Five ways to waste food: Food Wasting Behaviours Questionnaire

Michal Misiak[1,3], Małgorzata Sobol[2], Łukasz Sakowski, Marta Kowal[1], Aleksandra Jurczyk[1], Lidia Wojtycka[1]

[1] Institute of Psychology, University of Wroclaw, Poland
[2] Department of Psychology, University of Warsaw, Poland
[3] Institute of Anthropology & Museum Ethnography, University of Oxford, UK

THIS IS A POSTPRINT.
The Version of Record of this manuscript has been published and is available in British Food Journal.
Date of publication: 30 June 2023.
Citation information (APA): Misiak, M., Sobol, M., Sakowski, L., Kowal, M., Jurczyk, A. and Wojtycka, L. (2023), "Five ways to waste food: food wasting behaviours questionnaire", British Food Journal, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/BFJ-07-2022-0641

Author Note

The studies were pre-registered (https://osf.io/6e7ku; https://osf.io/f7hs4) and the data are publicly available (https://osf.io/gcfra/files/).

Acknowledgements: We would like to thank Paulina Idziak, Marta Rokosz, and Michał Stefańczyk for their help with the recruitment of participants and valuable comments on the design of the studies.

This study was supported by National Science Center, Poland (2016/23/N/HS6/00849 to Michał Misiak). Michał Misiak was supported by the START scholarship of the Foundation for Polish Science (FNP), by the scholarship of the National Science Centre (2020/36/T/HS6/00256).

Author contributions

All authors have approved the final article. Conceptualization: MM, MS; Methodology: MM, MS, ŁK, MK, AJ, LW; Formal analysis: MM; Investigation: MM, ŁS, MK, AJ, LW; Data Curation: MM; Writing – Original draft: MM; Writing – Review & Editing: MM, MS, ŁK, MK, AJ, LW; Visualization: MM; Supervision: MM, Project Administration: MM, Funding Acquisition: MM. **Declarations of interest: none.**

Corresponding Author: Michal Misiak, IDN Being Human Lab, University of Wroclaw, ul. Dawida 1, 50-527 Wroclaw, Poland; michal.misiak@uwr.edu.pl

Abstract

Design/methodology/approach - Based on pre-registered studies, a new questionnaire for measuring the frequency of food wasting behaviours, the Food Wasting Behaviours Questionnaire (FWBQ), was developed.

Purpose - The goal of the present research was to resolve two problems with contemporary methods used to assess consumer food waste: the lack of established categories of food wasting behaviours and difficulties in assessing food waste. In Studies 1A and 1B, a five-factor questionnaire for measuring food wasting behaviours was developed. Study 2 and Exploratory analyses verified whether, the questionnaire allows for predicting the amount of wasted meat, dairy, and bakery and a range of socioeconomic characteristics.

Findings - The results provided evidence that behaviours associated with food wasting could be narrowed down to five distinctive basic categories: (1) discarding food because of its' unpalatability; (2) preventing food waste through buying only the necessities; (3) preventing food waste through planning; (4) preventing food waste through sharing; and (5) preventing food waste through feeding animals. The FWBQ allowed for investigating the socio-economic factors that influence food wasting behaviour. Finally, the FWBQ allowed for predicting the amount of wasted meat, dairy, and bakery products. Also, particular factors were associated with a range of socioeconomic characteristics.

Originality/value - The FWBQ has been shown to be an inexpensive and easy-to-use method for systematising distinct categories of food wasting behaviours and demonstrating their determinants. Also, the study takes an empirical approach (rather than intuitive) to distinguish separate categories of food wasting.

Keywords: food waste, food wasting behaviour, food sharing, planning, food purchases

Consumer food wasting behaviour is a burning environmental and social problem—yet, it is still not fully understood how to prevent it (Principato, 2018; Quested *et al.*, 2013). Neglecting this issue contributes to environmental damage, like deforestation (Houghton, 2012), water contamination (Chapagain and James, 2013), and climate change (Melikoglu *et al.*, 2013). This, in turn, negatively affects the lives of people all over the world (IPCC, 2018). The most prominent international organizations aim to minimize the negative impact of food wastage in line with the idea of sustainable development. The United Nations aims at halving per capita global household and retail-level food waste by 2030 (United Nations, 2020). Following these goals, the European Commission calls for awareness campaigns to change consumer behaviour (European Commission, 2021).

In industrialised countries, the biggest amount of food is wasted by direct consumers in their households (Parfitt *et al.*, 2010). It happens regularly, even though food wasting behaviour could be detrimental to financial security (e.g., Aureli *et al.*, 2021), and people are highly motivated to avoid wasting (Berjan *et al.*, 2022; Haque *et al.*, 2021). To prevent all these repercussions, it is crucial to understand the behaviours that make people discard their foods and the reasons that lead them to do it. Recent research reviews, published on the topic of household food waste, stress the importance of two categories playing a deciding role in shaping food wasting behaviours: individual and situational factors (Hebrok and Boks, 2017; Porpino, 2016; Principato, 2018; Principato *et al.*, 2021; dos Santos *et al.*, 2022; Schanes *et al.*, 2018). Although one can have a fair idea of potential individual (e.g., psychological characteristics, age) and situational factors (e.g., household size, economic situation) shaping food wasting behaviours, it remains difficult to estimate and compare their impacts. The problem lays in a lack of tools for assessing consumer food wasting behaviours systematically.

Measuring food wastage is a challenge, not only on the global but also on the consumer level (Food and Agriculture Organization, 2019). According to the review by van Herpen and colleagues (2019), researchers lack a gold standard. They often use kitchen caddies, photo coding, or—less often—waste composition analysis. Employing these methods requires participants to put a lot of effort into measuring the food waste, sometimes over several days. This, in turn, increases the drop-out rate and questions data accuracy (van Herpen, van der Lans, *et al.*, 2019). Although these methods are much better at predicting the actual proportion of wasted food in the household (Delley and Brunner, 2018), they are also complicated for the participants as well as time and resource-consuming for the researchers. This limits the possibility of employing them in large-scale research programmes. They also do not provide any information on proximate causes of food waste, like consumer behaviours—they rather assess their effects.

There are two categories of self-report questionnaires for assessing consumer food waste: questionnaires directly aimed at measuring the amount of wasted food (e.g., van Herpen, van Geffen, et al., 2019), which often use visual aids to help people imagine the amounts of wasted food (Martindale, 2014; Shu *et al.*, 2021); and questionnaires assessing the frequency of behaviours that lead to food waste (e.g., Babbitt *et al.*, 2021; Misiak *et al.*, 2020).

The first category, although much less complicated and less expensive than direct observations, may result in biased estimates of the amount of wasted food due to underreporting caused by social desirability bias (van Herpen, van der Lans, *et al.*, 2019) along with difficulty in recollecting the memories of the amount of wasted food (Jörissen *et al.*, 2015). To improve the quality of direct self-reports, researchers have to pre-announce the survey several days before the actual study and specify detailed product categories to facilitate the recall (van Herpen, van Geffen, *et al.*, 2019). Also,

these types of measures assess the consumer food waste on a household level—these are not suitable to assess the amount of food waste produced by a single person, which limits the possibility of testing the hypotheses regarding individual factors (e.g., psychological), that may affect food wasting behaviours (Shu *et al.*, 2021). The perspective of the individual person might be even more important in the future. Given the declining household sizes (Bradbury *et al.*, 2014), an increased amount of people will be responsible for their personal wastage—in bigger households this responsibility is being shifted to others—in most cases, women (Shelton and John, 1996). Furthermore, there is a rising popularity of initiatives, such as food sharing, that allows people to minimize their personal amount of food waste through donating and exchanging foods (Schanes and Stagl, 2019).

The second category of self-report food wasting methods provides no information on the actual amount of wasted food. It assesses the frequency of behaviours that lead to food wasting, like poor shopping, storing or managing habits (Babbitt *et al.*, 2021; dos Santos *et al.*, 2022; Schanes *et al.*, 2018). This approach pinpoints the behaviours that could be addressed during informational campaigns or other interventions aimed at minimizing consumer food wasting behaviour (Schmidt and Matthies, 2018). Moreover, it allows for identifying and testing individual factors underlying particular behaviours that lead to food waste. For example, moral attitudes may influence planning more strongly than shopping (Stefan *et al.*, 2013). The untapped advantage of this approach lies in the possibility of assessing and comparing diverse types of behaviours leading to food waste. Thus, it allows for clarifying whether some individual and situational factors shape only specific food wasting behaviours, or whether these factors shape more than one category of behaviours. However, the current methods target only narrow groups of behaviours, which makes comparing them impossible (e.g., Misiak et al., 2020; Stancu et al., 2016; Stefan et al., 2013).

Recent conceptual models of consumer food waste highlight the importance of psychological and situational factors, which shape behaviours and influence the amounts of wasted food (Boulet *et al.*, 2020; Roodhuyzen *et al.*, 2017; dos Santos *et al.*, 2022; Stancu *et al.*, 2016). In his review, Porpino (2016) highlighted the key drivers. For example, he identified several psychological factors, namely, one's own identity, emotional responses to food waste or the knowledge on managing the leftovers; and situational factors, like caring for a pet and the size or composition of one's family. Similarly, recent studies have accentuated the importance of routines (Romani *et al.*, 2018), morality (Misiak et al., 2020), and cognitive processes (Nicholes *et al.*, 2019). Based on these and similar studies, Principato and colleagues (2021) proposed a theoretical framework: *the household food waste journey.* It was founded on the marketing and behavioural theories of the consumer decision-making process. The household food waste journey framework pictures wasteful behaviour

as the result of planning, in-store behaviours, pre-consumption, consumption and disposition. In turn, these behaviours are caused by psychological and situational factors, norms, demographics, and socioeconomic factors. As this approach is one of the most comprehensive theoretical accounts of food waste in households, any tool to measure the frequency of food waste must take into account at least some of the behaviours highlighted by Principato and colleagues (2021). Their work shows us that researchers when they study food waste, tend to focus on a single category of behaviour, such as grocery planning, but do not measure a comprehensive range of behaviours that would allow different categories of food waste behaviour to be compared with each other. This practice, in turn, hinders the possibility of quantitively synthesising the knowledge in meta-analyses and comparing the power of factors that lead to certain categories of behaviours.

Previous review work points to gaps that need to be filled. Among them, two in particular seem most prominent to us.

(1) The lack of established categories of food wasting behaviours. Reading through the review papers on food waste (e.g., Principato, 2018; Principato et al., 2021; dos Santos et al., 2022; Schanes et al., 2018), it is noticeable that researchers in each paper try to propose their own list of food waste behaviours, dividing them into categories (e.g., wastage due to poor cooking, planning, or poor storage). These divisions are often based on the intuitive assumptions of researchers and there is a risk they do not include behaviours that do not resonate with these intuitions. A method with clearly defined food waste categories would make it easier to systematise knowledge and conduct meta-analyses (which are virtually non-existent in the food waste literature).

(2) difficulties in assessing food waste—both for the participant and the researcher. Methods used to assess food waste at the consumer level or food wasting behaviour are either one-dimensional (e.g., Misiak et al., 2020), expensive to employ (like composition analysis) or have complicated procedures – both for a participant and a researcher (van Herpen, van der Lans, et al., 2019). This severely hinders the possibility of conducting preliminary, exploratory, or lower-budget studies. The high entry threshold for researching food waste may discourage researchers from pursuing this topic. Additionally, being able to use a low-cost initial method reduces the risk of wasting research funds. By using low-cost methods researchers could run preliminary studies to determine the most promising entry points for more complex research programmes.

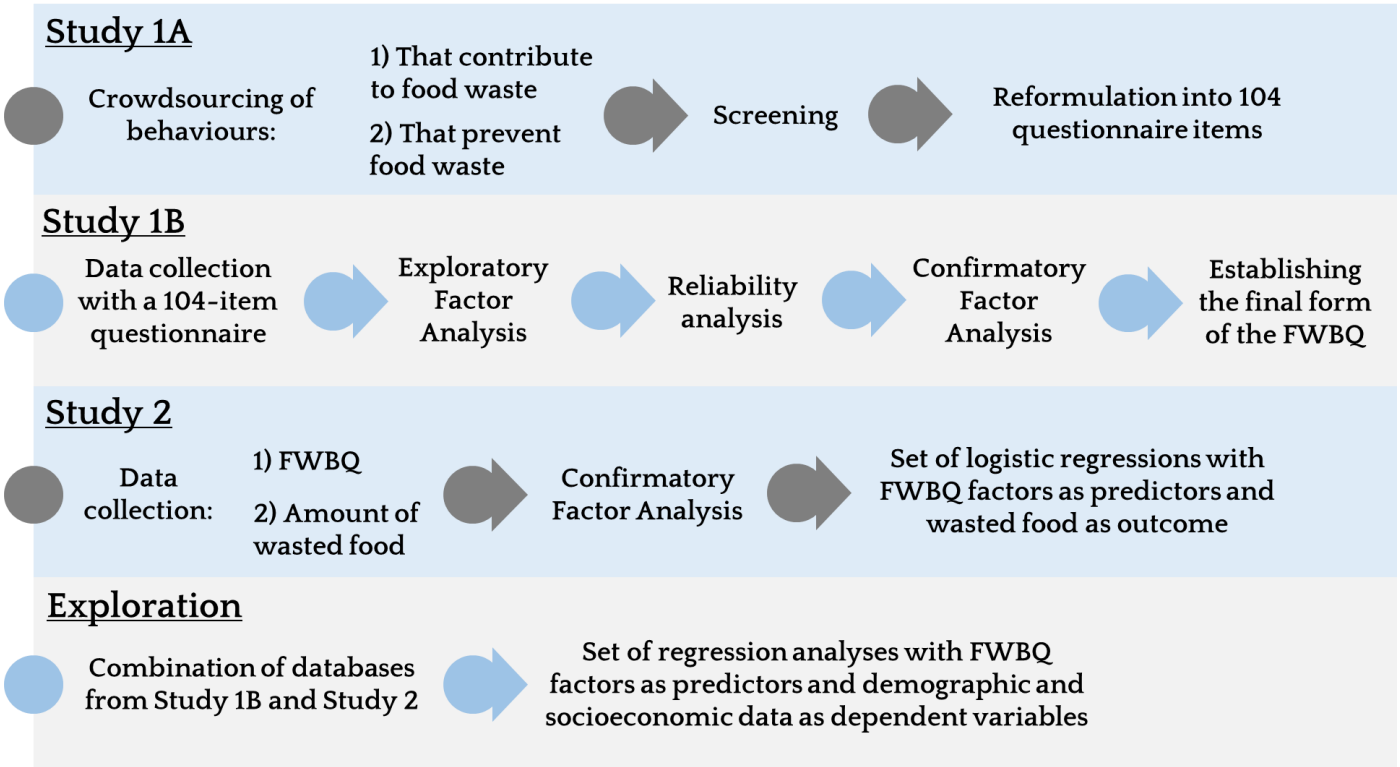
This paper introduces the Food Wasting Behaviours Questionnaire (FWBQ)—a novel method for preliminary research on food wasting behaviours that allows for inexpensive and systematized studies. The method was developed to solve two problems with contemporary methods used to assess consumer food waste.

2. Methodology

This research programme included a set of pre-registered empirical studies and exploratory analyses. The main steps that were taken in its course are shown in Figure 1. In the first part of the research (Study 1A), study participants were asked to generate a list, as long as possible, of behaviours that contribute to food waste and those that prevent it. The behaviours were crowdsourced to prepare as a detailed and comprehensive list of behaviours as possible. This procedure minimised the possibility of missing out on some important side of consumer food wasting behaviour. It generated a list of 104 distinctive behaviours, which were used in the next part as a long version of the questionnaire (Study 1B). The collection of data using the long version of the questionnaire made it possible to use factor analyses to determine the number of factors that underlie such a wide range of behaviours. In the following section (Study 2), the final version of the questionnaire was used to predict the declared amount of wasted food. The exploratory part (which was not pre-registered) verified the relationships of the factors with demographic and socioeconomic data. The last two steps aimed to verify the validity of the questionnaire and demonstrate its potential for future studies.

Figure 1

Diagram showing the main steps carried out in the present studies



The present studies were conducted on three Polish samples which were recruited online via the snowball sampling method. Poland is an industrialized Central European country with a mixed economy and developed market. It is placed by International Monetary Fund as the 52nd country regarding GDP per capita (out of 192 ranked countries; International Monetary Fund, 2022) and as the 21st country regarding food security (out of 113 ranked countries; Economist Impact, 2022). This shows that the people of this country can afford a healthy and balanced diet. Their food security is not compromised, partly because they can benefit from modern food production and food storage methods. In this context, Poland is not too different from other European countries and other countries with a modern food industry. We believe that the data collected on Poles will be a good reference point for other countries, as it is neither an extremely rich nor an extremely poor country. It should be noted, however, that the results of our study may need to be adapted to the conditions of a population with a much less developed food industry, as the range of possible food wasting behaviours may differ. The studies were conducted in accordance with the Declaration of Helsinki. Also, the Principal Investigator's Institutional Ethics Committee approved the studies. All the participants gave their informed consent to participate in the study.

It is important to stress that this research programme was not driven by any theoretical reasoning and its purpose was not to fill any bibliographical gaps. Nor did it answer any theoretical research questions. It was guided purely by pragmatic objectives and aimed to provide a needed tool to measure the frequency of food wasting behaviours. The results of the studies, however, have theoretical relevance as they identify specific dimensions of behaviour leading to food waste. These findings, therefore, will be discussed in the context of the *household food waste journey* theoretical framework (Principato *et al.*, 2021).

Study 1

Study 1 consisted of two parts: 1A and 1B. It was aimed at constructing a questionnaire suitable for assessing consumers' food wasting behaviours, by investigating the behaviours associated both with discarding edible foods and behaviours associated with preventing food spoilage. In Study 1A, participants were asked to spontaneously list different behaviours that in their opinion cause food to be discarded and to generate a separate list of behaviours that prevent foods from being discarded. In Study 1B, the proposed reasons were reformulated into items. It was further verified whether any common factors underlie these behaviours. The factor analysis was expected to reveal behavioural categories similar to those included in Food Recovery Hierarchy (FRH) by the USA Environmental Protection Agency: source reduction, feeding hungry people, feeding animals, and composting (Environmental Protection Agency, 2015). The FRH includes an additional step: industrial uses, but it is unavailable for a regular consumer. This

framework was previously used to describe the categories of behaviours associated with food wasting behaviours and because of that, it was assumed that it is a good reference point to start with (Papargyropoulou *et al.*, 2014). Results of Study 1A and 1B allowed for establishing a five-factor questionnaire—the Food Wasting Behaviours Questionnaire (FWBQ).

In Study 1A, the invitation to the online survey via social media was distributed. The participants listed the behaviours that, in their opinion, result in discarding edible food. Separately, they listed the behaviours that prevent food from being discarded. The sample consisted of 177 participants who listed 77 unique behaviours associated with food discarding and 73 unique behaviours associated with preventing food from being discarded. The complete list of behaviours is presented in Supplementary Material Table S1. The initial screening of participant's responses suggested that some of them did not list actual behaviours (e.g., *having a larger fridge*), some listed behaviours that are very unique and may not be exhibited frequently (e.g., *discarding food after an illness-related diet switch*), and some of them listed behaviours specific only to particular social groups (e.g., *donating food to community fridges*). Three independent judges (psychologists) rated each response on three dichotomous scales to establish (1) whether the participant's response concerns an actual behaviour; (2) whether it may occur more than once a month; and (3) whether it can be culturally universal. By doing so, the list of items was limited only to those that may be potentially exhibited frequently and those that could be understood in wider social groups. As a result, 104 behaviours were unanimously judged as fulfilling these criteria. The behaviours were reformulated so they could be used as items in a questionnaire.

Based on the results of the first study, we developed a 104-item questionnaire for measuring the frequency of behaviours associated with food wasting. Participants were asked to use a 7-point scale to assess how frequently they behaved in a given way. The authors distributed the questionnaire through a snowball sampling method by posting a link to the study on their social media. After the completion, each participant was asked to post the link on their social media pages. The goal was to gather a sample suitable for conducting exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). According to Goretzko and colleagues (2019), the lower bound of 300 cases for conducting EFA and 300 cases for conducting CFA could be sufficient.

The final sample consisted of 612 participants (444 women; 163 men; 5 people identified themselves as non-binary; age M = 28.10, SD = 8.02; one participant who declared to be 222 years old was excluded from the analyses). The study was conducted on September 2-25, 2019.

The sample was divided into halves to obtain two independent samples with similar characteristics. Firstly, the data were ordered by participants' gender and age. Secondly, participants with even-case numbers formed Sample 1 (n = 306), and participants with odd-

case numbers formed Sample 2 (n = 306). Both samples were identical in the distribution of gender and near-identical concerning mean age.

The EFA was conducted on the first half of the sample with the principal axis factoring and Promax rotation (according to recommendations by Goretzko and colleagues; 2019). The factors retention was decided according to multiple criteria (i.e., parallel analysis, scree test, the variance accounted for each factor, and theoretical criteria). After establishing the items that reflect the factor structure best, we measured the internal consistency of each factor with Cronbach's alpha.

In the second half of the sample, the CFA with maximum likelihood estimation was conducted. The multiple cut-off criteria (i.e., CFI, RMSEA, SRMR, expected parameter change and modification index) were used.

All the analyses were performed using the Jamovi software (version 1.6.9; The jamovi project, 2020). The methods, analyses, and hypotheses for this study were pre-registered (osf.io/6e7ku; osf.io/f7hs4) and the data are publicly available (osf.io/gcfra/files/).

Study 1 Results

Exploratory Factor Analysis

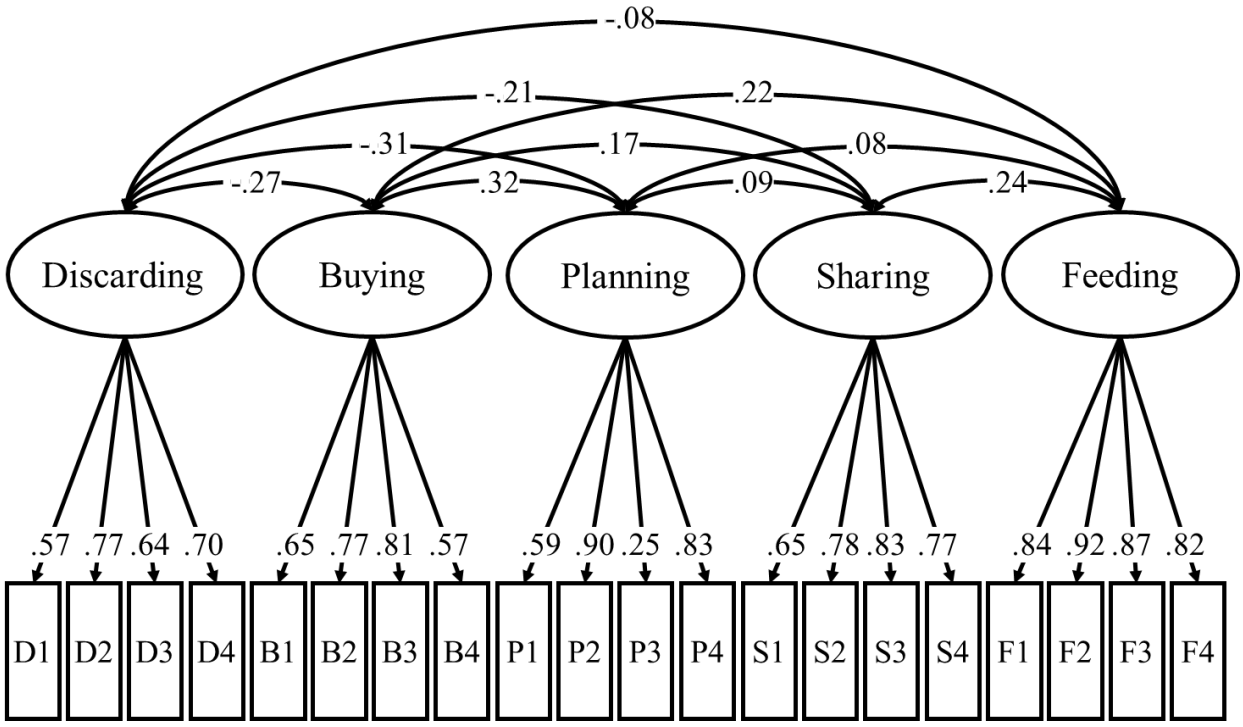
The correlation matrix of 104 items was suitable for factor analysis (KMO = .86; Kaiser & Rice, 1974). The scree test analysis suggested that there are five factors, therefore, the analyses for five fixed factors were conducted. Finally, four items per factor that best fitted the theoretical structure were extracted. The reliability analyses were conducted to test the internal consistency. The five factors included items that were describing behaviours of discarding an edible food that has become unpalatable (α = .77); behaviours of buying food according to one's needs (α = .82); behaviours of planning one's meals and groceries (α = .79); behaviours associated with sharing the excess food with other people (α = .84); behaviours associated with feeding the excess food to animals (α = .94).

Confirmatory Factor Analysis

The path diagram for confirmatory factor analysis is presented in Figure 2. All indicators showed a good model fit: $\chi^2(160)$ = 279, p < .001; CFI = 0.95; RMSEA = 0.05; SRMR = 0.06 (Brown, 2015; Hu and Bentler, 1999). One item in the Planning factor demonstrated a low loading (*I try to prepare meals that I can eat the next day;* loading = .25). However, it was decided to include this item as it perfectly fits the Planning factor theoretically. Some items might be more distant from the factor and therefore have lower factor loadings, but still comprise its' essential part (Knekta *et al.*, 2019). This particular item fits the factor well, as it describes day-to-day planning behaviour. It is also thematically different from other items and therefore is not idiothetic. Furthermore, including this item does not harm the model fit and the results of the EFA showed that it does not load on other factors (cross-loadings < .08). The modification indices suggested modifications to the model, but no sound theoretical justification for doing so was found. The questionnaire is presented in the Supplement.

Figure 2

Path diagram for the confirmatory factor analysis with standardized estimates for five categories of behaviours causing and preventing food waste



Note. Factor variances = 1

Study 1 Discussion

The behaviours associated with food wasting were linked to five distinctive factors: (1) discarding food because of its' unpalatability; (2) preventing food waste through buying only the necessities; (3) preventing food waste through planning meals and groceries; (4) preventing food waste through sharing food with others; and (5) preventing food waste through feeding animals. These categories are associated with hypothesis based on the categories described in the Food Recovery Hierarchy (FRH) (Environmental Protection Agency, 2015). The first category in the FRH describes methods of source reduction—in other words, methods for managing the surplus of food. Two of the identified factors directly related to this category: buying and planning. Other categories described by FRH are feeding hungry people and feeding animals. The results of the present study also reflected these two categories—factors associated with food sharing and feeding animals were successfully identified. However, the list of our factors differed from FRH in two ways. First, no evidence for a factor describing composting of foods was found. This behaviour was mentioned by the participants in the first part of the study (see Supplementary Materials); however, it did not emerge as a factor in the herein analyses. Second, another factor that is not associated with FRH was identified: wasting food due to its unpalatability. This is the

only factor that emerged from the list of behaviours associated with discarding edible foods, whereas buying, planning, food sharing, and animal feeding emerged from the list of behaviours that prevent food from spoilage.

Study 2

The second study aimed to verify whether the frequency of behaviours assessed through the FWBQ corresponds to the amount of wasted food. To date, studies demonstrated that self-descriptive questionnaires fail to reliably assess the actual amount of wasted food (van Herpen, et al., 2019). Although the FWBQ is not intended to make precise assessments of the amount of wasted food, the goal was to verify whether it can draw any relations between factors of food wasting behaviours and the amount of food waste.

It was hypothesized that people who declared to display behaviours associated with food wastage, as measured through the FWBQ, will also declare higher amounts of discarded food products: people who scored higher on (1) food unpalatability, and those who scored lower on (2) buying, (3) planning, (4) sharing, (5) feeding, waste the larger amount of food products. The list of food products was limited to three categories that are associated with the highest negative environmental impact when wasted: meat, dairy, and bakery (Schmidt and Matthies, 2018). The whole supply chain of these products (e.g., production, transportation and storage) contributes the greatest amount of greenhouse gases, and therefore leaves the greatest carbon footprint (Röös *et al.*, 2014). Furthermore, meat, dairy and bakery are also the types of foods that are wasted the most frequently in Poland (Banki Żywności, 2020).

Study 2 Method

The study was distributed in social media using the snowball sampling method, which gathered a sample of 683 people (531 women, 149 men, and 3 people who identified their gender as non-binary; age $M = 30.60$, $SD = 8.58$). The initial plan was to gather responses from 100 participants and to conduct a multiple linear regression to detect effect sizes of 0.20 with an alpha level of 0.05 and the power of 0.95, but this number was non-intentionally overshoot.

The FWBQ was used to measure the frequency of food wasting behaviours. To measure the amount of wasted food, a short questionnaire adapted from the study by Schmidt & Matthies (2018) was used. To facilitate the recollection of past-week memories of food wasting behaviours, each participant was asked to count how many times they threw away the edible foods (i.e., meat, dairy, bakery products, separately). After responding to this question, each participant was asked to estimate the amount of food wasted in three categories (measured in grams): meat, dairy, and bakery products with three examples accompanying each of the three questions, i.e., *Try to estimate how many grams in SUM the meat weighed (e.g., sausage - about 85g, pork chop - about 130g, a slice of ham - about 15g*).

First, a confirmatory factor analysis was conducted to see whether the structure of the questionnaire replicated. Then, four ordinal logistic regressions with the amount of wasted food in each category as dependent variables were performed. As measures of food wasted in grams were not distributed normally (skewness for meat = 12.20; dairy = 5.95; bakery products = 20.70; a composite score = 14.60), it was decided to conduct non-parametrical tests. The FWBQ factors scores, gender, age and being a vegan or vegetarian were included as predictors. To minimize the type I error, a Bonferroni correction was used, that is the alpha level below .013 was treated as significant. For exploratory purposes, alpha levels of .05 were also looked at, as these might suggest associations worth testing in future studies.

Participants were also asked to indicate whether they took care of a pet, were vegan or vegetarian, were responsible for preparing meals in a household, were responsible for groceries, how many people lived in a household, and their height and weight, which allowed for computing peoples' body mass index. The exploratory analyses are presented in the Exploratory analyses section.

All the analyses were performed using the Jamovi software (version 1.6.9; The jamovi project, 2020). The methods, analyses and hypotheses for this study were pre-registered (hidden for blind review – file attached to the submission).

Study 2 Results

The confirmatory factor analysis supported the proposed structure of the questionnaire: $\chi^2(160) = 696.47$, $p < .001$; CFI = 0.92; RMSEA = 0.07; SRMR = 0.05. The complete results of the analyses are presented in Tables S2-S5 in the Supplementary Material. The models were statistically significant: the Meat model: $R^2_{McF} = 0.05$, $p < .001$; the Dairy model: $R^2_{McF} = 0.03$, $p < .001$; the Bakery model: $R^2_{McF} = 0.03$, $p < .001$; the Summed model: $R^2_{McF} = 0.03$, $p < .001$. People who more frequently discarded food due to its' unpalatability wasted more meat (OR = 1.09, p < .001), more dairy (OR = 1.08, p < .001), more bakery (OR = 1.12, p < .001), and more food in general (OR = 1.13, p < .001). People who less frequently bought food according to their needs (over shopped more) wasted more meat (OR = 0.93, p = .002) and more food in general (OR = 0.95, p = .001). People who less frequently shared their food wasted more dairy (OR = 0.96, p = .013).

Study 2 Discussion

The results suggested that the Food Wasting Behaviour Questionnaire might be suitable for tracking the actual amount of wasted food. The analyses also highlighted that different categories of behaviours contribute to various types of waste. The results provided evidence that people who more frequently wasted food because of its unpalatability wasted more food, and this pattern was observed in all food categories. Furthermore, , people who over shopped more wasted more

meat and food in general, and those who shared less frequently wasted more dairy.

The findings confirm that to assess the amount of wasted food through a questionnaire, it is necessary to acknowledge different types of food wasting behaviours. Furthermore, specific kinds of food wasting behaviours might lead to the waste of specific food products. The study suggests that the most apparent relationship between behaviours and the amount of wasted food occurs in the case of wasting motivated through food unpalatability. This, in turn, suggests a promising entry point for designing interventions to limit consumer food wasting behaviour—for example, through designing methods of keeping food products more appetising for longer (Schmidt and Matthies, 2018).

Exploratory Analyses

In the process of conducting three studies, additional data was gathered to explore whether the FWBQ might provide any additional insights. The analyses listed below were not pre-registered. The databases from Study 1B and Study 2 were assembled, as they included data on participants' gender and age (N = 1287; 975 women, 312 men, 4 people self-identified as non-binary; mean age = 29.40, SD = 8.41). Both in Study 1B and Study 2, the participants were asked whether they took care of a pet, were vegan or vegetarian, were responsible for preparing meals in a household, were responsible for groceries, how many people lived in a household, and their height and weight, which allowed for assessing peoples' body mass index.

A set of multiple regression analyses was conducted to test whether (1) gender, (2) age, (3) taking care of a pet, (4) being vegetarian or vegan, (5) being responsible for cooking in a household, (6) being a person responsible for groceries in a household, (7) number of people living in a household, and (8) BMI predicted the frequency of behaviours in each factor of the FWBQ. As these were the exploratory analyses, it was decided to set the alpha level to .05 to observe as many potential associations as possible between the FWBQ and explored variables. the potential issue of multicollinearity was assessed using the Variance Inflation Factor. In addition, mediation analyses were conducted to verify whether gender differences in wasting behaviour could be the result of specific gender social roles. Previous studies on gender differences and food wasting behaviour were inconclusive — showing no gender differences (e.g., Misiak *et al.*, 2020), women wasting less food (e.g., Visschers *et al.*, 2016), and men wasting less food (e.g., Buzby and Guthrie, 2002). Chi-square independence analyses showed that neither men nor women were more frequently responsible for groceries (p = .217). However, women were more likely to be responsible for meal preparation (76% of women and 66% of men; $\chi^2(1) = 5.56$, $p = .018$), more likely to be vegan or vegetarian (26% of women and 12% of men; $\chi^2(1) = 12.16$, $p < .001$), and more likely to care for a pet (59% of women and 48% of men; $\chi^2(1) = 5.15$, $p = .023$). The mediation analyses included the significant

factors as potential mediators between gender and food wasting behaviours.

The results of multiple linear regression and mediation models are presented in Supplement, in Table S6 and S7.

Discussion of the exploratory analyses

The exploratory analyses suggested that each category of food wasting behaviours, as measured with the FWBQ, is associated with various demographic factors. Results revealed that food wasting behaviours could be partially associated with gender, age, taking care of a pet, being vegetarian or vegan, being the main cook in a household, number of people living in a household, and BMI.

- Older participants less frequently discarded food due to its unpalatability, less frequently shared food surplus with other people, and less frequently fed animals with leftovers.
- Women, compared to men, more frequently planned meals and groceries and more frequently shared food with others. Additional mediation analyses did not support the assumption that these differences could be explained to some extent by socioeconomic factors (being a main food supplier, being vegetarian or vegan, or taking care of a pet). There was, however, one exception — women were more likely to be the main cook in a household, and this was associated with more frequent planning of meals and groceries.
- People who took care of a pet, compared to those who did not, more frequently fed animals with food leftovers.
- Vegetarians and vegans, compared to people who did not indicate they are vegetarians or vegans, less frequently discarded food due to its unpalatability, more frequently bought food according to their needs, and less frequently fed animals with leftovers.
- People who identified themselves as the main cooks in their households more frequently planned meals and groceries.
- People who lived in larger households more frequently shared food leftovers with animals.
- People with a greater body mass index less frequently planned their meals and groceries.

General Discussion

The results of the studies suggest that a very wide list of food wasting behaviours and those that prevent food from being wasted could be narrowed down to five factors. The first one is the only one associated with direct food wasting: discarding food due to its unpalatability. The other four factors include behaviours that prevent food from being wasted: buying food according to one's needs, planning meals and groceries, sharing the surplus of food with others, and feeding animals. These categories of behaviours were previously studied separately through various methods (Principato, 2018; Principato *et al.*, 2021; dos Santos *et al.*, 2022; Schanes *et al.*, 2018). The FWBQ allows for studying them all at

once and makes observing the relationship between these behaviours possible.

Furthermore, the fact that these behaviours are clustered into factors means that they might operate independently and through different psychological and situational mechanisms. When this research programme started it was expected that the FWBQ factors might resemble the categories highlighted by the Food Recovery Hierarchy (Environmental Protection Agency, 2015). After the start of the project, Principato and colleagues (2021) published their theoretical proposal for analysing food waste in households: the household food waste journey. They identified several stages at which food can get wasted: *Planning, In-store, Pre-consumption, Consumption,* and *Disposition.* They also categorised factors that contribute to these behaviours: *Psychological factors, Norms, Situational factors,* and *Demographic and SES factors.* The results discussed in this section will mainly refer to this theoretical framework.

Theoretical implications

In the following paragraphs, we have provided brief descriptions of the results specific to each FWBQ category and included their theoretical implications.

(1) Discarding food due to its' unpalatability—this factor describes a group of wasting behaviours motivated by the quality of food. People who score high on this factor more frequently discard food because it appears to them as unappetising. This factor might be based on the affective reaction of disgust, as spoiling foods is an elicitor of this reaction (Hartmann and Siegrist, 2018)—previous research has shown that people who are more disgust-sensitive tend to waste more food (Egolf *et al.*, 2018). In present exploratory analyses, it was found that older people wasted less due to food unpalatability. It is consistent with previous research that suggests older people are less sensitive to cues of disgust (Curtis and de Barra, 2018). Furthermore, vegetarians and vegans were found to less frequently discard food due to its unpalatability. This could be a result of the fact that these types of diets do not include the most spoilage-vulnerable products, like meat (Dave and Ghaly, 2011). It could also be a result of greater environmental awareness: people who reduce their meat intake are often motivated by pro-environmental reasons and these underlie reduction in food wasting as well (Kim *et al.*, 2020). Looking at this category from the perspective of the household food waste journey (Principato *et al.*, 2021), it can be seen that this category fits into the *Pre-consumption* stage, as it describes behaviours mainly resulting from inadequate food storage. This phase is also closely linked to *Psychological factors*, as an aversion to unappetising food is triggered by disgust or fear of being poisoned.

(2) Buying food—this factor consists of behaviours associated with buying according to one's need and avoiding over shopping. Previous research documented that people who over shop waste more food and addressing this behaviour might be a promising method for reducing food waste (Canali *et al.*, 2017). Furthermore, over shopping could be driven by psychological mechanisms, like a good provider

identity (Visschers, et al., 2016). People who identify as good providers need to have plenty of food on hand to ensure they could feed their loved ones and manifest their hospitality. At the same time, it increases the probability of wastage, as perishable foods might never be used to serve their social function (Schanes *et al.*, 2018). In the exploratory analyses, vegetarians and vegans were found to more frequently buy their food according to their needs and over shop less. It could be that the environmental awareness of vegetarians and vegans reframes their understanding of being a good provider—they might see their diets as a way of benefitting something beyond themselves and their immediate social groups, like the animals and the environment (Rosenfeld, 2020). This category directly reflects the *In-store* stage of the household food waste journey as it is tightly associated with shopping routines (Principato *et al.*, 2021). In contrast to the previous FWBQ category, purchasing behaviour is a complex behaviour and results from a constellation of different factors. This study identified a potential *Psychological factor* related to identity (being vegetarian or vegan).

(3) Planning meals—this factor underlies the behaviours associated with planning meals and planning grocery shopping. The planning routines regarding these two domains might contribute to consumer food waste the most (Romani *et al.*, 2018). Unlike other factors, planning behaviour requires the most intentional and deliberate actions to be undertaken before food acquisition and consumption, like mastering cooking methods and controlling food purchases with a shopping list (Stancu *et al.*, 2016). The exploratory analyses showed people who were the main cooks in their households planned more frequently. This factor partly explained why women tended to plan more frequently (because they were more often responsible for cooking). The mediation analysis showed that being a main cook explained only 12% of the association between gender and planning. This suggests that food wasting behaviours could be associated with gender in some other way than through traditionally determined sexual division of responsibilities around food preparation (Jungowska *et al.*, 2021). Koivupuro and colleagues (2012) speculated that gender differences in food wasting behaviours might be a result of peoples' switch to healthier lifestyles and women's intention to buy fresh and healthy foods for the family. The link between a healthy lifestyle and wasting behaviour was also highlighted with present finding that those with lower BMI planned their meals and groceries more often—that could be explained by the fact that people who stick to a dieting regime more frequently plan their energy and nutrient intake. According to household food waste journey (Principato *et al.*, 2021), this FWBQ factor reflects *Planning*—the operationalization of this stage is almost identical to the one used in this study. Similarly to the previous factor, it is hard to point to specific determinants of planning behaviours as they are very complex—this study, however, showed its associations with *Demographic and*

SES factors: being responsible for cooking in a household, gender, and BMI.

(4) Sharing food with others—this factor is rarely described as a potential method to minimise food waste, although it has been acknowledged that people who want to minimize food wasting engage in food sharing (Schanes and Stagl, 2019). It has been hypothesized that food sharing cultural norms might serve as a strategy to avoid food wasting in small-scale societies (Misiak et al., 2019) and that there might be a specific psychological tendency that favours sharing food over sharing other objects (Sorokowska *et al.*, 2021). Yet, people living in industrialised western societies, in which the majority of studies on food waste is conducted, waste their food in households, where the visibility of this behaviour to other people is minimal (Quested *et al.*, 2013). The exploratory analyses suggested that women and younger people tend to share the surplus of food more often—a finding that is also reflected in the demographic structure of people that engage in food-sharing initiatives (Ganglbauer *et al.*, 2014; Schanes and Stagl, 2019). In the light of household food waste journey (Principato *et al.*, 2021), food sharing does not constitute a distinct stage of the household food waste journey. This is where the results of the studies provide one of the biggest theoretical contributions—the empirical approach and crowd-sourcing of potential behaviours demonstrated that food sharing is a viable method to minimise food waste. Principato and colleagues (2021) could omit this stage as their framework was based on the systematic review they conducted. Researchers in the past were apparently not interested in food sharing as a potential way to mitigate food waste to the extent it would produce a number of articles worth including in the review. Food sharing might be a viable option to minimise household food wasting behaviour worth studying. This research project demonstrated that it is associated to *Demographic and SES factors*: gender and age.

(5) Feeding animals—this factor underlies the behaviours associated with using food leftovers to feed pets and other animals. These behaviours could be controversial, as feeding animals with human food could be perceived by consumers as a way to reduce food wastage, but on the other hand, it could contribute to animals' health problems (Dodd *et al.*, 2020). In present exploratory analyses, it was found that people who more frequently fed the leftovers to animals were taking care of a pet, were younger, lived in bigger households, and less frequently were vegetarian or vegan. The relationship between age and household size could be potentially explained by economic status: people who have a smaller budget for pet care (younger ones and those who have bigger families) may save money by substituting commercial pet food with leftovers. Less frequent animal feeding by vegetarians and vegans could be explained by their better nutritional knowledge and their awareness of potential hazards associated with feeding animals with human food. This FWBQ factor could be linked to the *Disposition* stage of the household food waste journey (Principato *et al.*,

2021). It was associated with *Demographic and SES factors* (taking care of a pet, age, and household size) as well as *Psychological factors* (being vegetarian or vegan).

Specific kinds of behaviours may contribute to specific food products being wasted. The present project looked at foods that were associated with the biggest environmental impact when wasted: meat, dairy, and bakery (Schmidt and Matthies, 2018). The results showed that discarding food due to its' unpalatability was the best predictor of the amount of wasted meat, bakery and dairy. These are all products that quickly lose their sensory qualities. People who do not mind eating food products that lost their appeal might be less sensitive to the cues of spoilage. It could be that the change in food structure elicits a disgust response, therefore, disgust-sensitive people are more likely to discard it (Ammann et al., 2018). Also, the FWBQ allowed indicating that people who more frequently bought food according to their needs (over shopped less frequently) wasted less meat. Meat is a food product with a short expiry date, and over shopping could lead to problems with managing the surplus of this perishable vulnerable food product. It was also found that people who more frequently share the surplus of food waste less dairy. It could be that a commercial package of dairy products (e.g., yoghurt, milk, cottage cheese) facilitates sharing. Meat and bakery are often sold with no airtight packaging—this allows consumers to buy the exact amount of meat and bakery they want, but it also excludes these products from further sharing as it raises concerns about the safety of consuming it. In sum, these findings provide directions for people who want to design interventions aimed at decreasing the wastage of food products with the most negative environmental impact (Schmidt & Matthies, 2018). The present research suggests that focusing on minimizing food unpalatability, e.g., through improving the packaging methods or through educating people on food storing techniques, might be the most effective in minimizing household food wastage (Reynolds et al., 2019).

Practical implications

This project provides several potential practical applications. Firstly, the FWBQ can be used to monitor the effectiveness of interventions aimed at minimising food waste or targeted at changing consumer behaviour and routines. It can be used before and after interventions or long-term educational campaigns to verify which aspects of behaviour were affected and with what magnitude. Because of its simplicity and low cost, it can be used at the initial stage of developing information campaigns to clarify which methods of persuasion are most effective. Secondly, this questionnaire allows conducting segmentation research. This kind of research is aimed at describing different types of consumers and their demographic characteristics. For example, it could be that certain groups in the population might be characterized by a higher tendency to share food with animals (like people from the rural

parts or regions) or by a higher tendency to share food (like people who have access to food sharing initiatives in big cities). Identifying such groups could allow policymakers and activists to come up with more group-relevant initiatives, as FWBQ could provide them with information about food waste practices, which are particularly salient for a given group.

Limitations and future directions

The Food Wasting Behaviours Questionnaire allows for measuring the frequency of five categories of behaviours associated with food wasting. However, it is important to stress that these five categories do not include all possible factors that contribute to food wastage. The present research aimed to develop a short questionnaire suitable for conducting preliminary research on food wasting in various types of populations, therefore, only the behaviours that could be easily comprehended by people of different demographic and cultural backgrounds were included. Future studies might demonstrate more population-specific categories of food wasting behaviours. For example, people living in rural areas might limit their food wasting through composting. Composting was a kind of behaviour that was described by participants as the behaviour that limits food wasting in Study 1A, however, the factor analysis excluded it as a potential factor. This does not mean that this category would not emerge if a similar study was conducted in a different population, where composting is more popular.

A similar logic applies not only to the number of possible categories of food wasting behaviours but also to the frequency of each behaviour in a given population. The present study suggests that wasting food due to its' unpalatability, food sharing, and feeding animals are much less frequent than behaviours associated with buying foods and planning. This pattern of results is likely specific to the Polish sample. It was hypothesized that the FWBQ would yield different results if the study was conducted in a different population. For example, if the FWBQ was used among people whose culture stresses the importance of food sharing, the scores on the food sharing category might be expected to be much higher. Similarly, if a similar study was conducted in a population with limited access to electricity, people might be expected to overbuy less, as it would be harder to store the food surplus.

It should be stressed that the questionnaire is not suitable to replace the methods which measure the total amount of wasted food. It was never the intention of the authors of the present research. The FWBQ should be used as a preliminary method for assessing food wastage: it is suitable for verifying the hypotheses on the causes of food wasting behaviours, it also allows for monitoring the change in peoples' practices and routines, but it does not allow to evaluate the total amount of consumer food waste.

Using the FWBQ in future studies could extend our understanding of consumer food wasting behaviours in two main ways. First, it has been constructed with the premise to allow for using it in various populations. The field of

food wasting research has been dominated by studies that are conducted on western industrialized populations. However, the problem of food wasting concerns people all over the world. The FWBQ was designed to be comprehensible by people of various cultural, religious, and demographic backgrounds—because of that it might be suitable for conducting cross-populational comparisons. This potential advantage of the questionnaire should be tested in future studies. The second strength of the FWBQ lies in its potential for using it in systematic quantitative reviews, like meta-analyses. To date, researchers published several large reviews on consumer food wasting behaviours (e.g., (Principato, 2018; Principato et al., 2021; dos Santos et al., 2022; Schanes et al., 2018), but the diverse methods used in the field are not suitable for conducting meta-analyses.

Conclusion

This paper describes three studies that established a novel method for preliminary measurement of consumer food wasting behaviours—Food Wasting Behaviours Questionnaire (FWBQ). In Studies 1A and 1B, a five-factor questionnaire including the behaviours associated with discarding food and behaviours that prevent food from being wasted was developed. Study 2 demonstrated how these categories of food wasting behaviours are associated with wasting meat, dairy, and bakery products. After testing the pre-registered hypotheses, exploratory analyses were conducted to verify whether the FWBQ factors are associated with various demographic and socioeconomic characteristics.

Overall, the present multi-study project highlights the five categories of food wasting behaviours that are associated with food wasting: (1) discarding unpalatable foods, (2) overbuying foods, (3) planning meals and groceries, (4) sharing foods with others, and (5) feeding animals. These categories were interpreted within the household food waste journey framework and combined with a number of factors that shape different stages of food waste. The FWBQ is a method that may prove useful for preliminary and systematic research. It can enable practitioners to help monitor the effects of outreach campaigns and opens the possibility of food waste research to those who do not have a large enough budget to conduct sophisticated measurements of household food waste. This approach may yield new findings that can be systematically analysed to effectively address challenges posed by the current level of food waste.

References

Aureli, V., Scalvedi, M.L. and Rossi, L. (2021), "Food Waste of Italian Families: Proportion in Quantity and Monetary Value of Food Purchases", *Foods*, Multidisciplinary Digital Publishing Institute, Vol. 10 No. 8, p. 1920, doi: 10.3390/foods10081920.

Babbitt, C.W., Babbitt, G.A. and Oehman, J.M. (2021), "Behavioral impacts on residential food provisioning, use, and waste during the COVID-19 pandemic", *Sustainable Production and Consumption*, Vol. 28, pp. 315–325, doi: 10.1016/j.spc.2021.04.012.

Banki Żywności. (2020), *Nie Marnuj Jedzenia 2020. Raport Federacji Polskich Banków Żywności*.

Berjan, S., Vaško, Ž., Ben Hassen, T., El Bilali, H., Allahyari, M.S., Tomić, V. and Radosavac, A. (2022), "Assessment of household food waste management during the COVID-19 pandemic in Serbia: a cross-sectional online survey", *Environmental Science and Pollution Research*, Vol. 29 No. 8, pp. 11130–11141, doi: 10.1007/s11356-021-16485-8.

Boulet, M., Hoek, A.C. and Raven, R. (2020), "Towards a multi-level framework of household food waste and consumer behaviour: Untangling spaghetti soup", *Appetite*, Elsevier, p. 104856. doi: 10.1016/j.appet.2020.104856

Bradbury, M., Peterson, M.N. and Liu, J. (2014), "Long-term dynamics of household size and their environmental implications", *Population and Environment*, Vol. 36 No. 1, pp. 73–84, doi: 10.1007/s11111-014-0203-6.

Brown, T.A. (2015), *Confirmatory Factor Analysis for Applied Research*, Guilford publications.

Buzby, J.C. and Guthrie, J.F. (2002), "Plate waste in school nutrition programs", *The Journal of Consumer Affairs*, Vol. 36 No. 2, pp. 220–238.

Canali, M., Amani, P., Aramyan, L., Gheoldus, M., Moates, G., Östergren, K., Silvennoinen, K., *et al.* (2017), "Food waste drivers in Europe, from identification to possible interventions", *Sustainability*, Multidisciplinary Digital Publishing Institute, Vol. 9 No. 1, p. 37. doi: 10.3390/su9010037

Chapagain, A.K. and James, K. (2013), "Accounting for the Impact of Food Waste on Water Resources and Climate Change", in Kosseva, M.R. and Webb, C. (Eds.), *Food Industry Wastes*, Academic Press, San Diego, pp. 217–236, doi: 10.1016/B978-0-12-391921-2.00012-3.

Curtis, V. and de Barra, M. (2018), "The structure and function of pathogen disgust", *Philosophical Transactions of the Royal Society B: Biological Sciences*, The Royal Society, Vol. 373 No. 1751, p. 20170208. doi: 10.1098/rstb.2017.0208

Dave, D. and Ghaly, A.E. (2011), "Meat Spoilage Mechanisms and Preservation Techniques: A Critical Review", *American Journal of Agricultural and Biological Science*, Science Publications. doi: 10.3844/ajabssp.2011.486.510

Delley, M. and Brunner, T.A. (2018), "Household food waste quantification: comparison of two methods", *British Food Journal*, Emerald Publishing Limited, Vol. 120 No. 7, pp. 1504–1515, doi: 10.1108/BFJ-09-2017-0486.

Dodd, S., Cave, N., Abood, S., Shoveller, A.-K., Adolphe, J. and Verbrugghe, A. (2020), "An observational study of pet feeding practices and how these have changed between 2008 and 2018", *Veterinary Record*, Wiley Online Library, Vol. 186 No. 19, pp. 643–643. doi: 10.1136/vr.105828

Economist Impact. (2022), *Global Food Security Index (GFSI)*. https://impact.economist.com/sustainability/project/food-security-index/reports/Economist_Impact_GFSI_2022_Global_Report_Sep_2022.pdf

Egolf, A., Siegrist, M. and Hartmann, C. (2018), "How people's food disgust sensitivity shapes their eating and food behaviour", *Appetite*, Vol. 127, pp. 28–36, doi: 10.1016/j.appet.2018.04.014.

Environmental Protection Agency. (2015), "Food Recovery Hierarchy", Overviews and Factsheets, , available at: https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy (accessed 23 February 2021).

European Commission. (2021), "EU Platform on Food Losses and Food Waste", *Food Safety - European Commission*, Text, , available at: https://ec.europa.eu/food/safety/food_waste/eu_actions/eu-platform_en (accessed 26 January 2021).

FAO. (2019), *The State of Food and Agriculture in the World. Moving forward on Food Loss and Waste Reduction Food andAgriculture*. In: *State Food Agriculture; Food and Agriculture Organization of the United Nations:* Rome

Ganglbauer, E., Fitzpatrick, G., Subasi, Ö. and Güldenpfennig, F. (2014), "Think globally, act locally: a case study of a free food sharing community and social networking", *Proceedings of the 17th ACM Conference on Computer Supported Cooperative Work & Social Computing*, pp. 911–921. doi: 10.1145/2531602.2531664

Goretzko, D., Pham, T.T.H. and Bühner, M. (2019), "Exploratory factor analysis: Current use, methodological developments and recommendations for good practice", *Current Psychology*, Springer, pp. 1–12. doi: 10.1007/s12144-019-00300-2

Haque, A., Karunasena, G.G. and Pearson, D. (2021), "Household food waste and pathways to responsible consumer behaviour: evidence from Australia", *British Food Journal*, Emerald Publishing Limited, Vol. 124 No. 11, pp. 3783–3802, doi: 10.1108/BFJ-05-2021-0517.

Hartmann, C. and Siegrist, M. (2018), "Development and validation of the Food Disgust Scale", *Food Quality and Preference*, Vol. 63, pp. 38–50, doi: 10.1016/j.foodqual.2017.07.013.

Hebrok, M. and Boks, C. (2017), "Household food waste: Drivers and potential intervention points for design – An extensive review", *Journal of Cleaner Production*, Vol. 151, pp. 380–392, doi: 10.1016/j.jclepro.2017.03.069.

van Herpen, E., van Geffen, L., Nijenhuis-de Vries, M., Holthuysen, N., van der Lans, I. and Quested, T. (2019), "A validated survey to measure household food waste", *MethodsX*, Vol. 6, pp. 2767–2775, doi: 10.1016/j.mex.2019.10.029.

van Herpen, E., van der Lans, I.A., Holthuysen, N., Nijenhuis-de Vries, M. and Quested, T.E. (2019), "Comparing wasted apples and oranges: An assessment of methods to measure household food waste", *Waste Management*, Vol. 88, pp. 71–84, doi: 10.1016/j.wasman.2019.03.013.

Houghton, R.A. (2012), "Carbon emissions and the drivers of deforestation and forest degradation in the tropics", *Current Opinion in Environmental Sustainability*, Vol. 4 No. 6, pp. 597–603, doi: 10.1016/j.cosust.2012.06.006.

Hu, L. and Bentler, P.M. (1999), "Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives", *Structural Equation Modeling: A Multidisciplinary Journal*, Taylor & Francis, Vol. 6 No. 1, pp. 1–55. doi: 10.1080/10705519909540118

International Monetary Fund. (2022), "World Economic Outlook Database", *World Economic Outlook Database*, available at: https://www.imf.org/en/Publications/WEO/Issues/2022/10/11/world-economic-outlook-october-2022.

IPCC. (2018), "Mitigation pathways compatible with 1.5°C in the context of sustainable development", *Global Warming of 1.5 °C an IPCC Special Report on the Impacts of Global Warming of 1.5 °C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change*, Intergovernmental Panel on Climate Change.

Jörissen, J., Priefer, C. and Bräutigam, K.-R. (2015), "Food waste generation at household level: Results of a survey among employees of two European research centers in Italy and Germany", *Sustainability*, Multidisciplinary Digital Publishing Institute, Vol. 7 No. 3, pp. 2695–2715. doi: 10.3390/su7032695

Jungowska, J., Kulczyński, B., Sidor, A. and Gramza-Michałowska, A. (2021), "Assessment of Factors Affecting the Amount of Food Waste in Households Run by Polish Women Aware of Well-Being", *Sustainability*, Multidisciplinary Digital Publishing Institute, Vol. 13 No. 2, p. 976. doi: 10.3390/su13020976

Kaiser, H.F. and Rice, J. (1974), "Little jiffy, mark IV", *Educational and Psychological Measurement*, Sage Publications Sage CA: Thousand Oaks, CA, Vol. 34 No. 1, pp. 111–117.

Kim, M.J., Hall, C.M. and Kim, D.-K. (2020), "Predicting environmentally friendly eating out behavior by value-attitude-behavior theory: does being vegetarian reduce food waste?", *Journal of Sustainable Tourism*, Taylor & Francis, Vol. 28 No. 6, pp. 797–815. doi: 10.1080/09669582.2019.1705461

Knekta, E., Runyon, C. and Eddy, S. (2019), "One size doesn't fit all: Using factor analysis to gather validity evidence when using surveys in your research", *CBE—Life Sciences Education*, Am Soc Cell Biol, Vol. 18 No. 1, p. rm1. doi: 10.1187/cbe.18-04-0064

Koivupuro, H.-K., Hartikainen, H., Silvennoinen, K., Katajajuuri, J.-M., Heikintalo, N., Reinikainen, A. and Jalkanen, L. (2012), "Influence of socio-demographical, behavioural and attitudinal factors on the amount of avoidable food waste generated in Finnish households", *International Journal of Consumer Studies*, Vol. 36 No. 2, pp. 183–191, doi: 10.1111/j.1470-6431.2011.01080.x.

Martindale, W. (2014), "Using consumer surveys to determine food sustainability", *British Food Journal*, Emerald Group Publishing Limited, Vol. 116 No. 7, pp. 1194–1204, doi: 10.1108/BFJ-09-2013-0242.

Melikoglu, M., Lin, C.S.K. and Webb, C. (2013), "Analysing global food waste problem: pinpointing the facts and estimating the energy content", *Central European Journal of Engineering*, Vol. 3 No. 2, pp. 157–164, doi: 10.2478/s13531-012-0058-5.

Misiak, M., Kruger, D., Kruger, J.S. and Sorokowski, P. (2020), "Moral judgments of food wasting predict food wasting behavior", *British Food Journal*, Vol. ahead-of-print No. ahead-of-print, doi: 10.1108/BFJ-07-2019-0576.

Misiak, M., Sorokowski, P. and Karwowski, M. (2019), "Does the 'incentive hope' hypothesis explain food-wasting behavior among humans? Yes and no", *Behavioral and Brain Sciences*, Vol. 42, doi: 10.1017/S0140525X18001942.

Nicholes, M.J., Quested, T.E., Reynolds, C., Gillick, S. and Parry, A.D. (2019), "Surely you don't eat parsnip skins? Categorising the edibility of food waste", *Resources, Conservation and Recycling*, Vol. 147, pp. 179–188, doi: 10.1016/j.resconrec.2019.03.004.

Papargyropoulou, E., Lozano, R., Steinberger, J.K., Wright, N. and Ujang, Z.B. (2014), "The food waste hierarchy as a framework for the management of food surplus and food waste", *Journal of Cleaner Production*, Vol. 76 No. 10.1016/j.jclepro.2014.04.020, pp. 106–115. doi: 10.1016/j.jclepro.2014.04.020

Parfitt, J., Barthel, M. and Macnaughton, S. (2010), "Food waste within food supply chains: quantification and potential for change to 2050", *Philosophical Transactions of the Royal Society B: Biological Sciences*, Vol. 365 No. 1554, pp. 3065–3081, doi: 10.1098/rstb.2010.0126.

Porpino, G. (2016), "Household Food Waste Behavior: Avenues for Future Research", *Journal of the Association for Consumer Research*, Vol. 1 No. 1, pp. 41–51, doi: 10.1086/684528.

Principato, L. (2018), *Food Waste at Consumer Level: A Comprehensive Literature Review*, Springer.

Principato, L., Mattia, G., Di Leo, A. and Pratesi, C.A. (2021), "The household wasteful behaviour framework: A systematic review of consumer food waste", *Industrial Marketing Management*, Elsevier, Vol. 93, pp. 641–649. doi: 10.1016/j.indmarman.2020.07.010

Quested, T.E., Marsh, E., Stunell, D. and Parry, A.D. (2013), "Spaghetti soup: The complex world of food waste behaviours", *Resources, Conservation and Recycling*, Vol. 79, pp. 43–51, doi: 10.1016/j.resconrec.2013.04.011.

Romani, S., Grappi, S., Bagozzi, R.P. and Barone, A.M. (2018), "Domestic food practices: A study of food management behaviors and the role of food preparation planning in reducing waste", *Appetite*, Vol. 121, pp. 215–227, doi: 10.1016/j.appet.2017.11.093.

Roodhuyzen, D.M.A., Luning, P.A., Fogliano, V. and Steenbekkers, L.P.A. (2017), "Putting together the puzzle of consumer food waste: Towards an integral perspective", *Trends in Food Science & Technology*, Vol. 68, pp. 37–50, doi: 10.1016/j.tifs.2017.07.009.

Röös, E., Sundberg, C. and Hansson, P.-A. (2014), "Carbon footprint of food products", *Assessment of Carbon Footprint in Different Industrial Sectors, Volume 1*, Springer, pp. 85–112.

Rosenfeld, D.L. (2020), "Gender differences in vegetarian identity: How men and women construe meatless dieting", *Food Quality and Preference*, Vol. 81, p. 103859, doi: 10.1016/j.foodqual.2019.103859.

dos Santos, J.I.A.S., da Silveira, D.S., da Costa, M.F. and Duarte, R.B. (2022), "Consumer behaviour in relation to food waste: a systematic literature review", *British Food Journal*, Emerald Publishing Limited, Vol. 124 No. 12, pp. 4420–4439, doi: 10.1108/BFJ-09-2021-1075.

Schanes, K., Dobernig, K. and Gözet, B. (2018), "Food waste matters - A systematic review of household food waste practices and their policy implications", *Journal of Cleaner Production*, Vol. 182, pp. 978–991, doi: 10.1016/j.jclepro.2018.02.030.

Schanes, K. and Stagl, S. (2019), "Food waste fighters: What motivates people to engage in food sharing?", *Journal of Cleaner Production*, Vol. 211, pp. 1491–1501, doi: 10.1016/j.jclepro.2018.11.162.

Schmidt, K. and Matthies, E. (2018), "Where to start fighting the food waste problem? Identifying most promising entry points for intervention programs to reduce household food waste and overconsumption of food", *Resources, Conservation and Recycling*, Vol. 139, pp. 1–14, doi: 10.1016/j.resconrec.2018.07.023.

Shelton, B.A. and John, D. (1996), "The Division of Household Labor", *Annual Review of Sociology*, Vol. 22 No. 1, pp. 299–322, doi: 10.1146/annurev.soc.22.1.299.

Shu, Y., Roe, B.E. and Bender, K. (2021), "Adapting, refining and expanding a validated questionnaire to measure food waste in U.S. households", *Methods X*, Elsevier, Vol. 8, doi: 10.1016/j.mex.2021.101377.

Sorokowska, A., Marczak, M., Misiak, M., Oleszkiewicz, A., Niemczyk, A., Wróbel, M. and Sorokowski, P. (2021), "Humans tend to share food more generously than money and other objects: Preliminary evidence", *European Journal of Social Psychology*, John Wiley & Sons, Ltd, Vol. n/a No. n/a, doi: 10.1002/ejsp.2747.

Stancu, V., Haugaard, P. and Lähteenmäki, L. (2016), "Determinants of consumer food waste behaviour: Two routes to food waste", *Appetite*, Vol. 96, pp. 7–17, doi: 10.1016/j.appet.2015.08.025.

Stefan, V., van Herpen, E., Tudoran, A.A. and Lähteenmäki, L. (2013), "Avoiding food waste by Romanian consumers: The importance of planning and shopping routines", *Food Quality and Preference*, Vol. 28 No. 1, pp. 375–381, doi: 10.1016/j.foodqual.2012.11.001.

The jamovi project. (2020), "jamovi (Version 1.2) [Computer Software]. Retrieved from https://www.jamovi.org".

United Nations. (2020), "Goal 2: Zero Hunger", *United Nations Sustainable Development*, available at: https://www.un.org/sustainabledevelopment/hunger/ (accessed 26 January 2021).

Visschers, V.H.M., Wickli, N. and Siegrist, M. (2016), "Sorting out food waste behaviour: A survey on the motivators and barriers of self-reported amounts of food waste in households", *Journal of Environmental Psychology*, Vol. 45, pp. 66–78, doi: 10.1016/j.jenvp.2015.11.007.