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Original article

Attitudes and behaviors of household food waste among university students in Milan, Italy: The UniFoodWaste study protocol

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Abstract. *Background and aim:* Food waste is a pressing global issue with significant economic, environmental, and social implications. This protocol outlines an observational cross-sectional study aimed at assessing attitudes and behaviors related to household food waste among Italian university students. *Methods:* The study will involve the administration of a self-administered, online, anonymous questionnaire to university students enrolled at the University of Milan. Data collection will encompass socio-demographic characteristics, household food waste behaviors, lifestyle factors (such as physical activity, alcohol consumption, and diet), and health-related outcomes (including self-related health, eating disorders, alcohol use disorders, and depressive symptoms). The online questionnaire will be implemented using Microsoft Forms. All data will be self-reported, with participation being voluntary. *Results:* Anticipated results include insights into the prevalence of food waste behaviors among university students, associations with demographic and lifestyle factors, and potential impacts on health outcomes. Our study aims to provide a comprehensive understanding of the factors influencing household food waste among Italian university students by employing an epidemiological approach to understanding these behaviours over time and space. *Conclusions*: In conclusion, this study will contribute to filling gaps in knowledge within the scientific community, inform public health policies, and promote sustainable food consumption practices among young adults. (www.actabiomedica.it)

Key words: Italy, household food waste, cross-sectional study, lifestyle, health

Introduction

Food waste represents a global issue, and awareness and concern have grown over the last decades. The expected growth of the world population to 9 billion by 2050 will increase demand for larger quantities and a wider variety of higher-quality food (1). The evolution of customs and eating habits will lead to an increased demand for a wider variety of food with increased quality characteristics. This will pressure food chains, threatening their ability to meet these demands (2). Actions to minimize food waste are crucial in addressing this issue. Moreover, reducing food waste involves minimizing the consumption of natural resources, which are already heavily exploited, and not squandering the resources used in the production, processing, transportation, preparation, and storage of food (3). Economically, food waste also has impacts; a recent analysis within the European context suggested that achieving the Sustainable Development Goal

(SDG) target 12.3 on food waste and loss would not only increase income for food industries but also create jobs and lower prices for consumers (3). Because food waste has multiple repercussions on human health, the economy, and the environment, the fight against waste is an increasingly prominent topic on national and international political agendas (4, 5).

To address this phenomenon effectively, measuring food waste and its determinants is essential. It is estimated that globally, 1.4 billion tons per year of still-edible food is lost (6). In recent years, excessive resource consumption has led to a biological deficit where consumption capacity exceeds land's productive capacity by at least 30%. Food losses occur throughout the entire supply chain, with "food waste" specifically referring to losses at the retail and final consumption stages, distinct from "food loss," which occurs earlier in the supply chain (retail and final consumption) (7). The loss of food consists of two phenomena that significantly impact various levels of society, including food safety and food security, as well as overall economic and environmental sustainability. Food production entails emissions of Greenhouse Gas (GHG); when food loss occurs, these gases are emitted unnecessarily. GHG emissions result from environmental pollution, loss of biodiversity, and the degradation of natural ecosystems. Food waste is more relevant in terms of numbers when compared to food loss. In fact, 17% of the world's total food production is collectively discarded in households, food service establishments, and retail, and 61% of the total waste is attributable to domestic waste alone (8). Similar data were also attributable to Europe. In 2020, nearly 57 million tons of food waste were generated, equivalent to approximately 127 kg per capita annually. Household consumption accounts for 53% of all food waste (9). The remaining waste is attributed to waste generated in the food chain due to primary production (11%), and manufacturing of food and beverage products (20%). In Italy, food waste at the household level amounts to an average of 370 grams per capita per week, equal to 4.4% of the weight of the food purchased (10, 11).

In this scenario, young adults represent the current and, above all, tomorrow's adult consumers. Understanding how socio-demographic and lifestyle factors act in this category is of particular importance to build waste reduction strategies targeted to this population (12). Implementing these measures would significantly enhance the efforts to reduce food waste and bring us closer to achieving the SDG target 12.3 ("By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses"). Among young adults, university students represent a population on which scientific literature on food waste focuses rarely and only with studies characterized by small sample sizes (13). The components of this population group experience significant changes (14). During this period of their lives, these young adults exercise autonomy in their choices and also go through periods of crisis (15). These significant changes also concern the realm of lifestyles and, therefore, food habits (16). Consequently, it is reasonable to think that important changes occur and are also worthy of study in managing food expenditure and waste (17).

A limited number of studies have begun exploring how food waste behaviors correlate with health outcomes and lifestyles. Among the latter, adherence to dietary guidelines were found to be associated with consumers' behaviors aiming at reducing food waste (42). In terms of health outcomes, a study found that a lower BMI was associated with higher rates of food waste (43). In Italy, a study found significant associations between mental well-being and decreased household food waste production (44). Confirming these findings and exploring other associations between food waste behaviors and health outcomes and determinants is important to fill a gap in completely understanding the causes and consequences of these behaviors. In turn, this evidence can be used to foster knowledge and competencies of household members and positively reshape their food habits.

Patients and methods

Study design and aims

This will be an observational cross-sectional study aimed at assessing attitudes and behaviors of household food waste among university students in Italy. To better understand attitude and behaviors and

their associations with potential determinant factors, socio-demographic characteristics, lifestyle factors, and health outcomes will be assessed. With this in mind, we identified one primary object, which was defined as estimating the prevalence of relevant food waste behaviors in a population of Italian university students. Our secondary object will be to explore possible associations of food waste behaviors with demographic, social, lifestyle, and health-related characteristics. This protocol presents and discusses the methodology applied to design, develop, and conduct the study.

Participants and data collection

All university students enrolled at the University of Milan aged 18 years and older are eligible participants. Data will be collected anonymously through an online questionnaire created using Microsoft Forms (Microsoft Corporation, One Microsoft Way, Redmond, WA 98052, USA) and distributed via the mailing list. To ensure participation exclusively for students of the University of Milan, the function allowing access to the questionnaire will be set up for university users only. Participation will be on voluntary base. Furthermore, to address the issue of missing data, all questions will be made mandatory. This setting will prevent progression to different questionnaire sections until all items are completed.

Prior to completing the questionnaire, participants will be invited to read the study's aims and objectives, followed by instructions on how to participate. Furthermore, each participant will require informed consent, and individuals who decline to provide consent will be redirected to the questionnaire's conclusion.

The survey will be divided into four sections. The first section will enquire about socio-demographic aspects. The second section will explore household food waste behaviors using the Italian version of the household food waste behaviors questionnaire (HFWB) (42). The third section will investigate lifestyle factors such as level of physical activity, smoking habits, alcohol consumption, and dietary habits. The last section of the questionnaire will explore health-related outcomes including self-related health, eating disorders, alcohol use disorders, and depressive symptoms.

Socio-demographic data

The first section will explore socio-demographics factors including sex (female, male, I prefer not to reply), age, residency, body weight and height, smoking habit, educational level (high school, bachelor degree, master degree, integrated master's degree, or PhD) type of cohabitation (alone, with family, partner, friends/room-maters), number of family members, student status (commuter, non-local, residing in the city of Milan, participating in international exchange programs), the disciplinary field of the course of studies (healthcare field, humanities, scientific and technological field, social field), the degree course (bachelor or master, integrated master's degree, specialization degree or PhD) and lastly the use of food apps (both considering for food delivery and food save).

Weight and height will be collected as a continuous scale and will be used to compute body mass index (BMI), where BMI will be determined by dividing an individual's body weight in kilograms by the square of their height in meters. Following the guidelines provided by the World Health Organization, BMI will be categorized into the following groups: underweight (values below 18.4), normal weight (values ranging from 18.5 to 24.9), overweight (values between 25.0 and 29.9), and obese (values equal to or exceeding 30.0).

The smoking habit will be assessed through the use of a specific query: "Have you engaged in smoking or have you ever used tobacco?" Respondents will have the following response options: "I have never used tobacco," "I was a former smoker but have since ceased," "I smoke occasionally," and "I smoke regularly."

Household food waste behaviors

The HFWB is one of the most commonly used questionnaires available in the literature, consisting of 10 Likert scale questions, ranging from 0 (never or strongly disagree) to 6 (always or strongly agree) (42). Its purpose is to assess consumers' attitudes and behaviors regarding food waste. In detail, questions aimed at evaluating (i) precautionary measures (such as planning grocery shopping and food usage, avoiding spontaneous purchases, monitoring stored food, preparing

appropriate food quantities, and utilizing leftovers), (ii) skills (including perceived challenges in assessing food safety, cooking innovatively, planning accurately, and understanding how to extend shelf-life), and (iii) parental guidance on waste prevention (parental emphasis on avoiding food waste). The HFWB questionnaire was developed and validated by van Herpen et al. (45) and further adapted to the Italian context (11) by Scaldevi et al. The questionnaire was validated by comparing results obtained using the HFWQ and other questionnaires, achieving an accuracy of 61%, proving to be much more accurate compared to other available questionnaires.

Physical activity

Physical activity will be measured using the Italian version of the International Physical Activity Questionnaire (IPAQ) (46). The IPAQ is a validated questionnaire intended for use in adults aged 15 to 69 years. It comprises seven questions about the type (vigorous, moderate, walking) and the quantity (days per week and time per day) of physical activity over the past seven days.

Dietary habits

Dietary habits were assessed using the Medi-Lite questionnaire, a validated 9-item questionnaire introduced in 2017 (47). This questionnaire evaluates the daily consumption of nine food groups (fruits, vegetables, cereals, meat and meat products, dairy products, alcohol, and olive oil, as well as the weekly consumption of legumes and fish) and categorizes this consumption in alignment with the Mediterranean Diet (MD), and therefore, it is possible to estimate the level adherence to the MD. Participants' responses to the Medi-Lite questionnaire are assigned scores based on a point system that reflects three levels of consumption for each food group. For foods typical of the MD (fruits, vegetables, cereals, legumes, and fish), the highest category of consumption is awarded 2 points, intermediate consumption receives 1 point, and the lowest category of consumption is assigned 0 points. For olive oil, 2 points are granted for regular consumption, 1 point for frequent consumption, and 0 points for occasional consumption. Conversely, for foods not characteristic of the MD (meat and meat products, dairy products), the scoring is reversed, with 2 points going to the lowest category of consumption, 1 point to intermediate consumption, and 0 points to the highest category of consumption. As for alcohol consumption, 2 points are allocated for intermediate consumption (1–2 alcohol units per day), 1 point for the intermediate category of alcohol consumption (1 alcoholic unit per day), and 0 points are given to the highest category of consumption (>2 alcoholic units per day). The final MD score is calculated by summing the scores from the nine food categories and can range from 0 (indicating low adherence to the MD) to 18 (indicating high adherence to the MD) (48).

Self-related health

Self-related health will be measured using the self-related Health-5 (SRH-5), a validated single-item tool with five possible responses structured on a Likert scale that measures the current perceived general health (49).

Eating disorders

The Italian version of the Sick, Control, One, Fat, Food Test (SCOFF Test) will be used to examine eating disorders (50). The SCOFF Test is a validated screening tool consisting of five questions, typically utilized in primary care settings. Respondents are asked to answer each question with either "yes" or "no." If there are at least two "yes" responses, it suggests a potential eating disorder and warrants further investigation. The Cronbach's alpha coefficient was reported as 0.64 in the Italian validation study.

Alcohol use disorders

Alcohol use disorder was assessed by the Italian version of the Alcohol Use Disorders Identification Test - Short Version (AUDITc) (51). The AUDITc is a validated three-item abridged version of the full AUDIT questionnaire. Each of the three items allows for a score ranging from 0 to 4 points. If the final score equals or exceeds five for males or four for females,

it suggests a potential high-risk pattern of alcohol consumption.

Depressive symptoms

Depressive symptoms will be assessed using the Italian version of the 9-item Patient Health Questionnaire (PHQ-9) (52). This questionnaire consists of nine items rated on a four-point scale, with responses ranging from 0, indicating "not at all," to 3, indicating "nearly every day." The responses were utilized to compute a continuous total score from 0 (indicating the absence of symptoms) to 27 (suggesting the presence of all symptoms nearly every day). For the purposes of this study, we will apply two predefined thresholds: a cut-off score of 5 or higher for mild to severe depressive symptoms, and a cut-off score of 10 or higher for clinically relevant depressive symptoms (moderate to severe).

Sample size calculation

The calculation of the sample size was carried out considering a confidence level of 95% and a margin of error of 5%. The reference population considered was the student population enrolled at the University of Milan during the academic year 2021/2022, totaling 60,988 individuals (53). Furthermore, since the proportion of the Italian student population associated with food waste behaviors is not known, a conservative approach is adopted, setting the proportion value at 50%. The minimum sample size required is 382 subjects.

Statistical analysis

Continuous variables will be presented as means ± standard deviations (SD), while categorical variables will be presented as frequencies and percentages. Differences between groups will be calculated using the chi-square test for categorical variables, the Student's t-test or the analysis of variance (ANOVA) for normally distributed continuous variables between two or more groups respectively, the Mann-Whitney test or the Kruskal-Wallis test for continuous variables with non-parametric distribution between two or more groups, respectively. The Spearman correlation test will be used to assess the correlation between variables of interest. Regression models will be used to evaluate the association between exposure factors and food waste. Results will be reported along with their 95% confidence intervals.

Ethical approval

The study protocol has been approved by the Ethical Committee of the University of Milan ID n. 71.23.

Results

Expected results

In terms of expected results, we hypothesize observing a variety of attitudes towards household food waste among university students, influenced by sociodemographic characteristics such as gender, living arrangements/number of cohabitants, or field of study. We anticipate that students living independently or in shared accommodation may exhibit different behaviors regarding food purchasing, storage, and disposal compared to those living with their families. Additionally, students in scientific fields may demonstrate greater awareness and concern for environmental issues, leading to more proactive attitudes toward reducing food waste than other students.

Secondly, lifestyle factors such as dietary habits and culinary skills are likely to play a significant role in determining food waste behaviors among university students. Students with limited cooking abilities or who use food delivery apps more may be inclined to overbuy or discard perishable items, resulting in higher levels of household food waste attitude and behaviors. Conversely, students who prioritize home-cooked meals and mindful consumption practices may demonstrate lower levels of household food waste attitude and behaviors.

Thirdly, we expect that physical and mental health outcomes may be associated with household food waste attitudes and behaviors among university students. Students with healthier dietary patterns (or

in general healthier lifestyles) may have more positive attitudes and behavior toward household food waste. Conversely, negative attitudes and behavior toward household food waste may contribute to negative feelings that can affect students' health and well-being.

Overall, this study's expected results will provide a comprehensive understanding of the factors influencing household food waste among university students in Italy, highlighting opportunities for targeted interventions and policy measures aimed at promoting sustainable consumption practices and improving public health outcomes.

Conclusions

Advancements of knowledge and implications for public health policies

Our study aims to assess attitudes and behaviors regarding household food waste among university students in Italy, focusing on sociodemographic factors, lifestyle factors, and health outcomes. Our study will provide valuable insights into the complex interplay between these factors and their impact on food waste behaviors among this target population. In particular, by conducting a cross-sectional study, we aim to generate real-world data on the prevalence of food waste behaviors among university students. Indeed, an epidemiological approach to such issues allows, on one hand, to understand the attitudes/behaviors regarding household food waste among university students, while on the other hand, it enables the assessment over time and space of the development of these phenomena. Moreover, the target population identified for the current study is of paramount importance. Indeed, university students represent a unique group with distinctive features, including lifestyle, dietary habits, and socio-economic status, that contribute to their role in household food waste (54). It could be considered that some university students move from small towns to university cities where there is a culture of food waste and food waste management might differ. Moreover, our study is important because it does not only assess the level of household food waste attitude and behavior, but it aims to explore the associations with various sociodemographic, lifestyle, health, and health-related factors. This will contribute to the scientific literature by enhancing our understanding of the determinants of household food waste behaviors in this population. Considering lifestyle factors, studies suggest that university students often exhibit transient living situations, limited cooking skills, and irregular eating patterns, leading to increased food waste (55). Additionally, their reliance on convenience foods, busy schedules, and social activities may contribute to the purchasing and discarding of perishable items. Regarding health implications, we expect households characterized by lower levels of food waste are likely to exhibit better nutritional outcomes. Effective meal planning and reduced food waste may contribute to healthier dietary patterns, ensuring individuals have access to a diverse and nutritionally balanced diet (56). Conversely, households with higher rates of food waste may experience nutritional shortcomings and potential health consequences associated with suboptimal dietary choices (57). In light of these, our results will support policymakers by identifying factors associated with household food waste and, therefore, designing efficacy interventions to reduce waste and promote sustainable consumption patterns. This is extremely important, especially in our socio-cultural context, in which food and planetary sustainability are mandatory. In fact, food waste may have direct and indirect consequences on sustainability. Directly, excessive food waste contributes to economic losses and environmental degradation. Indirectly, it affects health by influencing dietary choices and nutritional adequacy (58).

Furthermore, our study will contribute to the emerging field of research on the social determinants of health, specifically focusing on the novel topic of food waste behaviors among young adults. Finally, through widespread dissemination of the results we will obtain, both at academic and outreach levels, it will allow us to inform the entire community, involving several interested stakeholders. For instance, universities or student organizations/associations could be targets of our results, which might be interested in fostering ongoing efforts to promote sustainable consumption practices and improve public health outcomes among university students.

Strengths and limitations

Our study has some limitations. specific cultural and educational context of Italian universities may influence the generalizability of our findings. Additionally, the cross-sectional study design will prevent us from establishing causality and limit our ability to assess changes in food waste behaviours among participants.

Regarding health outcome data, the research relies on self-reported data rather than clinical data-based diagnoses. As a result, a variance could exist between the actual values and those provided by the respondents. Furthermore, health outcomes will be assessed by means of screening tools that are not intended as diagnostic instruments. Nonetheless, we are confident that the misclassification rate will be low since these are validated screening tools used by clinicians in order to support diagnosis. Furthermore, potential social desirability bias might impact on the results. However, given that participants may feel inclined to respond in a manner consistent with social norms rather than providing truthful answers, it is expected that if social desirability bias exists, it will determine an underestimation of the true prevalence.

Nevertheless, the study has also important strengths. By employing rigorous methodology and data analysis techniques, we are confident in collecting trusting data. Moreover, by opting for an anonymous online questionnaire which has been associated with a lower rate of social desirability bias compared to another type of data collection. Further, by setting the requirement to answer all questions, will allow us to minimize the issue of missing data. Lastly, cross-sectional studies are among the cheapest and most efficient study design, making them suitable for exploring associations and generating hypotheses in a relatively short time frame.

To conclude, our study will provide a comprehensive understanding of the factors influencing household food waste among Italian university students. Through employing an epidemiological approach, we aim to understand these behaviors over time and space. By doing so, we will contribute valuable insights to the scientific community and inform public health policies. Our findings will provide evidence-based guidance for implementing targeted interventions and policy measures to foster sustainable food consumption practices and enhance public health outcomes.

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