



Evaluation of the Food Waste Volume in Pediatric Intensive Care Units (PICUs) of Akbar Hospital in Mashhad, Iran

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Introduction: Understanding food waste is essential to reduce environmental impact and financial burden and ensuring food security in hospital settings. Research on hospital food waste in Iran, especially in Pediatric Intensive Care Units (PICUs), has been limited despite the importance of reducing food waste. Therefore, this study aims to evaluate the amount of food waste in the Akbar Children's Hospital PICUs department. The findings of these studies can provide evidence to improve food management in hospital settings.

Method: The rate of food waste among patients admitted to the Akbar Hospital's PICUs was measured in this cross-sectional study. Food waste was measured by calculating the difference between the total food delivered to the patient and the total food they consumed. Patients or their parents provided information about the proportion of hospital food intake within the past 24 hours.

Result: Of the 140 patients in the initial sample, 21 received hospital food during the study. The average food waste for the one-week study period was 53.57%, indicating that 90.5% of patients caused varying degrees of food waste, with only 9.5% consuming the entire amount of hospital food they received. No significant association was found between patients' age or gender and food waste.

Conclusion: The results suggested a significant amount of food waste in the hospital setting that needs to be addressed to improve patient nutrition and reduce costs.

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Introduction

Hospital malnutrition is a critical problem affecting between 20 and 50% of patients admitted to the hospital (1). Malnutrition profoundly affects patients' clinical outcomes, increasing mortality rates and length of hospital stay (2). Furthermore, malnourished patients are at higher risk of developing complications during hospitalization. Two-thirds of malnourished patients admitted to the hospital worsen their nutritional status during hospitalization if not treated promptly, while one-third of non-malnourished patients become malnourished (1). Proper nutritional status and healthy feeding of hospitalized patients are paramount. In addition, the hospital nutrition department plays an essential role in ensuring that patients receive

appropriate diets and menus to optimize their nutritional status (3-5).

A hospital's nutrition and food service optimize patients' nutritional status by providing appropriate diets and menus (6). However, Simzari et al. revealed that hospital malnutrition is related to the amount of food waste, and the increase in food waste is related to inadequate protein and energy intake (7). According to Practice Green Health, 10-15% of hospital solid waste is food waste (8). Therefore, reducing food waste is a challenge for the nutrition department in every hospital (9).

As Williams and Walton demonstrated, food waste in hospitals is significantly higher than in other food services (10). Plate waste is one of the components of hospital food waste, which refers

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to the amount of food prepared for the patient that is not consumed (11). The causes of plate waste can be stress, anorexia, pain, quality, quantity, and inappropriate feeding time (12). Some strategies can be applied to manage food waste, such as optimizing portion sizes and delivery systems, increasing patient food choices, and employing people to help feed patients (13). In addition to reducing food waste, conducting food waste studies if it leads to increased food intake can reduce costs and financial burden (14), improve patient food access (15), increase food intake (15), prevention of malnutrition (16), and increase patient satisfaction (17).

Despite the importance of reducing food waste, limited research has been conducted on hospital food waste in Iran. To our knowledge, no study has examined the amount of food waste in the Pediatric Intensive Care Units (PICUs). Therefore, this study aims to evaluate the amount of food waste in the PICUs department of Akbar Children's Hospital, considering the

significant role of food waste management in reducing the financial burden and improving patient access to food.

Material and Methods

Participants

This observational exploratory research cross-sectional study was conducted in 2022 in the Pediatric Intensive Care Units (PICUs) of Akbar Hospital in Mashhad for one week to gain initial insights regarding food waste in PICUs. In this study, all the available patients in the PICUs were evaluated. The inclusion criteria were participants admitted to the PICUs, ability to receive the food orally, desire to participate in the study and consume the provided hospital food. The exclusion criteria included becoming nil per os (NPO), not desire to contribute to the study, and receiving oral nutrition support (ONS) or parenteral or enteral nutrition that could affect the amount of the daily provided hospital food amount and the condition of breastfeeding.

Table1- Descriptions of the codes used in the food waste checklist.

Code	Code Description
0	All the food delivered to the patient by the nutrition department has been eaten
1/4	3/4 of the food delivered to the patient by the nutrition department has been eaten
2/4	2/4 of the food delivered to the patient by the nutrition department has been eaten
3/4	1/4 of the food delivered to the patient by the nutrition department has been eaten
4/4	All the food delivered to the patient by the nutrition department has not been eaten

Data Collection

In this study, food waste was calculated by comparing the total food delivered to the patient with the total food consumed. The validity and reliability of the checklist used to evaluate food waste were established by Tabibi (5). Table 1 describes each code on the checklist ranging from 0 to 1. Patients or their parents were asked to provide information about the patient's proportion of hospital food intake within the past 24 hours (12). The food intake values reported by children were cross-checked with parents' observations at the patient's bedside.

Statistical Analysis

The data were analyzed using SPSS version 16 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to define baseline characteristics and determine the final food waste mean ratio. The data normality was evaluated using the Kolmogorov-Smirnov test. An Independent sample t-test was used to compare the food waste amount between the two

sexes and their age. The $p < 0.05$ is considered significant.

Results

This study examined the food intake of 140 patients in the PICU Wards of Akbar Hospital, Mashhad, Iran, during a one-week period in which food waste was measured. Among the initial sample, 52 patients were excluded due to eating nothing by mouth or "nil per os" (NPO) diet, seven patients due to exclusive breastfeeding, 42 patients were excluded due to enteral feeding, and 17 patients due to non-hospital foods consumed during the main meals. Finally, food waste for 21 patients receiving hospital food was evaluated. The mean age of the participants was 79.80 ± 4.82 months, and other baseline characteristics are presented in Table 2. The average food waste for the one-week study period is $53.57 \pm 29.88\%$, as shown in Table 3. Approximately 9.5% of patients consumed all the hospital food they received, while the remaining 90.5% caused varying degrees of food waste. Specifically, 28.6% of patients left 1/4 of their

food, 4.8% left 1/2 of their food, and 47.6% left 3/4 of their food. Additionally, 9.5% of patients left the entire hospital food they received (Table 4).

No significant association was found between patients' age or gender and their food waste ($P=0.53$ and $P=0.48$, respectively).

Table 2. Baseline characteristics of PICU patients

Variable	value	mean±SD / N (%)
Number	n	21
Age (months)	months	79.80± 4.82
Gender	Male	14(66.7%)
	Female	7(33.3%)

Table 3. Mean Main Course Waste among PICU patients

Food Waste	N	Mean	SD
Main Course Waste	21	53.57	29.88

Table 4. Food waste grades distribution among PICU patients

Food Waste	Total population	Male	Female
0	2 (9.5%)	1 (7.1%)	1 (14.2%)
1/4	6 (28.6%)	5 (35.7%)	1 (14.2%)
1/2	1 (4.8%)	1 (7.1%)	0 (0.0%)
3/4	10 (47.6)	6 (42.8%)	4 (57.1%)
4/4	2 (9.5%)	1 (7.1%)	1 (14.2%)
Total	21 (100%)	14 (100%)	7 (100%)

Discussion

In recent years, several studies have been conducted with the aim of evaluating the amount of hospital plate waste and the amount of patients' consumption of food received from hospital catering. Dehnavi et al. (2018) found that the average food wastage in lunch at Qaem and Imam Reza hospitals in Mashhad was $41.40 \pm 37.95\%$ for the Main Course meal and $27.84 \pm 34.47\%$ (18). Furthermore, the study revealed that 44.6% of patients did not waste any food, while 11.6% of patients left 1/4 of their food, 20% of patients left 1/2 of their food, 9.9% of patients left 3/4 of their food, and 13.9% of patients left the entire of their food.

Similarly, Tabibi et al. (2011) evaluated food waste in the lunch of patients hospitalized in Bo Ali Hospital in Tehran, and 58.4% of patients did not consume all the food they received. Of these patients, 5.5%, 30.5%, 9.4%, and 2.7% did not consume the total, 1/4, 1/2, and 3/4 of the received food, respectively. It is noteworthy that only 41.6% of patients consumed their entire received food (19).

Frakes et al. (1986) reported an average food waste of 21.9% for all meals (13), while Hirsch et al. (1979), which examined food waste in 11 UK hospitals, reported that 44.2% of patients consumed all their meals, while the rest produced varying amounts of food waste(20). The present study supports these findings,

indicating that the mean food waste produced was $53.57 \pm 29.88\%$. Specifically, 9.5%, 28.6%, 4.8%, and 3.5% of patients did not consume 100%, 25%, 50%, and entire received food, respectively.

The findings indicated that food waste in the hospital setting is notably higher than previous studies have reported. Additionally, a smaller proportion of patients succeeded in consuming all the food they were offered during their hospital stay. These observations could be attributed to the distinctive conditions of patients hospitalized in the intensive care unit, which may affect their appetite and food intake differently than non-ICU patients. Moreover, child patients' physiological and clinical states may differ significantly from adult patients, contributing to food consumption and waste differences.

The findings suggested no significant difference in the amount of food waste between genders, and we did not observe any association between the patient's age and their food waste amount. These observations align with a similar study conducted by Dehnavi et al. (2018), which did not find a significant association between the amount of food waste and patients' age or gender, with similar food waste levels observed across both genders (18). In previous research, Roberto S et al. (2004) (21) found that food waste levels were higher inwards with older patients, while Hamilton K et al. (2001) found that food

waste was more common in female patients compared to males (21, 22). The present study focused exclusively on food waste in the PICU ward. Dehnavi et al. (2018) found that food waste varied significantly across different hospital wards, specifically, the amount of waste in the heart ward was significantly more than in other wards. However, the surgical ward reported less food waste than other wards (18). A study in 2011 found that the surgery and rehabilitation wards had the least and most food waste, respectively, compared to other wards (21). Similarly, Barton A. et al. (2000) observed that medical and surgical wards had lower food waste than the geriatric ward, which had more waste than other wards (3, 4).

A notable strength of this study is that, to the best of our knowledge, it is the first to investigate food waste in specialized children's hospitals, particularly in PICUs. Children's food intake values were cross-checked with parents' observations at the patient's bedside. This rigorous approach provides confidence in the accuracy of the findings and underscores the importance of including parent observations in assessing food waste in pediatric hospital settings. A possible limitation of this study is not accounting for food waste caused by appetizers, and separately examining the amount of food waste caused by different main meals could provide a more detailed picture. Moreover, the limited number of participants who met the inclusion criteria for this study might be considered another limitation, as it reduces the generalizability of the findings.

Based on the findings, the researchers recommended the need for future studies with larger sample sizes and extended durations. Additionally, future studies should consider the inherent differences in food waste generated by different meals and variations between patients with different medical conditions. These efforts would contribute to a more comprehensive understanding of food waste management in hospital settings and facilitate the effective development of waste reduction strategies. Future studies should also evaluate the amount of waste of gavage formulas and parenteral nutrition products, as well as the amount of food waste, according to the authors of this study. It is also recommended that the amount of hospital capital wastage and possible cost savings if the

amount of food waste is reduced, should be considered as the goal of future studies.

Conclusion:

Food waste management is a critical issue that confronts hospitals and impacts treatment outcomes and financial viability. The first step toward reducing food waste is to understand the amount of waste generated by each department within the hospital. Based on a recent study, PICU wards pose unique challenges regarding food waste management due to the potential risk of malnutrition. Thus, hospitals should conduct comprehensive food waste assessments in the PICU ward to address this issue and optimize patient outcomes.

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Conflict of Interest

The authors declare the existence of any conflict of interest in this study.

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