



Changes in lifestyle, diet, and body weight during the first COVID 19 'lockdown' in a student sample

K. Palmer, A. Bschaten, N. Stroebele-Benschop^{*}

Institute of Nutritional Medicine, University of Hohenheim, Fruwirthstr. 12, 70593, Stuttgart, Germany

ARTICLE INFO

Keywords:

COVID-19 lockdown
Lifestyle
Body weight
Dietary habits
Students
Exercise

ABSTRACT

Changes in lifestyle and body weight were examined retrospectively in students at a German university during the first COVID-19 lockdown period (March 12- May 3, 2020) using an online survey. Data from a total of 827 participants was used. Almost half of the students reported perceived body weight changes with about 27% gaining weight and around 22% losing weight. Regression analyses showed that consumption changes in the following food categories: fruits, sweets and cakes, bread and bakery products, pasta, savoury snacks, and meats and sausages were predictive of weight changes. Additionally, changes in the frequency of cooking with fresh ingredients, physical activity, exercise, smoking, and alcohol consumption as well as pre-lockdown BMI were all predictive of weight changes. Given the continuous global pandemic, increased and innovative public health efforts to support this population group are needed.

1. Intro

Crises can lead to a lack of resources, or cause poor mental health (Mucci et al., 2016; Thompson et al., 2017; Udomratn, 2008). Poor mental health and reduced resources may in turn prompt changes in lifestyle and diet during and after crises (Foscolou et al., 2017; Yoshimura et al., 2016). In December 2019 reports emerged of a potential crisis, a novel coronavirus in Wuhan, China (World Health Organisation, 2020a, 2020b). By March 11th, 2020 the disease had spread to 114 countries, and was considered a pandemic (World Health Organisation, 2020a, 2020b).

The nature of the disease, including the method of transmission, prompted many regional or country-wide "lockdowns", which manifested differently in each location. Germany entered an initial lockdown period from the middle of March 2020 to May 3rd 2020. During this time, shops, pubs, theatres, schools, and universities started closing down and residents were encouraged not to meet with those outside of their household (Bundesregierung, 2020; Koch Institut, 2020; Koch Institute, 2020). The coronavirus pandemic and lockdown response has caused job losses throughout Europe (Eurostat, 2020), as well as reports of stress, especially in students, females, healthcare workers, and those reporting high engagement with coronavirus related news (Huang & Zhao, 2020; Traunmüller et al., 2020; Xiong et al., 2020). This could be due to fear of infection, uncertainty, or lockdown induced loneliness, in

fact, reasons likely vary for each group.

Research conducted so far into lifestyle changes during lockdowns has occurred in multiple countries with diverse samples (Ammar et al., 2020). Both favourable and unfavourable changes in dietary habits were found, such as increases in meal consumption frequency, and sweet and savoury snack consumption on the one hand, as well as more home cooking and a higher consumption of fresh products on the other hand (Ammar et al., 2020; (2019) Deutschland, 2019; International Food Information Council, 2020; Bracale & Vaccaro, 2020; Di Renzo et al., 2020; Bennett et al., 2021; Neira et al., 2021). Interestingly, alcohol consumption and physical activity seem to have increased in some countries, and decreased in others (Ammar et al., 2020; EIT Food, 2020; Gallo et al., 2020). The differing findings may reflect the strength of restrictions or the impact of the virus in each location, as well as socioeconomic status, cultural differences or other characteristics of the population groups investigated.

Weight changes during lockdown have also been demonstrated in several studies (Scarmozzino & Visioli, 2020; Sidor & Rzymiski, 2020; Zachary et al., 2020). Added stress related to coronavirus has led to weight changes observed in nursing students (Özden & ParlakKiliç, 2021). Stress may be one reason for weight gain during lockdown, as well as changes in the types of foods eaten, or snacking (Scarmozzino & Visioli, 2020; Zachary et al., 2020). Individual factors for instance overweight, obesity, and older age also play a role (Kriaucioniene et al.,

^{*} Corresponding author. Institute of Nutritional Medicine, University of Hohenheim, Fruwirthstr. 12, 70593, Stuttgart, Germany.

E-mail address: n.stroebele@uni-hohenheim.de (N. Stroebele-Benschop).

2020; Sidor & Rzymiski, 2020).

While the coronavirus pandemic has affected everybody, the study focuses on students because they usually enter a critical period in life while transitioning from high school to university. In their first years, students are commonly exposed to a variety of new experiences that may influence their health behaviour and body weight, such as changes in the living environment, eating habits, physical activity, financial responsibility and academic stress levels (Ferrara, 2009). Students have also been affected by the lockdown period through fundamental changes in teaching with online-only formats, leading to worries about adapting to new methods (Radu et al., 2020). In addition, less socialisation, including gym closures and prohibited group sports, as well as student's living conditions, may also contribute to lockdown stress (Elmer et al., 2020; Husky et al., 2020).

Generally, students' eating behaviour seems particularly vulnerable to weight fluctuations and inappropriate dieting behaviours. Recent studies in student populations revealed increased rates of binge eating, dietary restriction, and problematic use of alcohol during the lockdown period (Flaudias et al., 2020, 2021). Indeed, risk of disordered eating, low financial security and increased stress may mean that students are particularly vulnerable to weight, lifestyle, and behaviour changes during the lockdown and pandemic (MacNeil et al., 2012; Tavolacci et al., 2015; Volpe et al., 2016). However, the consequences of the pandemic and ensuing lockdowns on the situational differences and probable lack of important life experiences for students can only be speculated.

To further investigate the influence of a large range of factors, such as changes in food choices, lifestyle, risk and protective behaviour, worries, living conditions, and social demographics on body weight change during the first Covid-19 lockdown among students, the current exploratory study conducted a cross-sectional survey among students of a university in Germany. Thus, based on the above-mentioned literature, it was hypothesized that unfavourable changes in eating habits and food choices, as well as physical activity behaviours, would lead to body weight changes. In addition, alcohol consumption changes and increased worries were expected to also be associated with body weight changes.

2. Methods

2.1. Measures

The online survey contained 37 questions on personal information including study program, age group, body weight and height, sex, sleep quality before, during and after lockdown (5-point Likert scale, very good - very bad), changes in housing and job situation, eating behaviour, alcohol consumption, physical activity, and smoking, and was adapted using several existing questionnaires (Buisse et al., 1989; Sidor & Rzymiski, 2020; Termorshuizen et al., 2020). Furthermore, participants were asked several questions about their worries concerning the pandemic, whether they perceived any positive effects of the pandemic or lockdown, whether they were infected with coronavirus or knew someone who was, and whether they quarantined compulsorily or voluntarily. In addition to self-reported weight, students were also asked whether they have detected a change in their body weight since the beginning of the Coronavirus measures (mid-March) with the option to indicate the number of approximate kg that they had gained or lost. The lifestyle habits were assessed by a retrospective self-survey.

Questions regarding physical activity included two 7-point Likert scales asking about exercise and general physical activity during the lockdown compared to participants' usual routine (much more - unchanged - much less). For both alcohol consumption and smoking, the same 7-point Likert scales were used (more or less alcohol/smoking compared to their usual behaviour). To assess food choice behaviour a list of food items was created and participants were asked to indicate whether they consumed these foods more, less or the same amount

during the lockdown (7-point Likert scale). In addition, participants had the option to indicate that they did not consume a certain food type, or did not carry out a certain behaviour, which was recoded into "no change" during data preparation. A series of shopping behaviours and preparation techniques (cooking with fresh ingredients, trying out new recipes, preparing ready meals, ordering food delivery, stopping at a diner or fast food restaurant for takeout) were also listed using the same scale, allowing the participants to indicate which behaviours they engaged in, and to what extent when compared to the pre-lockdown period (more, less, or the same).

Finally, participants were asked about their worries regarding food availability and about their fear of infection during a grocery shopping trip (6-point Likert scales). Following Termorshuizen et al. a principal components factor analysis was conducted on the five items (6-point Likert scale; see supplementary materials) related to worries about COVID-19 infection or transmission (Termorshuizen et al., 2020). Components loaded onto one factor. A total 'worry score' was therefore created using the sum of the five questions (Cronbach's $\alpha = 0.74$). Using the same method, a score was created for three items about worries related to grocery shopping during the pandemic (Cronbach's $\alpha = 0.72$).

2.2. Procedure

The university administration invited 7317 students to take part in the survey via email. A total of 889 participants took part in the online survey (response rate 12.1%). Only data from participants that completed all mandatory questions was included in the data analyses. Furthermore, five more participants were excluded due to incongruent information, multiple irate text responses, or a temporary health condition that could cause weight, diet, and lifestyle changes during the lockdown. Finally, data from 827 participants was used for the analysis.

2.3. Statistical analysis

Data preparation and analysis was conducted in IBM SPSS Statistics 26. Perceived weight change data was recoded into one variable that indicated negative, positive, or no (=0) weight change in kg. Age was dichotomized into "18–23 years" and "24 years and older". Actual body mass index (BMI) after the lockdown was calculated by weight and height (kg/m^2) indicated by the participants. Using the self-reported weight change information, BMI before lockdown was calculated. BMI was classified using cut-offs by the World Health Organization (World Health Organisation, 2020a, 2020b).

Descriptive statistics were conducted. For categorical data, frequencies and percentages were determined, and for continuous data means and standard deviations were calculated. Multiple linear regression models predicting perceived weight changes during the lockdown were calculated using metric and dichotomous variables for consumption changes, changes in lifestyle, risk and protective factors, worries and living conditions, and social demographics. An initial model was calculated including all variables that might explain weight change during the lockdown. An optimized model was then calculated using backward elimination in regression.

3. Results

Three quarters (75.2%) of the sample were female and 56.1% were under 24 years of age; 15.2% were above normal weight at the time of the survey (Table 1). Over one third (35.2%) knew someone who had had a positive COVID-19 test, and 78.7% did not quarantine. About a third temporarily or permanently moved residence, and 22.9% experienced either job loss, or reduced work hours.

Half of the sample (50.7%) experienced no weight change, 27.5% gained weight, and 21.9% lost weight. Mean amount of weight lost was 3.7 ± 2.7 kg and mean weight gained was 3.1 ± 1.8 kg. Of the participants who were above normal BMI before lockdown, 71.2% changed

Table 1

Descriptions of the current sample and how they were affected by the pandemic, given in frequencies and percentages.

	Total (N = 827)	
	Frequency	%
Age (in years):		
18-20	134	16.2%
21-23	330	39.9%
24-26	248	30.0%
27-29	78	9.4%
30 und older	37	4.5%
Gender		
Male	205	24.8%
Female	622	75.2%
Nutritional status		
Underweight (BMI < 18.5)	51	6.3
Normal weight (18.5 ≤ BMI < 25.0)	632	78.5
Pre-obesity (25.0 ≤ BMI < 30.0)	99	12.3
Obesity (BMI > 30.0)	23	2.9
Weight change during lockdown		
Gained weight	226	27.5
No weight change	417	50.7
Lost weight	180	21.9
Positive Covid-19 test (self or other)	291	35.2%
Quarantined (compulsory or voluntary quarantine)	174	21.3%
Residence		
No change	528	63.8%
Permanently moved residence	47	5.7%
Temporarily moved residence	235	28.4%
Other	17	2.1%
Job changes		
No job	301	36.4%
No change	214	25.9%
Reduced hours or lost job	189	22.9%
Other e.g. gained new job	123	14.9%
Lifestyle behaviours (in the last six months)		
Smoked	126	15.3%
Drank alcohol	660	80.2%
Exercised	714	86.8%

weight (31.4% gained weight and 39.8% lost weight), of the participants with a BMI within the normal range 45.4% changed weight (of normal weight individuals 25.8% gained weight, and 19.6% lost weight). Being above normal BMI increased the odds of changing weight during lockdown by 2.97 times (95% CI: 1.93, 4.56).

Over half of the participants (N = 484, 58.8%) were personally impacted by the coronavirus pandemic in at least one of the following ways: were quarantined, knew someone who tested positive, were infected themselves, or experienced job loss or reduced work hours. The most common worry among the participants related to the coronavirus pandemic was regarding others being infected (4.28 ± 1.33 on a 6-point scale from 1 = 'not worried at all' to 6 = 'very worried'), followed by the potential impact on their own mental health (3.19 ± 1.61). None of the variables related to worries showed a significant influence on perceived weight change during the first lockdown in the initial or optimized regression model.

When asked about potential positive changes due to the pandemic, 17.4% of the participants reported no positive changes in their lives at all (=1 on a six-point scale); 82.6% reported at least some positive changes, but only 4.2% among them reported "many positive changes" (=6) as a result of the COVID-19 situation (mean = 3.24 ± 1.44).

3.1. Consumption changes

Many participants reported changes in the types of foods they ate (Fig. 1). For example, almost one quarter of the participants (22.3%) reported less frequent meat and sausage consumption, and almost a fifth reported less frequent frozen ready meals consumption (18.0%) during the lockdown. Inversely, increased consumption was reported for sweets and cakes by almost half of the participants (49.0%), and for coffee by a

third of the participants (32.2%).

Regression analysis showed that consumption changes in fruits, bread and bakery products, pasta products, meats and sausages, sweets and cakes and savoury snacks were associated with perceived weight change (Table 2). While an increased consumption of fruits and bread and bakery products during the lockdown was associated with weight reduction, increased consumption of pasta, meat and sausages, sweets and cakes as well as savoury snacks was associated with weight gain. Comparing regression coefficients for consumption changes, changes in sweets and cake consumption (B = 0.53, SE = 0.08) is the most substantial predictor for weight change. Other significant regression coefficients for consumption change variables range in absolute value from B = 0.16 (SE = 0.08) for meats and sausages to B = 0.27 (SE = 0.10) for pasta products.

3.2. Lifestyle changes

The most common reported increases in activities related to meal preparation were: trying new recipes or foods (64.9%), followed by cooking with fresh ingredients (56.7%) and ordering 'to go' food from a restaurant (41.4%; Fig. 1). Activities that participants engaged in less frequently included eating ready meals (24.9%), and ordering fast food 'to go' (24.2%). The only lifestyle change that was significantly associated with weight change is the change in cooking with fresh ingredients (B = 0.17, SE = 0.07; Table 2).

General physical activity increased in 37.2% of the sample, but decreased in 46.9% of the sample. Increased exercise was reported by 44.2% of the participants, and reduced exercise was reported by 27.2%. Average sleep quality was reported to be worse during lockdown (2.48 ± 2.00 , from 1 = 'very good' to 6 = 'very bad') compared to before (2.33 ± 2.00), and did not improve after lockdown (2.54 ± 2.00).

Protective factors such as doing sport or general physical activity, and risk factors such as smoking and drinking alcohol, are predictive for weight change, while the change in sleep quality seemed to have no impact on weight change. While an increased amount of sport (B = -0.20, SE = 0.05), physical activity (B = -0.15, SE = 0.05) and smoking (B = -0.46, SE = 0.12) were associated with weight loss, drinking more alcohol was associated with weight gain (B = 0.24, SE = 0.06). Across all risk and protective factors, smoking showed the strongest association with weight change.

Finally, we also controlled for some essential sociodemographic data. The regression analysis shows that neither age, gender, nor living arrangement or job situation were significantly associated with perceived weight change. Only initial weight before lockdown helped to explain the change in weight during lockdown. The higher the BMI before lockdown, the larger the weight loss during the lockdown (B = -0.14, SE = 0.03).

4. Discussion

The current study contributes to the growing body of research on the compounding consequences of the coronavirus health crisis on lifestyle behaviours and weight change. These findings show that students in Germany were likely to experience both lifestyle changes and weight changes during the lockdown. Both body weight increases as well as decreases were reported. Factors related to perceived weight change appear to be mainly due to changes in behaviour. Comparing the standardized regression coefficients across all variables in the optimized model revealed that, of the food products consumed during lockdown, changes in sweets and cake consumption exhibited the largest association with weight change. In addition, besides changes in food consumption, risk and protective behaviours seem to be the most important contributors to weight changes. In our model, worries did not seem to be related to perceived weight changes.

Overall, food intake changed in the entire sample during the lockdown with less meat and sausage consumption and fewer ready meals.

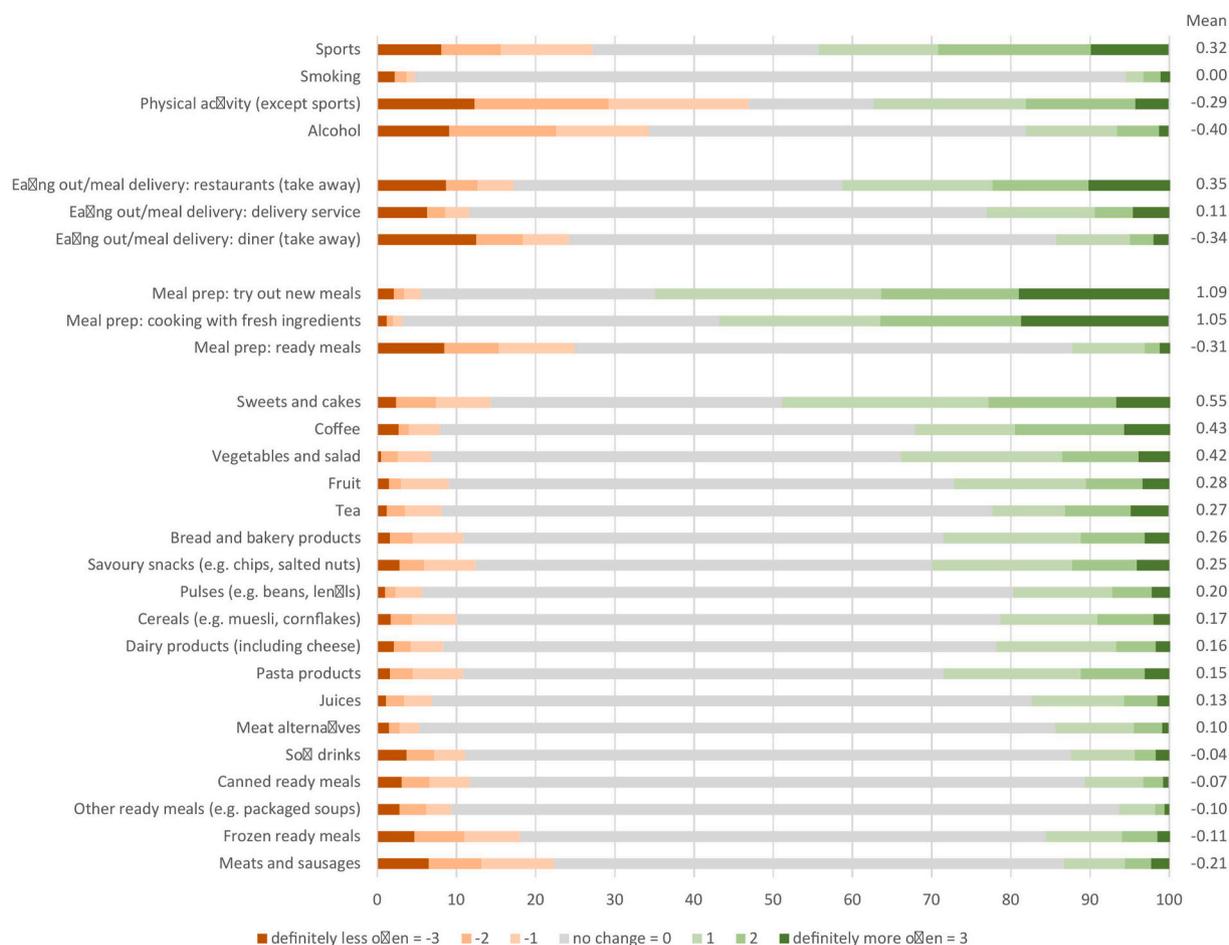


Fig. 1. Food consumption and lifestyle changes during the first COVID-19 lockdown in spring 2020, compared to before (in %; n = 827).

Previous surveys in Germany have confirmed the current findings of less meat consumption, and increased food preparation at home ((2019) Deutschland, 2019). This is also similar to some findings in other countries experiencing lockdown (EIT Food, 2020; Kriaucioniene et al., 2020). There are many possible positive reasons for changes in the types of foods eaten and how food is prepared, such as paying more attention to one’s health, or having more time and more awareness of the impact of one’s consumption on the environment. However, the observed reduction in meat consumption and increased cooking from home could also reflect a reduction in income, through possible loss of part-time jobs or familial financial support. As a matter of fact, over 20% of the participants reported personal job loss or hours lost. Consumption may also change due to concerns about food safety, or increased ease of cooking at home while studying at home. Another possible explanation could be the fact that people tend to consume meat more often outside of their home, in restaurants and canteens (Choi et al., 2011; Lachat et al., 2012). By having no option to do so, meat consumption might be reduced. A preliminary study conducted in April 2020 in Spain asked participants about their motivations for changes in food purchasing habits. Some products (pasta and pulses) were purchased more because they have a long shelf life, and others for their perceived health benefits (pulses, vegetables, citrus fruits) or to improve mood (cheese, chocolate, nuts). High price and difficulty finding foods were among the reasons why some items were not purchased, as were health concerns (Laguna et al., 2020). Similar research might be able to further explain motives behind consumption pattern changes during lockdown in Germany. However, it is outside the scope of this survey to determine the particular reasons for consuming more or less of certain food groups such as sweets and cakes.

An increase in the consumption of so called “comfort foods”, foods

which are often high in sugar and fat and eaten by people coping with stressful life events (also called emotional eaters), could be another explanation for the change in consumption patterns observed in the sample (Michels et al., 2012; van Strien & Ouwens, 2007). Recent research seems to indicate that emotional eaters reported eating more comfort foods during the coronavirus pandemic (Coulthard et al., 2021; Shen et al., 2020).

Not only do changes in consumption patterns seem to explain body weight changes, but behavioural risk factors such as smoking and alcohol consumption also appear to play a role in the reported weight changes among the students. While smoking is often used as a coping strategy against stress (Kassel et al., 2003; Slopen et al., 2012, 2013) or boredom, it is also known to reduce appetite and increase feelings of satiety (Chao et al., 2019), which might explain the negative association of smoking and weight change. Similarly, alcohol consumption has also been reported to be associated with stress and boredom (Cooper et al., 1995) but increased consumption is more often related to weight gain than weight loss (Coulson et al., 2013; Jequier, 1999). On the other hand, physical activity has been shown to be both related to stress release and weight loss (Fortier et al., 2020; Herren et al., 2021).

Taken together, BMI before the lockdown, and changes in food intake, cooking behaviour, and other health behaviours including physical activity, smoking and alcohol consumption, appear to be the main drivers of weight changes in students during the lockdown due to the coronavirus pandemic in spring 2020.

4.1. Limitations

Surveys are limited in terms of their ability to establish causal links,

Table 2

Linear regression model for all predictors (backward elimination, criterion: probability of F-to-remove ≥ 0.050); dependent variable is the weight change during Covid-19 lockdown in spring 2020.

		Initial model				Optimized model			
		<i>adj. R² = .230, F(41,747) = 6.743, p < .001</i>				<i>adj. R² = .241, F(12,776) = 21.867, p < .001</i>			
		B	SE	Beta	p	B	SE	Beta	P
Intercept		2.472	0.700	–	<0.001	2.866	0.611	–	<0.001
Consumption changes	Fruit	–0.216	0.116	–0.077	0.064	–0.267	0.096	–0.095	0.006
	Vegetables and salad	–0.047	0.115	–0.017	0.681	–	–	–	–
	Pulses (e.g. beans, lentils)	0.031	0.115	0.010	0.787	–	–	–	–
	Cereals (e.g. muesli, cornflakes)	–0.089	0.096	–0.031	0.352	–	–	–	–
	Bread and bakery products	–0.213	0.097	–0.080	0.027	–0.211	0.092	–0.079	0.022
	Pasta products	0.269	0.102	0.097	0.009	0.268	0.096	0.097	0.005
	Meats and sausages	0.192	0.080	0.082	0.016	0.158	0.075	0.068	0.036
	Meat alternatives	–0.037	0.124	–0.010	0.767	–	–	–	–
	Dairy products (including cheese)	–0.074	0.102	–0.025	0.467	–	–	–	–
	Sweets and cakes	0.501	0.081	0.244	<0.001	0.529	0.077	0.257	<0.001
	Savoury snacks (e.g. chips, salted nuts)	0.186	0.094	0.078	0.047	0.209	0.088	0.087	0.018
	Coffee	0.099	0.075	0.043	0.190	–	–	–	–
	Tea	0.019	0.086	0.007	0.825	–	–	–	–
	Juices	–0.053	0.117	–0.016	0.651	–	–	–	–
	Soft drinks	0.053	0.101	0.018	0.596	–	–	–	–
	Frozen ready meals	–0.003	0.114	–0.001	0.977	–	–	–	–
	Canned ready meals	–0.054	0.135	–0.017	0.688	–	–	–	–
	Other ready meals (e.g. packaged soups)	0.146	0.149	0.040	0.326	–	–	–	–
Lifestyle changes	Meal prep: cooking with fresh ingredients	0.192	0.088	0.093	0.030	0.166	0.068	0.080	0.015
	Meal prep: try out new meals	–0.031	0.084	–0.015	0.713	–	–	–	–
	Meal prep: ready meals	–0.055	0.100	–0.023	0.583	–	–	–	–
	Eating out/meal delivery: restaurants (take away)	–0.035	0.073	–0.020	0.631	–	–	–	–
	Eating out/meal delivery: delivery service	–0.072	0.091	–0.032	0.430	–	–	–	–
	Eating out/meal delivery: diner (take away)	0.114	0.081	0.056	0.157	–	–	–	–
Risk and protective factors	Sports	–0.207	0.056	–0.131	<0.001	–0.204	0.054	–0.128	<0.001
	Physical activity (except sports)	–0.142	0.054	–0.092	0.008	–0.146	0.052	–0.095	0.005
	Smoking	–0.467	0.125	–0.123	<0.001	–0.455	0.119	–0.120	<0.001
	Alcohol	0.221	0.066	0.11	0.001	0.242	0.063	0.120	<0.001
Worries and living conditions	Change in sleep quality	0.012	0.073	0.005	0.870	–	–	–	–
	Affected by the closure of the canteen	0.092	0.058	0.054	0.115	–	–	–	–
	Diet has been affected by the Corona crisis	0.085	0.084	0.039	0.310	–	–	–	–
	5-item-worry score	–0.029	0.107	–0.01	0.785	–	–	–	–
	3-item-worries at shopping	0.012	0.098	0.005	0.899	–	–	–	–
	Compulsory quarantine	–0.113	0.456	–0.008	0.805	–	–	–	–
	Voluntary quarantine	0.095	0.231	0.013	0.682	–	–	–	–
	Covid-19 infection (self or other)	–0.067	0.18	–0.012	0.709	–	–	–	–
	Lost job or reduced job hours	0.248	0.198	0.04	0.210	–	–	–	–
	Changes in housing situation	–0.048	0.186	–0.009	0.796	–	–	–	–
Social demographics	Gender (male)	–0.221	0.212	–0.036	0.297	–	–	–	–
	Age	–0.231	0.177	–0.043	0.192	–	–	–	–
	BMI before lockdown	–0.123	0.028	–0.143	<0.001	–0.136	0.027	–0.158	<0.001

and they rely on self-report, which is vulnerable to recall bias. Participants might not have been able to correctly judge or report their “normal” intake of certain food groups compared to the lockdown period. Furthermore, direct measures for food intake (e.g. 24-hour recall or food frequency questionnaires), physical activity (e.g. accelerometer or pedometer) or sleep (e.g. accelerometer) were not used in this study. The survey also did not ask about amounts or portions of food consumed but rather about the consumption frequency. Therefore, it is not possible to determine caloric intake or a comparison of caloric intake between before and during the lockdown. It is assumed that the consumption frequency is a good representation for actual intake and indirectly for the amounts of food consumed. Additionally, weight change was self-reported and research has shown that, although self-reported weight using recognised measurements is commonly used, perceptions of weight changes during lockdown are unreliable with participants overestimating weight gain (Keel et al., 2020). The current study asked participants to state their current weight in kilograms and then how much weight they lost or gained as they completed the weight change question, which relies on accurate recall of past weight. Recall of weight change in the past year in a very large US study found that participants

overestimated their weight loss (Wetmore & Mokdad, 2012). The measure used is therefore not validated but, due to the pandemic, direct measurement of height and weight by a researcher was unfeasible.

This study only investigated full-time students to gain better knowledge on how the lockdown affected this group. Students in Germany are unlikely to suffer from extreme economic hardship during the lockdown, and are generally a younger age group. Questions were not asked regarding either eating disorders, or health conditions that may predispose individuals to more severe coronavirus outcomes. It is possible that perceived risk plays a role in lifestyle changes and consumption patterns during lockdowns. Finally, measuring ‘worries’ about a novel virus is difficult, as a standardized tool does not exist and therefore questionnaires may not represent all causes of stress surrounding the virus for the population group.

At last, the response rate was very low which can be explained by several factors. The invitation to participate was only sent once by the university administration without further reminders or incentives for participation. Thus, the sample cannot be considered representative for German university students, not only because of the sample size, but also because of the relatively small number of students attending this

university (about 9000 students were enrolled in 2020), which offers only a small number of subjects with a focus on agricultural, natural, and economic sciences. Furthermore, females and students of natural sciences were overrepresented, and males and students of economic sciences were underrepresented compared to the university population.

4.2. Conclusions

Thus, the study results show an association of weight change with various changes in lifestyle and dietary behaviours during the first COVID-19 lockdown among students in Germany. The study highlights the importance of physical activity and exercise but also underlines how changes in the consumption of different food groups can impact body weight during a life changing time period. Given the continuous crisis due to COVID-19 and recurrent lockdowns in many countries globally (Margaritis et al., 2020), it might be time to deepen a specialized focus on the prevention of unhealthy behaviours that can cause weight changes during social isolation, particularly in young people. This would require encouraging physical activity while reducing smoking and alcohol consumption and advising on the intake of healthy foods, in a manner that can reach this educated population group and take into consideration their particular challenges. Students are a crucial population group for the future and their ability to cope with drastic life events without harming their health should be a high priority for health professionals and stake holders.

Acknowledgements

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.appet.2021.105638>.

Author contributions

KP and AB analysed the data, KP and NSB drafted the manuscript. All authors have approved of the final version of the manuscript.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability

The dataset generated during the current study is available from the corresponding author on reasonable request.

Ethical statement

The study obtained approval from the university administration including the data protection officer and the head of the ethics committee. Given the scientific approach and confirmed privacy rights of the participants, an ethics approval by the ethical committee was deemed as unnecessary. The survey was sent out by the university administration and included a box to cross if the students wanted to participate.

References

Ammar, A., Brach, M., Trabelsi, K., et al. (2020). Effects of COVID-19 home confinement on eating behaviour and physical Activity : Results of the ECLB-COVID19 international online survey. *Nutrients*, *6*, 1583. <https://doi.org/10.3390/nu12061583>

- Bennett, G., Young, E., Butler, I., et al. (2021). The impact of lockdown during the COVID-19 outbreak on dietary habits in various population groups: A scoping review. *Front. Nutr.*, *8*, 1–10. <https://doi.org/10.3389/fnut.2021.626432>
- BMEL. (2019). *Deutschland, wie es isst*. Der BMEL-Ernährungsreport. 2019.
- Bracale, R., & Vaccaro, C. M. (2020). Changes in food choice following restrictive measures due to Covid-19. *Nutrition, Metabolism, and Cardiovascular Diseases*, *30*, 1423–1426. <https://doi.org/10.1016/j.numecd.2020.05.027>
- Bundesregierung, Die (2020). Besprechung der Bundeskanzlerin mit den Regierungschefinnen und Regierungschefs der Länder. *Die Bundesregierung*. <https://www.bundesregierung.de/breg-de/themen/coronavirus/besprechung-der-bundeskanzlerin-mit-den-regierungschefinnen-und-regierungschefs-der-laender-1733248>. (Accessed December 2020) accessed.
- Byssse, D. J., Reynolds, C. F., Monk, T. H., et al. (1989). The pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research*, *28*, 193–213. [https://doi.org/10.1016/0165-1781\(89\)90047-4](https://doi.org/10.1016/0165-1781(89)90047-4)
- Chao, A. M., Wadden, T. A., Ashare, R. L., et al. (2019). Tobacco smoking, eating behaviors, and body weight: A review. *Curr. Addict. Reports*, *6*, 191–199. <https://doi.org/10.1007/s40429-019-00253-3>.Tobacco
- Choi, M. K., Kim, T. Y., & Yoon, J. S. (2011). Does frequent eating out cause undesirable food choices? Association of food away from home with food consumption frequencies and obesity among Korean housewives. *Ecology of Food and Nutrition*, *50*, 263–280. <https://doi.org/10.1080/03670244.2011.568909>
- Cooper, M. L., Frone, M. R., Russell, M., et al. (1995). Drinking to regulate positive and negative emotions: A motivational model of alcohol use. *Journal of Personality and Social Psychology*, *69*, 990–1005. <https://doi.org/10.1037//0022-3514.69.5.990>. American Psychological Association (APA).
- Coulson, C. E., Williams, L. J., Brennan, S. L., et al. (2013). Alcohol consumption and body composition in a population-based sample of elderly Australian men. *Aging Clinical and Experimental Research*, *25*, 183–192. <https://doi.org/10.1007/s40520-013-0026-9>
- Coulthard, H., Sharps, M., Cunliffe, L., et al. (2021). *Eating in the lockdown during the Covid 19 pandemic; self-reported changes in eating behaviour, and associations with BMI, eating style, coping and health anxiety*. *Appetite* *161*. Elsevier Ltd. <https://doi.org/10.1016/j.appet.2020.105082>.
- Di Renzo, L., Gualtieri, P., Cinelli, G., et al. (2020). Psychological aspects and eating habits during COVID-19 home confinement: Results of EHL-COVID-19 Italian online survey. *Nutrients*, *12*, 2152. <https://doi.org/10.3390/nu12072152>
- EIT Food. (2020). *COVID-19 impact on consumer food behaviours in Europe*.
- Elmer, T., Mepham, K., & Stadtfeld, C. (2020). Students under lockdown: Comparisons of students' social networks and mental health before and during the COVID-19 crisis in Switzerland. *PLoS One*, *15*, Article e0236337. <https://doi.org/10.1371/journal.pone.0236337>
- Eurostat. (2020). GDP down by 12.1% and employment down by 2.8% in the euro area. *ec.europa.eu/eurostat*, 1–4. <https://ec.europa.eu/eurostat/documents/2995521/10545332/2-14082020-AP-EN.pdf/7f30c3cf-b2c9-98ad-3451-17fed0230b57>. (Accessed December 2020) accessed.
- Ferrara, C. M. (2009). The college experience: Physical activity, nutrition, and implications for intervention and future research. *J. Exerc. Physiol. Online*, *23–35*.
- Flaudias, V., Iceta, S., Zerhouni, O., et al. (2020). COVID-19 pandemic lockdown and problematic eating behaviors in a student population. *J. Behav. Addict.*, *9*, 826–835. <https://doi.org/10.1556/2006.2020.00053>
- Flaudias, V., Zerhouni, O., Pereira, B., et al. (2021). The early impact of the COVID-19 lockdown on stress and addictive behaviors in an alcohol-consuming student population in France. *Frontiers in Psychiatry*, *12*, 1–13. <https://doi.org/10.3389/fpsy.2021.628631>
- Fortier, M., McFadden, T., & Faulkner, G. (2020). Evidence-based recommendations to assist adults with depression to become lifelong movers. *Heal. Promot. Chronic Dis. Prev. Canada*, *40*, 299–308. <https://doi.org/10.24095/hpcdp.40.10.01>
- Foscolou, A., Tyrovolas, S., Souliis, G., et al. (2017). The impact of the financial crisis on lifestyle health determinants among older adults living in the mediterranean region: The multinational MEDIS Study (2005-2015). *J. Prev. Med. Public Heal.*, *50*, 1–9. <https://doi.org/10.3961/jpmph.16.101>
- Gallo, L. A., Gallo, T. F., Young, S. L., et al. (2020). The impact of isolation measures due to covid-19 on energy intake and physical activity levels in australian university students. *Nutrients*, *12*, 1865. <https://doi.org/10.3390/nu12061865>
- Herren, O. M., Agurs-Collins, T., Dwyer, L. A., et al. (2021). Emotion suppression, coping strategies, dietary patterns, and BMI. *Eating Behaviors*, *41*, 101500. <https://doi.org/10.1016/j.eatbeh.2021.101500>. Elsevier Ltd.
- Huang, Y., & Zhao, N. (2020). Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: A web-based cross-sectional survey. *Psychiatry Research*, *288*, 112954. <https://doi.org/10.1016/j.psychres.2020.112954>
- Husky, M. M., Kovess-Masfety, V., & Swendsen, J. D. (2020). Stress and anxiety among university students in France during Covid-19 mandatory confinement. *Comprehensive Psychiatry*, *102*. <https://doi.org/10.1016/j.comppsy.2020.152191>. W.B. Saunders.
- International Food Information Council. (2020). COVID-19: Impact on food purchasing, eating behaviors, and perceptions of food safety. [foodinsight.org](https://www.foodinsight.org).
- Jequier, E. (1999). Alcohol intake and body weight: A paradox. *American Journal of Clinical Nutrition*, *173–174*. <https://doi.org/10.1093/ajcn/69.2.173>
- Kassel, J. D., Stroud, L. R., & Paronis, C. A. (2003). Smoking, stress, and negative affect: Correlation, causation, and context across stages of smoking. *Psychological Bulletin*, *129*, 270–304. <https://doi.org/10.1037/0033-2909.129.2.270>
- Keel, P. K., Gomez, M. M., Harris, L., et al. (2020). Gaining “The Quarantine 15:” Perceived versus observed weight changes in college students in the wake of COVID-

19. *International Journal of Eating Disorders*, 53, 1801–1808. <https://doi.org/10.1002/eat.23375>. John Wiley and Sons Inc.
- Koch Institut, Robert (2020). *Täglicher Lagebericht des RKI zur Coronavirus-Krankheit-2019 (COVID-19): 14.03.2020 - Aktualisierter Stand für Deutschland*.
- Koch Institute, Robert (2020). Health situation of the German population at the beginning of the COVID-19 pandemic. *J. Heal. Monit.*, 5, 1–31. <https://doi.org/10.25646/7172>
- Kriauciuniene, V., Bagdonaviciene, L., Rodríguez-Pérez, C., et al. (2020). Associations between changes in health behaviours and body weight during the COVID-19 quarantine in Lithuania: The Lithuanian COVIDiet study. *Nutrients*, 12, 1–9. <https://doi.org/10.3390/nu12103119>
- Lachat, C., Nago, E., Verstraeten, R., et al. (2012). Eating out of home and its association with dietary intake: A systematic review of the evidence. *Obesity Reviews*, 13, 329–346. <https://doi.org/10.1111/j.1467-789X.2011.00953.x>
- Laguna, L., Fiszman, S., Puerta, P., et al. (2020). The impact of COVID-19 lockdown on food priorities. Results from a preliminary study using social media and an online survey with Spanish consumers. *Food Quality and Preference*, 86. <https://doi.org/10.1016/j.foodqual.2020.104028>
- MacNeil, L., Esposito-Smythers, C., Mehlenbeck, R., et al. (2012). The effects of avoidance coping and coping self-efficacy on eating disorder attitudes and behaviors: A stress-diathesis model. *Eating Behaviors*, 13, 293–296. <https://doi.org/10.1016/j.eatbeh.2012.06.005>
- Margaritis, I., Houdart, S., El Ouadrhiri, Y., et al. (2020). How to deal with COVID-19 epidemic-related lockdown physical inactivity and sedentary increase in youth? Adaptation of anses' benchmarks. *Archives of Public Health*, 78, 52. <https://doi.org/10.1186/s13690-020-00432-z>
- Michels, N., Sioen, I., Braet, C., et al. (2012). Stress, emotional eating behaviour and dietary patterns in children. *Appetite*, 59, 762–769. <https://doi.org/10.1016/j.appet.2012.08.010>. Elsevier Ltd.
- Mucci, N., Giorgi, G., Roncaioli, M., et al. (2016). The correlation between stress and economic crisis: A systematic review. *Neuropsychiatric Disease and Treatment*, 12, 983–993. <https://doi.org/10.2147/NDT.S98525>
- Neira, C., Godinho, R., Rincón, F., et al. (2021). Consequences of the covid-19 syndemic for nutritional health: A systematic review. *Nutrients*, 13, 1–13. <https://doi.org/10.3390/nu13041168>
- Özden, G., & Parlar Kiliç, S. (2021). The effect of social isolation during COVID-19 pandemic on nutrition and exercise behaviors of nursing students. *Ecology of Food and Nutrition*, 1–19. <https://doi.org/10.1080/03670244.2021.1875456>. Bellwether Publishing, Ltd.
- Radu, M. C., Schnakovszky, C., Herghelegiu, E., et al. (2020). The impact of the COVID-19 pandemic on the quality of educational process: A student survey. *International Journal of Environmental Research and Public Health*, 17, 1–15. <https://doi.org/10.3390/ijerph17217770>
- Scarmozzino, F., & Visioli, F. (2020). Covid-19 and the subsequent lockdown modified dietary habits of almost half the population in an Italian sample. *Foods*, 9, 675. <https://doi.org/10.3390/foods9050675>
- Shen, W., Long, L. M., Shih, C. H., et al. (2020). A humanities-based explanation for the effects of emotional eating and perceived stress on food choice motives during the COVID-19 pandemic. *Nutrients*, 12, 1–18. <https://doi.org/10.3390/nu12092712>
- Sidor, A., & Rzymiski, P. (2020). Dietary choices and habits during COVID-19 lockdown: Experience from Poland. *Nutrients*, 12, 1–13. <https://doi.org/10.3390/nu12061657>
- Slopen, N., Dutra, L. M., Williams, D. R., et al. (2012). Psychosocial stressors and cigarette smoking among African American adults in midlife. *Nicotine & Tobacco Research*, 14, 1161–1169. <https://doi.org/10.1093/ntr/nts011>
- Slopen, N., Kontos, E. Z., Ryff, C. D., et al. (2013). Psychosocial stress and cigarette smoking persistence, cessation, and relapse over 9–10 years: A prospective study of middle-aged adults in the United States. *Cancer Causes & Control*, 24, 1849–1863. <https://doi.org/10.1007/s10552-013-0262-5>
- van Strien, T., & Ouwens, M. A. (2007). Effects of distress, alexithymia and impulsivity on eating. *Eating Behaviors*, 8, 251–257. <https://doi.org/10.1016/j.eatbeh.2006.06.004>
- Tavolacci, M. P., Grigioni, S., Richard, L., et al. (2015). Eating disorders and associated health risks among university students. *Journal of Nutrition Education and Behavior*, 47, 412–420. <https://doi.org/10.1016/j.jneb.2015.06.009>. e1. Elsevier Inc.
- Termorshuizen, J. D., Watson, H. J., Thornton, L. M., et al. (2020). Early impact of COVID-19 on individuals with self-reported eating disorders: A survey of ~1,000 individuals in the United States and The Netherlands. *International Journal of Eating Disorders*, 1–11. <https://doi.org/10.1002/eat.23353>
- Thompson, R. R., Garfin, D. R., Holman, E. A., et al. (2017). Distress, worry, and functioning following a global health crisis: A national study of Americans' responses to ebola. *Clin. Psychol. Sci.*, 5, 513–521. <https://doi.org/10.1177/2167702617692030>
- Traunmüller, C., Stefitz, R., Gaisbachgrabner, K., et al. (2020). Psychological correlates of COVID-19 pandemic in the Austrian population. *BMC Public Health*, 20, 1395. <https://doi.org/10.1186/s12889-020-09489-5>
- Udomratn, P. (2008). Mental health and the psychosocial consequences of natural disasters in Asia. *International Review of Psychiatry*, 20, 441–444. <https://doi.org/10.1080/09540260802397487>
- Volpe, U., Tortorella, A., Manchia, M., et al. (2016). Eating disorders: What age at onset? *Psychiatry Research*, 238, 225–227. <https://doi.org/10.1016/j.psychres.2016.02.048>. Elsevier Ireland Ltd.
- Wetmore, C. M., & Mokdad, A. H. (2012). In denial: Misperceptions of weight change among adults in the United States. *Preventive Medicine*, 55, 93–100. <https://doi.org/10.1016/j.ypmed.2012.04.019>
- World Health Organisation. (2020a). Origin of SARS-CoV-2, 26 March 2020. *World Heal. Organ.*, 1–2. [https://doi.org/10.1016/S1473-3099\(20\)30641-1](https://doi.org/10.1016/S1473-3099(20)30641-1)
- World Health Organisation. (2020b). *WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020*. WHO Dir. Gen. speeches <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19--11-march-2020>. (Accessed December 2020)
- World Health Organization. (2020). Obesity and overweight. *who.int*, 1. https://doi.org/10.1007/978-1-4419-1695-2_447. <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>. (Accessed December 2020)
- Xiong, J., Lipsitz, O., Nasri, F., et al. (2020). Impact of COVID-19 pandemic on mental health in the general population: A systematic review. *Journal of Affective Disorders*, 277, 55–64. <https://doi.org/10.1016/j.jad.2020.08.001>
- Yoshimura, E., Ishikawa-Takata, K., Murakami, H., et al. (2016). Relationships between social factors and physical activity among elderly survivors of the great east Japan earthquake: A cross-sectional study. *BMC Geriatrics*, 16, 30. <https://doi.org/10.1186/s12877-016-0203-8>
- Zachary, Z., Brianna, F., Brianna, L., et al. (2020). Self-quarantine and weight gain related risk factors during the COVID-19 pandemic. *Obesity Research & Clinical Practice*, 14, 210–216. <https://doi.org/10.1016/j.orcp.2020.05.004>