



## “Waste not and stay at home” evidence of decreased food waste during the COVID-19 pandemic from the U.S. and Italy

Rachel F. Rodgers<sup>a,b,c,\*</sup>, Caterina Lombardo<sup>c</sup>, Silvia Cerolini<sup>c</sup>, Debra L. Franko<sup>a</sup>, Mika Omori<sup>d</sup>, Jake Linardon<sup>e</sup>, Sebastien Guillaume<sup>b</sup>, Laura Fischer<sup>a</sup>, Matthew Fuller-Tyszkiewicz<sup>e</sup>

<sup>a</sup> APPEAR, Department of Applied Psychology, Northeastern University, Boston, USA

<sup>b</sup> Department of Psychiatric Emergency & Acute Care, Lapeyronie Hospital, CHRU Montpellier, France

<sup>c</sup> Department of Psychology, Sapienza University of Rome, Rome, Italy

<sup>d</sup> Department of Psychology, Ochanomizu University, Tokyo, Japan

<sup>e</sup> School of Psychology, Deakin University, Victoria, Australia

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### ABSTRACT

The COVID-19 pandemic has profoundly disrupted household food purchasing and preparation, including elements identified as important drivers of household food waste. The two main aims of this study were (1) to examine changes in food waste behaviors since the start of the COVID-19 pandemic in the U.S. and Italy; and (2) to investigate potential predictors of food waste behavior, including avoidance of supermarkets, increased home cooking, and increased role of health concerns in food choices. A sample of  $n = 478$  (79% female) individuals from the U.S., mean (SD) age = 30.51 (10.85), and  $n = 476$  individuals from Italy, (78% female), mean (SD) age = 33.84 (12.86), completed an online survey between April 8th and April 28<sup>th</sup> 2020. Just under half of respondents (49%) reported decreased food waste since the start of the pandemic. Rates were significantly higher among the U.S. sample (61.5%,  $n = 294$ ) compared to the Italian sample (38%,  $n = 180$ ). Controlling for the time since restrictions were introduced, age, gender, and perceived financial security, logistic regression revealed greater reduction in food waste since the beginning of the pandemic for U.S. individuals relative to participants from Italy (OR = 0.47,  $p < .001$ ). In addition, increased importance of health concerns when making food choices (OR = 1.34,  $p < .005$ ) as well as more frequent cooking (OR = 1.35,  $p < .001$ ), and greater avoidance of supermarkets (OR = 1.15,  $p = .049$ ) were associated with greater probability of less food waste. Scarcity and greater reliance on cooking may encourage individuals to reflect on food waste practices. Further research should explore how these factors may be targeted to reduce food waste beyond the pandemic.

### 1. Introduction

Across the world, a substantial proportion of food is wasted at the consumer level, with particularly high rates in the U.S. with estimates ranging up to 21% of post-harvest food (Buzby, Farah-Wells, & Hyman, 2014). This food waste has an important negative impact on economic, social, and environmental outcomes (Neff, Spiker, & Truant, 2015). Furthermore, the U.S. has lagged behind other countries in terms of successful efforts to address food waste (Neff et al., 2015). An important barrier to these efforts is the lack of understanding of the individual-level factors that contribute to food waste, and potential cultural specificities of the U.S. context. During the month of April 2020, throughout the U.S., food supply and usage pattern have been radically

altered due to the health, social, and economic impact of the COVID-19 pandemic. Such a change offers a unique opportunity to explore correlates of food waste. In addition, the global nature of the pandemic provides an opportunity to conduct cross-cultural investigations to better capture elements of these changes that are unique to different geographical settings. The aims of the present study were therefore both to explore the effects of the pandemic on food waste in two cultural settings, the U.S. and Italy, as well as to investigate potential mechanisms underlying these effects.

The current COVID-19 pandemic has profoundly disrupted a number of elements related to household food purchasing and preparation. Following the announcement by the World Health Organization on March 11th classifying the COVID-19 contagion as a pandemic, waves of

\* Corresponding author. APPEAR, Department of Applied Psychology, Northeastern University, Boston, USA.

E-mail address: [r.rodgers@northeastern.edu](mailto:r.rodgers@northeastern.edu) (R.F. Rodgers).

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panic buying of food and other necessities were observed across the world, including in the U.S. and in Italy (Sim, Chua, Vieta, & Fernandez, 2020). Such behaviors have been described as resulting from perceptions and fears of scarcity (Sim et al., 2020), and have the effect of modifying food availability in the home. In addition to changes in food availability at home, the increasing social distancing and restrictions to daily movements and business closing put into place in both Italy and the U.S. over the following weeks contributed to altered availability of food options for purchase outside the home. As a result, restaurant options were drastically reduced, with most outlets for prepared foods closed entirely, or offering limited options for take-out both in Italy and in the U.S. Furthermore, social distancing measures coupled with increased anxiety related to contagion constituted barriers to frequently shopping for groceries, particularly in more densely occupied public spaces such as supermarkets, and may have led individuals to be avoidant of or try to minimize grocery shopping as much as possible. Together, these factors modified the availability of foods and types of foods within and outside the home, and shifted both perceptions and the realities of food availability.

A recent systematic review and conceptual framework identified a number of factors as important drivers of household food waste, thus providing a conceptual framework to guide investigations changes related to the COVID-19 pandemic (Roodhuyzen, Luning, Fogliano, & Steenbekkers, 2017). Specifically, elements related to food purchasing, such as buying more than needed, and shopping frequency and routines, were highlighted as important behavioral factors. In addition, personal factors including perceived time and food availability, advantages and disadvantages of frequent grocery shopping versus time costs and burden, attitudes towards and experiences of food scarcity, as well as habits in terms of cooking or eating food prepared outside the home were listed as factors to consider (Roodhuyzen et al., 2017). Importantly, the authors highlighted that research related to many of these factors is inconsistent and fragmented. (Jörissen, Priefer, & Bräutigam, 2015; Marangon, Tempesta, Troiano, & Vecchiato, 2014; Roodhuyzen et al., 2017). Given the fact that elements impacted by the present circumstances have been identified as important factors in relation to food waste, the first goal of this study was to examine changes in household food waste since the start of the pandemic. We hypothesized that overall, individuals would report perceived changes in their food waste behaviors since the start of the pandemic. Furthermore, although panic buying might initially have increased food waste due to larger quantities of foods at home (Porpino, Wansink, & Parente, 2016), overall, in view of the perception of scarcity coupled with restrictions and likely anxiety related to leaving the home to purchase food, it was hypothesized that individuals would report having lowered their food waste compared to before the pandemic.

The second goal of this study was to investigate potential mechanisms of decreased food waste. Given the changes in access to grocery shopping described above, it was hypothesized that barriers to accessing large food stores would be associated with decreased food waste. Furthermore, in addition to perceptions of abundance or scarcity, and food purchasing, individual food preparation and cooking habits and skills have been highlighted as important factors related to household food waste (Gaiani, Caldeira, Adorno, Segrè, & Vittuari, 2018; Romani, Grappi, Bagozzi, & Barone, 2018; Roodhuyzen et al., 2017; Stancu, Haugaard, & Lähteenmäki, 2016). Engaging in more home cooking and improved cooking skills, versus the acquisition of prepared food from outside, have been associated with decreased household food waste (Gaiani et al., 2018). Given that the COVID-19 pandemic has decreased individuals' capacity to acquire food, we hypothesized that increased home cooking would be associated with decreased food waste.

A third potential mechanism examined was related to health concerns. The COVID-19 pandemic has affected practical aspects of daily life that impact food-related behaviors; however, importantly, the pandemic has also been accompanied by increases in concerns related to contagion. These fears have been suggested to result in changes in food

choices to prevent health issues (Rodgers et al., 2020), including foods that may be more expensive or difficult to obtain and are believed to have the capacity to increase immunity. Thus, it was also hypothesized that changes in food choices related to the health concerns resulting from the pandemic would predict lower food waste.

Although food waste is a global concern, previous research has suggested geographic differences, with estimates in the U.S. overall found to be higher compared to those in Europe (van der Werf & Gilliland, 2017). Cultural differences in terms of food-culture but also the food environment may contribute to this finding. In particular, it has been suggested that countries with strong food cultures that have developed over time, and include a focus on food preparation and moderation may experience lower levels of food waste (Thyberg & Tonjes, 2016). Italy possesses such a food culture (Brunori, Malandrini, & Rossi, 2013), leading to likely differences in food waste and related factors compared to the U.S. (van der Werf & Gilliland, 2017). In addition, Italy was one of the first countries worldwide to experience high rates of contagion in the context of the COVID-19 pandemic, following China. This makes it an interesting context to observe as the effects of social distancing, health-related concerns, and disruptions to daily life were exacerbated there. Thus, a final aim of our study was to compare changes in food waste since the start of the pandemic in Italy and U.S., and the relative impact of different potential mechanisms across both those cultural contexts.

In summary, the present study addressed three broad aims: (1) to examine perceived changes in food waste behaviors since the start of the COVID-19 pandemic and test the hypothesis that individuals would report having decreased their food waste; (2) to examine decreased access to grocery stores and supermarkets, increased home-cooking, and increased impact of health concerns on food choices as potential mechanisms of perceived changes in food waste behaviors; and (3) to examine cross-cultural differences in perceived changes in food waste behaviors and related factors between the U.S. and Italy. Given the lack of data focusing specifically on differences in food waste related factors between these two countries, the third aim was an exploratory one and no specific hypotheses were formulated. Finally, as previous work has highlighted the role of sociodemographic characteristics in food waste behaviors (Neff et al., 2015; Spang et al., 2019), we also explored the impact of age, gender, and financial insecurity.

## 2. Methods

### 2.1. Participants and procedure

A sample of  $n = 478$  (79% female) individuals from the U.S., mean (SD) age = 30.51 (10.85), and  $n = 476$  individuals from Italy, (78% female), mean (SD) age = 33.84 (12.86), completed an online survey between April 8th and April 28<sup>th</sup> 2020.

Participants were recruited using a snowball sampling procedure. Online advertisements for a study focusing on health behaviors during the COVID pandemic were placed on Facebook and other social media, and circulated through mailing list and social media. Participants were invited to complete an anonymous 20 min online survey as part of a larger study. Eligibility criteria included being 18 years or over. Participants provided informed consent online before proceeding to the online survey, and no compensation was offered. The study was approved by the Institutional review boards of Northeastern University, Boston, U.S., and the Sapienza University in Rome, Italy.

## 3. Measures

### 3.1. Demographics

Participants provided their age and self-identified as female, male, transgender, or indicated they preferred not to use a label. As the proportion of participants who chose the transgender or prefer not to label

options was very small (1.5%), those groups were not analyzed in terms of gender differences, although they were retained in the main analyses. In addition, participants reporting on the number of children they had, as well as whether or not they considered themselves to be financially insecure.

### 3.1.1. Food waste

Participants responded to a single item regarding increased concern related to food waste since the start of the pandemic, "Thinking about now compared to before the pandemic - Currently, are you more careful about not wasting food?" Response options were 1 (*Much less than before*), 2 (*A little less than before*), 3 (*The same amount*), 4 (*A little more than before*), or 5 (*Much more than before*). For analyses purposes the variable was dichotomized such that responses 1–3 were coded 0 (*no change in food waste*) and responses 4 and 5 were coded as 1 (*decreased food waste*).

### 3.1.2. Home cooking

Participants responded to a single item regarding increased home cooking since the start of the pandemic, "Thinking about now compared to before the pandemic - Currently, have you been cooking more than before?" Response options were 1 (*Much less than before*), 2 (*A little less than before*), 3 (*The same amount*), 4 (*A little more than before*), or 5 (*Much more than before*).

### 3.1.3. Food choices related to health concerns

Participants responded to a single item regarding increased home cooking since the start of the pandemic, "Thinking about now compared to before the pandemic - Currently, are your eating choices conditioned by your worry about your health status?" Response options were 1 (*Much less than before*), 2 (*A little less than before*), 3 (*The same amount*), 4 (*A little more than before*), or 5 (*Much more than before*).

### 3.1.4. Avoidance of supermarkets

Avoidance of public places and stores was assessed through the item "I avoid spending time in public places such as the supermarket." Response options ranged from 0 (*Never*) to 5 (*Always*).

## 3.2. COVID-19 pandemic circumstances

Participants reported on the duration of their current confinement situation, with response options 1 (*A few days*), 2 (*A week*), 3 (*2 weeks*), 4 (*3 weeks*), 5 (*4 weeks*), 6 (*4–6 weeks*), 7 (*2 months*), or 8 (*more than 2 months*). In addition, participants reported on the nature of their present circumstances and the restrictions in place. Participants described their situation as 1 (*Confined to home, not allowed to go outside to exercise*), 2 (*Confined to home but allowed outside for brief individual exercise*), 3 (*Recommended to stay at home, but no regulations or controls*), 4 (*In quarantine due to testing positive*), 5 (*In quarantine due to high-risk contact*), 6 (*Social distancing but not staying home*), 7 (*No social distancing*). For the current analyses, options 1 and 2 (confined to home) were combined, as were options 4 and 5 (in quarantine). Current household food security was also assessed, "Do the people in your household have enough to eat in the current context?" (*Yes/No*).

## 3.3. Data analyses

First, differences in the socio-demographic characteristics between participants from Italy and the U.S. were compared using t-tests, and chi-square tests. Second, univariate cross-cultural differences (U.S. vs. Italy) on the dichotomized perception of changes in food waste variable were tested using a chi-square test. In addition, differences between participants reporting perceived decreases in food waste and the other group on study variables were examined using parametric and non-parametric tests as appropriate (t-tests and chi-square tests) in the whole sample. These analyses were then repeated within the samples from the U.S. and

Italy separately. Third, multivariable hierarchical logistic regression models were conducted to examine the independent predictors of perceptions of decreases in food waste controlling for sociodemographic factors (age, gender, and financial insecurity), as well as time since restrictions related to the pandemic had been introduced. McFadden's R-squared was used to estimate the amount of explained variance accounted for in each block. For the purpose of sensitivity analyses, a multinomial regression was also conducted with perception of no change in food waste (midpoint) compared to perceived decreases and perceived increases. All analyses were conducted using SPSS 26.

## 4. Results

### 4.1. Participant characteristics

The demographic characteristics (Table 1) revealed that in both countries the sample was somewhat skewed as compared to the general population, with a greater proportion of female respondents compared to national data (78% female in our sample, 51% female in Italy and the U.S.) (Istituto Nazionale di Statistica, 2018; US Department of Commerce, 2020). Similarly, our sample was somewhat younger than the general population (32 years in our sample, as compared to 44 years in Italy and 38 in the U.S), and less likely to have children with 76% of our sample reporting no children, while in the U.S. approximately 50% of women aged 30–34 years had children in 2016, and in Italy the average age for giving birth is 32 years and an average of 1.3 births per woman (Istituto Nazionale di Statistica, 2018; US Department of Commerce, 2020; Vespa, 2017, pp. 1–23).

Despite differing from national statistics in their respective countries, the two samples were largely comparable. The mean (*SD*) age in the Italian sample was higher than in the US sample, 33.84 years (12.86) compared to 30.51 years (10.85),  $p < .001$ . However, results from the chi-square test revealed that the proportion of male and female participants was equal across the samples ( $p = .18$ ). In addition, a larger

**Table 1**  
Sample characteristics and study variables.

	Full sample	US (n = 478)	Italy (n = 476)
Age	32.18 (12.00)	30.51 (10.85)	33.84 (12.86)
Gender (% female)	n = 749 (78.5%)	n = 378 (79%)	n = 371 (78%)
No children	n = 718 (76%)	n = 372 (78%)	n = 346 (74%)
Financial Insecurity	n = 303 (32%)	n = 130 (27%)	n = 173 (36%)**
Food Insecurity	n = 26 (2.7%)	n = 18 (3.8%)	n = 8 (1.7%)
Time since restrictions were put in place [Median]	4 weeks	4 weeks	4–6 weeks***
Type of restriction			
Confined	n = 602 (63%)	n = 326 (68%)	n = 276 (60%)
Recommended to stay at home	n = 169 (18%)	n = 51 (11%)	n = 118 (25%)
In quarantine	n = 131 (14%)	n = 12 (2.5%)	n = 119 (25%)
Social distancing	n = 45 (5%)	n = 22 (4.6%)	n = 23 (5%)
Food related variables			
Decreased food waste	n = 474 (49%)	n = 294 (61%)	n = 180 (38%***)
Increased cooking [Mean ( <i>SD</i> )]	3.91 (.95)	4.00 (1.02)	3.82 (.87)**
Food choices conditioned by health concerns [Mean ( <i>SD</i> )]	3.32 (.81)	3.43 (.92)	3.20 (.64)***
Avoidance of supermarkets [Mean ( <i>SD</i> )]	4.07 (1.20)	3.95 (1.22)	4.19 (1.17)*

Note: \* $p < .05$  \*\* $p < .01$  \*\*\* $p < .001$ .

proportion of the Italian sample (36%) compared to the US sample (27%) described themselves as financially insecure ( $p = .003$ ). Italian respondents indicated that the current restricted circumstances due to the pandemic had been in place for longer than the US sample ( $p < .001$ ), with the majority of the Italian respondents indicating the duration as 4 weeks, or 4–6 weeks (86%) compared to a majority (59%) of the U.S. respondents responding 3 or 4 weeks. The majority of the sample reported having no children (76%) with no differences across samples ( $p = .35$ ). The majority of participants described being confined to their home (64%). However, differences emerged with stricter restrictions reported by participants in Italy ( $p < .001$ ). A very small proportion of respondents indicated perceived food insecurity (2.7%), with no differences across samples ( $p = .07$ ).

4.2. Univariate associations with perceived decreases in food waste

A significantly higher proportion ( $p < .001$ ) of participants in the U.S. sample, 61.5% ( $n = 294$ ) reported perceived decreases in food waste relative to before the start of the COVID-19 pandemic, compared to the Italian sample (38%,  $n = 180$ ). No differences were found for age ( $p = .11$ ) in the full sample, or the U.S. ( $p = .41$ ), or Italian sample ( $p = .09$ ). Regarding gender, although no differences were found overall ( $p = .10$ ), or among the U.S. sample, ( $p = .90$ ), a significant difference emerged within the Italian sample ( $p = .047$ ), such that women were more likely to report perceptions of decreases in food waste compared to men. No differences were found for perceptions of decreased food waste according to reported financial insecurity in the total sample ( $p = .40$ ), or in the U.S. ( $p = .75$ ) and Italian ( $p = .06$ ) samples, respectively. No differences were found for perceptions of decreased food waste according to reported avoidance of supermarkets in the total sample ( $p = .25$ ), or in the U.S. ( $p = .20$ ) and Italian ( $p = .30$ ) samples, respectively.

In the full sample, 44.2% reported similar perceived decreases in food waste relative to before the start of the COVID-19 pandemic. This proportion was significantly higher ( $p < .001$ ) for participants in the U.S. sample, 56.5% ( $n = 245$ ) compared to the Italian sample (33.1%,  $n = 158$ ). No differences were found for age ( $p = .29$ ) in the full sample, or the U.S. ( $p = .12$ ), or Italian sample ( $p = .08$ ). Regarding gender, in the overall ( $p = .035$ ), and Italian sample ( $p = .005$ ), but not the U.S. sample, ( $p = .71$ ), a significant difference emerged such that women were more likely to report perceptions of decreases in food waste compared to men. No differences were found for perceptions of similar food waste according to reported financial insecurity in the total sample ( $p = .21$ ), or in the U.S. ( $p = .41$ ) and Italian ( $p = .08$ ) samples, respectively. No differences were found for perceptions of similar food waste according to reported avoidance of supermarkets in the total sample ( $p = .71$ ), or in the U.S. ( $p = .41$ ) and Italian ( $p = .54$ ) samples, respectively (Table 2).

4.3. Multivariable predictors of increased care to limit food waste

The findings from the logistic regression are summarized in Table 3. Controlling for the time since restrictions had been introduced, as well

as age, gender, and perceived financial insecurity, findings from the logistic regression revealed that when entered into the second block ( $R^2 = 0.03$ ), country was a significant predictor of perceptions of decreased food waste, with individuals from the U.S. more likely to report perceiving decreases in food waste since the beginning of the pandemic, compared to those from Italy (OR = 0.47,  $p < .001$ ). When entered into the third block ( $R^2 = 0.06$ ), increased importance of health concerns when making food choices (OR = 1.34,  $p < .005$ ) as well as increased cooking (OR = 1.35,  $p < .001$ ), compared to before the pandemic, and greater avoidance of supermarkets (OR = 1.15,  $p = .491$ ) were all independently and significantly associated with higher odds of perceived decreases in food waste. As in the previous mode, country was still a significant predictor of perceived decreases in food waste. In the fourth block ( $R^2 = 0.06$ ), none of the interaction terms emerged as significantly predicting perceptions of decreased food waste. The goodness-of-fit test is the Hosmer–Lemeshow (H–L) test,  $\chi^2(8) = 4.66$ ,  $p = .79$  suggesting that the model was a good fit to the data.

Findings from the sensitivity analyses revealed that the multinomial regression approached yielded an identical pattern of results regarding the likelihood of perceived decreases in food waste, compared to a perception of no change.

5. Discussion

The aims of this study were to examine changes in food waste behaviors since the start of the COVID-19 pandemic, and predictors of these changes in two samples from Italy and the U.S. Overall, findings revealed that food waste decreased, and that the variables examined - namely avoiding supermarkets, engaging in more home cooking, and increased role of health concerns in food choices - were predictors of such decreases in both countries. While the samples were convenience ones, and not representative of the general population more broadly, these findings nevertheless convey important information regarding modifiable factors that may be useful targets for reducing food waste beyond the current context, in particular the role of perceived access to food and scarcity versus abundance, as well as cooking practices.

Regarding the existence of changes in food waste, consistent with our hypothesis, in the full sample, just under half of respondents (49%) reported perceived decreases in food waste since the start of the pandemic. This is an important finding as it suggests that the circumstances created by the pandemic resulted in changes in attitudes and behaviors related to food waste.

In addition, our findings showed that more respondents from the U.S. reported perceptions of decreased food waste compared to those in Italy. This is an interesting finding and may be explained by a couple of different factors. First, these differences may be related to the lower baseline levels of food waste in Italy (van der Werf & Gilliland, 2017), and therefore reflect a floor effect in that Italian respondents who were already attentive to food waste did not report perceiving changes in their behaviors as a result of the pandemic. Second, these cross-cultural differences also suggest that the changes observed may be attributable to

Table 2  
Group Differences Between Those Reporting Decreased Food Waste and those Reporting no Change in Food Waste.

	Total (n = 947)		U.S. (n = 478)		Italy (n = 476)	
	Decreased food waste	No change in food waste	Decreased food waste	No change in food waste	Decreased food waste	No change in food waste
Age	31.54 (11.20)	32.82 (12.75)	30.86 (10.52)	29.98 (11.36)	32.59 (12.13)	34.66 (13.27)
Gender	83% female	79% female	82% female	83% female	84% female	76% female*
Financial insecurity	33%	44%	28%	35%	42%	33%
Type of restriction	67% confined	60% confined	69% confined	67% confined	63% confined	56% confined
Increased cooking	4.08 (.94)	3.74 (.93)***	4.18 (.96)	3.70 (1.04)**	3.91 (.88)	3.76 (.85)
Food choices conditioned by health concerns	3.44 (.82)***	3.20 (.78)***	3.50 (.90)	3.32 (.94) *	3.34 (.65)	3.11 (.62)***
Avoidance of supermarkets	4.13 (1.16)	4.02 (1.24)	4.02 (1.09)	3.85 (1.24)	4.26 (1.10)	4.13 (1.23)

Note: \* $p < .05$  \*\* $p < .01$  \*\*\* $p < .001$ .

**Table 3**  
Results from the logistic regression analysis predicting perceptions of decreases in food waste.

Step	Variable	B (SE)	p	OR (95% CI)	
1	<b>Gender</b>	-.44 (.21)	.037	0.64 (0.42, 0.97)	
	Time since restrictions were put in place	-.09 (.08)	.239	0.91 (0.77, 1.06)	
	Age	-.00 (.01)	.841	0.99 (0.98, 1.01)	
	Financial insecurity	.16 (.17)	.353	1.17 (0.83, 1.64)	
2	<b>Gender</b>	-.40 (.22)	.062	0.66 (0.43, 1.02)	
	Time since restrictions were put in place	.01 (.08)	.920	1.01 (0.85, 1.19)	
	Age	.00 (.01)	.749	1.00 (0.98, 1.01)	
	Financial insecurity	.26 (.17)	.132	1.30 (0.92, 1.84)	
	<b>Country</b>	-.75 (.17)	<.001	0.47 (0.33, 0.66)	
	3	<b>Gender</b>	-.29 (.22)	.187	0.75 (0.48, 1.15)
Time since restrictions were put in place		-.05 (.08)	.593	0.95 (0.80, 1.13)	
Age		.00 (.01)	.120	1.00 (0.98, 1.01)	
Financial insecurity		.29 (.18)	.105	1.34 (0.94, 1.91)	
<b>Country</b>		-.65 (.18)	<.001	0.52 (0.36, 0.74)	
<b>Food choices conditioned by health concerns</b>		.29 (.10)	.005	1.34 (1.09, 1.65)	
<b>Increased cooking</b>		.30 (.09)	.001	1.35 (1.13, 1.60)	
<b>Avoidance of supermarkets</b>		.14 (.07)	.049	1.15 (1.00, 1.32)	
4		<b>Gender</b>	-.31 (.22)	.166	0.73 (0.47, 1.13)
		Time since restrictions were put in place	-.06 (.08)	.489	0.94 (0.79, 1.12)
	Age	.00 (.01)	.813	1.00 (0.98, 1.02)	
	Financial insecurity	.27 (.18)	.128	1.32 (0.92, 1.88)	
	<b>Country</b>	-.63 (.18)	<.001	0.53 (0.37, 0.75)	
	Food choices conditioned by health concerns	-.06 (.32)	.842	0.94 (0.50, 1.75)	
	<b>Increased cooking</b>	.74 (.28)	.010	2.09 (1.19, 3.66)	
	Avoidance of supermarkets	.18 (.23)	.430	1.19 (0.76, 1.87)	
	Health concerns X Country	.26 (.22)	.246	1.29 (0.84, 2.00)	
	Increased cooking X Country	-.29 (.18)	.105	0.74 (0.52, 1.06)	
Avoidance of supermarkets X Country	-.03 (.14)	.814	0.96 (0.73, 1.27)		

Note. OR = odds ratio. Bold denotes statistical significance.

the potential for the pandemic-related circumstances to impact food-related habits and practices, rather than the duration or intensity of the pandemic itself. Such an interpretation would be consistent with the fact that the Italian respondents in our sample had been experiencing more restrictive circumstances and for longer than the respondents from the U.S. Also consistent with this, the level of restrictions and confinement reported by participants did not emerge as associated with changes in food waste. It is therefore likely that the higher rates of decreases in food waste in the U.S. are due to the capacity for food-related practices to be disrupted by the social distancing and other circumstances related to the pandemic.

Consistent with this, and with our hypotheses, controlling for sociodemographic factors, avoiding supermarkets, engaging in more home

cooking, and increased role of health concerns in food choices, were all independently associated with perceptions of decreased food waste. The fact that these factors emerged as concurrent independent predictors highlights their unique and respective associations with food waste behaviors, and their potential usefulness as targets for further interventions. Regarding the role of shopping habits, previous research has been mixed (Jörissen et al., 2015), and more work is required to clarify the explanatory mechanisms accounting for the relationship between avoiding supermarkets and decreased food waste. It may be that given the need or wish to avoid densely populated places due to health concerns, individuals preferred acquiring groceries from smaller outlets that limited their options, requiring greater planification, decreasing perceptions of abundance, and/or decreasing impulse buying and susceptibility to special offers and other marketing strategies, that have been identified as contributors to household food waste (Roodhuyzen et al., 2017). In addition, the need to limit time spent shopping as well as the reduced number of family members participating in grocery shopping due to social distancing requirements may also have played a role. Previous work has documented that social facilitation of buying occurring when individuals shop together contributed to purchasing more, which might then affect waste (Sommer, Wynes, & Brinkley, 1992). Increasing our understanding of the factors at play in future work would be warranted.

While most literature has previously supported the fact that home cooking is associated with lower food waste (Marangon et al., 2014; Roodhuyzen et al., 2017), the current findings go one step further by demonstrating that perceptions of engaging in *more* cooking than usual was associated with perceptions of *lowered* food waste, which provides additional support towards identifying cooking as an underlying mechanism for decreased food waste. Again, more work focusing on the understanding of the mechanisms responsible for this would be useful, including, for example whether increased awareness of and appreciation for the effort involved in food preparation and/or greater control over portion size leads to decreased food waste (Nikolaus, Nickols-Richardson, & Ellison, 2018). Given the broader benefits of consuming home-cooked foods in terms of nutrition and diet (Carroll, Wallace, et al., 2020; Mills et al., 2017), targeting home cooking in intervention efforts focused on decreasing food waste would appear to be advantageous and have the capacity to support positive outcomes across a range of indicators. Similarly, the increased role of health concerns in food choices was found to be associated with perceptions of decreased food waste. It has been described that a halo of attitudes related to sustainability, morality, and other dimensions are related to decreased food waste (Roodhuyzen et al., 2017). It may be that health concerns are an element of this constellation of attitudes (Hoek, Pearson, James, Lawrence, & Friel, 2017; O’Kane, 2016). Research studies that attempt to better understand and characterize this relationship, as well as to delineate how health concerns impact food preparation, eating, and in turn waste, are warranted.

Overall, cross-cultural differences emerged in the rates of decreased food waste, with higher rates of change reported by respondents in the U.S. compared to Italy. In addition to this, cross-cultural differences emerged in levels of the variables explored as potential explanatory mechanisms. Specifically, individuals in the U.S. reporting more increases in home cooking, and basing food choices on health concerns, while those in Italy reported more avoidance of supermarkets. Given the intensity of the spread of the virus in Italy, as well as the more restrictive policies, it is not surprising that Italian respondents should have reported higher avoidance of supermarkets. In addition, the lower pre-pandemic levels of home cooking overall in the U.S. may partially explain why this group reported more changes in this area (Eisenberg & Burgess, 2015). This finding is consistent with those from other areas of North America describing increases in home cooking during the pandemic (Carroll, Sadowski, et al., 2020). Of note, however, none of the interaction terms investigated in the multivariate analyses emerged as significant, suggesting that despite different levels of cooking, their

relationships with changes in food waste were similar across cultural contexts. This last finding provides further support for continuing to investigate the usefulness of these factors as levers for change in food waste.

Importantly, however, these findings identify predictors of decreased food waste that may be useful targets beyond the context of the pandemic. While the changes in practices related to shopping for food, and preparing and cooking food, were here driven by externally imposed restrictions as well as suddenly increased anxieties related to health, the behaviors described could be promoted under other circumstances. Intervention programs with families aiming to increase home cooking and food preparation exist (Gillespie et al., 2019) and could be usefully adapted for households without children. In addition, brief online interventions targeting young adults have also shown promise as methods for increasing home cooking among this group (Nour, Cheng, Farrow, & Allman-Farinelli, 2018). Regarding shopping practices and food choices, most interventions have focused on purchase decisions within food stores, with some evidence for their capacity to modify behaviors (Escaron, Meinen, Nitzke, & Martinez-Donate, 2013). Expansion of online grocery shopping options witnessed during the pandemic, may be enduring, and may also promote changes in individual behaviors in terms of food purchasing. Clarification of the mechanisms underlying our findings, and appropriate adaptations of interventions such as these to focus on shopping behaviors might also be a fruitful avenue. Finally, although here the perception of food scarcity was specifically tied to the circumstances created by the pandemic, it is possible that concerns regarding food scarcity more broadly may increase over time, particularly among groups with financial insecurity, and therefore these findings may continue to be relevant moving forward and inform future research in these areas.

The study includes a number of limitations. Most importantly, our measure of food waste was self-reported and were point-in-time. The overall lack of consensus in terms of definitions, and therefore measures of food waste in the literature overall has previously been highlighted (Roodhuyzen et al., 2017; Sheen, Hardman, & Robinson, 2020; van der Werf & Gilliland, 2017), and single item assessments have previously been used with success (e.g. Robinson & Hardman, 2016). Nevertheless, future work should aim to use valid and reliable tools that might be implemented consistently across research. Furthermore, responses to this item may have been related to broader prosocial norms during the pandemic or driven by social desirability. In the context of the pandemic, changes to food-related behaviors were confounded by compliance with overall health recommendations, and may therefore have reflected current social norms during the initial months of the pandemic. In addition, it has previously been suggested that individuals are aware of and responsive to social norms regarding food waste (Stancu et al., 2016), and this may also have impacted responses here.

In addition, our samples are not representative of the general population, and are mainly composed of young adults with no children. This discrepancy limits the extent to which the findings may be generalized more broadly and applied to other groups. It has been previously shown that households without children tend to generate less food waste than those with children (Thyberg & Tonjes, 2016), and therefore extending these findings and exploring changes in food waste among households with young children in particular would be a useful direction. In contrast, however, it has also been suggested that overall young people are more wasteful of food, therefore the focus here on young adults is a useful one (Thyberg & Tonjes, 2016). As a related limitation, our sample was composed mainly of young women, and therefore, increasing our understanding of the factors related to food waste in young men, who may be less inclined than their female counterparts to engage in home cooking would be important.

To conclude, our study suggests that the circumstances created by the COVID-19 pandemic have been associated with individuals reporting decreases in their food waste, although the extent of these changes may vary across cultural contexts, with the greatest decreases reported

by U.S. participants in our sample. In addition, our findings indicate that lowered food waste may be related to recent changes in the way food is purchased and prepared, including increased home cooking, as well as food choices that are more strongly determined by health concerns. This is a novel and important contribution, and our study is the first to our knowledge to have investigated the effects of the COVID-19 pandemic on food waste. Although many of the effects of social distancing measures are detrimental at the individual and social level, and include negative impacts on mental and physical health (Brooks et al., 2020) as well as education and financial circumstances (Viner et al., 2020), it is interesting to note that the profound and sudden changes in some behaviors and habits may have positive effects such as the reduction of food waste. It would be important to work toward preserving these more positive behavioral changes moving forward as restrictions are lifted and the situational elements supported here as drivers of the increased attention to food waste disappear.

### Ethical statement and disclosures

The present study was approved by the Northeastern University IRB as well as that of the Sapienza University in Rome.

The authors declare no conflicts of interest.

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### Declaration of competing interest

The authors have no conflicts of interest to disclose.

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