



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Impact of COVID-19 lockdown on the perception of home meals and meal-related variables: A large-scale study within the Italian population during the acute phase of the pandemic

Maria Piochi^{a,*}, Federica Buonocore^b, Francesco Spampini^b, Luisa Torri^a

^a University of Gastronomic Sciences, Bra, Italy

^b Independent Researchers, Experts in Statistics and Data Analysis

ARTICLE INFO

Keywords:

Meal
Liking
COVID-19
Cooking dynamism
Food engagement
Conviviality

ABSTRACT

Italy was the first European country struck by the COVID-19 epidemic and experienced a national lockdown. This study explored the effect of lockdown on the perception of any meals prepared and/or conducted at home (home meals) and investigated which variables played a role in this. A group of Italians (n = 3,060) not suspected/diagnosed as having COVID-19 (18–91 years old; 33% males) completed an online survey during the first lockdown (April 2020).

Liking for home meals either increased (51% of the population) or did not vary (43%), while it decreased for only 6% of respondents. Total meal intake similarly either increased (51%) or remained unchanged (33%). Core variables describing meal perception (Liking for meal, Pleasure in meal preparation, Meal duration, Meal Time, Overall food intake, Snack intake) were positively associated with each other.

Two clusters with different perceptions of home meals were found, characterised by an increased appreciation (Cl1, 61%) and an unchanged appreciation (Cl2, 39%), respectively. In the acute phase of lockdown, increased meal pleasure was associated with home togetherness (not living alone), cooking with others more often, having high cooking dynamism (use of different kitchen tools, engaging in online food-related activities like using online recipe/website for cooking, use of ready-to-eat meal delivery), and being young, a student or a worker (Cl1). Conversely, Cl2 showed an unchanged meal pleasure, and it was mostly associated with living alone (before and during lockdown), being elderly, retired, widowed, having a low degree of cooking-related activities and dedicating a small weekly budget to food. Variables strictly describing the meal were discussed. Lockdown did not homogeneously affect the population in terms of meal pleasure, and high enjoyment of meals was related to high meal involvement. Younger subjects seemed to be more resilient and appreciated meals more due to high cooking dynamism, food-related activities and togetherness. Public health policies could consider these outputs to set up interventions that use meal-dedication activities to increase meal pleasure in vulnerable targets or in subjects experiencing poorly appreciated diets in similar future stressful situations.

1. Introduction

In December 2019, the SARS-CoV-2 virus emerged and caused COVID-19 disease, which was declared a pandemic by the World Health Organization on 11th March 2020. Italy was the first European country to face the COVID-19 pandemic, and the Italian government decided to reduce the risk of infection within the Italian population by establishing the first national lockdown, in force from 9th March to 18th May 2020. The lockdown imposed several restrictions, aiming to limit physical social interaction and the mobility of people through the confinement of

people in their own homes.

Although isolation conditions are considered a necessary measure to protect public health during a pandemic, the first available scientific evidence has indicated that lockdowns can dramatically impact on all fields of life and behaviour from several perspectives (e.g. psychological, social and economic). Among these, alterations in psychological and emotional responses are able to influence food behaviours in the whole population (Wang et al., 2020); particularly, the COVID-19 pandemic has severely impacted the mental health of older adults (De Pue et al., 2021). Although evidence is still accumulating, several studies have

* Corresponding author.

E-mail address: m.piochi@unisg.it (M. Piochi).

<https://doi.org/10.1016/j.foodqual.2021.104488>

Received 30 June 2021; Received in revised form 28 November 2021; Accepted 30 November 2021

Available online 3 December 2021

0950-3293/© 2021 Elsevier Ltd. All rights reserved.

already shown the impact of the COVID-19 pandemic and lockdown on food habits. Considering the impact of the epidemic and the related confinement, studies on consumer behaviour have been conducted in several European countries, including The Netherlands (Poelman et al., 2021), Spain (Laguna et al., 2020; Sánchez-Sánchez et al., 2020) and Italy (Cavallo et al., 2020; Scacchi et al., 2021; Scarmozzino & Visioli, 2020), as well as in other geographical areas like China (Wang et al., 2020), the USA (Powell et al., 2021) and Qatar (Hassen et al., 2020).

One of the main dimensions explored was food consumption and dietary patterns in relation to the COVID-19 situation. Most papers focused on changes in the frequency of consumption of specific classes of food (Di Renzo et al., 2020; Hassen et al., 2020; Sánchez-Sánchez et al., 2020; Scarmozzino & Visioli, 2020), on self-reported food consumption (Scarmozzino & Visioli, 2020), on food purchasing (Scacchi et al., 2021) or on compliance with healthy diet patterns (Jaeger et al., 2021; Molina-Montes et al., 2021). A relevant paper recently compared the changes in the eating behaviours of the adult population across 16 European countries (Molina-Montes et al., 2021). Indeed, the impact of COVID-19 on food behaviours differed from one country to another, depending not only on the epidemiological situation, but also, among other factors, on the level of socio-economic development (Hassen et al., 2020). Moreover, a study conducted on the Italian population investigated the variations in consumption patterns regarding sales, sales channels and consumption resilience for specific classes of food (Cavallo et al., 2020). Food waste production in households during the COVID-19 pandemic has also been explored (Filho et al., 2021; Scacchi et al., 2021), showing 43% and 53% increases in food waste and plastic packaging, respectively (Filho et al., 2021).

The impact of COVID-19 has been studied with regard to emotional eating, emotion dysregulation and impaired abilities to identify emotions (alexithymia) (McAtamney et al., 2021). Since it is known that anxiety affects food intake (Scarmozzino & Visioli, 2020) and it has been observed that greater levels of depression during the pandemic were associated with changes in eating behaviours (McAtamney et al., 2021), it is plausible to hypothesise that the stressful pandemic situation (due to emotional uncertainty, fear, etc.) would have consequently affected also the affective response to food in relation to home meals. To the best of our knowledge, the current study is the first to explore in depth the perception of home meals during the first Italian COVID-19 lockdown and to link these changes to many sociological variables that could explain diversity in meal perception, thus allowing for the profiling of different groups with different meal perceptions. Of note, the data were collected during the acute phase of lockdown, which is a strength of the study since many published retrospective studies took place later in the summer of 2020 (and so are more prone to memory bias when self-reporting). In general, all the above-mentioned studies, including the current one, contribute to creating a body of evidence that can help to better understand which factors affected food and cooking-related behaviours during the COVID-19 pandemic. Since the COVID-19 pandemic may be representative of a global stressful situation of social confinement and the stressful situation may have a detrimental effect on food behaviours and diet, the effects observed during lockdown and the derived data can contribute to reacting critically and more efficiently in the future in similar stressful situations. Solutions that minimise the negative effects of forced confinement at home may be suggested based on new insights (e.g., trying to minimise the condition of being alone, facilitating cooking-related activities, etc.).

The moment of the meal (especially family meals conducted in the home environment) represents an important phase of the day in Mediterranean culture (de la Torre-Moral et al., 2021), both because of experiencing pleasure from eating food, but also because of the function of socialising and promoting togetherness during the meal (Alm et al., 2015; Berge et al., 2018; Eck et al., 2019). Due to the pandemic situation, lockdown may have modified the satisfaction derived from meal preparation and consumption. In general, each meal can be seen as an interaction among three main factors: the person consuming the meal

(including the company and aspects related to socialisation), the dish consumed (type, quantity and choices available, etc.) and the environment in which the meal takes place (*ambience* or context) (Stroebele & De Castro, 2004). Many studies have shown the importance of the context of consumption and the environment on behaviours and food choices (Divert et al., 2015; Meiselman et al., 2000), and the importance of commensality (defined as 'eating together with others') on the perception of the meal (Cho et al., 2015). For example, the nature and the number of the tablemates influences food intake and, typically, the greater the degree of knowledge of the tablemate, the greater the degree of relaxation of the person and consequently the ease in consuming food (Stroebele & De Castro, 2004), with family seeming to be the most important meal commensal (Scander, Wiklund, et al., 2021). Moreover, the greater the degree of crowding in an environment, the greater the number of calories ingested (Hock & Bagchi, 2018). Additionally, the amount of time available to consume the meal can affect what is eaten: subjects in a rush tend towards more unhealthy dietary intake, thus influencing our food behaviours (Cohen et al., 2015). Therefore, in general, appreciation of the meal can become an influencing factor on other eating behaviours that, at a more macroscopic level, change our eating habits and the amount of food eaten. In recent decades, due to the intense rhythms of life due to work, family duties and various commitments, meals are not always experienced serenely and perceived as a pleasant moment (for example due to a lack of sufficient time to cook or eat or due to the limited availability of pleasant dishes, etc.). Thus, depending on how the complex factors mentioned above are combined, different levels of satisfaction with the meal can be generated.

During the first COVID-19 lockdown, the necessary isolation in one's home could have modified the context of meal consumption in terms of several variables (such as the nature and number of tablemates and time availability), which could have positively or negatively changed the perception and appreciation of meals. However, the direction of change was not predictable a priori. For example, the appreciation of meals could have been increased due to the greater amount of time available to prepare meals or decreased due to the negative emotional state potentially caused by isolation.

In general, some limitations were observed in previous studies focusing on the effect of the COVID-19 lockdown on food behaviours, such as the fact that the behaviours observed among consumers were considered to be homogenous (without segmenting or characterising patterns according to sub-groups) with the risk of underestimating potential differences in the population (Scarmozzino & Visioli, 2020). Moreover, some case studies were conducted on limited samples (Powell et al., 2021) and recent studies have stated the need to extend these investigations to a larger and more varied population to understand the implications of lockdown on consumers' food habits (Snuggs & McGregor, 2021). Indeed, home food practices and behaviours (including the act of cooking, the act of eating during meals and outside meals, i.e. snacking, etc.) are particularly worthy to be investigated due to the incredibly sudden increase in staying at home due to the restrictions imposed by governments.

To the best of the authors' knowledge, none of the currently published studies have focused specifically on the perception of 'home meals', intended as any meal prepared and/or consumed at home during the first COVID-19 lockdown. Thus, home meals included the main meals (breakfast, lunch, dinner) and snacking outside meals, and comprised both those meals self-prepared at home by respondents and meals prepared by someone else or delivered to the home (e.g. ready-to-eat meals provided by bars, restaurants or catering). Apart from breakfast, the classical Italian main meals (e.g., lunch or dinner) traditionally include a starter, a first course, a second course and eventually a dessert. Nowadays, both lunch or dinner may consist of a reduced version of these traditional meals, having one single main dish or sometimes two dishes. The current study aimed: I. to explore if and how lockdown changed the perception of home meals described by several variables (such as Liking for meals, Pleasure in meal preparation,

Overall meal intake, Snack intake, Meals duration, Meal Time); II. to understand which variables were mostly related to this variation in perception of home meals; III. to explore if groups with different meal perceptions can be outlined. We hypothesised that changes in liking for meals experienced during the first lockdown were not homogenous in the Italian population and that the perception of home meals was differently affected in population groups with different characteristics.

2. Methods

2.1. Questionnaire

An online survey was designed in the Italian language using the QualtricsXM® software (Provo, UT) and administered via email and social networks (Facebook, LinkedIn and WhatsApp). The questionnaire included 47 questions including different sections (Table 1 of the Supplementary Data). The first part of the survey was dedicated to the collection of demographic data (gender, age, nationality, region), socio-economic data (marital status, educational qualification, number of people in the family unit, number of cohabitants during quarantine, number of members under the age of 16, profession, annual gross income) and anthropometric characteristics (weight, height). The second section of the survey consisted of questions relating to established eating habits (diet, frequency of consumption of fresh food, local products, organic products). In the third part of the survey, attention was paid to the practices generally adopted before the lockdown concerning the channels used for food to be purchased, the methods and costs of food procurement and the preparation of meals. The same questions were asked again in the fourth section of the questionnaire, asking this time to refer to the behaviours adopted during the lockdown period. Finally, in the fifth section, six variables (called 'core') describing the perception of home meals were queried concerning how behaviour regarding meals changed during lockdown compared to the previous period. The six core variables were: liking for home meals (Liking for meals), pleasure in meal preparation (Pleasure in meal preparation), overall daily food intake during meals (Overall meal intake), snacking outside meals (Snack intake), overall daily meal duration (Meal duration) and time at which the meal was scheduled (Meal time). The question for these core variables was 'How did the ... change comparing the current situation of lockdown to the situation of before the lockdown?' employing a seven-point scale (1 = much decreased, 4 = unchanged, 7 = much increased). Since, in general, pleasure associated with a meal includes the enjoyment of the food eaten and the appreciation of the situation as a moment for socialisation and eating together ('commensality'; Cho et al., 2015; Scander, Yngve, et al., 2021), in the current study, 'pleasure associated with a meal' was mostly considered as the combination of the two core variables ('pleasure in meal preparation' and 'liking for meals eaten'). All variables labelled with an initial 'L_' indicate data from lockdown. The questionnaire was run for 26 days in the central part of the first Italian lockdown (from 08/04/2020 to 03/05/2020). The starting day of data recording coincided with the so-called 'phase 1' of lockdown, characterised by severe travel restrictions throughout the national territory imposed by the Italian government, while data collection stopped

Table 1
Distribution of core variables (related to home meal liking) in the population (n = 3060).

Variable	Decreased* (↓)	Unchanged (=)	Increased* (↑)
Liking for meals	172 (6)	1323 (43)	1565 (51)
Pleasure in meal preparation	246 (8)	1105 (36)	1709 (56)
Overall meal intake	496 (16)	1000 (33)	1564 (51)
Snack intake	702 (23)	1449 (47)	909 (30)
Meal duration	194 (6)	1526 (50)	1340 (44)
Meal time	706 (23)	1507 (49)	847 (28)

Note: percentages are expressed in brackets. *For the variable 'Meal time', 'decreased' and 'increased' were respectively 'anticipated' and 'postponed'.

the day before the start of 'phase 2' of national limitations, in which the restrictive mobility measures were partially relaxed. Questionnaires required approximately 10–25 min to be completed.

2.2. Respondents

A total of 4,364 subjects accessed the questionnaire, out of which 3,168 completed the survey. After the removal of respondents not complying with the inclusion criteria, 3,060 final respondents were included in the final matrix (33% males, age range 18–91 years, mean age: 45 years; see Appendix A - Supplementary Data Table 1). Inclusion criteria were: I. To have completed the questionnaire; II. To be at least 18 years old; III. Not being suspected/currently having COVID-19; IV. Living in Italy for at least two years; V. Having spent from 5 to 60 min completing the questionnaire. The study was approved by the Ethics Committee of UNISG (Ethics Committee Proceeding n. 2020.01). The work was carried out in accordance with the international ethical guidelines for research involving humans established in the Declaration of Helsinki. All subjects provided informed consent before answering the questionnaire.

2.3. Data analysis

Associations among categorical variables were assessed through Pearson's χ^2 test of independence. For three variables related to relevant food behaviours (frequency of grocery shopping; weekly food expense in €; frequency of cooking together at home) we computed overall trends (decreased, increased and unchanged) as a percentage of all respondents. Moreover, for the same three variables, we computed the percentage variation of each level, defined as the difference between subjects choosing that level to describe their behaviour during the lockdown minus the percentage of subjects choosing that level before lockdown ($\Delta\% = \text{during the lockdown} - \text{before lockdown}$; e.g.: $\Delta\%$ daily grocery shopping = % subjects choosing daily grocery shopping to describe their behaviour during lockdown - % subjects choosing daily grocery shopping to describe their behaviour before lockdown). Positive and negative $\Delta\%$ values indicated an increase and a decrease, respectively, in the level during confinement. A multiple correspondence analysis (MCA) was conducted to study the relationship among variable levels (class of answer), including all variables as active. In MCA, the core variables were included and variables that mostly affected the liking of the meal (the impact of each variable on liking of the meal was evaluated by computing double entry matrices between Liking for meals and each of the other variables and by measuring, for each combination of variables, the frequencies of each level).

A hierarchical clustering on principal components (HCPC) was then conducted on dimensions obtained by MCA, adopting Ward's criterion to segment individuals based on their different behaviours considering variables before and during lockdown. The obtained clusters are described in the text according to the dimensions of the MCA that were associated with the highest variability according to the v-test (Husson et al., 2010). Clusters were then characterised by the χ^2 test.

To characterise the clusters, the following percentages were computed separately for each cluster and for each variable: the percentage of subjects belonging to each variable's level ('cluster/level'; the sum of all cluster/level must give 100 in each cluster) and the percentage of how much the variable's level is represented within each cluster ('level/cluster', suggesting how the level is quantitatively represented in the cluster). In the text, the symbols '↑', '↓', and '=' are associated with a variable level to indicate an increase, decrease and unchanged, respectively. The variable 'cooking together' in the text refers to 'with family, friends, housemates, etc.'

3. Results

3.1. Variations in meal perception during the COVID-19 lockdown according to core variables describing the meal

The distribution of core variables describing the perception of meals during lockdown is shown in Table 1. Liking for meals showed two major trends: mainly increased or unchanged, while a decrease in meal liking was observed only in a minority of the population. Similarly, overall food intake during meals increased for about half of the population and did not change for one third of the respondents. Food intake outside of meals (Snack intake) was unchanged, increased and decreased, respectively, for about half, one third and one fourth of the subjects, so it mostly did not vary. Half of the participants declared that meals during lockdown had the same duration than before lockdown, while 44% of subjects answered that meals lasted longer. For almost half of respondents, the time at which the meals took place remained unchanged, while the rest of respondents were equally distributed between those subjects who anticipated and those who postponed.

Considering the associations among core variables, Liking of meals was positively associated with the other core variables (Fig. 1), suggesting that subjects who increased their liking for meals also had an increase in Pleasure in meal preparation, in Overall food intake, and in Meal duration. Weaker associations were observed between Liking for meals and Snack intake, and between Liking for meals and Meal time, meaning that a change in the appreciation of home meals did not strongly impact on the amount of food eaten outside of meals (as snacks) nor on the time at which the meal took place.

3.2. Variation in food-related behaviours during and before lockdown

Fig. 2 (a-c) shows the variation in three relevant food-related behaviours (frequency of grocery shopping; weekly expenses for food products in €; frequency of cooking together in the home environment) before and during lockdown in the population (expressed as $\Delta\%$). Moreover, the overall trends of these variables are shown in Fig. 2d, suggesting that the frequency of grocery shopping mostly decreased (58%) during lockdown in this population, an expected consequence of governmental restrictions (limiting activities outside the home). Most respondents who normally went grocery shopping two or three times per week reduced this to once a week or even less frequently (Fig. 2a). The weekly expenses for food remained substantially unvaried (57%) in the population, but for 32% it increased, in particular expense classes higher than 100€ increased, despite modest delta values (<6%) (Fig. 2b). The frequency of cooking together at home mostly remained unvaried (50%) or increased (41%) (Fig. 2d), with the increase especially in the answer classes ‘often’ and ‘always’ (Fig. 2c), suggesting that meal preparation became a more relevant aspect of socialisation during lockdown.

3.3. Relationship among meal-related variables and other variables in the whole population

MCA was applied to study the relationships among levels of all the variables considered in the study. Below, the biplot of Fig. 3 shows the two dimensions associated with the highest variability, obtained from the segmentation with HCPC conducted to find clusters with different meal perception. Variables associated with the highest cluster diversification were Dim1 and Dim3 (accounting for 6.6% and the 3.6% of the total variance in MCA, respectively) (Fig. 3).

The first dimension (Dim1) was positively associated with

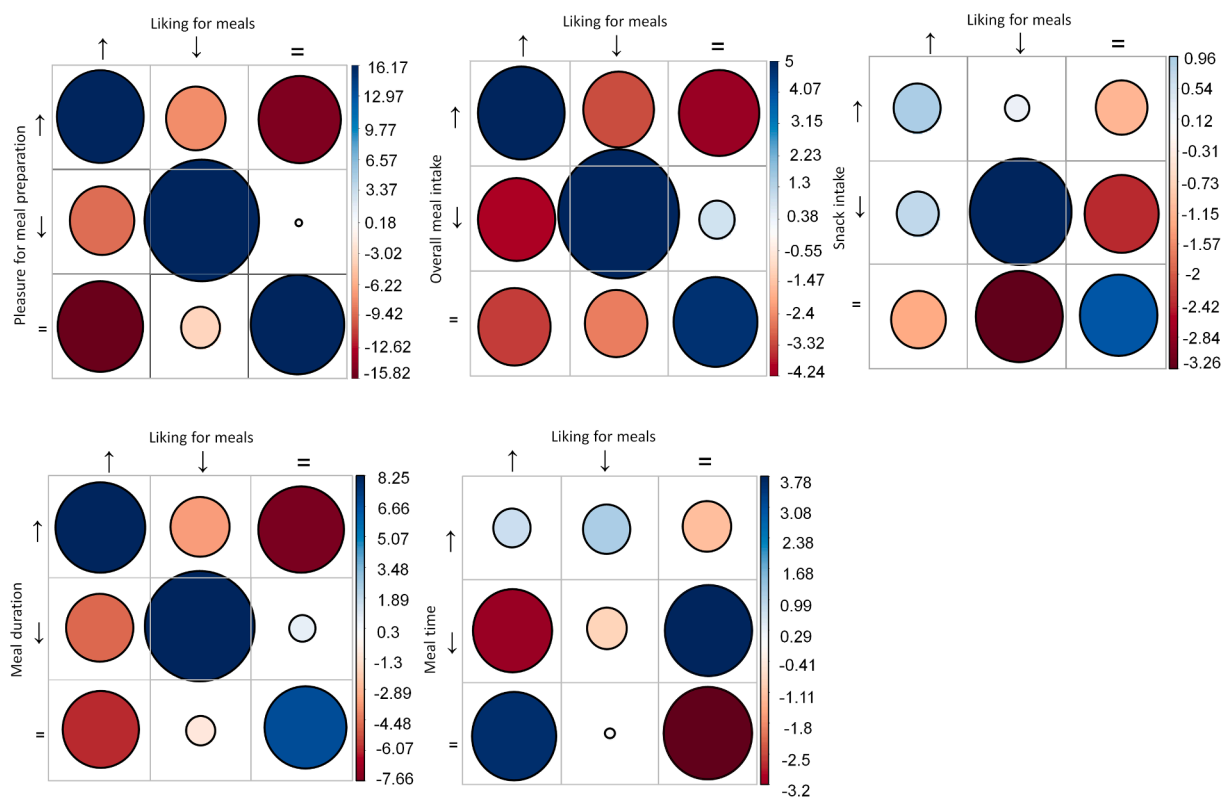


Fig. 1. Sign and values of the standardized residuals from Pearson Chi-square between liking for domestic meal and other core variables. In the figure symbols are used that identify: ‘↑’ for increased (anticipated for Meal Time), ‘↓’ for decreased (postponed for Meal Time), ‘=’ for unchanged. Positive residual values (blue) specify a positive association between the corresponding row and column modalities. Negative residuals (red) imply a negative association between the corresponding row and column modalities. The dimension and the color intensity of the circles are proportional to the values of residuals. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

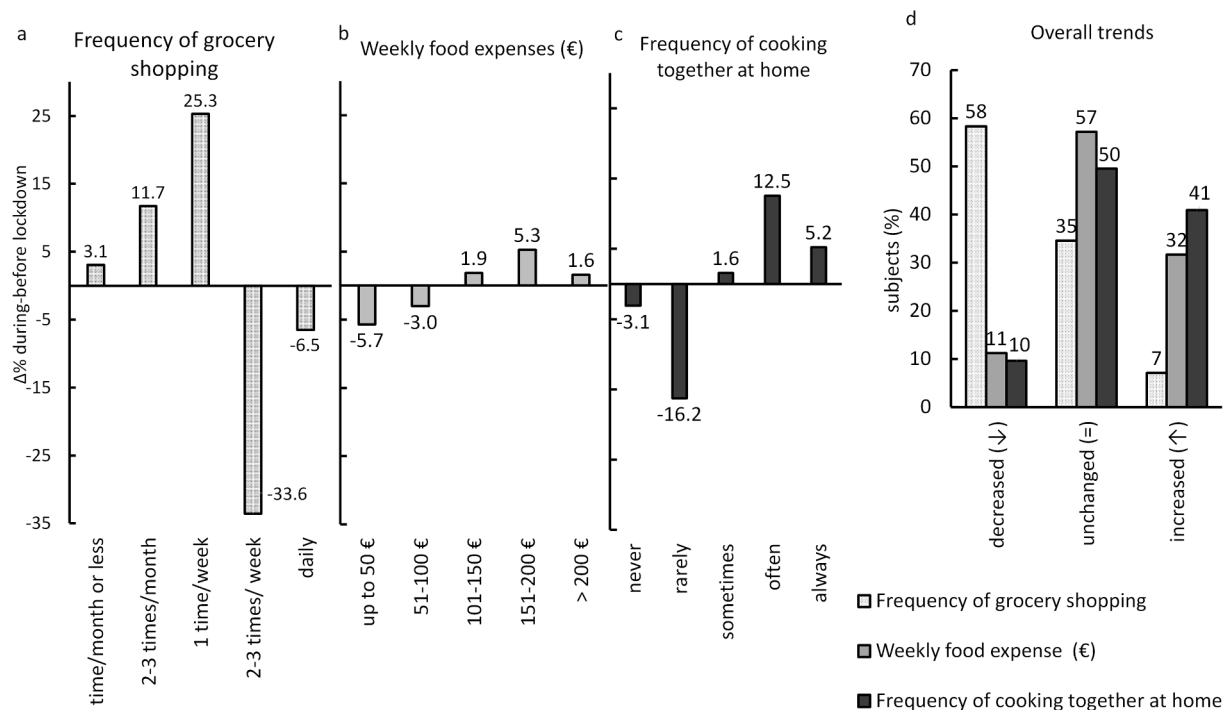


Fig. 2. Percentage variation ($\Delta\%$) in food-related behaviours comparing before and during the lockdown (a-b) and overall trends (d).

unchanged Liking for meals (=Liking for meal) and unchanged Pleasure in meal preparation (=Pleasure in meal preparation). Dim1 was also positively associated with subjects being older (≥ 65 years old), living alone both before and during lockdown (Alone at home, L_Alone at home, and Widowed), and not being occupied (Retired, L_non-working). Moreover, respondents positively associated with Dim1 were characterised by always cooking alone before the pandemic (Cooking alone always) and maintaining this habit even during lockdown (L_Low cooking together). Subjects with an unchanged Liking for meals spent $< 50\text{€}$ weekly on grocery shopping (Weekly expense $\leq 50\text{€}$) and spent < 1 h in total per day in preparing meals (L_<1 h daily meal preparation time). A low use of kitchen devices (L_Low kneading machine user, L_Low gas cooker/induction/infrared hob user) were also positively associated with Dim1. Moreover, Dim1 was positively associated with low activity in the use of online recipes to cook, low use of the advertisements when deciding what to buy while grocery shopping and to a low frequency of ready-to-eat meal delivery activity.

Instead, increased Liking for meals, Pleasure in meal preparation, Overall food intake and Meal duration during lockdown were negatively correlated to Dim1. Increased (\uparrow) Pleasure in meal preparation and Liking for meals were associated with a young age (18–29 years old), being a student, to high use of digital tools during lockdown as supporting tools to prepare/buy food and to high use of ready-to-eat meal home delivery. The increase in Liking for home meals (\uparrow Liking for meals) was also associated with high cooking activity during lockdown, as suggested by the positive association between high use of cooking appliances (L_High gas cooker/induction/infrared hob user) and high use of a mixer (L_High mixer user), as well as spending 2–3 h on meal preparation (L_2-3 h daily meal preparation time) and with a high social dimension during lockdown, represented by the modality 'L_High cooking together'. Married/cohabiting participants and living in a numerous housing nucleus (more than four people) both before and during lockdown were found to be negatively associated with Dim1.

Being a student, 18–29 years old, with frequent social media use and purchasing food online (L_High influence of recipe websites/social media on grocery shopping choices) and being never married/single had a positive association on Dim3. However, being married/cohabitant, a

worker, 30–64 years old and living with other (four household members or more) both before and during lockdown had a negative association on Dim3.

3.4. Cluster characterisation

From the HCPC, two clusters were obtained: C11 (61%) and C12 (39%). Table 2 shows the variables related to meal perception and meal-related activity and Table 3 shows the socio-demographic data of clusters (an extended description of cluster of socio-demographics is provided in Table 2 of Appendix A - Supplementary Material). The socio-demographic data shown in Table 2 of Appendix A (but not in Table 3) must be intended as not being included in the segmentation due to their low contribution to the dimensions of the MCA and consequently in differentiating clusters. Based on the χ^2 results, all the variables used to conduct segmentation significantly discriminated the two clusters ($p < 0.001$).

C11 was characterised mostly by an increase in Liking for meals (65%), an increase in Pleasure in meal preparation (70%), increased Overall food intake (63%), and increased Meal duration (58%) during lockdown (see Level/Cluster column in Table 2). Most of the respondents in the population ($> 80\%$) declared high use of online recipe/websites for cooking during lockdown, high use of online recipes/social media to decide what to buy while grocery shopping, as well as a high frequency of ready-to-eat meal home delivery use during lockdown belonged to C11 (Cluster/Level column in Table 2). It is well-known that food-delivery (including food, beverages, ready-to-eat meals, etc.) during the COVID-19 lockdown increased exponentially worldwide (for a review, see (Figliozzi & Unnikrishnan, 2021)), on one hand allowing the comfortable delivery at home of any goods (from supermarkets, producers, catering, restaurants, etc.) but on the other hand causing important negative environmental effects such as a huge increase in single-use plastic containers (Janairo, 2021). In the current study, the high microwave and cooker use characterising C11 could be also associated with high activity in terms of warming up ready-to-eat meals brought into the home by delivery services, since in C11 the frequency of ready-to-eat meal delivery was also high. In C11, several respondents

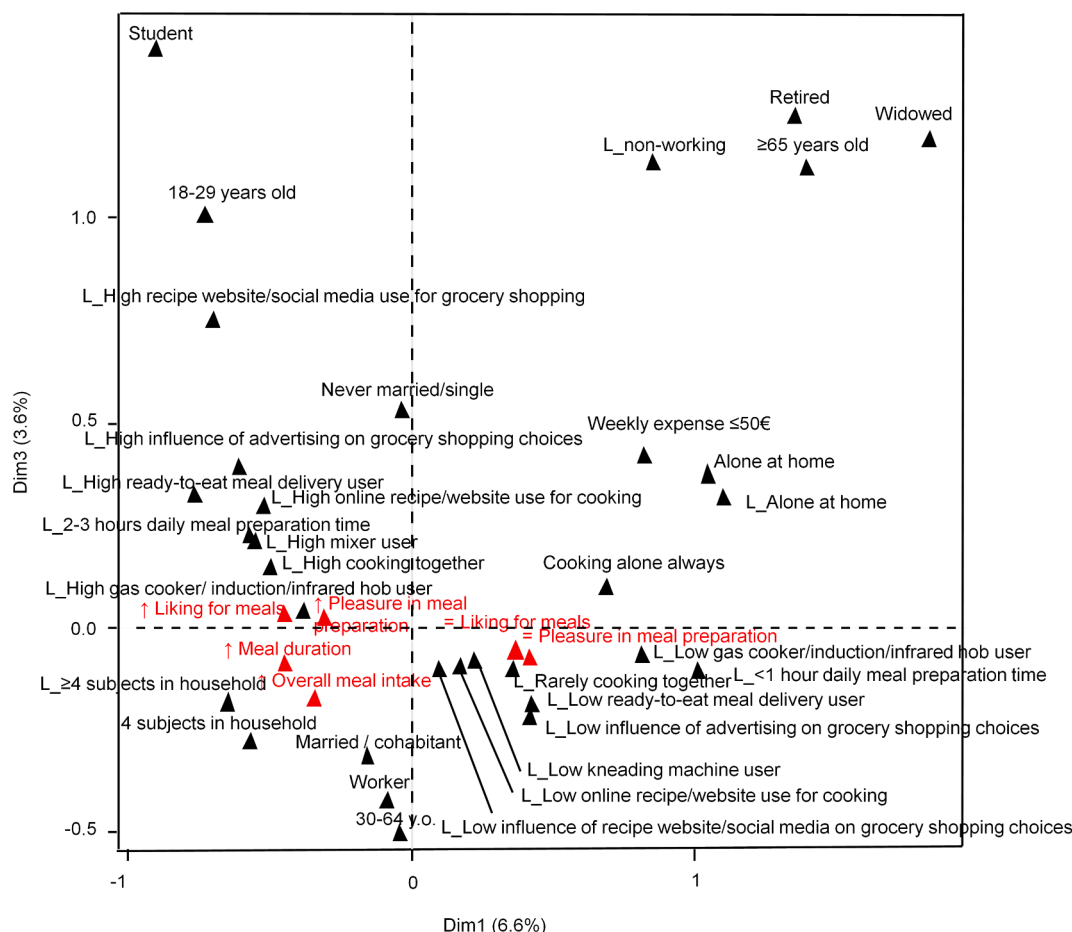


Fig. 3. Biplots of the Dim1 and Dim3 from MCA, depicting the relationships among the levels of the meal-related variables and all other variables. The dimensions were selected based on the v-test and were the two mostly representative in explaining the variability in the clusters considering home meals perception. Note: symbols (↓), (=), and (↑) indicate respectively: 'decreased', 'unchanged' and 'increased' for the considered variable's level. Variables identified with the letter 'L' referred to the condition 'during the lockdown' while the others refer to the normal situation (*before the lockdown*).

declared high use of advertising (53%) when deciding what to buy while grocery shopping.

Cl2, conversely, was mostly characterised by an unchanged Liking for meals (61%) or even decreased Liking for meals (10%) (Level/Cluster in Table 2). Most respondents in the population with a decreased Meal duration (77%) belonged to Cl2, suggesting that this group spent less time eating and enjoyed meals less overall (Cluster/Level, Table 2). Cl2 had a few subjects who frequently ordered ready-to-eat meals for home delivery, a few who used social media to decide what to purchase while grocery shopping and a few subjects using online recipes/websites for cooking. Therefore, Cl1 was clearly characterised by the highest social/online food engagement, while Cl2 had the lowest.

Regarding the social dimension of cooking together, Cl2 included 40% who never cooked together before lockdown. Moreover, most subjects (78%) in the population who dedicated <1 h/day to meal preparation during lockdown belonged to Cl2, consolidating the idea that this cluster was less involved in meal preparation. The degree of kitchenware use (burner, kneading machine) was clearly higher in Cl1 than in Cl2 during lockdown.

Regarding the socio-demographic variables used for segmentation (Table 3), if considering the Cluster/Level column, most subjects under 30 years old (83%) were assigned to Cl1, while most of the retired subjects (91%) belonged to Cl2. Cl1 had a high percentage of adults (73%), workers (78%), participants under 30 years old (26%), students (14%), married/cohabitant (67%), subjects living with others (≥3 people/nucleus) and only 6% living alone (see Level/Cluster in Table 3). Instead, in Cl2 there was a high percentage (37%) of people living alone

for different reasons (never married/single 30%, being divorced/separated 15%, widowed 5%). Moreover, almost one third of this cluster was composed of retired people (27%), thus explaining the high percentage of subjects over 65 years old who were mostly concentrated in this group.

Both clusters maintained the numerosity of housing during the lockdown.

4. Discussion

4.1. Meal perception and meal-related behaviour changes in the population

In this work, we observed modifications to some meal-related and food behaviours at home during the acute phase of the first COVID-19 lockdown.

The observed decrease in the frequency of grocery shopping was in line with expectations (since the government imposed a lockdown at home to reduce the number of exits from the home) and with previous studies conducted in Italy and New Zealand (Gerritsen et al., 2020; Scacchi et al., 2021). We also observed minimal variations in weekly expenses for food. This was tentatively explained by the fact that, even if in the Italian population (as for other countries) the COVID-19 situation dramatically affected the economic situation of individuals and of provinces (Bonaccorsi et al., 2020), since food is an essential good, respondents plausibly did not substantially change their weekly expenses for food during confinement. Moreover, the increase in occasions of

Table 2
Food-related activities, home meal dedication and meal perception in clusters.

Class of variable	Variable	Levels	Cluster/ Level*		Level/ Cluster**		Global	p- value	
			C11	C12	C11	C12			
Core variables: meal perception during lockdown	Liking of home meal	↑ Liking for meals	78	22	65	29	51	<0.001	
		↓ Liking for meals	29	71	3	10	6	<0.001	
		= Liking for meals	45	55	32	61	43	<0.001	
	Pleasure in meal preparation	↑ Pleasure in meal preparation	76	24	70	34	56	<0.001	
		↓ Pleasure in meal preparation	33	67	4	14	8	<0.001	
		= Pleasure in meal preparation	43	57	26	52	36	<0.001	
	Overall intake	↑ Overall meal intake	75	25	63	32	51	<0.001	
		↓ Overall meal intake	42	59	11	24	16	<0.001	
		= Overall meal intake	48	52	26	43	33	<0.001	
	Snack intake	↑ Snack intake	73	28	35	21	30	<0.001	
		= Snack intake	55	45	43	55	47	<0.001	
	Meal time	↓ Meal time	66	34	25	20	23	<0.001	
		↑ Meal time	74	26	33	19	28	<0.001	
	Meal duration	↑ Meal duration	80	20	58	23	44	<0.001	
↓ Meal duration		23	77	2	13	6	<0.001		
Food online engagement	Frequency of ordering ready-to-eat meals for home delivery	L_High ready-to-eat meal delivery user	90	10	54	9	36	<0.001	
		L_High online recipe/website user for cooking	80	20	33	13	25	<0.001	
	Social media channels used to decide what to buy when grocery shopping	L_High influence of online recipe/social media on grocery shopping choices	81	19	17	6	13	<0.001	
		L_Low influence of online recipe/social media on grocery shopping choices	58	42	83	94	87	<0.001	
	L_High influence of advertising on grocery shopping choices	L_High influence of advertising on grocery shopping choices	89	11	53	10	36	<0.001	
		L_Low influence of advertising on grocery shopping choices	45	55	47	90	64	<0.001	
	Meal dedication & cooking activity	Social cooking/eating activity	L_High ready-to-eat meal delivery use	85	16	15	4	11	<0.001
			L_Frequently cooking together	82	18	57	19	42	<0.001
			Cooking alone always	32	68	12	40	23	<0.001
			Cooking together rarely	69	32	31	22	28	<0.001
Cooking together often			75	25	20	10	16	<0.001	
>1 h daily meal preparation time			58	42	45	51	48	<0.001	
>2 h daily meal preparation time			71	29	8	5	7	<0.001	
L < 1 h daily meal preparation time			22	78	6	32	16	<0.001	
L_2-3 h daily meal preparation time	L_2-3 h daily meal preparation time	84	17	33	10	24	<0.001		
	L_>3 h daily meal preparation time	87	13	7	2	5	<0.001		
Kitchenware usage	Kitchenware usage	L_High gas cooker/Induction or infrared hob user	76	24	88	45	71	<0.001	
		L_Low gas cooker/Induction or infrared hob user	25	76	12	56	29	<0.001	
		L_High kneading machine user	84	16	40	12	29	<0.001	
		L_High microwave user	62	38	97	91	94	<0.001	
		L_Low microwave user	37	64	4	9	6	<0.001	

Note: *'Cluster/Level' = If reading each row, Cluster/level will give the percentage of subjects out of the whole population belonging to each cluster (the combination of Cluster/Level of the two clusters will give 100% = the whole population); **'Level/Cluster' = If reading in column of each variable, the Level/Cluster will give the composition as a percentage of how much the variable's level is represented within each cluster (composition within cluster); 'Global' is the percentage of subjects distributed in the whole population. For each variable, the modalities that are not depicted in the table must be intended as not being included in the segmentation due to a low contribution in explaining differences between clusters.

cooking together was expected, since it was found that the time spent cooking increased during the pandemic (Scacchi et al., 2021), as did the habits of cooking meals and baking/breadmaking (Gerritsen et al., 2020). Therefore, combining the higher availability of time spent at home and the intensification of cooking during lockdown, it is highly plausible that cooking activities were conducted with other family members or housemates for those living together during the pandemic, resulting in an increase in cooking together.

The current paper highlights two major trends regarding pleasure in meal preparation: increased in 51% and unchanged in 43%. Increased pleasure in meals was previously observed among respondents in France (Philippe et al., 2021), with comparable percentages. Instead, the fact that here the pleasure in home meals decreased only for a minority of subjects (6%) could be explained by the fact that the respondent sample was composed of subjects not suspected/currently having COVID-19, and who were therefore not among the most severely stricken despite experiencing lockdown. It is likely that, if we had included subjects who were positive for COVID-19, we could have observed a greater decrease

in satisfaction with meals due to the negative experience contributed by the illness in symptomatic participants, who may have experienced a total or partial loss of taste, smell and/or chemesthesis (Parma et al., 2020).

In the current study, approximately half of the population (51%) declared an increase in overall food intake during meals; this trend has been observed previously with comparable percentages (Buckland et al., 2021; Scarmozzino & Visioli, 2020), with an increase in comfort food consumption. We found that 33% of respondents declared no change in overall food intake. This percentage is somewhat lower than the one found in previous studies showing that almost half of the population (49.6%) did not substantially modify their diet during lockdown (Scarmozzino & Visioli, 2020) and with a study conducted in The Netherlands showing that most participants did not change their eating behaviours (83.0%) (Poelman et al., 2021). The observed differences may have been linked to the population composition, but we agree with previous studies in saying that the trend of unchanged food intake represents an important slice of the population.

Table 3
Composition of the subject clusters regarding socio-demographic data.

Variable	Modalities	Cluster/Level* (To be read in rows)		Level/Cluster** (To be read in columns)		Global	p-value
		Cl1	Cl2	Cl1	Cl2		
Body mass index (BMI)	Underweight	73	27	5	3	5	0.002
	Normal weight	64	36	64	57	61	0.000
	Overweight	56	44	24	30	26	0.000
Age	Obese	50	50	7	10	8	0.001
	18–29 years old	83	17	26	8	19	0.000
	30–64 years old	63	37	73	66	70	0.000
Marital status	≥65 years old	9	91	2	26	11	0.000
	Married/cohabitant	69	31	67	48	60	0.000
	Never married/single	55	45	24	30	27	0.000
Subjects composing the household	Divorced/separated	32	68	4	15	8	0.000
	Widowed	12	88	0	5	2	0.000
	I prefer not to declare this	72	28	4	2	3	0.024
Subjects composing the household during lockdown	Alone at home	20	80	6	37	18	0.000
	3 subjects in household	76	25	26	13	21	0.000
	4 subjects in household	84	16	30	9	22	0.000
Occupation	>5 subjects in household	89	11	8	2	6	0.000
	L_Alone at home	17	83	5	36	17	0.000
	L_3 subjects in household	74	27	27	15	23	0.000
Occupation during lockdown	L_ >4 subjects in household	87	13	37	9	26	0.000
	Worker	66	34	78	62	72	0.000
	Student	86	15	14	4	10	0.000
Physical activity during lockdown	Retired	7	93	1	27	11	0.000
	Unpaid position [§]	51	49	3	4	3	0.039
	L_smartworker	69	31	54	38	48	0.000
L_weekly expense	L_non-working	79	22	15	6	12	0.000
	L_physical activity 3–4 times per week	67	34	20	16	18	0.003
	L_weekly expense ≤ 50€	30	70	6	23	13	0.000
Frequency of consumption of fresh food	L_weekly expense 101–150€	72	29	33	21	28	0.000
	L_weekly expense 151–200€	75	25	20	10	16	0.000
	L_weekly expense > 200€	76	24	8	4	6	0.000
Frequency of consumption of local food	Low fresh food eater	44	56	6	11	8	0.000
	High fresh food eater	62	38	95	89	93	0.000
Frequency of consumption of local food	Low local food eater	56	44	21	26	23	0.0015
	High local food eater	63	38	79	74	77	0.0015

Note: *'Cluster/Level' = If reading each row, Cluster/Level will give the percentage of subjects out of the whole population belonging to each cluster (the combination of Cluster/Level of the two clusters will give 100% = the whole population); **'Level/Cluster' = If reading in column of each variable, the Level/Cluster will give the composition in percentage of how much the variable's level is represented within each cluster (composition within cluster); 'Global' is the percentage of subjects distributed in the whole population. For each variable, the levels that are not depicted in the table must be intended as not being included in the segmentation due to a low contribution in dimensions of MCA. [§] Unpaid position included unemployed or stay at home parents.

In terms of snacking, while we found that most respondents did not show a substantial change, one third increased snacking, in agreement with other studies conducted among students in Australia (Powell et al., 2021) and in Italy, showing an increase in comfort food consumption (Scarmozzino & Visioli, 2020). Additionally, snacking between meals increased in 36% of children in France (Philippe et al., 2021). Snacking can be interpreted as so-called 'emotional consumption' which may be due to negative experiences, such as self-isolation or boredom resulting from not working. Some individuals, in fact, tend to seek rewards and gratification physiologically associated with the consumption of food as a means of combating emotional distress (Evers et al., 2018). Regarding meal duration, while half of the respondents did not change the overall time spent on meal consumption, an important segment of the population (44%) reported an increase in meal duration. This last trend was expected (due to the greater amount of time generally available at home) and has been recently confirmed in the literature (Tribst et al., 2021). To the best of the authors' knowledge, these two dimensions of scheduled meal times were not previously observed in the literature on COVID-19.

In general, the current study confirmed several trends regarding some previously studied variables (total food intake, snacking) and added important insights about pleasure in home meals (defined as satisfaction in having a meal, described by both the pleasure in preparing meals and liking of the food eaten during the meals themselves) and variables linked to meal duration and the moment of the day in which the meal took place. The original aspect of the current research

was to consider all these variables together and to have collected other variables that helped to explain among which consumers the trends were observed. Apart from critical aspects of the study that may have biased the data (discussed below), our findings I. reinforce the idea of home meals being in general an important tool of socialisation during the COVID-19 lockdown and II. suggest that, in particular during unique stressful situations like an enforced lockdown, meal dedication may be one of the few tools able to increase the resilience (intended as the capacity to resist a stressful situation) of people in enforced confinement. For the first time, it was documented that meal-related activities like cooking together, searching for food online, etc. are related to increases in home meal pleasure. This was not expected at the beginning of the study, since the stressful situation induced by the enforced lockdown led us rather to hypothesise a general lowering of pleasure in all activities conducted at home.

4.2. Cluster differences and variable interplay in meal perception

In the current study, the segmentation highlighted two clusters of subjects showing different responses to confinement and different home meal perceptions during lockdown, clearly showing that lockdown did not equally impact the population in terms of meal perception.

One of these clusters (Cl1) was characterised by increased pleasure in home meals. This increased meal appreciation was clearly associated with both a high sense of togetherness (being together before and during lockdown) and to high food dynamism that included both being active in

cooking (high use of kitchen tools like cooking appliances, the mixer, the microwave; prolonged time dedicated to meal preparation) and to intense food-related activities like searching for recipes online, using advertising to buy food, intense food home delivery). Indeed, it has been previously shown that culinary capabilities increased during confinement (Hassen et al., 2020), that people had an increased desire to cook (Di Renzo et al., 2020) and that some cooking activities specifically increased during pandemic like baking (Sánchez-Sánchez et al., 2020), but the current study clarifies that this trend did not equally interest the whole population.

Home food delivery has been one of the most important elements among Italians during lockdown (Cavallo et al., 2020). As expected, we found that intense ready-to-eat meal home delivery and intense social media/internet-based activity (use of virtual social media to decide what to buy while grocery shopping, frequency of ready-to-eat meal delivery use, use of online channels to search for recipes, frequency of use of advertising to grocery shopping) were associated with youngsters. In this sense, since youngsters had increased pleasure in meals, the concept of digital applications/activities appears to be an interesting tool to increase resilience in difficult situations for younger people (Henderson & McLaughlin, 2020).

The fact that the group with the highest liking for meals (C11) had a higher percentage of participants under 30 years old is in agreement with Cavallo and colleagues, who found that, among those Italians with increased appetite, youngsters were the most numerous (Cavallo et al., 2020). Moreover, the fact that more 'positivity/enthusiasm' for meals was found mainly in youngsters goes in the same direction as several studies. For example, a recent study showed that those respondents who reported having made positive dietary change/s tended to be younger rather than older and had a higher educational attainment (Jaeger et al., 2021). Several studies conducted during the pandemic on eating behaviours in children in France (Philippe et al., 2021) and among students (18–24 years old) in Australia (Powell et al., 2021) suggested that negative changes in food choices may be due to boredom and an increase in snacking at home. In this sense, Australian youngsters (Powell et al., 2021) may have had different involvement towards meal preparation (for example a more passive role in food-related activities), and did not benefit from higher food involvement, in contrast to our population.

Unchanged liking for meals was associated with the 'older' age group and with being alone before and during the pandemic (C12). Since meal satisfaction in the elderly can be increased if the meal is shared with their families (Lee & Mo, 2019) and C12 was mainly composed of people maintaining their 'being alone condition' also during lockdown, it is not surprising that their appreciation for meals did not substantially change compared to before the confinement. This result is also in full agreement with another study performed in the Netherlands, showing that older participants were more likely to indicate experiencing no differences in their eating behaviours compared to those in the younger age group (Poelman et al., 2021). Indeed, it is known that conviviality, i.e. the pleasure of sharing meals with people, can increase pleasure in meals (de la Torre-Moral et al. 2021), but this was the first study explicitly documenting this aspect for meals experienced during the COVID-19 pandemic. Moreover, the current study clearly showed that participation in meal-related activity has a positive effect on meal appreciation, as previously observed in elementary school children (meal participation was positively correlated with food liking in children) (Hanson et al., 2020).

Taken together, these results suggest that low involvement with a meal (in terms of time dedication, weekly expense, and low interest in food-related activities, etc.) maintains the liking for meals unchanged, while an increase in meal appreciation was associated with high cooking activity, high togetherness, and intense food/meal-related online activity ('food online engagement'). More broadly, having found clusters with a different perception of meals (characterised by different sociological patterns) suggests that future policies of public health interventions could vary depending on the target. Since the perception of

meals may contribute to different degrees of a healthy/unhealthy diet (for a review on infants and toddlers, see Verhage et al., 2018), future stressful situations similar to the one experienced during the COVID-19 lockdown (e.g. situations that require home confinement) may be approached differently. Keeping in mind that meal involvement and conviviality increase pleasure in meals, for elderly people living alone or having poor meal dedication, it could be proposed for example to increase togetherness and to promote physical activity by cooking together. In contrast, for youngsters who often use social media and virtual tools, virtual cooking or virtually sharing experiences about meals and cooking could be a powerful tool to maintain resilience in these subjects.

4.3. Limitations

The current study had some limitations, mostly related to the characteristics of the sample. In particular, we used a convenience sample with a disbalanced proportion of females. A disbalanced and high proportion of females is quite common and often observed in sensory studies based on surveys (Di Renzo et al., 2020), as well as the use of opportunistic samples, which has also been recently observed in studies on COVID-19 consumption behaviour (Scacchi et al., 2021). However, in the current study, the unbalanced high number of females may have faithfully depicted the fact that females spent more time at home (and thus were more available for answering the survey) because of having lost their jobs more severely than men. In fact, in Italy, women and workers with fixed-term contracts were the two categories mostly penalised in terms of job loss by the COVID-19 pandemic (retrieved online from: Sole24 ore, 2021). Moreover, in the current study, we wanted to reach the widest age span in population, including elderly people who represent an essential part of the Italian population. However, the chosen system of data collection (online survey) may have reduced the percentage of older adults (>55 years old) completing the survey, since in general the use (and the effects) of virtual social media are not equal across age groups (Hardy & Castonguay, 2018). In particular, the use of social media is generally higher among youngsters (Spies Shapiro & Margolin, 2014) and decreases with age (retrieved online from: Pew Research Center, 2021), even if older adults increasingly use virtual social media (He et al., 2020). Thus, we decided not to exclude elderly subjects from the data, even if we were conscious of the possible underrepresentation of older adults. Another aspect that may have biased our results is that we voluntarily excluded participants positive for COVID-19 (both those suspected and those diagnosed). Since it is known that COVID-19 can alter smell, taste and chemesthesis perception (Aziz et al., 2021; Kumar et al., 2021; Parma et al., 2020; Santos et al., 2021) and it can lead to a reduction in meal appreciation, the choice to exclude diagnosed or suspected ill people was correct from a methodological point of view, because it excluded subjects having a lower *a priori* meal appreciation due their clinical condition. However, the exclusion of subjects with suspected or diagnosed COVID-19 may have underestimated the overall negative effects of the pandemic situation on meal pleasure. Finally, in respect to the comparison that we did for variables referring to behaviours *before* and *during* the lockdown, data related to the '*before*' situation were collected retrospectively (that is during the lockdown). Even if this an obvious limitation in such studies, it should be mentioned. Instead, as positive element, the current study is, remarkably, the Italian study involving the highest number of participants (>3,000), together with the one of Di Renzo and colleagues (Di Renzo et al., 2020). The high number of observations allowed for effective segmentation, which is an element of novelty in studies on food and the impact of COVID-19.

5. Conclusions

The current study highlights that the outbreak did not homogeneously affect meal-related behaviour and the perception of meals among

Italians, described by several dimensions (including Liking for meals, Pleasure in meal preparation, Overall food intake, Snack intake, Meal duration, Meal time). The perception of meals was related to different factors, among which the most influential seemed to be related to togetherness (being together) and to high engagement connected to meal-related activities ('food engagement').

In a population of people not suspected/not diagnosed with COVID-19, liking of meals was strongly associated with pleasure in meal preparation, and with overall food intake and the duration of meals. Higher meal appreciation was associated with a high social dimension (being together before and during lockdown, cooking together), to high cooking dynamism (intended as intense cooking activities including the frequent use of kitchen devices, online food-related activities and meal delivery), to the status of being a worker and being young (under 30 years old or a student).

In contrast, lockdown did not substantially vary meal pleasure in elderly/retired people, non-workers, people who were alone before and during lockdown and not used to cooking with others, people who showed low meal dedication (time spent on meal preparation, use of kitchen tools, weekly expenses) and low food-related activities (home delivery, digital activities like searching for recipes on the internet and social media).

These results suggest that a high level of involvement in cooking activities and meal preparation is important to increase the final appreciation of the meal. Since satisfaction in food consumption may have a positive impact on people's emotional well-being, but at the same time can induce an increase in the amount of food eaten, it is required that future studies further explore the individual variables that can play a relevant role in influencing food consumption during stressful situations like the one induced by the COVID-19 pandemic, in order to take actions aimed at promoting positive emotional states and simultaneously reducing the spread of eating behaviours that could have a negative effect on health during a pandemic. In the case of future stressful situations (like those experienced during the COVID-19 lockdown), specific interventions from public health authorities should be diversified based on the target subject to improve meal perception. While people living alone (such as the elderly) may benefit from physical togetherness to enhance meal-related activities and thus pleasure in meals, youngsters may benefit from virtual tools (social media related activities, etc.) to enhance meal appreciation.

Funding

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

CRedit authorship contribution statement

Maria Piochi: Methodology, Investigation, Data curation, Writing – original draft, Conceptualization, Visualization. **Federica Buonocore:** Software, Formal analysis. **Francesco Spampani:** Software, Formal analysis, Visualization. **Luisa Torri:** Conceptualization, Methodology, Investigation, Writing – review & editing, Supervision, Project administration.

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.

Acknowledgements

This work is part of a research project conducted at the University of Gastronomic Sciences by a multidisciplinary research group that also involved Paolo Corvo, Michele Filippo Fontefrancesco, Maria Giovanna

Onorati, and Donatella Saccone. The authors are grateful to all staff members, students, alumni and stakeholders of the University of Gastronomic Sciences who contributed to the data collection distributing the link to the online survey.

References

- Alm, S., Olsen, S. O., & Honkanen, P. (2015). The role of family communication and parents' feeding practices in children's food preferences. *Appetite*, 89, 112–121. <https://doi.org/10.1016/j.appet.2015.02.002>
- Aziz, M., Goyal, H., Haghbin, H., Lee-Smith, W. M., Gajendran, M., & Perisetti, A. (2021). The Association of "Loss of Smell" to COVID-19: A Systematic Review and Meta-Analysis. *American Journal of the Medical Sciences*, 361(2), 216–225. <https://doi.org/10.1016/j.amjms.2020.09.017>
- Berge, J. M., Draxten, M., Trofholz, A., Hanson-Bradley, C., Justesen, K., & Slattengren, A. (2018). Similarities and differences between families who have frequent and infrequent family meals: A qualitative investigation of low-income and minority households. *Eating Behaviors*, 29(February), 99–106. <https://doi.org/10.1016/j.eatbeh.2018.02.007>
- Bonaccorsi, G., Pierri, F., Cinelli, M., Flori, A., Galeazzi, A., Porcelli, F., Schmidt, A. L., Valensise, C. M., Scala, A., Quattrociochi, W., & Pammolli, F. (2020). Economic and social consequences of human mobility restrictions under COVID-19. *Proceedings of the National Academy of Sciences of the United States of America*, 117(27), 15530–15535. <https://doi.org/10.1073/pnas.2007658117>
- Buckland, N. J., Swinnerton, L. F., Ng, K., Price, M., Wilkinson, L. L., Myers, A., & Dalton, M. (2021). Susceptibility to increased high energy dense sweet and savoury food intake in response to the COVID-19 lockdown: The role of craving control and acceptance coping strategies. *Appetite*, 158(November 2020), 105017. <https://doi.org/10.1016/j.appet.2020.105017>
- Cavallo, C., Sacchi, G., & Carfora, V. (2020). Resilience effects in food consumption behaviour at the time of Covid-19: Perspectives from Italy. *Heliyon*, 6(12), e05676. <https://doi.org/10.1016/j.heliyon.2020.e05676>
- Cho, W., Takeda, W., Oh, Y., Aiba, N., & Lee, Y. (2015). Perceptions and practices of commensality and solo-eating among Korean and Japanese university students: A cross-cultural analysis. *Nutrition Research and Practice*, 9(5), 523–529. <https://doi.org/10.4162/nrp.2015.9.5.523>
- Cohen, J. F. W., Jahn, J. L., Richardson, S., Cluggish, S. A., Parker, E., & Rimm, E. B. (2015). Amount of time to eat lunch is associated with children's selection and consumption of school meal entrée, fruits, vegetables, and milk. *Journal of the Academy of Nutrition and Dietetics*, 116(1), 123–128. <https://doi.org/10.1016/j.jand.2015.07.019>
- de la Torre-Moral, A. L., Fàbregues, S., Bach-Faig, A., Fornieles-Deu, A., Xavier Medina, F., Aguilar-Martínez, A., & Sánchez-Carracedo, D. (2021). Family meals, conviviality and the mediterranean diet among families with adolescents. *International Journal of Environmental Research and Public Health*, 18(5), 1–17. <https://doi.org/10.3390/ijerph18052499>
- De Pue, S., Gillebert, C., Dierckx, E., Vanderhasselt, M. A., De Raedt, R., & Van den Bussche, E. (2021). The impact of the COVID-19 pandemic on wellbeing and cognitive functioning of older adults. *Scientific Reports*, 11(1), 1–11. <https://doi.org/10.1038/s41598-021-84127-7>
- Di Renzo, L., Gualtieri, P., Pivari, F., Soldati, L., Attinà, A., Cinelli, G., Cinelli, G., Leggeri, C., Caparello, G., Barrea, L., Scerbo, F., Esposito, E., & De Lorenzo, A. (2020). Eating habits and lifestyle changes during COVID-19 lockdown: An Italian survey. *Journal of Translational Medicine*, 18(1), 1–15. <https://doi.org/10.1186/s12967-020-02399-5>
- Divert, C., Laghmaoui, R., Crema, C., Issanchou, S., Van Wymelbeke, V., & Sulmont-Rossé, C. (2015). Improving meal context in nursing homes. Impact of four strategies on food intake and meal pleasure. *Appetite*, 84, 139–147. <https://doi.org/10.1016/j.appet.2014.09.027>
- Eck, K. M., Delaney, C. L., Olfert, M. D., Shelnett, K. P., & Byrd-Bredbenner, C. (2019). "If my family is happy, then I am happy": Quality-of-life determinants of parents of school-age children. *SAGE Open Medicine*, 7, 2050312119828535. <https://doi.org/10.1177/2050312119828535>
- Evers, C., Dingemans, A., Junghans, A. F., & Boevé, A. (2018). Feeling bad or feeling good, does emotion affect your consumption of food? A meta-analysis of the experimental evidence. *Neuroscience and Biobehavioral Reviews*, 92(May), 195–208. <https://doi.org/10.1016/j.neubiorev.2018.05.028>
- Figliozzi, M., & Unnikrishnan, A. (2021). Home-deliveries before-during COVID-19 lockdown: Accessibility, environmental justice, equity, and policy implications. *Transportation Research Part D: Transport and Environment*, 93(February), Article 102760. <https://doi.org/10.1016/j.trd.2021.102760>
- Filho, W. L., Voronova, V., Kloga, M., Paço, A., Minhas, A., Salvia, A. L., Ferreira, C. D., & Sivapalan, S. (2021). COVID-19 and Waste Production in households: A trend analysis. *Science of the Total Environment*, 777, 145997. <https://doi.org/10.1016/j.scitotenv.2021.145997>
- Gerritsen, S., Egli, V., Roy, R., Haszard, J., Backer, C. D., Teunissen, L., Cuykx, I., Decorte, P., Pabian, S. P., Van Royen, K., & Te Morenga, L. (2020). Seven weeks of home-cooked meals: Changes to New Zealanders' grocery shopping, cooking and eating during the COVID-19 lockdown. *Journal of the Royal Society of New Zealand*, 51(sup1), S4–S22. <https://doi.org/10.1080/03036758.2020.1841010>
- Hanson, J., Elmore, J., & Swaney-Stueve, M. (2020). Food trying and liking related to grade level and meal participation. *International Journal of Environmental Research and Public Health*, 17(16), 1–11. <https://doi.org/10.3390/ijerph17165641>

- Hardy, B. W., & Castonguay, J. (2018). The moderating role of age in the relationship between social media use and mental well-being: An analysis of the 2016 General Social Survey. *Computers in Human Behavior, 85*, 282–290.
- Hassen, T. B., Bilali, H. E., & Allahyari, M. S. (2020). Impact of covid-19 on food behavior and consumption in qatar. *Sustainability (Switzerland), 12*(17), 1–18. <https://doi.org/10.3390/su12176973>
- He, T., Huang, C., Li, M., Zhou, Y., & Li, S. (2020). Social participation of the elderly in China: The roles of conventional media, digital access and social media engagement. *Telematics and Informatics, 48*, 101347. <https://doi.org/10.1016/j.tele.2020.101347>
- Henderson, D., & McLaughlin, N. (2020). Relationships and resilience in the time of the Coronavirus. *Scottish Journal of Residential Child Care, 50*(5), 182. <https://doi.org/10.3928/00485713-20200409-02>
- Hock, S. J., & Bagchi, R. (2018). The impact of crowding on calorie consumption. *Journal of Consumer Research, 44*(5), 1123–1140. <https://doi.org/10.1093/jcr/ucx088>
- Husson, F., Josse, J., & Pagès, J. (2010). Principal component methods - hierarchical clustering - partitioning clustering: Why would we need to choose for visualizing data? In *Technical Report - Agrocampus, 18*(1). <https://doi.org/10.2478/v10037-010-0003-0>
- Il Sole24 ore, 2021. <https://www.ilsole24ore.com/art/lavoro-300mila-posti-11-mesi-la-pandemia-penalizzati-donne-e-contratti-termina-ADRQbrTB>
- Jaeger, S. R., Vidal, L., Ares, G., Chheang, S. L., & Spinelli, S. (2021). Healthier eating: Covid-19 disruption as a catalyst for positive change. *Food Quality and Preference, 92*, 104220. <https://doi.org/10.1016/j.foodqual.2021.104220>
- Janairo, J. I. B. (2021). Unsustainable plastic consumption associated with online food delivery services in the new normal. *Cleaner and Responsible Consumption, 2* (December 2020), 100014. <https://doi.org/10.1016/j.clrc.2021.100014>
- Kumar, L., Kahlon, N., Jain, A., Kaur, J., Singh, M., & Pandey, A. K. (2021). Loss of smell and taste in COVID-19 infection in adolescents. *International Journal of Pediatric Otorhinolaryngology, 142*(December 2020), 110626. <https://doi.org/10.1016/j.ijporl.2021.110626>
- Laguna, L., Fiszman, S., Puerta, P., Chaya, C., & Tárrega, A. (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* (May), Article 104028. <https://doi.org/10.1016/j.foodqual.2020.104028>
- Lee, K. H., & Mo, J. A. (2019). The Factors Influencing Meal Satisfaction in Older Adults: A Systematic Review and Meta-analysis. *Asian Nursing Research, 13*(3), 169–176. <https://doi.org/10.1016/j.anr.2019.06.001>
- McAtamney, K., Mantzios, M., Egan, H., & Wallis, D. J. (2021). Emotional eating during COVID-19 in the United Kingdom: Exploring the roles of alexithymia and emotion dysregulation. *Appetite, 161*(December 2020), 105120. <https://doi.org/10.1016/j.appet.2021.105120>
- Meiselman, H. L., Johnson, J. L., Reeve, W., & Crouch, J. E. (2000). Demonstrations of the influence of the eating environment on food acceptance. *Appetite, 35*(3), 231–237. <https://doi.org/10.1006/appe.2000.0360>
- Molina-Montes, E., Uzhova, I., Verardo, V., Artacho, R., García-Villanova, B., Jesús Guerra-Hernández, E., Kapsokefalou, M., Malisova, O., Vlassopoulos, A., Katidi, A., Koroušić Seljak, B., Modic, R., Eftimov, T., Hren, I., Valenčić, E., Šatalić, Z., Panjkota Krbavčić, I., Vranješić Bender, D., Giacalone, D., ... Rodríguez-Pérez, C. (2021). Impact of COVID-19 confinement on eating behaviours across 16 European countries: The COVIDiet cross-national study. *Food Quality and Preference, 93* (October 2020). <https://doi.org/10.1016/j.foodqual.2021.104231>
- Parma, V., Ohla, K., Veldhuizen, M. G., Niv, M. Y., Kelly, C. E., Bakke, A. J., Cooper, K. W., Bouysset, C., Pirastu, N., Dibattista, M., Kaur, R., Liuzza, M. T., Pepino, M. Y., Schöpf, V., Pereda, V., Abdulrahman, O., Dalton, P., Yan, C. H., & Voznessenskaya, V. V. (2020). More than smell – COVID-19 is associated with severe impairment of smell, taste, and chemesthesis. *Chemical Senses, 45*(7), 609–622. <https://doi.org/10.1093/chemse/bjaa041>
- Pew Research Center, 2021. <https://www.pewresearch.org/internet/fact-sheet/social-media/>
- Philippe, K., Chabanet, C., Issanchou, S., & Monnery-Patris, S. (2021). Child eating behaviors, parental feeding practices and food shopping motivations during the COVID-19 lockdown in France: (How) did they change? *Appetite, 161*, 105132. <https://doi.org/10.1016/j.appet.2021.105132>
- Poelman, M. P., Gillebaart, M., Schlinkert, C., Dijkstra, S. C., Derksen, E., Mensink, F., Hermans, R. C. J., Aardening, P., de Ridder, D., & de Vet, E. (2021). Eating behavior and food purchases during the COVID-19 lockdown: A cross-sectional study among adults in the Netherlands. *Appetite, 157*(August 2020), 105002. <https://doi.org/10.1016/j.appet.2020.105002>
- Powell, P. K., Lawler, S., Durham, J., & Cullerton, K. (2021). The food choices of US university students during COVID-19. *Appetite, 161*(July 2020), 105130. <https://doi.org/10.1016/j.appet.2021.105130>
- Sánchez-Sánchez, E., Ramírez-Vargas, G., Avellaneda-López, Y., Orellana-Pecino, J. I., García-Marín, E., & Díaz-Jimenez, J. (2020). Eating habits and physical activity of the spanish population during the covid-19 pandemic period. *Nutrients, 12*(9), 1–12. <https://doi.org/10.3390/nu12092826>
- Santos, R. E. A., da Silva, M. G., do Monte Silva, M. C. B., Barbosa, D. A. M., Gomes, A. L. d. V., Galindo, L. C. M., da Silva Aragão, R., & Ferraz-Pereira, K. N. (2021). Onset and duration of symptoms of loss of smell/taste in patients with COVID-19: A systematic review. *American Journal of Otolaryngology - Head and Neck Medicine and Surgery, 42*(2), 102889. <https://doi.org/10.1016/j.amjoto.2020.102889>
- Scacchi, A., Catozzi, D., Boietti, E., Bert, F., & Siliquini, R. (2021). COVID-19 Lockdown and Self-Perceived Changes of Food Choice, Waste, Impulse Buying and Their Determinants in Italy: QuarantEat, a Cross-Sectional Study. *Foods, 10*(2), 306. <https://doi.org/10.3390/foods10020306>
- Scander, H., Wiklund, M. L., & Yngve, A. (2021). Assessing time of eating in commensality research. *International Journal of Environmental Research and Public Health, 18*(6), 1–13. <https://doi.org/10.3390/ijerph18062941>
- Scander, H., Yngve, A., & Lennernäs Wiklund, M. (2021). Assessing Commensality in Research. *International Journal of Environmental Research and Public Health, 18*(5), 2632. <https://doi.org/10.3390/ijerph18052632>
- 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*(5), 675. <https://doi.org/10.3390/foods9050675>
- Snuggs, S., & McGregor, S. (2021). Food & meal decision making in lockdown: How and who has Covid-19 affected? *Food Quality and Preference, 89*(November 2020), 104145. <https://doi.org/10.1016/j.foodqual.2020.104145>
- Spies Shapiro, L. A., & Margolin, G. (2014). Theories of Adolescent Social Media Use. *Child and Family Psychology Review, 17*(1), 1–18. <https://doi.org/10.1007/s10567-013-0135-1.Growing>
- Stroebele, N., & De Castro, J. M. (2004). Effect of ambience on food intake and food choice. *Nutrition, 20*(9), 821–838. <https://doi.org/10.1016/j.nut.2004.05.012>
- Tribst, A. A. L., Tramontt, C. R., & Baraldi, L. G. (2021). Factors associated with diet changes during the COVID-19 pandemic period in Brazilian adults: Time, skills, habits, feelings and beliefs. *Appetite, 163*(November 2020). <https://doi.org/10.1016/j.appet.2021.105220>
- Verhage, C. L., Gillebaart, M., van der Veek, S. M. C., & Vereijken, C. M. J. L. (2018). The relation between family meals and health of infants and toddlers: A review. *Appetite, 127*(January), 97–109. <https://doi.org/10.1016/j.appet.2018.04.010>
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., & Ho, C. (2020). Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Qjm, 113*(5), 311–312. <https://doi.org/10.1093/QJMED/HCAA110>

Further reading

- De Backer, C. J. S., & Hudders, L. (2015). Meat morals: Relationship between meat consumption consumer attitudes towards human and animal welfare and moral behavior. *Meat Science, 99*, 68–74. <https://doi.org/10.1016/j.meatsci.2014.08.011>
- European Parliament, European Council 2003. Regulation (EC) No 1059/2003 of the European Parliament and of the Council of 26 May 2003 on the establishment of a common classification of territorial units for statistics (NUTS), <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02003R1059-20051126>.