



The Impact of Visual Nudges on Food Waste Behavior in All-Access Dining Halls

Prepared by: *Kristine Panganiban, Qingjia Zeng, Catalina Garcia, Yutong Wu, Jiahui Qin, and Chromie He*

Prepared for: UBC Food Services

PSYC 421

The University of British Columbia

April 2024

Cover Photo: Brooke Lark on Unsplash

Disclaimer: UBC SEEDS Sustainability Program provides students with the opportunity to share the findings of their studies, as well as their opinions, conclusions and recommendations with the UBC community. The reader should bear in mind that this is a student research project and is not an official document of UBC. Furthermore, readers should bear in mind that these reports may not reflect the current status of activities at UBC. We urge you to contact the research persons mentioned in a report or the SEEDS Sustainability Program representative about the current status of the subject matter of a report.



Executive Summary

Introduction

Our study was operated in the setting of all-access university dining halls, testing an unexplored area – the effectiveness of visual nudge on food waste behaviour, highlighting the environmental consequences.

Research Question

In what way does a poster showing how food waste influences environmental damage affect the amount of food waste at an all-access student dining hall?

Methods

We observed students and other consumers who dined at the FEAST dining hall at UBC during dinner hours. We designed a baseline condition and an intervention condition with posters. Food waste was quantified using a 0-5 scale, and the total weight of food waste in kilograms was also recorded.

Results

We found a slight decreasing trend in food waste during the intervention, but results were not statistically significant (p -values > 0.05), indicating no substantial impact of posters on food waste behaviors. Though, the study offers insights into the potential limitations and challenges of using visual nudges to promote sustainable behaviors in dining halls.

Recommendations

Firstly, if using visual materials such as posters, ensure the legibility and clarity of both the design and message. Placing posters more strategically in areas without the risks of obstruction can enhance visibility and engagement among students. Furthermore, it might be useful to test and consider consolidating information into larger size posters instead of multiple small ones, as this could potentially impact the saliency and effects of the visual materials and rule out the possibility of desensitization. Coordinating with students, soliciting feedback, and letting them be involved in the development of strategies might also help in improving food waste reduction initiatives that are tailored to their habits and preferences. Establishing clear policies and guidelines regarding visual material design and placement can ensure consistency and possibly strengthen its effectiveness in conveying these messages to the students across campus.

Table of Contents

<i>Executive Summary</i>	3
Introduction	3
Research Question	3
Methods	3
Results	3
Recommendations	3
<i>Introduction, Hypothesis, Research Question, & Significance</i>	5
<i>Methods</i>	7
Participants	7
Conditions	7
Measures	7
Primary Measure	7
Secondary Measure	8
Procedure	8
Observational data collection.....	8
Kilogram data collection.....	8
<i>Results</i>	9
Descriptive Statistics Overview	9
Inferential statistics	10
Statistical Analysis Findings	10
<i>Discussion</i>	11
<i>Recommendations</i>	13
<i>References</i>	14
<i>Appendices</i>	15

Introduction, Hypothesis, Research Question, & Significance

As the amount of food waste in the world continues to rise, environmental sustainability and the reduction of food waste have become major concerns in a number of fields, particularly food service environments. University dining halls, especially those that provide all-access eating, are becoming a vital location to address the problem of food waste as concerns grow. According to Luis & Vyrastekova (2017), between 83 and 151 kg of consumable food are lost per day on average. In order to reduce food waste in university dining halls, this study intends to investigate the viability of using visual nudges posters that illustrate the negative environmental effects of food waste.

Beyond just financial loss, food waste raises important environmental issues such as needless greenhouse gas emissions and the depletion of resources needed in food production (Davison et al., 2022). Even with the increased knowledge and concern around food waste, there is still a disconnect between people's intentions to reduce waste and their actual actions. This debate emphasizes how urgent it is to develop novel treatments that can successfully turn awareness into action, especially in settings that promote excess and consumption. Previous research has demonstrated the effectiveness of different nudging techniques in decreasing food waste. For example, Luo & Yan's research from 2023 showed that using anthropomorphic designs in messaging might greatly increase empathy and decrease food waste by as much as 63%. Additionally, studies have demonstrated that the implementation of educational prompts and prominent advertising in various dining environments can lead to significant reductions in food waste (Davison et al., 2022). According to related studies, food waste in food service settings is decreased by 13% in the UK and 50% in India when interventions like signs, posters, and digital advertisements are implemented (Davison et al., 2022).

In the setting of all-access university dining halls, however, the effectiveness of posters, highlighting the environmental consequences of food waste, remains unexplored. Our study's research question aims to investigate in what ways a poster showing the environmental damage caused by food waste would affect the amount of food wasted in an all-access student dining hall. The current study revolves around the hypothesis that visual nudges, through posters depicting the climate impact of food waste, can influence the volume of food waste in all-access university dining halls. This hypothesis is predicated on the premise that visual imagery can serve as a powerful tool in influencing human behaviour, a notion supported by Wang et al. (2020), who found that imagery related to the negative impact of food waste could motivate individuals to reduce their food waste. Moreover, the study draws upon the behavioural framework suggesting that even minimal cues can act as potent mediators to foster sustainable behaviours among consumers (Ong et al., 2023).

Understanding the dynamics of how visual nudges influence food waste behaviours in university dining settings not only fills a significant knowledge gap but also holds the potential to inform the development of more effective waste reduction strategies. By integrating insights from behavioural science with environmental sustainability efforts, this research aims to offer novel perspectives on reducing food waste through targeted interventions. Consequently, the findings

of this study could provide actionable insights for university dining services to enable evidence-based strategies to curb food waste and contribute to the broader goals of environmental sustainability and resource conservation.

Methods

Participants

The target participants for this study were UBC students who use the campus dining halls, representing various backgrounds, majors, and interests within the university community. To determine the appropriate sample size for this study, an a priori power analysis was conducted using G*Power. Based on a minimum effect size of Cohen's $d=0.2$, $\alpha=0.05$, $\text{power}=0.8$, and 2 between-subjects conditions, we computed that the appropriate sample size we need is a minimum of $N=788$ participants.

In total, we observed and collected data from 900 participants who were having dinner at the 'Feast' dining hall, meeting our minimum participant recruitment goal. The participants included both resident and non-resident students of UBC, which provided a broad perspective on food waste behaviors in the dining hall. Due to the observational nature of our study, the participants were not aware of the observation, and we did not individually record the demographic details of our participants, such as age and gender distribution.

Conditions

Our study, with $N=900$ participants, was divided into two distinct conditions to assess the impact of visual nudges on food waste behavior. The control condition period was from March 12th to 15th. During this 4-day period, no visual nudges or interventions were implemented. This allowed us to observe the natural food waste levels to establish a baseline. The intervention condition was from March 18th to 22nd. The independent variable, which is the presence of environmental posters in the dining hall, was introduced during this condition. During this phase, posters depicting the environmental consequences of wasting food were strategically placed at the entrance, near the food stations (Figure 1), and in the napkin holders (Figure 2) at 'Feast' to encourage students to reduce their food waste. The dependent variables of our study are the total quantity of wasted food and the observed food waste behavior of participants.

Our hypothesis is that these visual nudges (posters) will influence the volume of food waste in the dining hall and decrease the food waste behavior of participants. The imagery on the posters is aimed at conveying the message that food waste is causing greenhouse gas emissions on Earth, along with the slogan "Take what you want, but eat what you take" (See Figures 1 and 2).

Measures

Primary Measure

Our first dependent variable, amount of diner food waste, was observed during dinner times in the 'Feast' dining hall. The data was quantified through a self-designed 0-5 scale (Figure 3). The levels of food waste were concisely defined in our scale to measure the effectiveness of our posters on food waste reduction. Each number indicates a specific level of waste, from no waste to the entire meal wasted. A 0-5 scale without decimals was simple enough to reduce potential

inconsistencies in scoring. It can speed up our collection process considering the amount of participants we needed.

Secondary Measure

The secondary dependent variable was the total weight of food waste generated in the dining hall, measured in kilograms. We requested data points for breakfast, lunch, and dinner including baseline week and intervention week. Having this data provides more insight into the effectiveness of our poster on food waste reduction. Using the total weight helped quantify the assessment of changes in food waste levels before and after our intervention.

Procedure

Observational data collection

The observation period was for 1 hour at dinner time, any time after 5pm. We recorded participants' food waste by using our scale, where a score of 0 indicated no food waste or only non-consumable parts were disposed of, and 5 indicated the entire meal was wasted (Figure 3). To address the consistency and accuracy observations, at least two members were stationed near the disposal bins, and the observers recorded a score that they both agreed on, ensuring inter-rater reliability and avoiding bias. In addition to this, observers maintained a distance from the diners and did not interact with them to avoid observer bias.

Kilogram data collection

We acquired the daily food waste data in kilograms as well as the number of diners from the dining hall. We gathered a total of 27 data points over nine days, including breakfast, lunch, and dinner from March 12 -15 for our baseline period and from March 18-22 for our intervention period. To address the challenges of the accuracy and completeness of the data, we connected with the dining hall manager both in-person and through email for our data collection process.

Results

Descriptive Statistics Overview

Our intervention had two data sources: observational food waste scores and the data from the cafeteria that we converted to grams per person. The observational data was recorded from 400 and 500 students, collected from before and after the introduction of the visual nudge posters, respectively. The data revealed a slight decrease in mean food waste scores from 1.40 (SD = 1.03) in the control phase to 1.31 (SD = 0.919) post-intervention. Similarly, our ‘grams per person’ data analysis from the cafeteria data showed a slight reduction in average food waste per person from 73.6 grams (SD = 26.1) to 60.2 grams (SD = 11.1), with sample sizes of 12 (control) and 15 (experimental).

Based on the descriptive plots illustrated in Figure 4, both the observational data conditions are similar in variability. However, in the measurement of ‘grams per person’ data, the control group displays greater variability compared to the outcome of the experimental group.

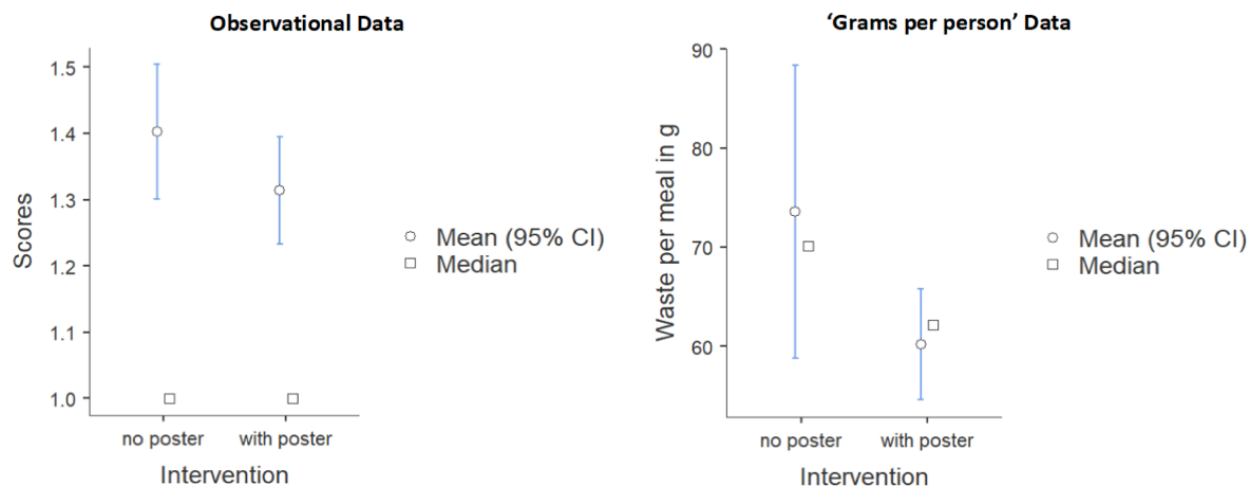


Figure 4. Descriptive plots.

Daily trend analyses in Figures 5 and 6 show a very slight downward slope in the results, as seen in both observational data and ‘grams per person’ measurements during the intervention. In Figure 5, the shape of the fluctuation for observational scores is initially gentle with small rises and falls during the baseline period. As we move into the intervention period, the pattern shows a more consistent downward slope, indicating a gradual decrease in scores. Figure 6 shows a more pronounced fluctuation in food waste per person with a significant peak early in the baseline period, followed by smaller undulations. During the intervention period, the fluctuations become less severe, with a clear sharp drop towards the end. Both tables demonstrate a consistent downward trend across the two measures, underscoring the coherence and reliability of the experimental results.

Inferential statistics

Parametric testing assumptions were tested for the data using Shapiro-Wilk (normality) and Levene's (variance homogeneity) tests. The observational data's Shapiro-Wilk p-value of 0.033 and Levene's p-value of 0.066 exhibits a violation of normality and a violation of variance homogeneity, respectively. 'Grams per person' data showed clearer breaches, with Shapiro-Wilk and Levene's tests yielding p-values of less than 0.001 and 0.001, respectively. These findings necessitated the use of the non-parametric Mann Whitney U test instead due to the violation of the assumptions and unsuitability of parametric tests under these conditions.

Statistical Analysis Findings

For the observational data, the U test yielded a W-value of 95913 with a p-value of 0.267 and an effect size (measured by rank biserial correlation) of 0.0409. In the 'grams per person' data, the W-value was 58, with a p-value of 0.126 and an effect size of 0.356. Neither set of data demonstrated statistically significant differences between conditions, suggesting that the observed slight reductions in our results were not powerful enough to validate the efficacy of visual nudges in decreasing student food waste behaviors. Thus, the findings do not support the hypothesis that the poster showing the climate impact of food waste will affect food waste volume at an all-access student dining hall.

Discussion

The statistical analysis done revealed that the intervention did not significantly impact the food waste behaviors. The implications of our results suggest that merely relying on visual nudges to evoke sustainable behavior changes may not be sufficient enough to alter people's food waste habits. The null effect of our poster intervention on the 'Feast' dining hall underscores the need for more sophisticated, comprehensive approaches to achieve meaningful behavioral modification.

The results of our study are not consistent with the results of past findings mentioned in our background literature as we did not record any notable decreases in food waste, despite our intervention strategy employing the use of visual imagery to depict the environmental consequences of food waste. This reflects the idea that environmental attitudes and behaviors are shaped by a mix of individual, social, and contextual factors (Kollmuss & Agyeman, 2002). Our study is able to offer deeper insight into highlighting how visual nudges as behavioral change strategies are possibly not universally applicable across various environments and demographics. It is possible that the efficacy of the intervention is context-specific and must be more tailored to the setting of an all-access dining hall—where students are actually encouraged to take as much food as they would like—in order to observe significant food waste behavior change.

Several limitations and challenges were also encountered in this research. The potential design flaws in the posters, such as small font or poster size issues, could have led to the message of the poster being misunderstood or overlooked. Moreover, the placement of posters in areas with obstructions could have compromised the impact or saliency of the message. Should this study be run again in the future, the interference of these limitations could possibly be prevented if the researchers consider incorporating post-intervention feedback or debriefing surveys into the study design in order to assess the effectiveness of the visual materials and ensure that the strategies resonate with participants to accurately assess behavioural change due to the nudge.

Moreover, the two-week observation period focused solely on data collection for dinner times, and the specific times the researchers collected data fluctuated which possibly affected the results. Future research should not only extend the observation period duration but also include multiple meal times (e.g. breakfast, lunch, and dinner), and standardizing the observation schedules would improve data accuracy and reliability. Assessing interventions' long-term and indirect effects is essential for developing strategies that foster sustainable behavioural changes in food waste reduction (Tian et al., 2022).

Overall, by exploring how visual nudges affect food waste behaviours in university dining halls, this study not only bridges a critical gap in the current knowledge in this area but also offers practical insights for developing more efficient waste reduction measures in the future. Intervention strategy effectiveness in reducing food waste can vary with factors like dining settings, demographics, and cultural norms, emphasizing the need for tailored approaches. Future studies should cover more diverse environments and consider underrepresented groups to effectively assess how to change food waste behaviours. The outcomes of this research could serve as a foundation for university dining services to implement more evidence-based

approaches, thereby supporting their broader environmental sustainability and resource conservation goals.

Recommendations

Despite the limitations encountered in our study, the outcome can still provide insights for refining and developing future food waste reduction solutions at UBC. Firstly, if using visual materials such as posters, ensure the legibility and clarity of both the design and message. Clear and readable text size, color schemes, and graphics are needed to reduce the likelihood of misinterpretations. Placing posters more strategically in areas without the risks of obstruction can enhance visibility and engagement among students. Furthermore, it might be useful to test and consider consolidating information into larger size posters instead of multiple small ones, as this could potentially impact the saliency and effects of the visual materials and rule out the possibility of desensitization.

Coordinating with students, soliciting feedback, and letting them be involved in the development of strategies might also help in improving food waste reduction initiatives that are tailored to their habits and preferences, thereby facilitating co-creation of more effective intervention strategies specific to the dining hall setting and fosters a sense of accountability. We recommend UBC food services to take these into account when integrating food waste reduction strategies and other projects related to the school's sustainability goals and initiatives moving forward. Establishing clear policies and guidelines regarding visual material design and placement can ensure consistency and possibly strengthen its effectiveness in conveying these messages to the students across campus. By addressing design flaws, enhancing visibility, and fostering student engagement and coordination in the process, UBC food services can take tangible steps towards achieving its sustainability objectives and fostering a culture of better food waste reduction on campus.

References

- Davison, N., Young, W., Ross, A., Cockerill, T., & Rajput, S. (2022) Investigating the Impacts of Behavioural-Change Interventions and COVID-19 on the Food-Waste-Generation Behaviours of Catered Students in the UK and India. *Sustainability*, 14, 1-23. https://mdpi-res.com/sustainability/sustainability-14-05486/article_deploy/sustainability-14-05486-v2.pdf?version=1651916301
- Giménez, A., Alcaire, F., Vitola, A., Curutchet M. R., & Ares, G. (2022). Exploring the economic and environmental effects of food waste in Uruguayan households. *Enterprise Development and Microfinance*, 33(4), 1-23. <https://doi.org/10.3362/1755-1986.22-00061>
- Kollmuss, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8(3), 239–260. <https://doi.org/10.1080/13504620220145401>
- Luo, B. & Yan, J.. (2023). How can ‘I’ Make You Empathize? Research on the influence of anthropomorphic design on against food waste. *Current Psychology*, <https://doi.org/10.1007/s12144-023-05234-4>
- Luis, H. & Vyrastekova, J.. (2017). Behavioural approach to food waste: an experiment. *Emerald Insight*, 119(4), 882-894. [10.1108/BFJ-05-2016-0213](https://doi.org/10.1108/BFJ-05-2016-0213)
- Ong, D., Chiu, S., Andrews, E., Nadarajan, G.. (2023). One needs to be reminded and motivated: mediating role of digital nudging for food waste reduction. *Emerald Insight*, 13(3), 449-471. [10.1108/JSOCM-02-2023-0025](https://doi.org/10.1108/JSOCM-02-2023-0025)
- Tian, X., Xia, Z., Xie, J., Zhang, C., Liu, Y., & Xu, M. (2022a). A meta-analytical review of intervention experiments to reduce food waste. *Environmental Research Letters*, 17(6), 064041. <https://doi.org/10.1088/1748-9326/ac72b6>
- Wang, X., Ming, M., Zhang, Y. (2020). Are “People” or “animals” more attractive? Anthropomorphic images in green-product advertising, *Elsevier*, 276. <https://doi.org/10.1016/j.jclepro.2020.122719>

Appendices

TAKE WHAT YOU CAN EAT

**A BETTER FUTURE STARTS
WITH A CLEAN PLATE**

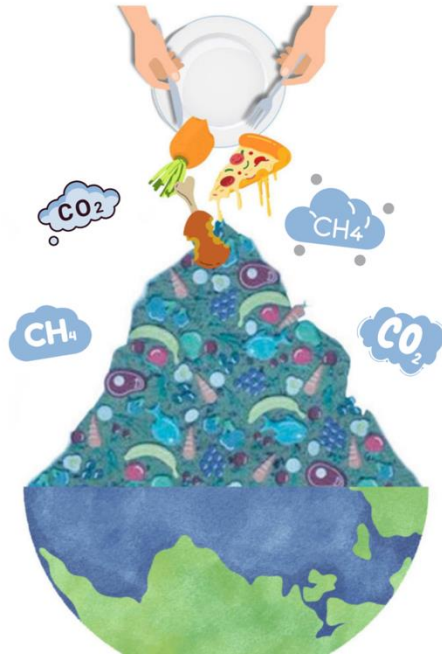


Figure 1. Vertical Poster



Figure 2. Horizontal Poster

0	1	2	3	4	5
No waste or only non consumable parts (e.g., bones, used napkins).	Very little waste (less than a quarter of the meal).	Some waste (about a quarter of the meal).	Moderate waste (half of the meal).	Substantial waste (three-quarters of the meal).	Almost the entire meal wasted.

- 0 = No waste or only non consumable parts (e.g., bones, used napkins).
- 1 = Very little waste (less than a quarter of the meal).
- 2 = Some waste (about a quarter of the meal).
- 3 = Moderate waste (half of the meal).
- 4 = Substantial waste (three-quarters of the meal).
- 5 = Almost the entire meal wasted.

Figure 3. Observation scale.

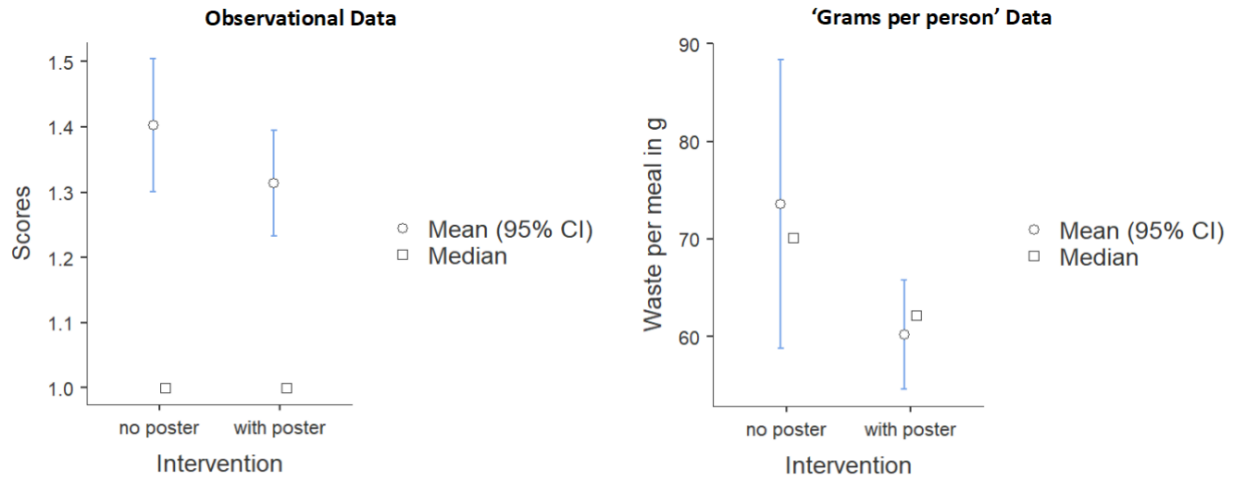


Figure 4. Descriptive plots.

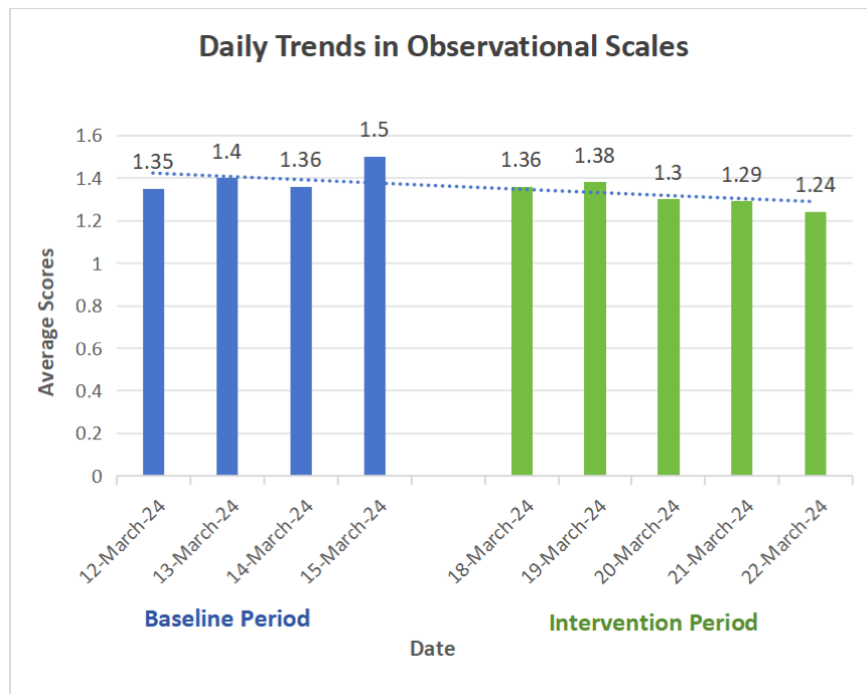


Figure 5. Daily trends in observational data.

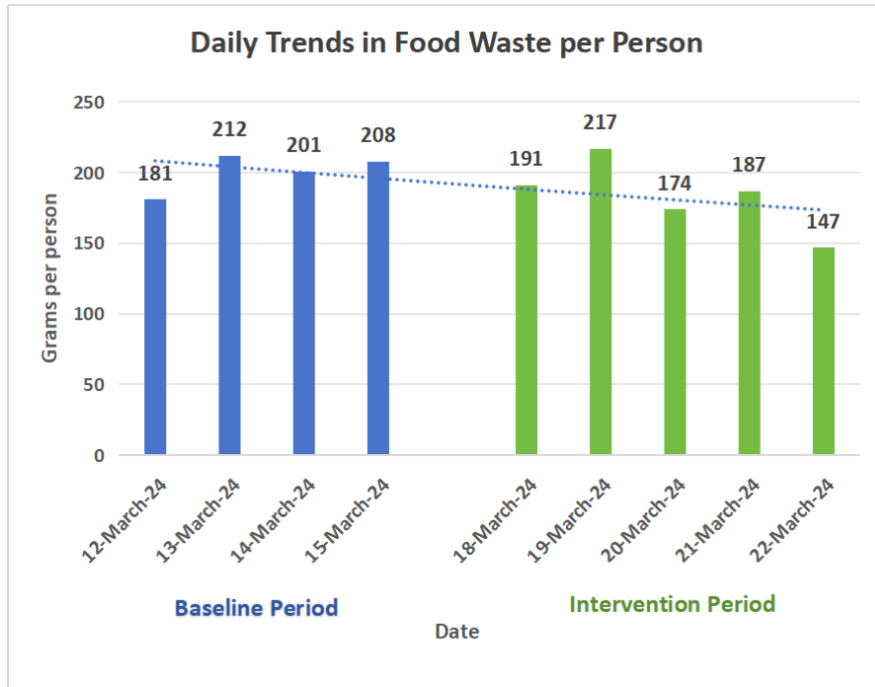


Figure 6. Daily trends in "Grams per person" data.