

Article

Sustainable Food Consumption in Nursing Homes: Less Food Waste with the Right Plate Color?

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Abstract: The problem of unsustainable food consumption among vulnerable residents of nursing homes who suffer from dementia is often multifaceted. From an individual perspective, people with dementia who do not finish their meals are likely to encounter serious health issues associated with malnutrition. Moreover, at the institutional level, nursing homes generate tons of nonrecoverable food waste each year, impairing not only their economic position but also the natural and social environment at large. The purpose of this study is to explore the possibility of reducing food waste in Norwegian nursing homes by appraising how large this reduction could be as one replaces traditional dining white porcelain with plates with diverse color combinations. A quasi-experimental method was adopted. The results of the pilot study were extrapolated to the annual amount of food wasted at the national level. The findings indicate that, on average, 26% of food was thrown away when served on white plates compared to only 9% when served on one of the colored plate options tested. Nationally, approximately 992.6 tons of food per year could potentially be saved with only a single change, ultimately ameliorating the unsustainable food consumption problem among residents of nursing homes.

Keywords: food waste; sustainability; nursing home; plate colors; pilot study

1. Introduction

Generally, food waste is perceived as an ecological, economic, and social problem. Existing estimations of global food production and consumption indicate that every year roughly 1.3 billion tons of food are lost or wasted [1,2]. The gravity of the situation has been recognized by the United Nations, which issued a list of Sustainable Development Goals (SDGs) that included a 50% reduction per capita in global food waste at the retail and consumer levels by 2030 (Goal 12: “Responsible Consumption and Production” [3]). Similarly, Borzan [4] articulates the concern that “for every kilogram of food produced, 4.5 kg of CO₂ are released into the atmosphere; whereas in Europe the approximately 89 Mt of wasted food generate 170 Mt CO₂ eq./yr” (pp. 4–5). When one considers the complexity of the entire food supply chain (i.e., production/procurement, distribution, preparation, consumption, and waste management/disposal [5]), it becomes apparent that, next to food waste and emissions, vast resources (e.g., energy, water, and land) are also being dissipated every year. Thus, from a global perspective, the waste of edible food appears to have far-reaching implications for environmental, social, and economic conditions of individuals and society at large.

Moreover, existing research supports the assertion that the foodservice sector accounts for a considerable percentage of the total food wasted within the confines of the food supply chain. For instance, it has been reported that the European Union (EU) foodservice sector produces approximately 12,263,210 tons of food waste per year, accounting for 14% of the total food waste generated [6]. Furthermore, several authors [7] argue that the level of meal waste tends to vary

according to the type of foodservice setting being investigated, such as schools and universities, workplace restaurants and canteens, or hospitals and nursing homes. As an illustration, Engström and Carlsson-Kanyama [8] report 9–11% meal waste in some school foodservices. Norton and Martin [9] find 17% waste in a university dining hall environment and waste in elderly nursing care centers between 20% and 27% of the food produced [10,11].

Having recognized the previously mentioned arguments, this study aims to contribute to the line of research examining the unsustainable food waste problem in institutional settings. Specifically, we scrutinize through a (quasi-) experimental manipulation of how plates with different color combinations influence the amount of food wasted among people with dementia living in nursing homes in Norway. For the sake of specificity, as the definition of “food waste” is not universally shared, [12] in this article, it refers to waste from food that is not eaten from the plates on which they are served. Throughout this paper, the terms “food waste” and “plate waste” are used interchangeably.

2. Food Waste Problem in Nursing Homes

It has long been advocated that consumer behavior is critical in today’s society in the fight for a more sustainable future. This includes meeting organizers such as the World Food Summit in Copenhagen, where various organizations and groups meet every year to discuss, among other things, food waste as part of sustainability in the world. [13] Residents of nursing homes that offer care and services for those no longer able to live independently represent a group of people who do not have the same opportunities to decisively affect their consuming patterns. In fact, people with dementia living in nursing homes receive all their care, including all meals, from staff members working there. According to WHO Dementia [14], dementia is chronic and progressive; cognitive function deteriorates beyond what might be expected from normal aging. Most people affected by dementia are 65–90+ years. It affects memory, thinking, orientation, comprehension, calculation, learning capacity, language, and judgment and has major consequences when sufferers perform activities in everyday life [15]. Regular and balanced food and fluid intake represent a case in point. Indeed, malnutrition is found between 10% and 60% of patients in Norway’s hospitals and nursing homes [16,17]. Undernutrition increases this rate up to 70% [18]. For persons with dementia, this risk is increased due to physical and psychological changes, which lead to lower food intake, combined with age-related malnutrition risks [19,20]. One can argue that these conditions present a challenge for most countries that have an aging population.

Worldwide, an estimated 21 million people suffered from dementia in 2009, and experts predict that this number will increase to 81.1 million by 2040 if no treatment methods for dementia are found [21]. In the Norwegian context, people with long-developed dementia often live in sheltered wards. According to the latest estimates, approximately 70,000 individuals have dementia, and this number is expected to increase to 140,000 by 2040 [15,18,22]. That number is significant in the whole world, and the estimates and projections today indicate considerably large numbers [21].

Norway had 942 nursing homes in 2018 [23], providing about 40,000 places with capacity close to 100%. Every day of the year, dinner is served to all these nursing home residents. An estimated 80% of long-term residents in nursing homes have dementia [24], which is equivalent to approximately 32,000 people. The number of dinners served throughout the year is then approximately 11.6 million and appropriate dinnerware, such as plates, cups, and mugs, needs to be in place and preferably in a shape that encourages people to eat.

A 1997 study indicated a reduction in food waste in long-term care homes when using dinnerware instead of tray service [25]. This may be related to residents feeling as if they were in their own home when they ate dinner [17]. According to Hackes et al. [25], family-style service produced the least food waste among three different serving methods.

Food waste accounts for a large part of waste in industrialized parts of the world and contributes to the fact that important nutrients are not used for human consumption, but instead go to waste and create environmental problems of great magnitude [26]. Food waste in hospitals, nursing homes,

and other health facilities contributes to the total food waste, and is often referred to as plate waste [27]. The reduction in food waste in nursing homes affects vulnerable groups of people. Today, there may be several strategies for reducing food waste, as suggested in the article by Williams and Walton, [27] such as clinical, food and menu, service, and environmental issues.

A previous study that focused on dinnerware color versus the traditional white dishes on which the vast majority of Norwegian nursing homes served dinners in 2015/16 concluded that people with dementia less often ate all the food on the white plates compared to food served on different colored plates [28]. Although the authors of this study focused on several aspects related to porcelain, dementia, and colors, they did not offer an assessment of food waste per se [28]. In a similar vein, a study by Rossiter and associates presents an alternative of a completely blue crockery used among elderly patients in an acute setting and concludes that colored porcelain was associated with increased food intake, [29] yet again no food waste amount was estimated.

Sustainability in the health sector and food service has been discussed and recommended in a Danish study [30] conducted over an 8 year period. The results showed little progress in public hospitals when it came to sustainable food systems for elderly people.

Therefore, given these arguments, we endeavor to explore the possibility of reducing food waste in Norwegian nursing homes by appraising how large this reduction could be by simply replacing traditional white porcelain dinnerware.

3. Method

To achieve the overall estimates of meal intake from estimates of individual food ingestion, it is necessary to perform some sort of calculation [31]. Therefore, this scholarly endeavor employed the following quantitative methodological approach.

3.1. Research Design and Data Collection Procedure

Whereas a given research design is often seen as a blueprint for a study, this project utilized an exploratory approach where no *a priori* (theory-driven) hypotheses were tested [32]. Instead, our primary objective was to explore the subject in question so as to provide ideas and insights that could potentially serve as an initial step for future investigations. Furthermore, in order to go beyond the frequently employed, yet not uniformly appreciated, survey method, [33] we put to use the quasi-experimental method instead [34]. Thus, for the purpose of this investigation, four plate types with different color compositions were designed (see Figure 1), where the white plate (A) option was treated as a baseline for comparisons. Of relevance, plates where all food was eaten were counted and marked as fully consumed food. The different plate combinations are described outside each image, and the interventions were carried out in that particular order. The surveys were conducted on random days over a three-week period.

Concerning the data collection procedure, this project was conducted at a nursing home in Rogaland County in Norway among people with dementia. It was carried out on two wards, with altogether 12 residents (five females) between 65 and 85 years; all residents had been diagnosed with dementia. The departments received the dinner meal in food containers directly from the communal kitchen. The staff put the food on the plates, which they then served. Plates subsequently collected by the staff were analyzed to determine whether they were with or without food residue. Some of the residents needed special diets, which were laid out ready-made from the communal kitchen and delivered together with the other meals. The staff served the ready-made plates to each resident. All photography was performed in a separate post kitchen to avoid disturbing residents before, during, and after the meal. Altogether, 88 pictures were taken, which resulted in 44 pairs of photographs (pre- and postconsumption) viable for further analysis.

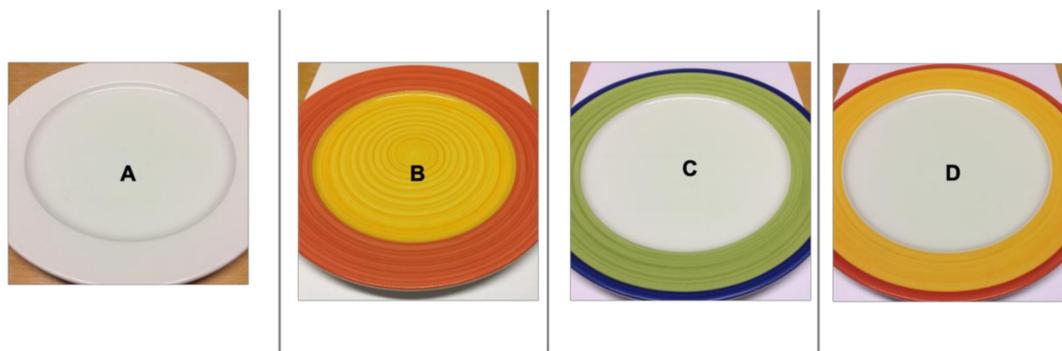


Figure 1. The different plate types used in this research: photo by author. Explanation of the different plates: Plate (A): white porcelain (a baseline for comparisons). Plate (B): yellow well, red lip, and red ring around the edge. Plate (C): white well, green lip, and blue rim on the edge. Plate (D): white well, yellow rim, and red ring around the edge.

3.2. Photo Analysis

In general terms, food waste can be measured directly by weighing the amount of food waste or estimated indirectly by, for example, visual estimations [35]. Given the diverse data collection techniques, this pilot project used data extracted through an indirect approach. Specifically, each dish was photographed before the serving occurred and later on when the plates were returned to the post kitchen. To keep the track of incoming/outcoming dishes, all plates were marked with a unique code. Finally, when all paired pictures were in place, an estimate of the percentage of actual food consumed was derived for each meal. The following formula was adopted to capture the amount of food wasted in a single meal: FW_i (in %) = $100\% - FC_i$ (in %), where FW_i is food waste from i th single meal and FC_i is food consumed in i th single meal.

3.3. Ethical Concerns

As this scholarly endeavor focuses on individuals who belong to so-called vulnerable populations [36], the following processes were established to ensure ethical conduct during the study. Information and consent forms were provided to the nursing home before the intervention. Separate forms were provided for staff and residents and adjusted for their role in the study. Nursing home managers distributed the consent forms, provided information to residents and their families, and brought in the consent forms. When residents were not able to give consent, a relative's vicarious consent was used. The project was submitted for research approval to the Norwegian Centre for Research Data (NSD) and was approved (No: 44818/3/LT).

4. Results

4.1. Experimental Results

The results presented in this quasi-experimental pilot study are based on the calculation of uneaten food during dinner by an individual with dementia who lives in a nursing home. The next section offers extrapolated calculations of how much food waste would occur during a year among people with dementia in Norway if one used different types of plates designed with a focus on color.

As for the results derived from the pilot project, the food waste when using traditional white porcelain (option A, see Figure 1) was on average equal to 26% ($N_A = 11$, $M = 0.26$, $SD = 0.28$, range from 0 to 0.80). This estimate is in line with approximations found in existing literature, as several authors have asserted that 20% to 27% of food produced in nursing homes is being wasted [10,11]. Plate B manipulation (yellow well, red lip, and red ring around the edge) resulted in an average food waste of 10% ($N_B = 10$, $M = 0.10$, $SD = 0.17$, range from 0 to 0.40). Furthermore, the second manipulation (Plate C, white well, green lip, and blue rim on the edge) led to an average food waste of 22% ($N_C = 12$,

$M = 0.22$, $SD = 0.22$, range from 0 to 0.60). The last condition (Plate D, white well, yellow rim, and red ring around the edge) recorded the least waste at 9% ($N_D = 11$, $M = 0.09$, $SD = 0.14$, range from 0 to 0.40).

4.2. Extrapolated Results

Table 1 presents the extrapolated results of our study, taking into account general statistics unique to the context of Norwegian nursing homes (as described in Section 2) and the findings obtained from the pilot project.

Table 1. Estimates for plate waste and potential saving of food waste depending on different plate color.

1	2	3	4	5	6	7	8
Plate Type	Nursing Home Beds in Norway	Average Number of People with Dementia	Average Weight of a Dinner (in kg)	Weight of Dinners Served in 365 Days (in tons)	Average Percentage of Plate Waste	Dinner Plate Waste in Norway (per year, in tons)	Saving of Food Waste (Plate A as a Baseline, per year, in tons)
	40,000	80%	0.5 kg	365 days	Pilot test		
A	40,000	32,000	16,000	5840	26%	1518.4	-
B	40,000	32,000	16,000	5840	10%	584	934.4
C	40,000	32,000	16,000	5840	22%	1284.8	233.6
D	40,000	32,000	16,000	5840	9%	525.6	992.6

Our data reveal that, if dinners served to elderly people with dementia continue to be delivered on traditional white porcelain, it will produce approximately 1518.4 tons of food waste (per year) from this single meal (column 7 in Table 1). However, introducing color-based variants into the design of pottery can possibly lead to saving a nonnegligible amount of meal waste. That is, our crude estimates imply that around 934.4 tons of food per year (column 8 in Table 1) could potentially be spared by introducing Plate B's design in nursing homes in Norway. Plate C's design could save up 233.6 tons of meal waste, whereas Plate D's design could save the biggest amount of food, equaling 992.6 tons per year.

Available literature on food waste has long recognized the distinction between edible food and nonedible food as well as between recoverable and nonrecoverable food [37]. The recoverable food category includes surplus food from restaurants, grocery stores, and cafeterias, whereas nonrecoverable food consists of animal bones, shells, and skin as well as uneaten food prepared/served by institutions. The latter argument is of particular relevance here. Food waste in nursing homes represents a major challenge in that food served to residents is more difficult to reuse for further human consumption. The number of kilos per day that go to waste from residents who do not eat all of the food served is not desirable, but when the amount of food waste throughout the year is considered, it becomes a challenge. The estimates presented imply that the savings are the greatest between Plate A and Plate D, which could save 992.6 tons per year for all of Norway. Regardless, the results clearly indicate that, of all plates, food served on white plates comes out the worst compared to the other three plates with color combinations.

4.3. Sources of Bias

The estimated results are based on several different calculated figures. Different norm numbers were extracted and approximated including dinner portion weight in kilogram per person, number of nursing home places in Norway, number of individuals with dementia in nursing homes in Norway, and percentage of dinners not fully eaten from different color combinations in the pilot project. Thus, it is necessary to point out several sources of errors that might confound our estimations. Regardless of their magnitude, in our view, the presented evidence should still be a cause for concern when considering sustainable food consumption among residents with dementia in Norwegian nursing homes.

One potential source of error in the study is the small number of individuals who participated in the pilot project, meaning our conclusions may not necessarily be transferred directly to the whole country. The small sample size also did not allow us to statistically test and verify differences in food waste production across the four investigated quasi-experimental conditions (e.g., using an ANOVA test).

A second possible source of error is that various dishes were served on the different intervention days. The residents may have liked the food better on one day than the other day. In addition, the same staff did not serve meals every single intervention day. This may have led to a greater variation in how the food was served and added up. There might have been large differences between consistently adapted food from the kitchen and how the food was plated. A last source of error was that the kitchen manual that provided pictures to show what the dinner plates should look like was oftentimes not used by the staff.

5. Discussion

According to Borzan [4], “[t]o reduce food waste, improve food safety as well as enhance the overall sustainability of food production, research and development have a highly important role to play in all sectors of the food supply and consumption chain” (p. 29). Of relevance, past research points to the fact that food waste in developing countries occurs primarily in the postharvest stages, whereas food waste in developed countries (such as Norway) occurs primarily in the consumer and postconsumer stages [38]. Thus, this project focuses on (un)sustainable food consumption patterns observed among residents of Norwegian nursing homes who suffer from dementia.

The discussion is based on the original findings published that showed how much food was eaten in terms of the colors of dinnerware on which the food was served. This was the relevant issue when the project was conducted. The result was that all types of dinnerware with colors showed a greater effect in the number of dinners eaten among people with dementia. The data indicated that the white plate used to serve dinner at the nursing home resulted in the fewest residents eating all the food on the plate.

In this article, any food not eaten by the residents was considered food waste. This means that any measures that can increase food intake and reduce food waste will be important in the fight for the better utilization of food for the sake of ensuring a sustainable future (as emphasized by the United Nation’s Sustainable Development Goals).

However, at a more fundamental level, food that is eaten provides the necessary energy, protein, minerals, vitamins, and other nutrients humans need for a good life. There are many areas that can stimulate increased food intake, but the focus of this article was how changing color combinations on a plate would affect the appetite of people with dementia.

The group that participated in this research project (often described as a vulnerable population) included people with a diagnosis of dementia. They need a regular supply of food to prevent malnutrition, from which many elderly people suffer. It is important that food is eaten to prevent malnutrition and that people with dementia receive natural nutrients and the building blocks for their body. An equally important part is that food waste needs to be reduced. A reduction in food waste among people with dementia in nursing homes faces several challenges, but the benefits of the elderly eating more food affect the individual occupant, the nursing home, the community, and finally, the natural environment.

As previously noted, food served on a plate to people in nursing homes cannot be reused and must be considered as food waste. The food is then treated as if it were contagious and cannot be destined for any further human consumption. In general terms, it is important that the risk of any possible infection is reduced, and that the food follows current laws and legislations such as, e.g., hazard analysis and critical control points (HACCP) and other national regulations [39,40]. Thus, food leftovers produced in nursing homes cannot be reused in any way that would resemble, for instance, several hotel chains and restaurant strategies (i.e., where they offer mobile apps such as “Too Good To Go” where one can purchase food at a discounted price that would otherwise be thrown away). From a sustainability perspective, it is, therefore, important that as many residents of nursing homes as possible eat the food being served. The basic premise is that everyone should be fed on white porcelain. However, our findings suggest that white dinnerware can be associated with the largest amount of food waste, while Plate D can save more than 992.6 tons of food per year. The amount of food served on average on

one plate was 0.5 kg per person per day [41]. Different interventions with white plates versus colorful plates showed different outcomes in terms of food waste from the various servings. The figures are based on estimates documented through various sources and research [41–43]. The lowest estimate is 525.6 tons of food waste if all nursing homes switched to the colored plate that showed the best result (Plate D) rather than continuing to use white plates. As a final thought, it is important to note that the provided estimations relate to only one meal (i.e., dinner). If other meals are considered when determining the amount of food waste avoided, even greater prosustainable changes could occur that would perhaps make a considerable difference to the environment and the people directly affected.

Taken together, improving the efficiency of food production and consumption, as well as changing the general diet in Western countries, appear to be vital for securing the sustainable future of food supply. Along this line, several authors contend that food waste occurring in particular at the end of the food supply chain (i.e., consumption) is especially harmful to the environment and economy due to the resources invested and emissions produced while growing, transporting, and retailing foodstuffs [44,45]. Having considered the gravity of the situation, this scholarly endeavor brings in a possible solution for ameliorating the unsustainable food consumption problem specifically among residents of nursing homes.

6. Conclusions

The findings of this article indicate that with only a single change (such as redesigning the colors of dinnerware), a lot of food can be eaten instead of it turning into waste in institutions such as nursing homes. Although this was just a pilot project, the estimated number of tons of food saved from waste is tremendous (i.e., up to 992.6 tons of food per year). It seems that sustainable consumption at institutions such as nursing homes has not received adequate attention thus far, and we believe that this stream of research holds the potential to benefit individuals (e.g., residents' health), institutions (e.g., their general food expenses), and/or the natural environment at large (e.g., by producing less nonreusable food waste).

Therefore, further research should look at conditions that encourage nursing home residents to eat more of the food being served, especially people with dementia, who make up a large proportion of these residents. Several measures can be adopted and (e.g., experimentally) manipulated to comprehend how, for instance, the size of the plate, atmosphere in the dining room, brightness in the food room, or diverse plate colors encourage or discourage overall food consumption and waste production among the elderly with dementia living in nursing homes.

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