ORIGINAL

Evaluation of Factors Affecting Food Wastage among Hospitalized Patients on Therapeutic Diet at Ministry of Health (MOH) Hospitals

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ABSTRACT

High food wastage is associated with reduced energy intakes leading to malnutrition-related complications in hospitals. This study aims to determine food wastage prevalence among hospitalized patients on therapeutic diets and associated factors affecting food waste. Association of contributing factors with food waste among inpatients on therapeutic diets in 21 study sites were investigated. This study was conducted from October 2016 to November 2016 where 2759 subjects were randomly recruited. Overall, 47.4% therapeutic diet were wasted. 52.4% vegetables had been wasted followed by protein (48.4%), carbohydrate (44.5%) and desserts (44.3 %). Food wastage was significant higher among female (50.7%), centralized food serving system (49.7%), outsource food service system (56.8%) and during dinner time (58.5%). Physical factors like eating and swallowing difficulties; psychological factors (alone, abandoned, stress and food belief) and food quality factors; unclean food and delay eating time were found significantly associated with higher food waste at $p<0.01$. Food wastage was also significantly affected by nutritional impact symptoms (NIS) like abdominal distension, diarrhoea, dysphagia, lethargy, nausea, poor appetite, poor dentition and vomiting. Several factors had been identified as associated factors affecting food waste. A negative and high correlation was observed between energy and protein intake with food wastage suggesting that a reduction in energy and protein intake will lead to higher food waste. With this knowledge, necessary measures can be plan and implement to reduce food waste and improves the therapeutic diet deliverance in improving hospitalized patients' nutritional status.

Keywords: Food waste, food wastage, nutrition impact symptoms, therapeutic diet

INTRODUCTION

Food waste is one of the issues that become a global concern nowadays[1]. An estimated one-third of all food that is produced worldwide is wasted, which amounts to about 1.3 billion tonnes per year[2]. Food waste can be defined as any edible foods or leftover from some process, cooked or uncooked food[3]. The causes of food waste are numerous, and occur at the stage of production, processing, retailing and consumption[4]. Statistics from Solid Waste Corporation of Malaysia

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(SWCorp) showed that in 2015 the food waste in Malaysia reached 15,000 tonnes daily, including 3,000 tonnes that was still fit for consumption and should not have been discarded[5]. According to Williams & Walton, 2011, food waste related to clinical issue in hospital settings had become the most challenging in food waste reduction strategies[6].

Food wastage is commonly reported in Malaysian hospitals. In a review article summarizing literatures on the extent of plate waste occurring in hospital settings until 2012, a median plate waste of 30% with a wide range of 6% to 67% were reported in 32 international studies[6]. In hospitals, 50% of the total waste generated in a ward environment was food[7,8]. Several studies had shown that the problem of food wastage in hospitals ranges from 17% to 67%[9,10]. It was estimated that plate waste in hospitals can add up to 30 percent to food costs[9]. In year 2000, an estimation of the cost of wasted food in British hospitals was worth £28 million[11]. Food wastage in hospitals has always been much higher than other food service sectors. Restaurants, cafes, hotels, schools and workplace canteens usually have levels of plate waste of less than 15%, in which hospitals plate waste can be two or three times higher[7].

High food wastage is associated with reduced energy and protein intakes and has an impact on malnutrition-related complications in hospitals, as well as financial and environmental costs[12]. The wasted food contains energy, protein, and important micro nutrients that could have been consumed by hospitalized patients of whom 40% are at risk of under nutrition[13]. Hospital malnutrition could delay patients' recovery, thus extending the length of the stay and contributing to its worsening[12]. There are several reasons that have been associated with high level of plate waste in hospitals including appetite variations. Meal waste in hospitals could also be caused by alterations in the sensorial quality of foods served[14]. In a study done in the United State of America, loss of appetite along with taste loss was the most common reasons found which made up 28% of the reasons inpatients consumed less than half of the main starter[15]. In a Swiss study, half of the inpatients declared they had less appetite than at home[16]. As expected, illness often can affect appetite and the senses of taste or smell. Reduced activity during hospitalization, side effects of treatment drugs, nausea or gastrointestinal symptoms, can also interfere with the normal desire to eat. Diet prescriptions, such as texture modification or therapeutic diet like low salt diet, could reduce the sensory appeal of food, and it has been estimated that being on a special diet doubles the risk of insufficient energy intake[17].

Reducing food waste should be of prime concern to health care multidisciplinary team including food service providers, medical and nursing staff, dieticians and catering's staff. Reducing in food wastage helps cut costs while supporting patients to consume their food which lead to better clinical outcome through improve nutritional. This study aims to determine the prevalence of food wastage among hospitalized patients who received therapeutic diets and evaluate its association with gender, ethnic, mealtime, diagnosis, type of therapeutic diet received, nutrition impact symptoms, psychological and physiological factors, food quality as well as food serving and food service system.

METHODS

Selections of subjects: A cross sectional study was conducted to determine prevalence of food wastage and its association with energy and protein intake adequacy among inpatients receiving therapeutic diets in 21 study sites comprising of number of state and number hospital specialist government hospital under the Ministry of Health, Malaysia from October 2016 to November 2016. Eligible subjects were inpatients aged above 18 years old who received therapeutic diet and able to take orally with no communication barriers in medical wards with at least 48 hours of admission. In patients who received normal diet, on Ryle's tube feeding (RT feeding) or parenteral nutrition, with psychiatric disorder, diagnosed with HIV/AIDS, pregnant woman or bedridden and Nil by Mouth (NBM) patients were excluded. The sample size needed in this study was 2759 included 10% calculation for attrition and calculated based on power sample of 80% and confidence interval 95%, an expected difference of 5% and standard deviation (SD) of 134 the nutritional value wasted by patient in a pilot study on nutrition impact symptoms (NIS) and food wastage[18] in National Cancer Institute, Putrajaya and at the proportionate sampling were used to recruit the subjects in respective study sites. A

replacement of new subjects was applied when the appointed subjects refused.

Ethical approval was obtained from Medical Ethical and Research Committee, Ministry of Health (NMRR-16-1482-31605). Additionally, permission to conduct the study was obtained from the Director of selected hospitals with informed consent approved by the Ethical Committee signed by subjects or authorized representative in the presence of witness were also obtained. A total of 2587 subjects were recruited in this study constituted with 50.1% male subjects (n=1296) and female, 49.9% (n=1291). Social-demographic and clinical data such as age, ethnicity, gender, marital, employment and educational status and clinical diagnosis are listed in **Table 1** were obtained from subject's file and a face-to face interview.

Data collection: Food wastage in this study was indicated as any food that is discarded or uneaten. A visual estimation method was used to measure proportion of leftovers food using semi quantitative 5-point scale (all, ¾, ½, ¼, none) (Williams & Walton, 2011). An illustration of food wastage was done according to pictograph as a standard measurement of observation for the usage of Data Collector in this study. Observation was done during lunch or dinner only and the wastage was categorised into 4 main groups; carbohydrate, protein, vegetables and desserts. All observation on the food wastage was recorded in the Data Collection Form designed for the study.

Table 1: Characteristics of the Study Population

Study Characteristic		Frequency (n)	Percentage (%)
Gender	Male	1296	50.1
	Female	1291	49.9
Educational level	No education	396	15.4
	Primary	824	32.1
	Secondary	1146	44.6
	Diploma	118	4.6
	Bachelor	83	3.2
Marital status	Single	296	11.5
	Married	2100	81.5
	Divorced	29	1.1
	Widowed	153	5.9
Ethnic	Malay	1643	63.5
	Chinese	439	17.0
	India	333	12.9
	Bumiputera Sabah	84	3.2
	Bumiputera Sarawak	56	2.2
	Others	32	1.2
BMI (kg/m^2)	Underweight	204	8.0
	Normal	1238	48.5
	Overweight	713	27.9
	Obese	396	15.5
Diagnosis	Diabetes mellitus	1620	62.6
	Hypertension	1643	63.5
	Renal Disease	632	24.4
	Hyperlipidaemia	357	13.8
	Heart Disease	502	19.4
	Gout	100	3.9
	Wound	43	1.7
	DVT/AF	40	1.5
	Others	692	28.0

Data analysis: The data analysis was conducted using IBM SPSS version 22. Descriptive date is expressed as mean and standard deviation. Independent T-Test and One-way ANOVA were conducted for analysis of the mean difference in normally distributed data. Categorical data were analysed using Chi-square or Fisher's exact test. Pearson's and Spearman's correlation were used to analyse correlation between numerical data.

Table 2: Average Food Wastage by Study Site and Food Group

Item		N	Food Wastage (%) Mean (±SD)
Overall		2587	47.4 (± 31.3)
Study Sites	Hospital Tuanku Jaafar, Seremban	200	46.2 (± 31.6)
	Hospital Selayang	141	62.0 (± 29.6)
	Hospital Tunku Ampuan Rahimah	183	35.0 (± 31.1)
	Hospital Serdang	44	40.5 (± 28.7)
	Hospital Kuala Lumpur	122	29.9 (± 28.9)
	Hospital Sultanah Nur Zahirah	52	63.8 (± 27.8)
	Hospital Raja Perempuan Zainab II	87	63.5 (± 25.4)
	Hospital Sultanah Aminah	133	44.6 (± 28.0)
	Hospital Pakar Sultanah Fatimah	153	52.3 (± 36.5)
	Hospital Sultan Ismail	84	59.2 (± 28.6)
	Hospital Sultanah Bahiyah	159	53.5 (± 27.2)
	Hospital Sultan Abdul Halim	134	36.3 (± 30.3)
	Hospital Tuanku Fauziah	82	47.5 (± 28.4)
	Hospital Melaka	193	38.0 (± 32.1)
	Hospital Pulau Pinang	109	55.2 (± 26.6)
	Hospital Raja Permaisuri Bainun	192	48.9 (± 33.7)
	Hospital Taiping	107	37.4 (± 24.5)
	Hospital Sultan Haji Ahmad Shah	51	60.8 (± 29.2)
	Hospital Tengku Ampuan Afzan	105	48.2 (± 30.6)
	Hospital Umum Sarawak	139	48.3 (± 31.4)
	Hospital Queen Elizabeth	117	52.8 (± 24.8)
Food Group	Carbohydrate	2587	44.5 (± 37.1)
	Protein	2587	48.4 (± 39.2)
	Vegetables	2587	52.4 (± 40.1)
	Fruits/desserts	2587	44.3 (± 45.8)
Type of Carbohydrate	Rice	2188	42.8 (± 36.9)
	Porridge	353	52.5 (± 35.9)
	Mixed Porridge	30	66.7 (± 39.0)
	Pureed	9	69.4 (± 46.4)
	Blended	7	53.6 (± 50.8)
Type of Dessert	Fruit	2067	32.8 (± 42.2)
	Jelly	59	65.3 (± 40.2)
	Pudding	79	60.1 (± 43.4)

RESULTS

A total of 2587 (93.7%) subjects were successfully recruited into this study. In this study, male subjects constituted 50.1% of the sample studied compared to female, 49.9% .63.5% study subjects were Malay, followed by Chinese (17.0%) and Indian (12.9%). 44.6% subjects received secondary education, 81.5% were married and more than 60% were diagnosed with diabetes mellitus and hypertension. The mean age of subjects was 57±14.8 years old. Based on WHO (2006) BMI classification, most of the subjects 48.5% had normal weight. Overweight and obese subjects were 27.9% and 15.5% respectively. Only 8% of study's subjects were underweight.

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Food Wastage: Overall food wastage in therapeutic diet served in 21 Ministry of Health hospitals was 47.4% ranging from 16% to 79%. Table 2 presents the average food wastage by study site where Hospital Sultanah Nur Zahirah, Kuala Terengganu, Terengganu had the highest percentage of food wastage (63.8 %), followed by Hospital Raja Perempuan Zainab II, Kota Bharu, Kelantan (63.5%), Hospital Selayang, Selangor (62.0%) and Hospital Sultan Ahmad Shah, Temerloh, Pahang (60.8%). Hospital Kuala Lumpur had the lowest percentage of food wastage (29.9%).

Table 3: Comparing Mean Food Wastage with Study Characteristics

Study Characteristic		N	Food Wastage (%) Mean (± SD)	*p*-value[a]
Gender	Male	1296	44.2 (± 32.5)	<0.001
	Female	1291	50.7 (± 29.7)	
Food Serving System	Bulk	798	42.2 (± 31.6)	<0.001
	Centralised	1789	49.7 (± 30.9)	
Food Service System	In-house	2203	45.8 (± 31.4)	<0.001
	Outsource	384	56.8 (± 29.1)	
Referral to Dietitian	Yes	617	47.6 (± 32.2)	0.883
	No	1964	47.4 (± 30.9)	
Time of Meal Observed	Lunch	2447	46.8 (± 31.4)	<0.001
	Dinner	138	58.5 (± 27.3)	
Ethnic	Malay	1643	47.5 (± 31.1)	0.082[b]
	Chinese	439	48.7 (± 33.0)	
	India	333	43.6 (± 31.2)	
	Bumiputera Sarawak	56	54.3 (± 26.0)	
	Bumiputera Sabah	84	46.7 (± 29.3)	
	Others	32	46.7 (± 31.3)	
Educational level	No education	396	53.0 (± 30.5)	<0.001[b]
	Primary	824	49.2 (± 30.5)	
	Secondary	1146	45.1 (± 31.2)	
	Diploma	118	42.7 (± 34.1)	
	Bachelor	83	42.1 (± 33.8)	
Marital status	Single	296	40.8 (± 31.9)	<0.001 [b]
	Married	2100	48.3 (± 31.5)	
	Divorced	29	29.1 (± 21.9)	
	Widowed	153	52.2 (± 25.5)	
BMI (kg/m^2)	Underweight	204	56.3 (± 31.6)	<0.001 [b]
	Normal	1238	50.0 (± 31.2)	
	Overweight	713	43.9 (± 31.2)	
	Obese	396	41.3 (± 29.7)	
Age group, years old	Young adult (18 – 30)	159	40.7 (± 32.6)	<0.001 [b]
	Middle age adult (30 – 50)	587	43.0 (± 31.0)	
	Senior adult (> 50)	1841	49.4 (± 31.0)	

[a] *Independent t-test;* [b]*One – way Anova; Significant tested by p<0.05*

Vegetables had become the highest wastage among the food groups (52.4%) in most of the government hospitals, followed by protein (48.4%), carbohydrate (44.5%) and desserts (44.3 %). Moreover, among types of carbohydrate wasted the most was pureed diet (69.4%) compared to others. For dessert, the data shows that jelly had the highest food wastage (65.3%), followed by pudding (60.1%) and fruit (32.8%). Food wastage was significant higher among female (50.7%), centralised food serving system (49.7%), outsource food service system (56.8%) and during dinner time (58.5%).

Table 4: Food Wastage and Nutritional Impact Symptoms and Factors Influencing Nutritional Status (Physical, Psychological and Food Quality)

Factors	N	Food wastage (%) Mean (SD)	*p*-value[a]
NIS			
Abdominal Distension			<0.001
Yes	125	57.9 (30.6)	
No	2462	46.9 (31.2)	
Ascites			0.87
Yes	61	48.1 (32.9)	
No	2526	47.4 (31.2)	
Constipation			0.56
Yes	105	49.2 (30.5)	
No	2482	47.3 (31.3)	
Diarrhoea			<0.001
Yes	92	60.4 (30.8)	
No	2495	46.9 (31.2)	
Dysphagia			<0.001
Yes	43	70.1 (26.0)	
No	2544	47.0 (31.2)	
Early satiety			0.099
Yes	132	51.1 (26.2)	
No	2455	47.2 (31.5)	
Edema			0.81
Yes	75	48.3 (29.5)	
No	2512	47.7 (31.3)	
Lethargy			<0.001
Yes	299	63.4 (28.2)	
No	2288	45.3 (31.1)	
Nausea			<0.001
Yes	235	62.2 (27.9)	
No	2352	45.9 (31.2)	
Poor appetite			<0.001
Yes	952	62.7 (26.0)	
No	1635	38.5 (30.7)	
Poor dentition			<0.001
Yes	194	59.9 (26.9)	
No	2393	46.4 (31.4)	
Vomiting			<0.001
Yes	125	60.1 (30.2)	
No	2462	46.8 (31.2)	
Physical			
Difficulties to eat			<0.001
Yes	209	67.1 (27.2)	
No	2374	45.7 (31.0)	
Difficulties in swallowing			<0.001
Yes	125	71.8 (24.9)	
No	2458	46.2 (31.1)	
Delay eating time			<0.001
Yes	26	70.9 (20.8)	
No	2557	47.2 (31.3)	
Psychological			
Alone			<0.001
Yes	67	59.5 (29.6)	
No	2516	47.1 (31.3)	
Abandoned			0.005
Yes	85	56.8 (28.7)	
No	2498	47.1 (31.3)	
Stress			<0.001
Yes	134	64.9 (24.8)	
No	2449	46.5 (31.3)	
Food Belief			
Yes	97	53.6 (25.7)	
No	2486	47.2 (31.5)	
Food quality			
Unclean food			0.030
Yes	9	63.2 (18.1)	
No	2574	47.4 (31.3)	
Big portion			0.431
Yes	79	49.2 (20.2)	
No	2504	47.4 (31.6)	
Physical Contamination			0.488
Yes	6	38.5 (30.0)	
No	2577	47.4 (31.3)	

[a] *Independent T-Test; Significant at p<0.05, NIS=Nutrition Impact Symptoms*

Table 5: Correlation between Energy and Protein Intake with Food Wastage

Mean Intake ±SD	Food Wastage (%) Mean±SD	*r*	*p*-value[a]
Energy intakes (kcal)			
794.6 ±487.8	47.4±31.3	- 0.951	<0.001
Protein intakes (g)			
35.2 ±24.3	47.4 ±31.3	- 0.873	<0.001

[a]*Pearson's correlation test, r=Correlation Coefficient*

No significant difference was observed on food wastage among subjects whether referred to dietician or not. Food wastage also differs significantly among educational level groups, marital status groups and BMI groups. Subjects with no education had significantly the highest mean food wastage and differ significantly when compared to subjects with secondary, diploma or bachelor education. This study also observed that divorced subjects had significantly the lowest food wastage percentage when compared to married, single and widowed subjects. Food wastage among young adults and middle age adults was not significantly different but both of these groups had mean food wastage that differ significantly with the senior adult group ($p<0.001$). There were no significant difference between food wastage with ethnic group and dieticians' consultation as shown in Table 3

According to BMI group, mean total of food wastage for underweight and normal weight subjects was statistically significant ($p<0.001$) compared to overweight group; obese group. As observed mean food wastage was the highest in underweight groups (56.3%), followed by normal BMI subjects (50.0%), overweight (43.9%) and obese subjects (41.3%)

Table 4, shows findings on mean food wastage affected by nutritional impact symptoms (NIS). Abdominal distension, diarrhoea, dysphagia, lethargy, nausea, poor appetite, poor dentition and vomiting are among the NIS that shows significant difference when compared with subjects without the symptoms. This study did observed that there were significant associations between food wastage with physical factors; eating difficulties ($p<0.001$), swallowing difficulties ($p<0.001$), delay eating time ($p<0.001$), psychological factors; alone ($p<0.001$), abandoned ($p=0.005$), stress ($p<0.001$), and food belief ($p<0.001$), and food quality factors; unclean food ($p<0.001$).

Table 5 shows significant association between energy and protein intake with food wastage ($p<0.001$). A negative and high correlation was observed between energy and protein intake with food wastage. This suggests that a reduction in energy and protein intake will lead to higher food wastage.

DISCUSSION

Throughout this study our food wastage findings were consistent with a local study[9] conducted in a Penang district hospital involving normal diet. Almost half (47.4%) of the therapeutic diet served in MOH hospitals in Malaysia had been wasted and it was expected to be higher than the wastage of normal diet as shown in the above study. Similar findings were observed where female subjects had a significantly higher plate waste compared to male. Strengthened by another local research[19] states that food wastage is more common in women for most of the food items. There was no apparent reason for why female patients wasted more food other than to surmise that females might be a little more fussy when it comes to food intake. Among the food categories, it can be seen wastage consistently reported to be highest in the vegetables groups (52.4%) compared with other categories as observed from others studied. Probable factors contributing to vegetables wastage include preference towards vegetables or the preparation of vegetables dishes[9,20], or it might be a result of poor cooking practices[6].

Food serving systems practised by hospitals under Health Ministry can be divided into two systems, either bulk systems or centralised systems. This study showed higher proportions of food waste in centralised systems compared to bulk systems. In the bulk systems freshly prepared dishes are wheeled in trolleys into the wards pantry instead of at the patient bedside. It is thus able to retain the temperature of the freshly prepared

foods and ensure foods are always warm enhance patients's appetite. In contrast, however two studies reported an increase in total food waste through the adoption of a bulk system[21,22].

Additionally the pattern on dinner contributing to the highest mean percentage food waste (58.5%), compared to lunch (46.8%). Data for breakfast consumption could not be collected for this study which focuses on lunch and dinner only. Home cooked food brought by caretakers after working hours, and the absences of clear policy to control home or retail food deliver services from patient's care takers or retailer may contribute to higher food wastage during dinner.

There is greater food wastage as age increases. These figures, however, are difficult to interpret because of the nature of each patient's illness. However, since illness can often affect appetite and the senses of taste or smell[23]. According to age group, senior adult had the highest food wastage when compared to younger population. Age related decline in functional ability (dysphagia and lethargy) and dental problems (poor dentition) can significantly affect food consumption that can contribute towards wastage[24]. Difficulties to eat and swallowing had significantly affects food wastage as consequences of reduction in oral intake.

Besides that, this study affirmed the observation some of the factors that influencing to food waste. Nutritional impacts symptoms (NIS) were also found significantly contribute to food waste. According to Williams & Walton (2011), food waste related to clinical issues is the most challenging issue in food waste reduction. Approximately 30% of hospitalized patients are at nutritional risk, often experiencing eating problems, unpredictable changes in appetite, and requiring different food items and services making the development of strategies to ensure relevant food is provided but does not become wasted very challenging[21,25,26]. In this present study, we found that almost all NIS was significant causes of food waste among patients at hospitals. This is not unexpected, since illness can often affect appetite and the sense of taste and smell. Drug causing nausea and gastrointestinal symptoms can also interfere normal desire to eat and impaired oral intake. These conditions can affect appetite and sense of smell which leads toward further food wastage[6].

Another important consideration in food waste studies was the assessment of energy and protein intakes as it can reflect nutrient intake and influences cost of the hospital. Food waste is a great importance as it can reflect nutrient intakes, and high levels of food waste can be indicative of poor health status[27]. Studies showed that food waste can significantly cause reduction in calorie and protein intake. These finding applicable to patients who have a higher susceptibility changer to preferences, reduce of appetite therefore increase of malnutrition risk. Many diet prescriptions, such as texture modification or low salt, reduce the sensory appeal of food, and it has been estimated that being on a special diet doubles the risk of insufficient energy intake[6]. Another probable reason is that they tend to limit food intake especially to achieve good control of blood glucose as in a diabetic diet[19].Therefore, including effective routine monitoring of patients' food choices, food intakes and food waste should be part of strategy to ensure patients are being served with a portion size that will enhance consumption and increase energy and protein contributions to the total daily recommended intake.

There are other factors contributing to food waste which need to be considered for improvement. Those reason include physical factors (difficulties to eat, difficulties in swallowing, delay eating time), psychological factor (alone, abandoned, stress, food belief) and food quality (unclean food, big portion, physical contamination). Furthermore, physical constraints such as eating in bed, having immobilized limbs or age-related declines in functional ability and dental problems, can all significantly affect food consumption[6]. This is a complex area of research, but there is some evidence suggesting that dining room environment and the consequent social interaction can improve dietary intakes[28].

CONCLUSION: This study was aimed to evaluate of factor affecting food wastage and had revealed an important to see from various aspects and factors that can affect food waste in hospitals. Further evaluation should be conducted to see how it may contribute to foods waste, before any possible strategies can be taken as an action for implementation. By finding the common reason for plate waste generation among patients in this study, it will help in gaining knowledge to further improve the quality of food and services in hospitals. A reduction in food wastage can helps on cost-effectiveness, optimize productivity and at the same time can encourage patients to eat their

food and lead to better clinical outcomes through improved nutritional care. *Acknowledgement*
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