food, such as sugary snacks, increased (Bracale & Vaccaro, 2020; Scarmozzino & Visioli, 2020). Contrary to these findings, other studies found reduced consumption of unhealthy foods such as snacks, cakes, cookies, and pastries (Ben Hassen et al., 2021; Di Renzo et al., 2020), higher vegetable consumption (Murphy et al., 2020; Scarmozzino & Visioli, 2020) or higher adherence to a Mediterranean diet (which was suggested to be among the healthiest (Muscogiuri et al., 2020)) during the time of confinement (Molina-Montes et al., 2021). This evidence reflects cultural differences in coping with a crisis.

Looking into possible predictors of behaviour change, several factors have been identified as influential in individuals' food choice or change thereof during the pandemic. For instance, a reduced consumption of fresh food was found with the exception for households with children (Janssen et al., 2021). Different patterns were found in regard to education and its impact on diet quality. Jaeger et al. (2021) found positive changes in food choice for individuals with higher levels of education, which was reasoned to be related to increased opportunity to work from home. Contradicting these findings, Poelman et al. (2021) reported the opposite effect with higher educated individuals reporting unhealthier diets during lockdown than individuals with lower education levels.

Another important predictor of food choice during the pandemic is age (Mitchell et al., 2021). Specifically, it seems that younger individuals were more likely to make healthier food choices during the pandemic. Various studies reported that being 40–59 years old was a barrier to positive change in eating behaviours, with younger individuals being more likely to increase consumption of healthy foods (Gornicka et al., 2020; Jaeger et al., 2021; Snuggs & McGregor, 2021). Similarly, another study found that older age groups were more resistant to changes in diet (Mitchell et al., 2021). Contrasting these findings, another study demonstrated higher adherence to a Mediterranean diet during the confinement as compared to the elderly population (Di Renzo et al., 2020).

Besides food consumption, the pandemic also impacted alcohol intake, which has important implications on an individual's health. On the one hand, alcohol is often consumed as part of a social setting or "social drinking" in bars or restaurants (Scarmozzino & Visioli, 2020). On the other hand, it can be seen as possible coping mechanism in stressful times. This makes it an interesting aspect to look at during the COVID-19 pandemic. Most studies reported a decrease in alcohol consumption during the pandemic (Ammar et al., 2020; Di Renzo et al., 2020; Espinoza-Ortega et al., 2021; Scarmozzino & Visioli, 2020), which was probably due to the closing of restaurants and bars. However, the picture is more complex than that. Scarmozzino and Visioli (2020) found that while 37% reported a decrease, 10% reported an increase in alcohol consumption during the pandemic in Italy. It further seems that increases in alcohol consumption were mostly found among individuals with high levels of stress (Callinan et al., 2021).

### 1.2. COVID-19, physical activity and body weight

Besides changing food and beverage consumption patterns, the pandemic can also impact physical activity, which may be regarded as a means to improve mood, mental health and can therefore be regarded as a coping strategy (Robertson et al., 2021). It was found that those who did not exercise before the lockdown did not report a significant change in activity during lockdown. However, those who did exercise before tended to increase their physical activity during the lockdown (Di Renzo et al., 2020). An international study reported a general decrease in physical activity (Ammar et al., 2020), whereas data from Australia suggest that individuals changed their behaviour both to the better and the worse. Specifically, 35% of the general population reported more exercise and 43% reported less (Phillipou et al., 2020). In terms of sociodemographic predictors, it seems that women and individuals from

younger age groups exercised more during the lockdown than before (Robertson et al., 2021).

A final health-related aspect to mention here is the change in body weight. Both food choice and physical activity ultimately contribute to changes in body weight. Similarly, other factors such as anxiety associated with the pandemic can lead to weight changes as well. The current body of literature indicates that there seems to be a trend towards weight gaining during the pandemic (Di Renzo et al., 2020; Scarmozzino & Visioli, 2020). This effect was especially pronounced for individuals with obesity and low education (Pellegrini et al., 2020). A review and meta-analysis found the same effect for children and adolescents with significant increases in body weight and BMI during the lockdown (Chang et al., 2021).

### 1.3. Aims and relevance of the present research

As previous studies (Marty et al., 2021), this study asked participants to retrospectively describe their food choices and behaviour before and during the first lockdown in 2020. With that, our study contributes to a better understanding of the impact of COVID-19 on individual health-related behaviours including changes in food consumption, physical activity and body weight. Besides identifying these changes, our work looks into sociodemographic and individual predictors of behaviour change. As described above, the evidence suggests that age and education are important predictors to follow up on. This enables us to identify population groups that were affected by the pandemic the most, which ultimately allows recommendations to be derived for policy measures that can help to protect these particularly vulnerable population groups from the negative effects of a pandemic.

As discussed by Cecchetto et al. (2021), there is a thin line between protecting the population from the effects of the pandemic and protecting them from the effects of isolation. Therefore, it is important to be well aware of the positive and negative consequences that policy measures aiming to limit the spread of the virus will have on individuals and society as a whole. The present research aims to contribute to this understanding by investigating how various factors (e.g., being able to work remotely) contribute to individuals' health-related behaviour. With that, our study is among few which investigates the combined impact of environmental, sociodemographic and psychological factors on individuals' health-related behaviours during the lockdown. Further, while most of the previous studies focus on either food consumption (Ben Hassen et al., 2021; Eftimov et al., 2020), physical activity (Castaneda-Babarro et al., 2020) or body weight (Pellegrini et al., 2020), only few studies investigate multiple health-related behaviours (Robinson et al., 2021).

Finally, the information obtained herein is also important in an international context as it provides data from a middle European country. Our findings for Switzerland are of interest for local policy makers as much as for other countries. Firstly, the results add to the evidence of how policy measures to contain the spread of the virus, such as remote work, have affected the health-related behaviours. Secondly, we identify how different population groups were affected differently, which can ultimately help adapt future crisis management and communication to protect groups that are most vulnerable (e.g., those with less access to healthy diets or those more prone to snacking in stressful situations). Thirdly, we provide recommendations for the development of policies that contribute to population resilience to pandemics that are directly related to food systems and health. Finally, our analyses provide insights on consumption changes on selected product categories, which can help food producers adapt their offer according to the needs of the public during a health crisis.

## 2. Materials and methods

### 2.1. Questionnaire development

Data were collected using an online survey which focused on the lockdown between March 13 and April 26 in 2020. It mainly consisted of four parts (as visualised in Fig. 1). In the first part, demographic information on age, level of education, gender, and place of residence were collected. Sociodemographic variables are generally important in food research. Moreover, recent research investigating the effects of the COVID-19 pandemic on food choice supports this importance as it revealed that gender (Coulthard et al., 2021), age (Gornicka et al., 2020; Jaeger et al., 2021; Snuggs & McGregor, 2021) and educational level (Poelman et al., 2021) were important variables driving changes in food choice behaviour.

In the second part, participants were asked if and how their work situation (including working from home). This variable was included because on the one hand, working from home can lead to more self-prepared meals which in turn has an impact on individuals' food choice. On the other hand, this is an important disruption in individuals' everyday lives, which can lead to behaviour change. In this part, we further asked whether their food behaviour changed during the lockdown in terms of food choice and food preparation. To measure changes in food choice, participants indicated for 13 food categories whether their consumption decreased (1), stayed the same (2), or increased (3) during the lockdown as compared to before.

The third part of the questionnaire addressed participants' physical activity for which participants indicated whether it decreased (1), stayed the same (2), or increased (3) as compared to before the lockdown. Together with the question about individuals' work situation, we

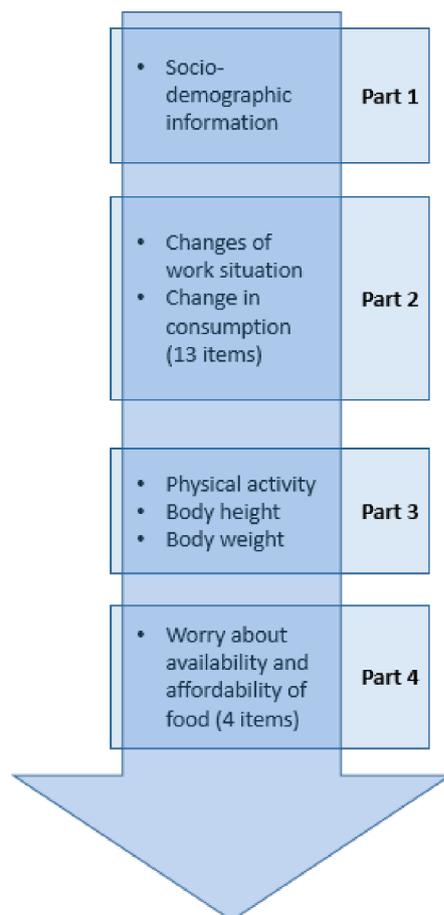


Fig. 1. Overview of the survey structure.

aimed to find out whether the lockdown led to less physical activity and generally caused individuals to stay home more. Both variables are assumed to have a major impact on individuals' health and psychological wellbeing. We further asked participants about their height and weight. Based on this information, we calculated their body mass index (BMI). In accordance with the literature (Matthes et al., 2020), values between 14 and 60 kg/m<sup>2</sup> were considered<sup>1</sup> and following the recommendations of the WHO (World Health Organization, 2020a), BMI values were grouped into the following categories: underweight (BMI < 18.5 kg/m<sup>2</sup>), normal weight (BMI 18.5–24.9 kg/m<sup>2</sup>), overweight (BMI 25.0–29.9 kg/m<sup>2</sup>) and obese (BMI ≥ 30.0 kg/m<sup>2</sup>). To assess the pandemic's influence on body weight, participants indicated whether they felt that they have lost weight (1), stayed the same (2), or gained weight (3) during the time of the lockdown. Information on body weight was included as previous research found that individuals with higher BMI were subject to an increase in emotional eating or ate unhealthier during the lockdown (Coulthard et al., 2021; Poelman et al., 2021).

In a fourth and final part, participants were asked how worried they were during the lockdown regarding the availability of food (*availability worries*). Given that increased stress-levels can negatively impact diet quality for instance through increased food intake (Mediouni et al., 2020; Muscogiuri et al., 2020), we developed four items aiming to assess this level of *availability worries*, causing stress, concerning the availability and affordability of food during the pandemic. The items used are "During that period, I was worried about not having enough money to feed myself properly", "..., I was worried about not having enough money for healthy food", "..., I was concerned about not being able to find certain foods", and "..., I was worried about not having enough money for healthy food", "..., I was concerned about not being able to find certain foods for a healthy diet". In accordance with previous parts of the survey, a 3-point response scale was used including not worried not at all (1), a little (2) and worried a lot (3). We summarised the four items in an averaged scale called *availability worries* (4 items,  $\alpha = 0.78$ ,  $M = 1.3$ ,  $SD = 0.4$ ). The scale was then used to analyse the effect of perceived food system disturbance on health-related behaviours related to food choices, physical activity and changes in body weight.

### 2.2. Sample description

Data were collected by the Swiss Federal Food Safety and Veterinary Office using an online questionnaire (Swiss Federal Food Safety and Veterinary Office (FSVO), 2020) and quotas on language region, gender and age. The survey was completed between June and July 2020 by 1028 individuals (51% female) across Switzerland (Table 1). Almost half of our sample indicated living in villages, in the mountains or in the countryside. A total of 71.6% of participants lived in the German speaking part, 24.2% in the French speaking part, and 4.2% lived in the Italian speaking part of Switzerland. Participants' age ranged from 18 to 86 years ( $M = 49$ ,  $SD = 18$ ). As shown in Table 1, around 20% of participants lived in a one-person household and around 30% lived in a two-person household, as is common in Switzerland (Bundesamt für Statistik (BFS), 2020). The major part with 40% of participants are found to be normal weight, and 38% have overweight or are obese, 21% of the participants did not answer the question and were thus not included in the regression analyses. As shown in Table 1, the pandemic had a major impact on the individuals' work situation. A substantial part of our sample (46%) indicated to work 80% or more. In terms of work place, 48% of the employed individuals indicated that they continued to go to their place of work whereas 52% stayed at home full time or part time during the lockdown.

<sup>1</sup> Based on this, one person was excluded from the analyses.

**Table 1**  
Sample description (N = 1028).

		N	% total	% valid
Gender				
	Male	506	49.2	49.2
	Female	522	50.8	50.8
Age				
	18–29	181	18	18
	30–44	264	26	26
	45–59	279	27	27
	60–74	195	19	19
	≥75	110	11	11
Place of residence				
	Cities, small and medium-sized towns	566	55	55
	Villages, mountains and countryside	453	44	45
	other	9	1	–
Language region				
	German	736	72	72
	French	249	24	24
	Italian	43	4	4
Household composition				
	Single person	231	22	23
	Couple	293	29	29
	Couple / single parent with child(ren)	333	32	33
	Other	146	14	15
	Prefer not to answer	25	3	–
Body mass index (BMI)				
	Underweight (BMI < 18.5)	14	1	2
	Normal weight (18.5 ≤ BMI < 25)	409	40	50
	Overweight (25 ≤ BMI < 30)	274	27	34
	Obese (30 ≤ BMI < 60)	116	11	14
	No response	215	21	–
Education				
	None	3	<1	<1
	Compulsory education	38	4	4
	Basic vocational training	412	40	40
	Middle school	164	16	16
	Higher vocational training	177	17	17
	High school, university degree	228	22	22
	Prefer not to answer	7	1	–
Employment situation (professional occupation rate) before lockdown				
	80% and more	455	44	46
	20–79%	174	17	17
	<20%	21	2	2
	Maternity leave, sabbatical	4	<1	<1
	None (retired, unemployed etc.)	343	33	34
	Other / prefer not to answer	31	3	–
Work situation during lockdown <sup>a</sup>				
	Continued working as before	291	29	48
	Worked partly or completely from home	314	31	52
	Prefer not to answer / no response	45	40	–

Note. For the sake of completeness, all answers are depicted in the row “total”. The row “valid” is adjusted for the missing data and depicts the values that are used for further analyses herein.

<sup>a</sup> : n = 650 individuals who indicated that they had an employment before the lockdown.

### 2.3. Data analysis

To investigate changes in food consumption, three among the thirteen food categories were chosen for a more detailed investigation. First of all, we were interested in food categories where substantial changes were reported (e.g. >20% reported an increase/decrease in consumption). Next, we chose categories that are critical for healthy or unhealthy diets. Following nutrition reports, most Swiss individuals do not consume the recommended amount of vegetables (Swiss Federal Office of Public Health, 2019). Therefore, we consider an increase in vegetable consumption as an indicator for a change towards a more healthy diet, that is, change in vegetable consumption was used as dependent variable to investigate the predictors of healthy food choice. On the basis that more than 50% of Swiss men and women consume more than 10%

of total energy intake through sugar (the World Health Organization recommends max. 10%, Chatelan et al., 2019), sweet snack consumption was used as dependent variable to investigate the predictors of unhealthy food choice. Finally, we used alcohol consumption as dependent variable to investigate the predictors of unhealthy lifestyle choices because alcohol can have severe health effects.

In a first step, correlation analyses were used to assess the interrelations between the different socio-demographic and health-related behaviour, i.e. healthy and unhealthy food choice, physical activity, changes in body weight and the worries Swiss adults had during the lockdown regarding food availability and affordability. Next, we used multinomial logistic regression models to investigate the predictors of health-related behaviour. To predict the changes in healthy and unhealthy food choices, we used two exemplary food categories (i.e. vegetable and salad, sweet snacks) and defined the dependent variable as follows: (3) increase in consumption; (2) no change in consumption; (1) decrease in consumption. Finally, in terms of lifestyle changes, we used alcohol consumption as the dependent variable as follows: (3) increase in alcohol consumption; (2) no change in alcohol consumption; (1) decrease in alcohol consumption. For physical activity, the dependent variable was defined as: (3) increase in physical activity; (2) no change in physical activity; (1) decrease in physical activity. Finally, with regard to changes in body weight, the dependent variable weight change was defined as follows: (3) increase in body weight; (2) no change in body weight; (1) decrease in body weight. For physical activity, the dependent variable was defined as: (3) increase in physical activity; (2) no change in physical activity; (1) decrease in physical activity. Finally, with regard to changes in body weight, the dependent variable weight change was defined as follows: (3) increase; (2) no change; (1) decrease in body weight.

The independent variables used in the regression analyses are the socio-demographic variables as described in Table 1 and the stated worries regarding the perceived availability and affordability of food. Odds ratios, i.e. the exponentiation of the coefficients, and the 95% confidence intervals are presented. In multinomial regressions, an odds ratio above (below) 1 indicates that the comparison outcome is more (less) likely. For instance, if a higher vegetable consumption (change of interest, comparison outcome) is compared with a constant (no change) vegetable consumption during the lockdown, an odds ratio above 1 of a specific explanatory variable indicates that this variable positively contributes to higher vegetable consumption. In contrast, an odds ratio below 1 of a specific explanatory variable indicates, that the outcome is more likely to be in the referent (no change) group. All analyses were run using the Statistical Package for the Social Sciences (SPSS) version 26 (IBM, New York, USA) for Windows.

## 3. Results

### 3.1. Consumption behaviour

The pandemic has changed consumption patterns of certain food items enormously, especially during the lockdown in spring 2020 (Fig. 1). In our sample, the food categories where at least one third of the respondents indicated a change in consumption levels are homemade bread, fresh and frozen prepared meals, alcoholic beverages, salty and sweet snacks, and sodas. The biggest increase was reported for homemade bread. While changes are clearly visible, it is not easy to rate them in terms of making a clear statement on whether the pandemic has contributed to a general healthier or unhealthier diet of the Swiss population. Across our sample, more individuals indicated that they increased than decreased their consumption of vegetables, fruits, food supplements during the lockdown. At the same time, they indicated that the consumption of sweet and salty snacks increased as compared to before the lockdown (Fig. 2).

What seems clear, however, is that more people reported a decrease than an increase in their consumption of fresh and frozen prepared

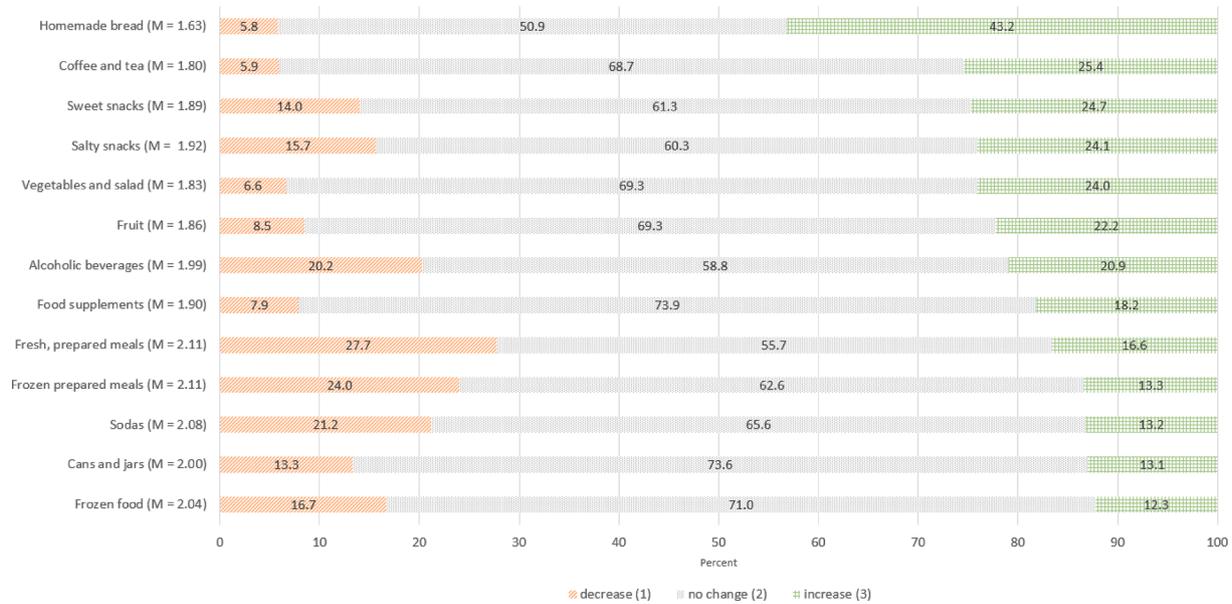


Fig. 2. Perceived change of consumption for different food categories during the lockdown in 2020. Due to missing answers, n ranges between 560 and 988.

meals.

### 3.2. Physical activity and changes in body weight

In terms of physical activity, 21% reported an increase, 44% trained as often as before, and 35% indicated that they exercised less during the lockdown as compared to before ( $M = 1.9, SD = 0.7$ ). The BMI distribution in our sample is comparable to other studies in Switzerland (Matthes et al., 2020). However, it is interesting to note that the percentage of non-responders for this question is relatively high with 21%. Body weight and its changes appeared to be a sensitive topic as well with 5% missing responses. From the remaining 974 individuals who provided an answer, 20% reported a decrease, 51% no change and 29% indicated an increase in their body weight during the lockdown (Fig. 3).

### 3.3. Sociodemographic correlates

Participants' degree of worry about the availability and affordability

of food during the lockdown was significantly correlated with their education level ( $r = -0.13, p \leq 0.001$ , Table 2), indicating that individuals with higher educational degrees were less worried about not being able to get or afford a healthy diet. Similarly, with higher degrees of education, participants were more likely to be able to work remotely ( $r = 0.32, p \leq 0.001$ ). Individuals with higher levels of education were significantly more likely to be able to work from home ( $t(618) = -8.4, p < .001$ ). The possibility to work remotely reduces the number of contacts and therefore the risk of infection with COVID-19.

We further found that participants' age was significantly negatively correlated with the change in consumption of vegetables ( $r = -0.08, p < .01$ ), indicating that with increasing age, participants were more likely to consume fewer vegetables during the lockdown. With increasing age, participants also reported to worry less about being able to afford or to be able to get food ( $r = -0.26, p < .001$ ). The simultaneous increase, i.e. the positive correlation, of alcohol consumption, sugar consumption and weight gain demonstrates a possible negative downwards spiral of the pandemic.

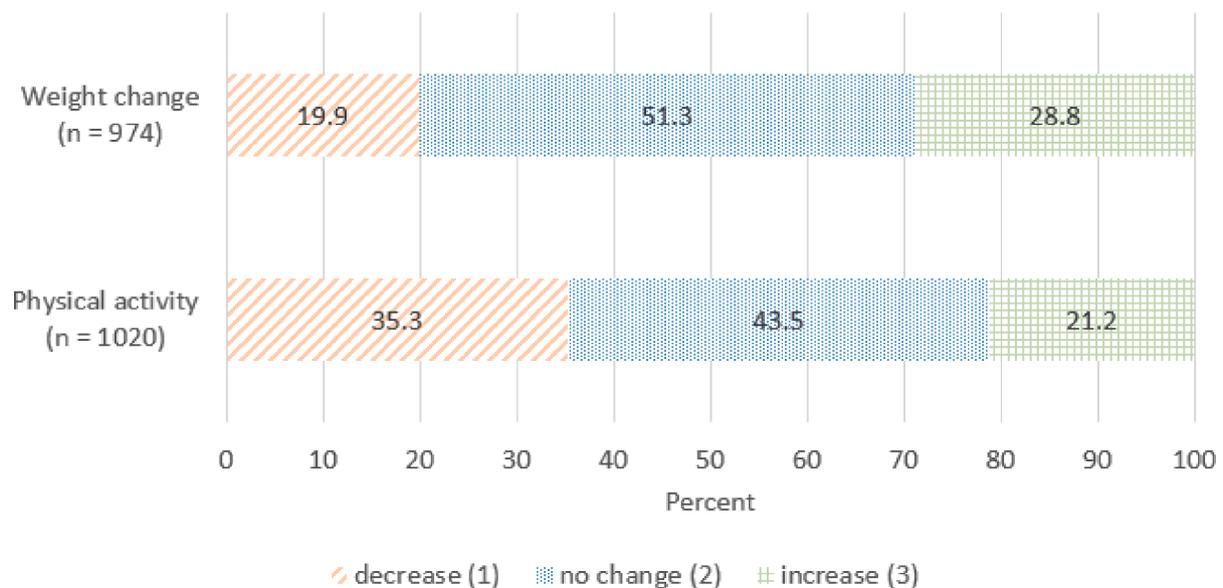


Fig. 3. Perceived changes in physical activity and body weight during the lockdown in 2020.

**Table 2**

Pearson's correlations for change of consumption of certain food groups, sociodemographic variables, and health-related behaviour.

	1	2	3	4	5	6	7	8	9	10	11	12
1. Vegetable consumption <sup>a</sup>	1											
2. Sweet snack consumption <sup>a</sup>	-0.08*	1										
3. Alcohol consumption <sup>a</sup>	0.01	0.24***	1									
4. Physical activity <sup>a</sup>	0.13***	-0.13***	-0.07*	1								
5. Weight change <sup>a</sup>	-0.06	0.31***	0.09*	-0.29***	1							
6. Age	-0.08**	-0.10**	0.01	-0.03	0.03	1						
7. Gender <sup>b</sup>	0.01	0.02	-0.02	-0.03	0.09**	0.04	1					
8. Children in the household <sup>c</sup>	-0.03	0.08*	0.03	-0.04	0.03	-0.34***	0.05	1				
9. BMI	0.01	0.05	0.05	-0.08*	0.11**	0.19***	-0.14***	-0.05	1			
10. Education	0.08*	-0.03	0.07*	0.03	-0.05	-0.11**	-0.05	0.12**	-0.09**	1		
11. Availability worries <sup>d</sup>	0.04	0.10**	0.03	-0.08*	0.07*	-0.26***	<-0.01	0.09*	0.12**	-0.13***	1	
12. Remote work <sup>c</sup>	0.11**	0.03	0.09*	0.01	-0.07	-0.08*	0.06	0.08	-0.10*	0.32***	-0.06	1

Note. <sup>a</sup> 3-point answer scale (1 = decrease, 2 = no change, 3 = increase); <sup>b</sup> 0 = man, 1 = woman; <sup>c</sup> 0 = no, 1 = yes; <sup>d</sup> averaged scale on the basis of four items participants answered on a 3-point answer scale (1 = no, 2 = slightly, 3 = yes).

\* $p \leq 0.05$ , \*\* $p \leq 0.01$ , \*\*\* $p \leq 0.001$ .

### 3.4. Predictors of health-related behaviour

To determine the most important predictors of health-related behaviours, we conducted multinomial regression analyses to predict changes in food choices as well as changes in physical activity and changes in body weight, using “no change” as reference category. Table 3 lists the finding of the multinomial logistic regression analysis predicting changes in vegetable consumption as an example of healthy food choice.

The results show that a reported decrease in vegetable consumption is related do individuals worrying more about the availability and affordability of food and place of residence with worried individuals and city-dwellers being more likely to decrease vegetable consumption. For reported increases in vegetable consumption, we find that individuals with lower levels of education as well as younger individuals and remote workers were more likely to increase vegetable consumption.

Table 4 depicts the results for the multinomial logistic regression predicting changes in sweet snack consumption, as an example of unhealthy food choice. Interestingly, we find that individuals who were worried about the availability and affordability of food and remote workers were more likely to change their behaviour and report both decreases or increases in sweet snack consumption as compared to no change. Further, we find that individuals with lower levels of education were more likely to increase their sweet snack consumption as compared to no change.

Table 5 shows the results for the multinomial logistic regression predicting changes in alcohol consumption, as an example of unhealthy lifestyle. We find that younger individuals and those worrying about the availability and affordability of food were more likely to decrease alcohol consumption as compared to no change during the lockdown in

2020. Further, the results show that for city-dwellers, remote workers and those who worried a lot, a reported increase in alcohol consumption was more likely than no change.

In terms of physical activity, multinomial logistic regression analysis revealed that especially individuals who were worried about the availability and affordability of food and remote workers were likely to reduce their physical activity (Table 6). At the same time, remote workers were also more likely to increase physical activity as compared to no change.

Table 7 shows the results of the multinomial logistic regression analysis predicting changes in body weight. Based on our data, it seems that individuals with higher BMI, lower education levels, more worries, remote workers and individuals without children were more likely to report a decrease in body weight as compared to no change. Further, the results show that individuals with higher BMI and more worries were more likely to report increases in body weight as compared to no change.

## 4. Discussion

In the present study, we investigate the impact of COVID-19 on individual health-related behaviour including changes in food consumption, physical activity and body weight. We find that these changes in individuals' health-related behaviour were both to the better and the worse, depending on the individuals, their circumstances and socio-demographic profiles. We find that individuals with higher degrees of education were more likely to work remotely than individuals with lower educational degrees. Remote work in turn was connected to both healthy and unhealthy changes in behaviour, which serves as an indication for the complexity of those interactions. It seems that the

**Table 3**

Multinomial logistic regression predicting vegetable consumption (n = 413).

	Sig.	Decrease (as compared to no change) 95% CI for Odds Ratio			Sig.	Increase (as compared to no change) 95% CI for Odds Ratio		
		OR	Lower	Upper		OR	Lower	Upper
Intercept	0.02				0.48			
BMI	0.48	1.04	0.93	1.16	0.07	1.05	1.00	1.10
Education	0.75	0.93	0.61	1.43	0.03	<b>0.81</b>	0.67	0.98
Availability worries	<0.01	<b>4.25</b>	1.79	10.08	0.32	1.28	0.78	2.09
Age	0.44	1.02	0.97	1.06	0.03	<b>0.98</b>	0.96	1.00
Countryside (BL: City)	0.04	<b>0.31</b>	0.10	0.96	0.37	0.81	0.51	1.28
Remote work (BL: Office)	0.42	1.61	0.51	5.14	<0.01	<b>2.61</b>	1.56	4.35
Children (BL: no children)	0.87	0.91	0.32	2.63	0.17	0.72	0.45	1.15
Women (BL: men)	0.62	1.31	0.46	3.74	0.96	0.99	0.62	1.58

Note. An odds ratio above (below) 1 indicates that a change is more (less) likely than no change. Model  $\chi^2(16) = 43.52^{***}$ ; OR = odds ratio, City: 0 = small or big city, 1 = countryside; Office: 0 = working from the office, 1 = working from home; Children: 0 = without children, 1 = with children, Gender: 0 = man, 1 = woman, significant effects in bold print.

**Table 4**  
Multinomial logistic regression predicting sweet snack consumption (n = 392).

	Sig.	Decrease (as compared to no change)			Sig.	Increase (as compared to no change)		
		95% CI for Odds Ratio				95% CI for Odds Ratio		
		OR	Lower	Upper		OR	Lower	Upper
Intercept	0.01				0.10			
BMI	0.56	1.02	0.95	1.10	0.34	1.03	0.97	1.09
Education	0.96	1.01	0.77	1.31	0.03	<b>0.79</b>	0.64	0.97
Availability worries	<0.01	<b>2.54</b>	1.34	4.79	<0.01	<b>2.31</b>	1.37	3.90
Age	0.13	0.98	0.95	1.01	0.08	0.98	0.96	1.00
Countryside (BL: City)	0.07	1.83	0.95	3.51	0.65	1.12	0.68	1.85
Remote work (BL: Office)	<0.01	<b>3.03</b>	1.47	6.25	<0.01	<b>2.49</b>	1.44	4.31
Children (BL: no children)	0.12	0.60	0.31	1.15	0.15	1.45	0.88	2.40
Women (BL: men)	0.90	1.04	0.55	2.00	0.77	0.93	0.56	1.54

Note. An odds ratio above (below) 1 indicates that a change is more (less) likely than no change. Model  $\chi^2(16) = 57.14^{***}$ , OR = odds ratio, BL = base line, City: 0 = small or big city, 1 = countryside; Office: 0 = working from the office, 1 = working from home; Children: 0 = without children, 1 = with children, Gender: 0 = man, 1 = woman, significant effects in bold print.

**Table 5**  
Multinomial logistic regression predicting alcohol consumption (n = 347).

	Sig.	Decrease (as compared to no change)			Sig.	Increase (as compared to no change)		
		95% CI for Odds Ratio				95% CI for Odds Ratio		
		OR	Lower	Upper		OR	Lower	Upper
Intercept	0.91				<0.01			
BMI	0.49	0.98	0.91	1.05	0.13	1.05	0.99	1.11
Education	0.62	0.94	0.74	1.19	0.61	0.94	0.76	1.18
Availability worries	0.03	<b>1.91</b>	1.05	3.46	0.02	<b>1.98</b>	1.14	3.44
Age	<0.01	<b>0.96</b>	0.94	0.98	0.35	0.99	0.97	1.01
Countryside (BL: City)	0.11	1.60	0.90	2.84	0.01	<b>2.00</b>	1.17	3.44
Remote work (BL: Office)	0.34	1.34	0.73	2.46	<0.01	<b>3.53</b>	1.93	6.46
Children (BL: no children)	0.39	0.77	0.43	1.39	0.22	0.71	0.41	1.23
Women (BL: men)	0.36	0.76	0.42	1.37	0.35	0.77	0.44	1.33

Note. An odds ratio above (below) 1 indicates that a change is more (less) likely than no change. Model  $\chi^2(16) = 54.74^{***}$ , OR = odds ratio, BL = base line, City: 0 = small or big city, 1 = countryside; Office: 0 = working from the office, 1 = working from home; Children: 0 = without children, 1 = with children, Gender: 0 = man, 1 = woman, significant effects in bold print.

**Table 6**  
Multinomial logistic regression predicting physical activity (n = 418).

	Sig.	Decrease (as compared to no change)			Sig.	Increase (as compared to no change)		
		95% CI for Odds Ratio				95% CI for Odds Ratio		
		OR	Lower	Upper		OR	Lower	Upper
Intercept	0.03				0.81			
BMI	0.22	1.03	0.98	1.09	0.18	0.96	0.89	1.02
Education	0.34	1.10	0.90	1.34	0.50	1.08	0.87	1.34
Availability worries	<0.01	<b>2.18</b>	1.30	3.63	0.33	1.36	0.74	2.50
Age	0.09	0.98	0.96	1.00	0.07	0.98	0.96	1.00
Countryside (BL: City)	0.87	0.96	0.60	1.54	0.63	1.14	0.67	1.93
Remote work (BL: Office)	<0.01	<b>2.78</b>	1.68	4.61	<0.01	<b>2.43</b>	1.39	4.24
Children (BL: no children)	0.89	0.97	0.60	1.56	0.06	0.59	0.34	1.01
Women (BL: men)	0.18	1.40	0.86	2.26	0.94	1.02	0.59	1.76

Note. An odds ratio above (below) 1 indicates that a change is more (less) likely than no change. Model  $\chi^2(16) = 54.06^{***}$ , OR = odds ratio, BL = base line, City: 0 = small or big city, 1 = countryside; Office: 0 = working from the office, 1 = working from home; Children: 0 = without children, 1 = with children, Gender: 0 = man, 1 = woman, significant effects in bold print.

pandemic may not only give individuals more time and space for certain behaviours (e.g., more exercise due to remote work) but also fosters a feeling of uncertainty which may cause changes in behaviours (e.g., binge eating for stress relief or emotional comfort).

An interesting behaviour change identified in our sample is the reported increase in consumption of homemade bread. It was reasoned that the well-documented increase of homemade bread is simply the result of more leisure time (Easterbrook-Smith, 2020) or can be seen as a safety element (Bracale & Vaccaro, 2020). Building on the second, it was argued that bread-making is symbolic in that it connotes a person's ability to produce food and support their family and loved ones. Overall,

there is a tendency to cook more during the pandemic as compared before (Ammann & Casagrande, 2021), which may also be related to individuals spending more time at home due to contact restrictions, closure of shops, or remote work. For future crises, this is an important aspect to consider in order to ensure security of supply and to prevent shortages as those we have seen for instance for yeast (Easterbrook-Smith, 2020).

Also related to the time individuals spend at home, an important predictor that emerged throughout our analyses was the individual work situation. Specifically, we found that those individuals who reported having been able to work remotely during the lockdown were more

**Table 7**  
Multinomial logistic regression predicting weight change (n = 402).

	Sig.	Decrease (as compared to no change)			Sig.	Increase (as compared to no change)		
		95% CI for Odds Ratio				95% CI for Odds Ratio		
		OR	Lower	Upper		OR	Lower	Upper
Intercept	<0.01				<0.01			
BMI	0.01	<b>1.10</b>	1.02	1.18	<0.01	<b>1.18</b>	1.11	1.26
Education	0.02	<b>0.77</b>	0.62	0.97	0.32	0.89	0.72	1.11
Availability worries	<0.01	<b>2.41</b>	1.32	4.41	<0.01	<b>3.39</b>	1.92	5.98
Age	0.66	1.00	0.97	1.02	0.82	1.00	0.98	1.03
Countryside (BL: City)	0.46	1.22	0.72	2.08	0.32	1.31	0.77	2.21
Remote work (BL: Office)	<0.01	<b>3.69</b>	2.01	6.74	0.08	1.66	0.94	2.95
Children (BL: no children)	<0.01	<b>0.44</b>	0.25	0.76	0.05	0.58	0.34	0.99
Women (BL: men)	0.95	0.98	0.57	1.70	0.54	1.18	0.69	2.03

Note. An odds ratio above (below) 1 indicates that a change is more (less) likely than no change. Model  $\chi^2(16) = 93.00^{***}$ , OR = odds ratio, BL = base line, City: 0 = small or big city, 1 = countryside; Office: 0 = working from the office, 1 = working from home; Children: 0 = without children, 1 = with children, Gender: 0 = man, 1 = woman, significant effects in bold print.

likely to report an increased intake of vegetables and salad as well as increased or decreased sweet snack consumption as compared to no change. As emotional eating and the motive of eating to comfort oneself have been documented effects of the pandemic (Cecchetto et al., 2021; Laguna et al., 2020), an increased consumption of snacks may have served as coping mechanism for some population groups.

We further find a more unhealthy behaviour change, with remote workers being more likely to report an increased consumption of alcohol, which is in line with previous research (Szajnoga et al., 2020). Additionally, remote workers more likely reported an increase or decrease of physical activity and weight loss. Consequently, it appears that the possibility to work remotely served as a catalyst for individual behaviour change with a tendency towards positive changes. In line with other researchers (Grunert et al., 2021; Grunert et al., 2022), who suggested that those affected most by the pandemic were more likely to change their behaviour, the shift from working in the office to working at home can be seen as major change in individuals' everyday lives.

Still, with the pandemic enabling a significant part of the working population to work remotely, more research is needed to investigate the changes that a shift in work place brings to employees' health-related behaviour. Employers and policy makers should focus on how they can help their employees or population, respectively, to follow healthy behaviour patterns including healthy food choice and physical activity when working from home and to socially exchange with their environment while limiting physical contacts. For instance, knowing that home confinement can negatively influence individuals' physical activity (Ammar et al., 2020), companies could actively integrate physical activity or active breaks in their work routines. Health supporting measures for employees are of crucial importance as it can be expected that the proportion of employees working remotely will be higher after the pandemic than it was before. As a political measure, information campaigns could help individuals to find and follow more healthy routines, such as for instance taking specific breaks from sedentary work for people working at home.

Another important finding to point out is that the pandemic appears to foster inequalities in the population. Income is correlated with educational degree and households with lower incomes were less likely to be able to work from home (Martinez et al., 2021). Furthermore, it has been argued that education in general is a proxy for socioeconomic status (Pellegriani et al., 2020). This in turn means that better educated individuals not only were less exposed to the virus but were also able to spend more money on nutritious food and more time cooking a healthy meal (e.g., for lunch). It is important to ensure that all workers do have access to a healthy and affordable meal. Possible solutions would be subsidised canteens or restaurant vouchers, which could make healthy meals more affordable and easier available for all workers independent of income.

Indications for inequality can also be found when looking at

psychological predictors of behaviour change. For this, we investigated individuals' worries about the availability and affordability of food and find that age, BMI and education were important predictors for individuals' degree of availability worries. Given the relationship between education and income (Boshara et al., 2015), we reason that individuals with higher education faced fewer monetary difficulties during the pandemic, which ultimately led to fewer worries about the availability and affordability of food. Individuals' worries were also a significant predictor for all tested health-related behaviours (healthy and unhealthy food choice, alcohol consumption, physical activity and weight change) investigated herein with a tendency to negative changes. It has been established that stress impacts alcohol consumption and the tendency is that stress increases drinking but the interactions are clearly more complex than that (Anthenelli & Grandison, 2012). Similarly, increased stress can lead to more snacking (Elshurbjy & Ellulu, 2017), which can be seen as a means to soothe the nerves. These are important findings that again highlight the need for policy measures that address specific population groups, which are identified as the most vulnerable in crises such as the current pandemic. These policy measures should focus on the most vulnerable and make sure that they have access to healthy and nutritious food during the pandemic and thereby provide support where needed most in challenging times.

It is, however, important to notice that worries about the availability and affordability of food also led to positive changes. Again, we conclude that the pandemic and the worries that come with it serve as a catalyst for change, both for the better and the worse, depending on the individual. It is important to take these individual differences into account, for instance when designing information campaigns, to ensure that the campaigns appeal to the target group in the best possible way.

As suggested by Robertson et al. (2021), our demonstrate that the interactions are complex. Depending on an individuals' environment, the pandemic can have different effects on behaviour. In the case of farmers and consumers, it appears that they have sought each other out during the pandemic (Yousefian et al., 2021). Our data, with city dwellers more likely to decrease vegetable and salad consumption, suggests that it might be harder for city dwellers to buy fresh food from local farmers than for individuals living in the countryside. Policy efforts such as information campaigns and food distribution schemes can help increase the availability of fresh produce in cities and to overcome the "last mile" problem, which means that transporting food into the cities is very expensive, and thereby contribute to more resilience in the food supply chain.

As in all research, there are some limitations to this study that need to be acknowledged. Our research provides a snapshot of individuals' behaviour during the lockdown. It is important to note that we asked participants for perceived changes of behaviour during the lockdown and did not record a baseline before the pandemic. For instance, we only know whether their amount of vegetables consumed changed, but we

did not record how much they consumed before the pandemic. As in all self-reports, our data is also subject to individual bias. Another aspect to mention is that our study focuses on behaviour, perceptions and behaviour change but we did not ask participants for their motives. Future studies should therefore aim to put these findings into context by considering individuals' motives and psychological traits. Furthermore, it would be interesting to compare our findings from the first wave to results that were collected at later stages of the pandemic. Our results contribute to the understanding of the complex interaction various factors. However, they also lead to the conclusion that it is not trivial to conclude whether the pandemic or its consequences such as remote work overall led to more healthy or unhealthy behavioural changes. Clearly, further research is needed to identify different consumer clusters and how the pandemic impacted them.

## 5. Conclusion

The present study investigates the impact of COVID-19 on individual health-related behaviours including changes in food consumption, physical activity and body weight. With that, this study is one of few which investigate the combined impact of environmental, sociodemographic and psychological factors on individuals' health-related behaviour during the lockdown and look at multiple health-related behaviours. This is an important contribution as the inclusion of various aspects allows for a more complete picture of individuals' health-related behaviours during the lockdown. We find that the interactions are complex with changes in individuals' health-related behaviour being both to the better and the worse, depending on the individuals, their circumstances and sociodemographic profiles. For policy measures, this means that they should be specifically tailored to population groups in order to have the best possible impact. We find tendencies for positive behaviour changes for remote workers and tendencies towards negative behaviour changes for individuals who worried more. This implies that the possibility to work remotely should be encouraged. Further, we find that individuals with lower education levels and higher BMI values are affected more severely by the pandemic and the measures taken to contain the spread of the virus. When designing policy measures, care should be taken to protect these population groups. Overall, our findings are important for employers and policy makers alike to mitigate the impact of the pandemic and help protect the most vulnerable in our society.

## CRedit authorship contribution statement

**Jeanine Ammann:** Formal analysis, Writing – original draft.  
**Christian Ritzel:** Conceptualization, Investigation, Writing – review & editing.  
**Nadja El Benni:** Project administration, Writing – review & editing.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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