ORIGINAL ARTICLE

# A Quasi-experimental Study on Plate Colours on Plate Waste Percentage Among Patients in a Public Hospital in Selangor, Malaysia

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**ABSTRACT**

**Introduction:** The plate and the foods create visual platescapes that can influence food intake in many ways. However, whether the plate colour could indirectly enhance hospitalised patients' appetite and reduce plate waste is unclear. This study aimed to determine plate waste percentage and whether blue plate (BP) has a lower plate waste percentage than white plate (WP) when served to hospitalised patients. This study also determined the interaction effect between plate colours on socio-demographic characteristics, medical background, nutritional status and appetite level with plate waste percentage. **Materials and methods:** This quasi-experimental study was conducted among patients who received a normal diet during one lunch hour and those in a public hospital in Selangor who received a normal diet. Plate waste was evaluated for the lunch menu for 125 meals. All the patients were randomly chosen to receive hospital meals from a WP or BP on the same day during lunch hour, and patients, with assistance from the researcher, completed the questionnaire. The primary outcome was the total plate waste percentage between the patients receiving BP and those receiving WP. **Results:** The result shows only a significant interaction effect between the plate colour and education level. After controlling for all the covariates, the plate waste percentage between the WP and BP remains significant. **Conclusion:** A significant difference in plate waste percentage between the plate colours suggests that BP indirectly improve appetite and reduces plate waste among hospitalised patients.
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**Keywords:** Color, Platescape, Plate waste, Hospital diet, Appetite

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## INTRODUCTION

Hospital food is essential as part of medical nutrition therapy for patients' recovery (1). Thus, the hospital diet served to patients was set to achieve patients' nutrition requirements. Despite that well-known fact, it was difficult to maintain energy and protein adequacy among hospitalised patients. Poor food intake is common in acute care patients and can worsen malnutrition and jeopardise healing status. Many food intake challenges were identified among hospitalised patients, including the complexity of patients' illness, social well-being, and psychological and biological factors (2).

A recent study showed that 32.1% of patients ate a quarter of their meals or less (3). Similar findings were reported that 56% of patients' hospital food intake was ≤50% (4). Achieving patients' nutritional requirements has been a real challenge, even among well-nourished patients in healthcare settings (3). The socioeconomic implications of patients' nutrition inadequacy are not only lengthened admission days and increased treatment costs but also significantly causing food waste due to wasted hospital food, which increases the cost of hospital food (5).

Understanding the fundamental influence of patients' food intake is essential to overcome plate waste. There are three levels of influence on food consumption among individuals: macro, immediate and micro-level. At the macro-level, the focus is on government regulation, the food industry, and advertising programs, and from the view of the hospital food service context, the hospital menu served could be the primary influence on patient food intake. The micro-level of food intake refers to choices made by an individual. An immediate level is often overlooked within this macro and micro level because it lies between policy and personal preference. This immediate level refers to four ubiquitous microscale-

built environments influencing food consumption: kitchenscapes, tablescapes, platescapes, and foodscapes (6).

These microscale scapes concepts are based on the fact that places and objects could influence eating behaviour and food intake without adjusting the food's taste, texture, or quality (7). From these microscale-built environments, platescapes are one of the elements that influence food intake unconsciously. The term "platescapes" refers to the physical appearance of the food container from which the food is served, given shape, size, and colour (8). The first sensory contact with food is always through the eyes, even though taste is an essential factor influencing food intake (9).

Current gastrophysics research shows that enhancing colour contrast is the key to making the food's presentation look best (10). It appears that meal appearance gave an overall impression of perceived quality and influenced appetite and food intake among hospitalised patients (11). Evidence shows that enhancing visual colour contrast between food and dinnerware makes consumers more alert to their meal intake (12). In a study conducted at a long-term care facility, changing the white plate to high-contrast blue resulted in a 25% increment in food consumption (13).

In one study on the perception of meal quality on different plate colours among more than 2000 hospitalised patients, the result showed a positive rating trend for darker meats served on a light plate and light meat (fish and chicken) positively rated on the dark plate (14). These consistent findings seem possible due to the simultaneous contrast that makes the meal appear more vivid and appealing (15). The visual contrast between the food and the blue tray and plate colour may enhance the appetising effect and boost the hospital meal intake among patients (16). Plate colour can accentuate and emphasise the expected taste of familiar food among the Asian population (12). Based on this concept, changing the white plate used to serve the meal to a blue plate colour could be another initiative to reduce plate waste issues in the hospital setting.

This study aims to determine the effect of platescapes on plate waste among hospitalised patients, as limited research focused on the influence of platescapes on dietary intake, especially among the unwell population. Given the impact of plate colour on perception, it is crucial to fill the knowledge gap in understanding the platescapes. The outcome could be a guideline for improving food intake among the sick adult population in the real hospital setting. .

## MATERIALS AND METHODS

### Study Design

This was a quasi-experimental study design conducted in a public hospital in Kajang, Selangor, only during lunch hours to standardise the type of protein received by patients from December 2019 until January 2020. This is a single-blind study where the patients are unaware of the study's objective and do not know the existence of another plate colour. To mask the purpose of the study, patients were informed the study was to rate the lunch meal. Therefore, they received different coloured plates from other patients to differentiate those who participated in the study.

Each ward received both plate colours simultaneously, but the colour allocation was randomly assigned based on the cubical arrangement with only one colour at one cubical at one time. The experiment was repeated at different wards, such as medical, surgical, orthopaedics, gynaecology, and oncology wards, throughout the data collection period until the maximum sample size was reached. An enumerator helped assist patients by answering questions, weighing meals, and serving food throughout the data collection period. Consented patients signed their consent forms before the commencement of the study procedure. This study was approved by the ethics committee of the National Institute of Health (NIH) of the Ministry of Health Malaysia (MOH) from the National Medical Research Register (NMRR), NMRR-19-2332-48195 - [Research ID: 48195]. Permission was also obtained from the hospital director and the Department of Food Service and Dietetics.

The study population consisted of Malay or English-speaking patients aged 18 to 59 years old, on a normal diet, and staying at the hospital for at least one day. The exclusion criteria were patients who self-reported colour blindness, receiving oral nutrition support, having chewing or swallowing difficulty, post-partum, mental disability, or who were considered to be too weak to answer the questions adequately. Patients were screened using purposive sampling from the Department of Dietetics and Food Services based on the diet indent list. All patients' diet indent list was assessed. Patients' bed numbers who were receiving normal diet were recorded and approached. The patient's medical records were checked to confirm the study criteria, age, and any latest non-by-mouth order or soon-discharged by the physician. Following these criteria, 361 patients screened were excluded from the study.

### Experimental Procedure

Procedure

After the patients confirmed involvement in the study, study procedures were explained, and they were informed that participation was voluntary for one lunch meal time only. The diagnosis, date of admission, length of stay, and age data were taken from the medical record. These were followed by answering the questionnaire with assistance from the researcher and anthropometric assessments. Patients were again reminded not to take

any outside food during lunch and to avoid snacking while waiting for lunch to be served.
By 12:15 p.m. patients were served their meal lunch with either the white plate (WP) or blue plate (BP) group according to the selected bed cubical arrangement to avoid experiment contamination of which patients observed different colours of tray or plate served and influence their food intake due to personal perception. After 1 hour lunch period, all the plates were collected and sent to the pantry for the plate waste assessment.

Meals, plating, delivery, and distribution
The meals provided to the patients are cooked in the hospital's kitchen according to the instructions of the dietitian and foodservice officer in charge. The meals provided follow a specific menu of 8-day cycles, as shown in Table I. The serving size of a normal diet is standardised according to the National Hospital Diet Manual (17). A normal diet refers to a 2000kcal protocol consisting of 51% carbohydrates, 18% proteins, and 31% fat distributed throughout four meals a day. The lunch meal was composed of the following items: 200g rice, 80-100g cooked vegetables, 90g main dish (chicken), and 100-150g fruit.

**Table I: Eight Menu cycles for Normal Diet for lunch in Hospital Kajang**

| Cycle | Menu for lunch | | | |
|---|---|---|---|---|
| | **Rice** | **Protein** | **Vegetables** | **Fruits** |
| 1 | White rice | Chicken soup | Water spinach | Honeydew |
| 2 | White rice | Chicken tomyam | Bok-choy | Honeydew |
| 3 | White rice | Chicken curry | Napa cabbage | Papaya |
| 4 | White rice | Chicken kurma | Soybean sprout | Papaya |
| 5 | White rice | Grilled chicken | Egg-plant | Watermelon |
| 6 | White rice | Soy-sauce chicken | Cabbage | Rock melon |
| 7 | White rice | Chicken ginger | Cabbage | Papaya |
| 8 | Chicken rice | Grilled chicken | Soybean sprout | Watermelon |

Every plate set was labelled with the patient's ID and bed number. Plating for the lunch was conducted at 11.45 a.m. and finished at noon daily by the kitchen staff. Researchers supervised and helped the kitchen staff to ensure all the serving amounts followed the hospital meal guidelines. Throughout this study, chicken thighs were purposely served to reduce bias and to standardise the weight of food served among patients. All the lunch meals were set into the meal delivery cart and delivered to the wards. At 12.15 p.m., the meal was assembled and distributed to patients according to the label on the plate.

Measures
All patients completed the questionnaire via face-to-face interviews, including socio-demographics, medical background, appetite level, and nutritional status. Some of the data were obtained from patient's medical records. TANITA Digital Weight Scale HD306 (TANITA Corporation, USA) and SECA Portable Stadiometer (SECA 213, Germany) were used to measure weight and height readings, respectively. In this study, BMI was used as an indicator to determine the patient's nutritional status using the Malnutrition Universal Screening Tool (MUST).

The simplified nutritional appetite questionnaire (SNAQ) assessed the appetite (18). The total SNAQ score is the sum of scores on the four items. A score of ≥14 is considered good appetite, and <14 is categorised as poor appetite. Both plates used in this study featured the international symbol for the "food safe" logo. The plate size for the white and blue plates was 27cm and was made of feldspar porcelain and stoneware, respectively. Both dining sets were supplied by Cambro and IKEA.

For plate waste assessment, the total weight of each food served on the plate was obtained during plating. Plate waste was weighed in the ward pantry after all patients ate. The difference between before and after the meal was determined. Plate waste was analysed for total weight and each food component weight, namely rice, chicken, vegetables, and fruits (TANITA KD 400 weighing scale). Plate waste percentage was calculated using the formula and used as data for analysis.

$$\text{Plate waste \%} = \frac{\text{Total weight before (g)} - \text{Total weight after (g)}}{\text{Total weight before (g)}} \times 100$$

**Statistical Analysis**
Statistical analyses were performed using IBM SPSS Statistics version 25 (SPSS Inc. Chicago, USA), with a statistical significance level of $p<0.05$. Descriptive statistics were calculated for all variables. First, the comparison baseline characteristic was reported between BP and WP to ensure the homogeneity of baseline characteristics between both groups. An independent t-test was conducted to observe the difference in plate waste percentage between the plate colours. ANCOVA analysis was conducted to analyse the effect of plate colours on plate waste percentage by controlling continuous variable factors such as age. Two-way ANOVA examined the interaction effects between plate colours and other factors such as socio-demographic characteristics, medical status, nutritional status, and appetite level. Simple main effect analysis or post-hoc analysis was conducted to identify the effect of an independent variable on plate waste percentage at which a specific level of another independent variable

is found to be significant.

## RESULTS

### Patient Characteristics

Of 490 patients screened, 125 patients participated in the study with a mean age of 32 ± 11 years old. The mean BMI between the BP (25.2 ± 6.16 kg/m2) and WP groups (25.5 ± 6.38 kg/m2) were no different. Depending on the cubical bed arrangement, the patients were randomly assigned to the Experimental BP (n=61) and Control WP groups (n=64). The groups had no significant difference in all baseline characteristics (Table II).

**Table II: Patients' characteristics.**

| Characteristic | n (%) | | |
|---|---|---|---|
| | Experimental Blue plate (n=61) | Control White Plate (n=64) | Total (n=125) |
| Sex | | | |
| Male | 29 (47.5) | 40 (62.5) | 69 (55.2) |
| Female | 32 (52.5) | 24 (37.5) | 56 (44.8) |
| Ethnicity | | | |
| Malay | 45 (73.8) | 45 (70.3) | 90 (72) |
| Chinese | 5 (8.2) | 4 (6.3) | 9 (7.2) |
| Indian | 10 (16.4) | 13 (20.3) | 23 (18.4) |
| Bumiputra | 1 (1.6) | 2 (3.1) | 3 (2.4) |
| Educational level | | | |
| No formal | 5 (8.3) | 2 (3.1) | 7 (5.6) |
| Primary | 5 (9.7) | 9 (14.1) | 14 (11.3) |
| Secondary | 31 (51.7) | 34 (53.1) | 65 (52.4) |
| Tertiary | 19 (31.7) | 19 (29.7) | 38 (30.6) |
| Monthly household income[a] | | | |
| ≤ RM1000 | 7 (11.5) | 7 (10.9) | 14 (11.2) |
| RM1001-RM3000 | 38 (62.3) | 36 (56.3) | 74 (59.2) |
| RM3001-RM5000 | 13 (21.3) | 13 (20.3) | 26 (20.8) |
| > RM5000 | 3 (4.9) | 8 (12.5) | 11 (8.8) |
| Medical Field | | | |
| Medical | 46 (75.4) | 52 (81.3) | 98 (78.4) |
| Surgical | 2 (3.3) | 2 (3.1) | 4 (3.2) |
| Orthopaedics | 7 (11.5) | 8 (12.5) | 15 (12) |
| Gynaecology | 4 (6.6) | 0 (0.0) | 4 (3.2) |
| Oncology | 2 (3.3) | 2 (3.1) | 4 (3.2) |
| Length of stay | | | |
| 1-3 days | 37 (60.7) | 37 (57.8) | 74 (59.2) |
| 4-7 days | 21 (34.4) | 20 (31.3) | 41 (32.8) |
| >7 days | 3 (4.9) | 7 (10.9) | 10 (8) |
| Nutritional Risk | | | |
| Low (0) | 48 (78.7) | 50 (78.1) | 98 (78.4) |
| Medium (1) | 7 (11.5) | 6 (9.4) | 13 (10.4) |
| High (≥2) | 6 (9.8) | 8 (12.5) | 14 (11.2) |

CONTINUE

**Table II: Patients' characteristics. (CONT.)**

| Characteristic | n (%) | | |
|---|---|---|---|
| | Experimental Blue plate (n=61) | Control White Plate (n=64) | Total (n=125) |
| Appetite level | | | |
| Good (≥14) | 32 (52.5) | 25 (39.1) | 57 (45.6) |
| Poor (<14) | 29 (47.5) | 39 (60.9) | 68 (54.4) |

All the data are normally distributed
p>0.05 not significant using Chi-Square
[a]Monthly salary was expressed in RM (Ringgit Malaysia) or also known as Malaysian Ringgit (MYR)

### Plate waste

This study aimed to determine plate waste percentage and whether blue plate (BP) has a lower plate waste percentage than white plate (WP) when served to hospitalised patients. The findings of this study in Table III showed that the mean total plate waste percentage was (32.45 ± 25.15%). Significant differences were found in total plate waste and rice waste percentage between the WP and BP groups, with lower total plate waste percentage reported in the BP group as compared to the WP group (25.69 ± 21.72% vs. 38.87 ± 26.64 %, p<0.005). No significant difference was found for other meal component wastage, and vegetables had the highest wastage among all other mean components (50.06 ± 38.23%). The most frequent reason for plate waste percentage was different food preferences/ meal taste (35.3%), followed by portion size too big/ full (31.8%), no appetite (24.7%), timing (5.9%), and eat outside food during the mealtime as well as due to medical condition/procedure (1.2%).

**Table III: Meal Component Plate Waste Percentage Based on Plate Colors**

| Food Component Wastage | BP | WP | Total | t-value | p-value |
|---|---|---|---|---|---|
| | Mean (SD) % | Mean (SD) % | Mean (SD) % | | |
| Rice | 22.46 (27.83) | 45.30 (37.23) | 27.83 (34.16) | 3.871 | 0.000* |
| Chicken | 30.26 (24.05) | 32.81 (31.15) | 31.56 (27.83) | 0.953 | 0.343 |
| Vegetables | 46.71 (40.91) | 53.25 (35.52) | 50.06 (38.23) | 0.957 | 0.341 |
| Fruits | 20.15 (33.57) | 20.13 (31.79) | 20.14 (32.54) | -0.004 | 0.996 |
| Total | 25.69 (21.72) | 38.87 (26.64) | 32.45 (25.15) | 2.861 | 0.005* |

*Significant difference at p<0.05 using independent t-test

### Interaction effect of plate colour with other factors on plate waste percentage

This study also determined the interaction of the plate colours and the main effect of socio-demographic characteristics, medical background, nutritional status and appetite level on plate waste percentage. The ANCOVA analysis shows no significant interaction effect

between plate colour and age and each foodservice dimension as a covariate. A two-way ANOVA analysis was run to determine the effects of interaction between the plate colours and other factors associated with plate waste percentage. The analysis was conducted to determine the interaction effects of plate colour with other factors on plate waste percentage. The result shows a significant interaction effect between the plate colour and education level on plate waste percentage (F=3.478, p=0.034) (Table IV). Thus, a simple main effect was conducted to determine the effect of educational level on different plate colours on plate waste percentage. The results show that the BP group has a 17.3% lower plate waste percentage than WP within the medium educational level (Mean % ± SE: 27.06% ± 4.16 vs. 44.36% ± 3.97, p =0.003). Similarly, a lower plate waste percentage in the BP group was reported in high-educated patients compared to the WP group by 21.3% (21.50% ± 5.31 vs. 42.83% ± 5.31, p=0.005), but no difference between the plate colours for the low education group. Meanwhile, the simple main effects of the educational level show that lower-educated patients in the WP group have 29.3% lower plate waste percentage than medium-educated patients (p=0.001) and 27.7% lower than high-educated patients (p=0.006).

**Table IV: Effect of Plate Colors and Other Factors on Plate Waste Percentage**

| Characteristic | Plate Waste (%) (SD) | | Mean Plate Waste (%) (SE) | 95% Confidence Interval | | p-value ($\pi_p^2$) |
|---|---|---|---|---|---|---|
| | Experimental Blue plate (n=61) | Control White Plate (n=64) | Total (n=125) | Lower Bound | Upper Bound | Interaction effect |
| Sex | | | | | | |
| Male | 17.55 (17.09) | 34.58 (28.45) | 26.061 (2.877) | 20.365 | 31.757 | 0.636 (0.002) |
| Female | 33.09 (23.03) | 46.05 (22.04) | 39.571 (3.185) | 33.265 | 45.878 | |
| Educational level | | | | | | |
| Low | 25.21 (16.83) | 15.11 (18.65) | 22.275 (5.171) | 12.035 | 32.515 | 0.034 (0.056)* |
| Medium | 27.06 (23.41) | 44.36 (26.07) | 33.710 (2.939) | 27.890 | 39.530 | |
| High | 24.99 (21.18) | 42.83 (25.00) | 36.867 (3.840) | 29.263 | 44.471 | |
| Monthly household income | | | | | | 0.256 (0.034) |
| ≤ RM1000 | 18.23 (14.42) | 39.06 (36.44) | 28.646 (6.441) | 15.890 | 41.403 | |
| RM1001-RM3000 | 26.13 (21.13) | 32.74 (26.16) | 29.431 (2.803) | 23.881 | 34.982 | |
| RM3001-RM5000 | 24.64 (23.60) | 51.45 (20.25) | 38.045 (4.726) | 28.685 | 47.406 | |
| > RM5000 | 42.29 (36.07) | 45.94 (24.09) | 44.117 (8.158) | 27.961 | 60.274 | |
| Ward Specialty | | | | | | 0.434 (0.023) |
| Medical | 25.79 (22.93) | 42.52 (25.42) | 34.161 (2.366) | 29.475 | 38.848 | |
| Surgical | 12.94 (18.30) | 6.33 (8.95) | 9.635 (11.690) | -13.519 | 32.789 | |
| Orthopaedics | 18.82 (8.49) | 17.24 (23.39) | 18.030 (6.050) | 6.047 | 30.014 | |
| Gynaecology | 31.47 (14.26) | 38.88 (26.64) | 31.471 (11.690) | 8.316 | 54.625 | |
| Oncology | 48.69 (37.62) | 63.27 (10.35) | 55.982 (11.690) | 32.828 | 79.136 | |
| Length of stay | | | | | | 0.943 (0.001) |
| 1-3 days | 28.39 (20.81) | 41.81 (24.95) | 35.099 (2.830) | 29.495 | 40.702 | |
| 4-7 days | 22.49 (24.00) | 38.27 (29.57) | 30.385 (3.803) | 22.855 | 37.916 | |
| >7 days | 25.69 (21.72) | 25.12 (25.92) | 20.050 (8.400) | 3.417 | 36.682 | |
| Nutritional Risk | | | | | | |
| Low (0) | 27.15 (22.45) | 36.29 (27.52) | 31.721 (2.468) | 26.835 | 36.608 | 0.227 (0.025) |
| Medium (1) | 19.76 (24.08) | 47.54 (14.87) | 33.649 (6.795) | 20.195 | 47.103 | |
| High (≥2) | 21.04 (11.39) | 55.59 (27.78) | 34.792 (6.596) | 21.732 | 47.852 | |
| BMI Category (kg/m$^2$) | | | | | | 0.205 (0.026) |
| Underweight | 20.25 (12.55) | 55.59 (27.78) | 37.923 (7.316) | 23.436 | 52.410 | |
| Normal | 32.84 (20.14) | 41.71 (26.84) | 37.278 (6.795) | 31.360 | 43.195 | |
| Overweight/Obese | 15.33 (18.86) | 33.35 (25.53) | 24.341 (6.596) | 18.068 | 30.614 | |
| **Appetite level** | | | | | | 0.438 (0.005) |
| Poor | 24.25 (25.41) | 32.84 (25.15) | 35.027 (2.978) | 29.132 | 40.921 | |
| Good | 27.30 (17.05) | 42.75 (27.16) | 28.545 (3.241) | 22.127 | 34.962 | |

ϖp2 – partial Eta square
BMI – Body mass index
*p<0.05, two-way ANOVA

## DISCUSSION

The plate waste percentage in this study (32.5%) was within the range of hospital plate waste of 30%, similar to other plate waste studies, which ranged from 6% to 42% (19). This was also similar to a recent local study in public hospitals in East Malaysia that found an average plate waste of 35% (20). It was found that vegetables were the highest wastage of meal components (38.2%). Consistent with the previous study by Schiavone et al. (21) in Italy, vegetables generated the most significant amount of waste, up to 55.0% of which 40.7% of the patients discarded this part of their meals. The plate waste study in Wales hospitals also reported vegetables as the most significant waste contributor, up to 46% (19). In the local context, the plate waste study confirmed that vegetables were the highest meal component wastage (22). This is predictable as the National Health and Morbidity Survey (2015) reported only 6 to 7.5% of Malaysians consumed an adequate five servings of fruits and/or vegetables daily, which indicated very minimal consumption of fruits and vegetables among Malaysian adults that might explain the high vegetable wastage in this study (23).

Apart from the colour contrast of food and the plate, blue plate colour was chosen in this study as blue dinnerware was commonly tested due to the visual contrast, as limited food colour elements are blue, which consistently resulted in better food consumption (24). This study confirmed that the blue plate has a lower plate waste percentage than the traditional white plate. The present findings seem consistent with other research, which found blue crockery significantly increased food intake from 114g to 152g compared to white crockery among acute elderly patients (24). The possible explanation for this similar trend of blue-coloured plates improving food intake and reducing food waste was probably due to the platescapes of the high colour-contrast conditions between the colour of the plate and the meal that was able to emphasise visual exposure, thus indirectly influencing physiological changes and appetite (14). In addition, another explanation of why blue plate had a positive effect on reducing plate waste percentage in this study was probably because of the new meal experience that improves sensory-specific satiety when patients received a rare plate colour instead of the typical tray given before (25).

This study reported a significant interaction of plate colour with the educational level on plate waste percentage among patients who received WP. However, there was no difference across educational levels when the meal was served on the BP. A significant difference was noted between medium and high educational levels, with a lower plate waste percentage reported among patients who received the BP. Interestingly, lower educated patients have had a lower plate waste percentage in the WP group compared to medium and high educated levels. A local study reported a similar finding where a higher education level tends to be more knowledgeable, have a higher expectation, and are not easily satisfied with hospital meals, eventually leading to higher plate waste percentages (20). The data available for the association between educational level and plate waste was still limited.

## CONCLUSION

In conclusion, hospitalised patients have a lower plate waste percentage when served with blue plates than the traditional white plate. Patients tend to waste more rice when served with a white plate. Patients with medium and high educational levels in the BP group tend to waste less plate waste compared to the WP group but no difference in plate waste percentage among low educational levels between groups. To our knowledge, this study was the first in the country to compare the difference between the BP and WP on plate waste in a local setting.

The findings of this research may guide policymakers or food service dietitians to consider platescapes as one of the strategies to reduce plate waste percentage. This is important in achieving the Sustainable Development Goals (SDGs) set by the United Nations in 2015 to reduce food waste. At the same time, this will improve patient food intake and reduce the mortality risk related to poor nutritional status. Changing dinnerware to the blue plate may provide a realistic solution with minimal effort and minor changes in the current hospital system compared to other existing strategies requiring considerable financial support or more staff to overcome the plate waste issue.

This study exerts both strengths and limitations that are worth taking into consideration. A quasi-experimental design was more feasible in this study due to the time and logical constraints when implementing the study. It provides a real-life platescape effect and application to hospitalised patients, as the survey was conducted in a hospital setting. The study design reduces the time and resources needed as extensive pre-screening and randomisation are unnecessary. Nevertheless, the lack of random allocation into the groups leads to non-equivalent test groups, which can limit the generalizability of the results to a larger population. To reduce the limitation, this study was analysed to control the confounding found between the groups.

Secondly, the food served to patients was different daily following the standard 8-day menu cycles provided by the hospital. Therefore, the food prepared and served in these experiments was not the same every day but depended on the menu on the list. There is not much difference in the type of rice served except for one flavoured rice served once a week. Even though the menu is different for the chicken, only chicken thigh was

chosen to serve to patients. The vegetables and fruits were also different daily, suggesting a difference in food preference might influence the plate waste. To minimise bias, the study was conducted on blue and white plates served on the same menu.

Third, the study did not collect the reason for admission or underlying diseases of the patients due to limited access to the patient's medical files. It was known that illness and medication may cause physiological changes and alter the taste, influencing plate waste. Therefore, the patients were at least categorised according to ward speciality to minimise the inter- and intra-variability within the patients.

Future research should apply randomised controlled trials to eliminate patient selection bias and ensure that the control and experimental groups are homogenous. Furthermore, more hospitals should be used for future studies so a large sample size can represent the hospitalised patients and limit the influence of outliers or extreme observation. In addition, another factor that will influence food intake should be assessed and included in future research. This is because it might be a confounding variable to the effect of platescapes on plate waste percentage. It is also recommended that this platescape effect be studied among elderly patients or specifically in any particular ward speciality, such as oncology, that is known to have higher food wastage due to physiological changes.

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