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COVID-19, body weight and the neighbourhood: food system dimensions and consumption associated with changes in body weight of Peruvian adults during first wave lockdowns

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ABSTRACT

Objective The objective of this study is to assess changes in the dimensions of the food system and consumption associated with body weight variations during the first month's lockdown in Peruvian adults in Metropolitan Lima.

Methods A cross-sectional study conducted during the first months of lockdowns in Peru. 694 adults completed a web-based survey about changes experienced in the process of acquiring food during lockdown, changes in their intake and self-perceived body weight. A multinomial logistic regression analysis was conducted to evaluate the factors associated with changes in body weight.

Results Weight gain was perceived in 38% of the participants and 22.8% perceived weight loss. 39.2% did not perceive changes in their weight. Risk factors for body weight gain were increased alcohol consumption (OR=4.510, 95% CI 1.764 to 11.531) and decreased fruit consumption (OR=2.129, 95% CI 1.290 to 3.515), while decreasing cereal intake (OR=0.498, 95% CI 0.269 to 0.922) and choosing nutritious food as a driver for purchase (OR=0.512, 95% CI 0.320 to 0.821) were found to be protective against gaining weight. Decreasing food intake during the pandemic (OR=2.188, 95% CI 1.348 to 3.550) and having to miss important foods (OR=2.354, 95% CI 1.393 to 3.978), were associated with weight loss.

Conclusions During confinement, weight gain was mostly associated with food consumption and personal food system factors. Meanwhile, weight loss was associated with external food system factors.

Key messages

What is already known on this topic

⇒ This is the first study in Peru to address food system and consumption factors associated with body weight change in Peruvian adults in Metropolitan Lima during the first wave of the COVID-19 pandemic.

What this study adds

⇒ During the first wave of COVID-19 confinement, body weight change in Peruvian adults in Metropolitan Lima was found to be associated with external and personal food system and food consumption factors.

How this study may affect research, practice or policy

⇒ The results of this study will inform policy makers and programme designers to strengthen food systems and promote healthy eating habits among their population, in order to prevent excess and deficit malnutrition during this and similar events.

INTRODUCTION

The COVID-19 is an infectious disease caused by SARS-CoV-2, it is spread through human-to-human transmission mainly by droplets or aerosols. An infected person can manifest mild flu-like symptoms like fever, cough and fatigue. However, in severe and critical conditions, especially among people suffering from non-communicable diseases, it can cause multiple organ dysfunctions and a higher risk of death.[1] It was declared a pandemic by the WHO on 11 March 2020.[2] Ever since, it has caused the saturation of health systems worldwide and the disruption of all human activity, including daily food purchasing behaviours, vendors' availability, eating habits and income.

To reduce contagion,[3] most territories in the world implemented voluntary or

compulsory social distancing measures. In Peru, after confirming seven cases of COVID-19, the government declared a State of National Emergency on 1 6March 2020.[4–6] Strict borders closures; suspension of classes and non-essential work; and strict lockdown and curfews lasted until the end of June 2020 and remained moderately strict the following months.

During the first stages of the lockdown, street vendors, who constitute a great proportion of the local food trading in Peru,[7] were banned. Capacity limits were imposed in markets, grocery stores and corner shops, where long queues formed the first weeks. Some food providers were indefinitely closed. A few empty shelves were a sign of the coping mechanism adopted in response to the shortage threat.[8]

The pandemic has impacted the external domains of the food system, food prices and availability of foods, as well as the internal: accessibility, affordability, shelf life, convenience of the food product and desirability. It is not clear if these modifications to food acquisition and consumption practices could lead to deterioration of the nutritional status and health of populations and individuals.[9 10] There is evidence that the pandemic and social distancing have negative effects on mental health, stress[11] and physical activity[12] which, added to changes in food consumption,[13] could lead to weight changes.

In 2019, it was reported that 37.8% of the Peruvian adult population was overweight, 22.3% had obesity[14] and 75.8% did little physical activity. The factors associated with greater sedentary lifestyle were being obese, female, to live in an urban area or in the country's capital.[15] The convenience and ubiquity of ultra-processed foods could also contribute to the increase of overweight and obesity[11 16] and increase the risk for severe COVID-19 and higher mortality.[17]

Studies that assess weight variation during the COVID-19 pandemic are emerging. In Spain, 12.8% of adults that completed an online survey reported experiencing weight gain during confinement.[18] In Chile, 25.6% of men and 38.1% of women out of a sample of 700 volunteers reported perceiving an increase in their weight.[19]

In virtual surveys in France[20] and Zimbabwe,[21] 35% and 45.5% adults, respectively, reported an increase in their weight during compulsory social isolation. In Peru, only one study has explored the variation in body weight associated to eating habits and mental health during the pandemic. Authors found that out of 1031 respondents to an online survey, 38.9% reported an increase in their weight, while 29.3% reported having lost weight. Almost all bad habits and stressful scenarios were significantly associated with weight gain.[22]

In order to design policies and programmes that prevent food insecurity and malnutrition during the evolution of this pandemic, it is necessary to understand the effects of COVID-19 induced lockdown, given that this contention measures promote, either willingly or inadvertently changes in the food system and in the decisions that families make regarding their food consumption. In addition, understanding how these changes affect their health through increases in body weight can create a basis to better manage and understand the complexity of this topic for future similar events. Considering the scarce evidence in these subjects, the present study aims to assess the factors of the food system and consumption associated with the change in body weight in Peruvian adults from Metropolitan Lima after 108 days of mandatory confinement during the first wave of COVID-19 pandemic in Peru.

METHODS

Study design and participants

This cross-sectional observational study was carried out by a team of researchers and expert advisors in nutrition and public health using a web-based survey, which was available throughout from 1 to 26 June 2020, corresponding to weeks 12–16 and days 78–108 of the confinement in Peru. The inclusion criteria were to reside in the city of Lima; to be 18 years old or older; and to have access to internet, an electronic device such as smartphone, tablet or computer.

To determine the sample size, it was used a convenience sampling considering the population of Metropolitan Lima aged 18 years and over who reported using the internet service (6 112 087 people) during the first quarter of 2020, calculated from the database provided by the National Institute of Statistics and Informatics (INEI) through its National Household Survey (ENAHO). A confidence level of 95%, a variability of 50% and an estimation error of 4% were used to obtain the sample size of 694 participants.

Data collection and tools

Because of the circumstances of lockdown, specific population that could access to the web-based survey was considered for this study to avoid bias. Also, due to the design of the survey that considered required questions, there are no missing data found in this study.

The instrument was digitalised using the Google Forms tool. A pilot test was conducted within 30 participants to evaluate both the clarity of contents and responsiveness of the design. Dissemination was made through social networks such as Facebook, Instagram and WhatsApp groups and individuals based in Lima, and emails. A link to the multiple-choice, 26-question questionnaire was shared within a short greeting message briefly explaining the study.

Socioeconomic characteristics

The first group of questions assessed the place of residence, age, sex, educational level, change in household income before and during the pandemic, number of members of the home, access to drinking water and presence of comorbidities.

Self-perceived body weight

The scale of seven silhouettes of Montero, Morales and Carbajal was used to measure the participants perception of their body weight.[23] The male silhouette resembles a height of 1.75 m and weights of 55 kg, 67 kg, 77 kg, 83 kg, 92 kg, 107 kg and 122 kg. For the female figures, the height is 1.65 m and the weights are 50 kg, 60 kg, 68 kg, 74 kg, 82 kg, 95 kg and 109 kg. Participants were asked to select the silhouette that best represented them before and during this stage of confinement. The silhouettes were numbered from 1 to 7.

Food system

In the present study, we considered two dimensions of the food system: external domain and personal domain.

External domain: factors outside the individual that intervene for food choice or consumption in the context of the COVID-19 pandemic, which included: (A) food availability: we asked if in the previous week you noticed if the availability (supply) of 10 food groups had been reduced (yes/no), (B) the characteristics of the place of purchase: if it had order and cleanliness, little influx of people, affordable prices, offered a variety of foods and had adequate location (close to home), all with dichotomous responses yes/no, (C) characteristics of the food that motivated the purchase: being a nutritious food, fresh, having low risk of contamination, quick preparation, low in fat, good taste, easy to prepare, low/moderate amount of sugar and low/moderate amount of salt as multiple choice question and (D) geographic accessibility to the place of purchase: access on foot or access by vehicle.

Personal domain: individual-level factors influencing food consumption included were: (A) affordability of food: asked whether in the previous week, because of low purchasing power, they had to: eat less number of meals in the day, reduce the portion of meals, eat cheaper food or stop eating some important food, all with dichotomous answers yes/no; and (B) convenience: it was inquired if in the previous week he or she prepares for suitability more frequently the following preparations: fried foods, salads, desserts, nutritious and healthy preparations, all with dichotomous responses yes/no.

In this study, we considered two aspects of the food system: external and internal; the questions assessing the impact of the blockage on the external factors of the food system explored the availability of food during the previous week; the quality of the place of purchase that would make it attractive (store looks tidy, cleanliness, capacity compliance and variety of products); food prices; accessibility and characteristics of the food that motivated the purchase (nutritional value and whether fresh or canned); risk of contamination; abd how long the product lasts on the shelf. However, the questions on the domestic domain assessed food affordability and food restriction due to lack of resources.

Variation in food consumption

First, we assessed changes in consumption of food groups (section A), where we included three groups: vegetables, fruits and cereals, then preparations (section B) such as: bakery products (sponge cakes and cakes), canned food, bread/crackers, processed meats, snacks, sweets and instant foods. At last, beverages (section C) including sugary and alcoholic beverages were also assessed. For each of the categories, we asked about the increase, decrease or maintenance of consumption of these foods/drinks during the pandemic.

Finally, we assessed variations in the consumption of 20 food groups, whether traditional recipes or tasty fast food were preferred during confinement, if the types of preparation had changed and the motivation behind these changes.

Data analysis and processing

A descriptive analysis was performed on qualitative and quantitative variables. After verification of the normality of the data, a bivariate inferential analysis was performed using Pearson's χ^2). In the multivariate analysis, a multinomial logistic regression model was used, having the body weight variation as a dependent variable and the variables of the food system and significant consumption in the bivariate analysis as independent. The final model with raw and adjusted OR was selected by evaluating the goodness of fit indicators. A significance level of $p<0.05$ and 95% CIs were considered. Data analysis was performed using SPSS software (Statistical Package for the Social Sciences) V.25.

RESULTS

Descriptive statistics

In total, 696 people accessed the web-based survey but two of them refused the informed consent and could not participate in the study. Figure 1 summarises the participant enrolment and data availability in this study.

Most participants were female (71.8%), aged between 18 and 44 years old (75.6%); 15.0% of participants indicated that they had a comorbidity. A percentage of 41.5 of participants had higher education. A percentage of 45.2 shared their residency with three to four people. A percentage of 68.9 of the volunteers reported a decrease in income. In addition, the majority perceived that their weight had changed (60.8%), weight gain was perceived in 38% of the volunteers and 22.8% perceived weight loss. A percentage of 39.2% did not perceive changes in their weight (table 1). Of the total number of participants who perceived weight gain at the time of filling out the questionnaire, 5.7%, 16.3%, 64% and 14% had perceived that they were underweight, normal, overweight and obesity, respectively, before stage of confinement (see online supplemental table 1).

The changes in the food system affected factors in the external domain such as food availability, so the foods perceived as least available were fish and seafood (30.4%), fruits (24.2%) and vegetables (22.5%). The

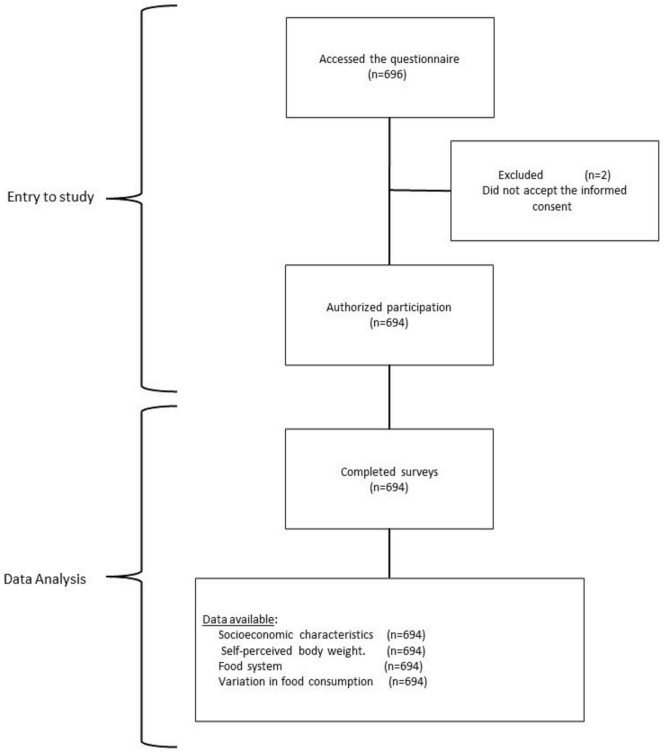

Figure 1 Participant enrolment and data available flow diagram.

characteristics of the place of purchase considered most important were order and cleanliness (71.6%), low influx of people (66.3%) and affordable prices (48.7%). The most important characteristics of the food that motivated the purchase were that the food be nutritious (80.8%), fresh (61.7%) and with low risk of contamination (55.6%). In terms of accessibility, 66.1% of the participants said they preferred vendors within walking distance and 27.8% had to use a vehicle. At the level of internal control, it was found that 10.5% could not afford to eat as many meals as they usually did, 18.6% had to eat less food, 16.3% had to switch to cheaper food alternatives and 21.3% had to stop eating important foods (see online supplemental table 2).

Variation in consumption during the lockdown were observed. An increase of the consumption of vegetables (39.6%), fruits (36.2%) and cereals (31.4%) were reported while the consumption of sweets (40.6%), snacks (39.8%), alcoholic beverages (39.3%), sugary drinks (38.5%) and processed meats (36%) decreased (see online supplemental figure 1).

Bivariate analysis

The bivariate analysis shows that only variation in household income, as a sociodemographic characteristic, was associated with variation in weight (table 2) (p=0.032), while the changes in food consumption associated with variation in perceived body weight were variation in the consumption of fruits (p<0.01), vegetables (p<0.01), processed meats (p=0.001), snacks (p=0, 004), cereals (p=0.000), pastries (p<0.01), sugar-sweetened beverages (p<0.01), canned foods (p=0.049), instant food (p=0.047), sweets (p<0.01), sliced bread/biscuits (p=0.002) and alcoholic beverages (p=0.010).

In the external domain level, the food system factors that were associated with weight changes were the following: less availability of food for fruits (p=0.048); food variety as an important characteristic of the place of purchase (p=0.043) and as important characteristics of the food, the nutritional value of the food (p<0.01), quick to spoil (p=0.027) and low or moderate in sugar (p<0.01). However, all the factors of the internal domain were associated with weight changes according to affordability or convenience conditions (table 3).

Table 1 Sociodemographic, economic characteristics, presence of comorbidities and perceived weight change

Variables	Category	N (%)
Sex	Woman	498 (71.8)
	Man	196 (28.2)
Age	18–44 years	525 (75.6)
	45–65 years	169 (24.4)
Educational level	Primary education	9 (1.3)
	Secondary education	150 (21.6)
	Higher technical education	97 (14.0)
	University higher education	288 (41.5)
	Postgraduate	150 (21.6)
Number of household members	1–2 members	229 (33.0)
	3–5 members	314 (45.2)
	More than five members	151 (21.8)
Change in household income	Less money than before	478 (68.9)
	No change	205 (29.5)
	More money than before	11 (1.6)
Number of illnesses suffered	0	574 (82.7)
	1	104 (15.0)
	More than 2	16 (2.3)
Perceived weight change (before and during the stage of confinement)	Lost weight	158 (22.8)
	Maintained weight	272 (39.2)
	Gained weight	264 (38.0)

Factors of the food system and consumption associated with weight variation in the multivariate analysis

Factors associated with weight loss

In the multivariate analysis, the food system factors associated with decreased body weight were consuming less

Table 2 Sociodemographic factors and changes in food consumption associated with change in body weight during the pandemic

Variables	Category	Lost weight n (%)	No change n (%)	Gained weight n (%)	P value†
Sociodemographics, economy and presence of comorbidities					
Age	18–44 years old	118 (74.7)	201 (73.9)	206 (78)	0.653
	45–60 years old	22 (13.9)	44 (16.2)	38 (14.4)	
	Over 60 years old	18 (11.4)	27 (9.9)	20 (7.6)	
Gender	Female	110 (69.6)	199 (73.2)	189 (71.6)	0.732
	Male	48 (30.4)	73 (26.8)	75 (28.4)	
Education level	Primary education	2 (1.3)	4 (1.5)	3 (1.1)	0.518
	Secondary education	36 (22.8)	52 (19.1)	62 (23.5)	
	Higher technical education	17 (10.8)	35 (12.9)	45 (17)	
	University higher education	71 (44.9)	120 (44.1)	97 (36.7)	
	Postgraduate	32 (20.3)	61 (22.4)	57 (21.6)	
Number of household members	1–2 members	46 (29.1)	98 (36)	85 (32.2)	0.242
	3–5 members	82 (51.9)	110 (40.4)	122 (46.2)	
	More than five members	30 (19)	64 (23.5)	57 (21.6)	
Household income	Less money than before	115 (72.8)	181 (66.5)	182 (68.9)	0.032
	No changes	37 (23.4)	87 (32)	81 (30.7)	
	More money than before	6 (3.8)	4 (1.5)	1 (0.4)	
Comorbidity (number of diseases)	0	126 (79.7)	238 (87.5)	210 (79.5)	0.097
	1	29 (18.4)	29 (10.7)	46 (17.4)	
	2	3 (1.9)	5 (1.8)	8 (3)	
Change in food consumption before and during the pandemic					
Fruit consumption	No change	54 (34.2)	123 (45.2)	87 (33)	0.000**
	Less	39 (24.7)	48 (17.6)	92 (34.8)	
	More	65 (41.1)	101 (37.1)	85 (32.2)	
Consumption of vegetables	No change	57 (36.1)	124 (45.6)	101 (38.3)	0.005**
	Less	29 (18.4)	39 (14.3)	69 (26.1)	
	More	72 (45.6)	109 (40.1)	94 (35.6)	
Consumption of processed meats	No change	87 (55.1)	147 (54)	133 (50.4)	0.008**
	Less	63 (39.9)	99 (36.4)	88 (33.3)	
	More	8 (5.1)	26 (9.6)	43 (16.3)	
Consumption of snacks	No change	81 (51.3)	149 (54.8)	123 (46.6)	0.004**
	Less	66 (41.8)	108 (39.7)	102 (38.6)	
	More	11 (7)	15 (5.5)	39 (14.8)	
Consumption of cereals	No change	78 (49.4)	164 (60.3)	133 (50.4)	0.000**
	Less	35 (22.2)	43 (15.8)	23 (8.7)	
	More	45 (28.5)	65 (23.9)	108 (40.9)	
Consumption of bakery products	No change	61 (38.6)	117 (43)	89 (33.7)	0.000**
	Less	61 (38.6)	92 (33.8)	62 (23.5)	
	More	36 (22.8)	63 (23.2)	113 (42.8)	
Consumption of sweetened beverages	No change	83 (52.5)	159 (58.5)	139 (52.7)	0.000**
	Less	72 (45.6)	101 (37.1)	94 (35.6)	
	More	3 (1.9)	12 (4.4)	31 (11.7)	

Continued

Table 2 Continued

Variables	Category	Lost weight n (%)	No change n (%)	Gained weight n (%)	P value†
Consumption of canned foods	No change	69 (43.7)	157 (57.7)	131 (49.6)	0.049
	Less	40 (25.3)	47 (17.3)	51 (19.3)	
	More	49 (31)	68 (25)	82 (31.1)	
Consumption of instant foods	No change	100 (63.3)	181 (66.5)	156 (59.1)	0.047
	Less	51 (32.3)	76 (27.9)	79 (29.9)	
	More	7 (4.4)	15 (5.5)	29 (11)	
Consumption of candy	No change	70 (44.3)	140 (51.5)	111 (42)	0.000**
	Less	76 (48.1)	107 (39.3)	99 (37.5)	
	More	12 (7.6)	25 (9.2)	54 (20.5)	
Consumption of sliced bread and crackers	No change	78 (49.4)	140 (51.5)	111 (42)	0.002**
	Less	51 (32.3)	81 (29.8)	68 (25.8)	
	More	29 (18.4)	51 (18.8)	85 (32.2)	
Consumption of alcoholic beverages	No change	90 (57)	160 (58.8)	134 (50.8)	0.010
	Less	62 (39.2)	105 (38.6)	106 (40.2)	
	More	6 (3.8)	7 (2.6)	24 (9.1)	

*Significant at the 0.05 level. **Significant at the 0.01 level.
†χ^2 test of independence.

food (OR=2.18; 95% CI 1348 to 3550) and missing a major meal (OR=2.35; 95% CI 1.393 to 3.978).

Factors associated with weight gain

The risk factors for weight gain were lower fruit consumption (OR=2.129; 95% CI 1.290 to 3.515) and higher alcohol consumption (OR=4.510; 95% CI 1.764 to 11.531). While the protective factors against weight gain were preferring nutritious foods to buy (OR=0.512; 95% CI 0.320 to 0.821) and low consumption of cereals (OR=0.498; 95% CI 0.269 to 0.922) (table 4).

DISCUSSION

The results of the study show that 60% of the participants perceived changes in their body weight, 38% reported weight gain, and the consumption factors associated with the risk of weight gain were lower consumption of fruit and higher consumption of alcohol, while at the food system level, the following factors that stood out as protectors were choosing nutritious foods and lower intake of cereals. However, at the level of the food system, the reduction in self-perceived body weight had as risk factors the reduction of the amount of food and not consuming any important food.

The perceived weight increase found in the study (38%) is consistent with most studies in countries such as Spain, Chile, France, Zimbabwe, Italy and Poland that have reported changes in weight in the adult population due to confinement and the COVID-19 pandemic.[15 17–20 23] Studies in Peru, Zimbabwe and France also reported weight loss of 29.3%–31.2% and 23.0%, respectively, similar trends to those found in the present study.[20–22]

The most important risk factor associated with weight gain was increased alcohol consumption. A similar trend was found in a study in France and Poland, where alcohol consumption was notably increased during the lockdown.[20 24] It is worth nothing that according to the evidence, alcohol consumption is positively associated with weight gain; hence, heavy drinkers may experience such an effect more commonly than light drinkers.[25] Another risk factor for weight gain was decreased consumption of fruits. Other data have previously shown that increased consumption of fruits did not lead to an increase in weight gain; this relationship has multiple factors involved and should be better addressed in future studies.[26 27]

In the present study, a decrease in cereal consumption during confinement was found to be a protective factor, reducing the risk of weight gain by 51%. The role of cereals for weight gain becomes important in Peru where the consumption of white rice is estimated at 50 kg/year per person.[28] Some studies such as that of Pellegrini *et al*[16] in Italy report that increased cereal consumption correlated with significantly higher weight gain during confinement as well as that of Sawada *et al*[29] in Japan where they found that high rice consumption was associated with a higher risk of body weight gain.

Another protective factor against weight gain found in the study was choosing nutritious foods as a purchase driver. A longitudinal study in France reported that people who lost weight reported having stopped eating a food to

Table 3 Food system factors associated with change in body weight during the pandemic

Variables	Category	Lost weight n (%)	No change n (%)	Gained weight n (%)	P value†
External domain					
Reduced food availability					
Fish and seafood	Yes	77 (29.2)	80 (29.4)	54 (34.2)	0.501
	No	187 (70.8)	192 (70.6)	104 (65.8)	
Poultry meat	Yes	11 (4.2)	7 (2.6)	8 (5.1)	0.382
	No	253 (95.8)	265 (97.4)	150 (94.9)	
Eggs	Yes	9 (3.4)	5 (1.8)	7 (4.4)	0.286
	No	255 (96.6)	267 (98.2)	151 (95.6)	
Dairy	Yes	16 (6.1)	22 (8.1)	14 (8.9)	0.51
	No	248 (93.9)	250 (91.9)	144 (91.1)	
Cereals	Yes	11 (4.2)	11 (4.0)	10 (6.3)	0.502
	No	253 (95.8)	261 (96.0)	148 (93.7)	
Legumes and vegetables	Yes	22 (8.3)	26 (9.6)	16 (10.1)	0.802
	No	242 (91.7)	246 (90.4)	142 (89.9)	
Fruits	Yes	77 (29.2)	55 (20.2)	36 (22.8)	0.048*
	No	187 (70.8)	217 (79.8)	122 (77.2)	
Vegetables	Yes	66 (25.0)	54 (19.9)	36 (22.8)	0.359
	No	198 (75.0)	218 (80.1)	122 (77.2)	
Tubers	Yes	8 (3.0)	7 (2.6)	3 (1.9)	0.778
	No	256 (97.0)	155 (98.1)	155 (98.1)	
Processed foods	Yes	24 (9.1)	14 (5.1)	13 (8.2)	0.193
	No	240 (90.9)	258 (94.9)	145 (91.8)	
Important feature of the place of purchase					
Order and cleanliness	Yes	115 (72.8)	191 (70.2)	191 (72.3)	0.804
	No	43 (27.2)	81 (29.8)	73 (27.7)	
Low influx of people	Yes	106 (67.1)	178 (65.4)	176 (66.7)	0.928
	No	176 (66.7)	94 (34.6)	88 (33.3)	
Affordable prices	Yes	82 (51.9)	117 (43.0)	139 (52.7)	0.055
	No	76 (48.1)	155 (57.0)	125 (47.3)	
Variety of food	Yes	70 (44.3)	111 (40.8)	87 (33.0)	0.043*
	No	88 (55.7)	161 (59.2)	177 (67.0)	
Good location	Yes	27 (17.1)	37 (13.6)	28 (10.6)	0.161
	No	131 (82.9)	235 (86.4)	236 (89.4)	
Important food characteristic					
Nutritious	Yes	135 (85.4)	233 (85.7)	193 (73.1)	0.000**
	No	23 (14.6)	39 (14.3)	71 (26.9)	
Fresh	Yes	93 (58.9)	171 (62.9)	164 (62.1)	0.699
	No	65 (41.1)	101 (37.1)	100 (37.9)	
Low risk of contamination	Yes	84 (53.2)	142 (52.2)	160 (60.6)	0.115
	No	74 (46.8)	130 (47.8)	104 (39.4)	
Quick to spoil	Yes	61 (38.6)	82 (30.1)	108 (40.9)	0.027*
	No	97 (61.4)	190 (69.9)	156 (59.1)	
Low in fat	Yes	31 (19.6)	42 (15.4)	36 (13.6)	0.26
	No	127 (80.4)	230 (84.6)	228 (86.4)	

Continued

Table 3 Continued

Variables	Category	Lost weight n (%)	No change n (%)	Gained weight n (%)	P value†
Tasty	Yes	12 (7.6)	26 (9.6)	37 (14.0)	0.084
	No	146 (92.4)	246 (90.4)	227 (86.0)	
Easy to prepare	Yes	11 (7.0)	24 (8.8)	30 (11.4)	0.3
	No	147 (93.0)	248 (91.2)	234 (88.6)	
Low/moderate in sugar	Yes	21 (13.3)	18 (6.6)	9 (3.4)	0.001**
	No	137 (86.7)	254 (93.4)	255 (96.6)	
Low/moderate in salt	Yes	7 (4.4)	10 (3.7)	7 (2.7)	0.606
	No	151 (95.6)	262 (96.3)	257 (97.3)	
Accessibility					
Transport	On foot	106 (67.1)	188 (69.1)	165 (62.5)	0.259
	Vehicular means	52 (32.9)	84 (30.9)	99 (37.5)	
Internal domain					
Affordability					
Eating fewer meals per day	Yes	25 (15.8)	27 (9.9)	21 (8.0)	0.036*
	No	133 (84.2)	245 (90.1)	243 (92.0)	
Eating less food	Yes	51 (32.3)	42 (15.4)	36 (13.6)	0.000**
	No	107 (67.7)	230 (84.6)	228 (86.4)	
Eating cheaper foods	Yes	36 (22.8)	32 (11.8)	45 (17.0)	0.011*
	No	122 (77.2)	240 (88.2)	219 (83.0)	
Skipping an important food	Yes	48 (30.4)	37 (13.6)	63 (23.9)	0.000**
	No	110 (69.6)	235 (86.4)	201 (76.1)	
Convenience					
Prepared fried foods more frequently	Yes	17 (10.8)	32 (11.8)	56 (21.2)	0.002**
	No	141 (89.2)	240 (88.2)	208 (78.8)	
Prepared salads more often	Yes	66 (41.8)	96 (35.3)	59 (22.3)	0.000**
	No	92 (58.2)	176 (64.7)	205 (77.7)	
Most frequently prepared desserts	Yes	20 (12.7)	51 (18.8)	67 (25.4)	0.006**
	No	138 (87.3)	221 (81.3)	197 (74.6)	
Reason for choosing preparations					
They are nutritious and healthy	Yes	110 (69.6)	186 (68.4)	129 (48.9)	0.000**
	No	48 (30.4)	86 (31.6)	135 (51.1)	

*Significant at the 0.05 level.**Significant at the 0.01 level.
†$\chi 2$ test of independence.

avoid weight gain and considered the period of confinement as a great opportunity to better balance their diet,[20] while in Italy it was found that choosing unhealthy foods was significantly associated with weight gain and body mass index in adults during COVID-19 confinement.[16]

In a high-income country such as Belgium, 5% of the population experienced not having enough money for food often or eventually and 10% could not afford a healthy diet during confinement.[30]

The factors associated with weight loss during confinement, eating less amount of food and missing important foods belong to the external domain of the food system, meaning they are factors beyond the control of individuals. A study in Peru, carried out during lockdown, found that weight reduction was associated with moderate to severe food insecurity at home.[30] Food insecurity is characterised by survival strategies such as reducing serving size and stop the consumption of foods deemed important.[31] These results are similar to those found in Colombia during confinement, where 35% of families reported lacking money to buy food, while 15.3% reported eating less amounts in main meals.[32] Weight loss was observed in individuals with previous low weight and those who reported eating less. This pattern is seen in low-income

Table 4 Multinomial regression model of factors associated with body weight change in adults during the COVID-19 pandemic

	Decrease in body weight*			Increase in body weight*		
Factors	β	OR (95% CI)	P value	β	OR (95% CI)†	P value
Food system						
Nutritious food	−0.084	0.919 (0.516 to 1.636)	0.775	−0.669	0.512 (0.320 to 0.821)	0.005
Eating less food	0.783	2.188 (1.348 to 3.550)	0.002	−0.176	0.838 (0.497 to 1.413)	0.508
Eating a food that you considered important	0.856	2.354 (1.393 to 3.978)	0.001	0.497	1.644 (0.987 to 2.741)	0.056
Food consumption						
Lower fruit consumption‡	0.231	1.260 (0.709 to 2.239)	0.431	0.756	2.129 (1.290 to 3.515)	0.003
Higher fruit consumption‡	0.272	1.313 (0.816 to 2.112)	0.262	0.004	1.004 (0.644 to 1.566)	0.985
Lower consumption of cereals‡	0.245	1.277 (0.725 to 2.250)	0.398	−0.698	0.498 (0.269 to 0.922)	0.026
Higher consumption of cereals‡	0.180	1.197 (0.726 to 1.972)	0.480	0.329	1.389 (0.900 to 2.144)	0.138
Lower alcohol consumption‡	0.033	1.034 (0.667 to 1.602)	0.881	0.283	1.328 (0.893 to 1.973)	0.161
Higher alcohol consumption‡	0.323	1.381 (0.434 to 4.396)	0.584	1.506	4.510 (1.764 to 11.531)	0.002

*Change in body weight. Reference: no change in perceived body weight.
†Change in consumption. Reference: no change in consumption.
‡Models were adjusted for total number of diseases.

populations and particularly in individuals that attained lower educational levels.[33]

Our study is the first to analyse the factors of the food system and food consumption that influence body weight variations in Peruvian adults during the strictest stages of the COVID-19 pandemic and lockdowns. It has several limitations, such as the cross-sectional design, identification of risk and protective factors for the increase or decrease in body weight could be better assessed through longitudinal studies. Using a non-probabilistic sampling, self-administered questionnaire, lack of anthropometric information could affect the response rate and accuracy of data collected. Also, the Morales and Carbajal silhouettes scale has been validated in young adults only. Internet and device access are also barriers that could promote under-representation of people with scarce resources. However, this methodology was selected for being the best alternative to reach people located in different districts of Metropolitan Lima during the strict lockdown.

The results of the study indicate that there were changes in the food system, consumption and body weight. If more sedentary behaviours due to confinement are considered, there could be an increase in risk factors for severe and fatal COVID-19.

Changes in food system factors and in intake behaviour during the pandemic and lockdowns associated with body weight variation, such as increased alcohol consumption, decreased fruit consumption, restrictions in quantity and frequency of nutritious foods, are among those known to activate the innate immune system and impair adaptive immunity leading to increased chronic inflammation and reduced defence against viruses.[34]

CONCLUSIONS

The results of this study show that 60.8% of respondents noticed variations in their body weight during the lockdown. Body weight gain was mostly associated with changes in food consumption habits such as increased alcohol intake and decreased intake of fruits, while regarding internal factors of the food system, eating less cereals and nutritious value of the food as purchase driver were found as protective habits against weight gain. Finally, body weight loss was associated with external factors of the food system such as having to eat smaller portions and missing important foods.

This study provides information related to the situation of the food system and the perception of body image in an urban area in Peru. Lima is a multicultural city like most Latin American capitals, so the results obtained could be replicated in other Peruvian urban areas and in other major cities in the region where most people can access new methods of data collection such as web-based surveys

More sedentary and diverse behaviours are evident due to confinement, which increases the risk factors for COVID-19. Given this, it is necessary to promote preventive policies, guidelines, programmes and communications that help mitigate the impact of the pandemic on food systems, consumption habits, physical activity and active rest and aim to promote healthy lifestyles that can adapt to the restrictions that could arise and protect the population.

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