



Comparison of the effectiveness of cognitive behavioral therapy-based nutrition counseling and standard nutrition counseling on meal remains and blood sugar levels in hospitalized diabetes mellitus patients

Perbandingan efektivitas konseling gizi berbasis cognitive behavioral therapy dan konseling gizi standar terhadap sisa makan dan kadar gula darah pada pasien diabetes mellitus rawat inap

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Abstract

High levels of food waste among hospitalized patients, particularly those with type 2 diabetes mellitus (T2DM), may indicate a mismatch between hospital food services and patient acceptance, potentially affecting their glycemic control. This study aimed to evaluate the effectiveness of cognitive behavioral therapy (CBT)-based nutrition counseling in reducing food waste and blood glucose levels compared with standard nutrition counseling. A quasi-experimental study with a pretest-posttest control group design was conducted at Klaten Islamic General Hospital in March 2026. Forty-five patients with T2DM were assigned to three groups: CBT-based counseling, standard counseling, and control. Food waste was assessed using the Comstock method, and blood glucose levels were measured using a GlucoDR glucometer. Data were analyzed using the Wilcoxon, paired-samples t-, Kruskal-Wallis, and one-way ANOVA tests. Results: Significant differences were observed among the groups after the intervention. The CBT group showed the greatest reduction in food waste and blood glucose levels compared to the standard counseling and control groups ($p = 0.001$ and $p < 0.001$, respectively). In conclusion, CBT-based nutrition counseling was more effective than standard nutrition counseling and usual care in reducing food waste and improving glycemic control in patients with T2DM.

Keywords: Blood glucose, cognitive behavioral therapy, diabetes mellitus, food waste, nutritional counseling.

Abstrak

Tingginya sisa makanan pada pasien rawat inap, khususnya pasien diabetes melitus tipe 2 (DMT2), menunjukkan adanya ketidaksesuaian antara pelayanan makanan rumah sakit dan penerimaan pasien yang berpotensi memengaruhi pengendalian kadar gula darah. Penelitian ini bertujuan untuk mengevaluasi efektivitas konseling gizi berbasis *Cognitive Behavioral Therapy* (CBT) dalam menurunkan sisa makanan dan kadar gula darah dibandingkan dengan konseling gizi standar. Metode, penelitian quasi-eksperimental dengan rancangan *pretest-posttest control group design* dilakukan di RSUD Islam Klaten pada Maret 2026. Sebanyak 45 pasien DMT2 dibagi ke dalam tiga kelompok, yaitu kelompok konseling gizi berbasis CBT, konseling gizi standar, dan kelompok kontrol. Sisa makanan diukur menggunakan metode Comstock, sedangkan kadar gula darah diukur menggunakan glukometer GlucoDR. Analisis data dilakukan menggunakan uji Wilcoxon, *paired-samples t-test*, Kruskal-Wallis, dan *one-way ANOVA*. Hasil, terdapat perbedaan yang bermakna antar kelompok setelah intervensi. Kelompok

CBT menunjukkan penurunan sisa makanan dan kadar gula darah yang paling besar dibandingkan kelompok konseling standar maupun kelompok kontrol ($p = 0,001$ dan $p < 0,001$). Kesimpulan, konseling gizi berbasis CBT lebih efektif dibandingkan konseling gizi standar dan perawatan rutin dalam menurunkan sisa makanan serta meningkatkan pengendalian kadar gula darah pada pasien diabetes melitus tipe 2.

Kata Kunci: *Cognitive behaviour therapy*, diabetes mellitus, glukosa darah, konseling gizi. sisa makan

Introduction

Nutritional care for inpatients includes standardized nutritional care and the provision of diet-specific meals tailored to individual needs. Nutritional services in hospitals are provided and tailored to the patient's condition based on their clinical, nutritional, and metabolic statuses, with one area of focus being inpatient nutritional care (Yenni et al., 2024). Hospital food services have been proven to be a significant part of the patient experience and a key element in shaping patients' overall perceptions of the hospital. The availability of hospital food services that balance expectations with service quality will yield the best results in enhancing patients' trust in hospital food (Aminuddin et al., 2018).

Furthermore, hospital food serves as an example of nutritious and healthy meals tailored to patients' specific health conditions (Trisilawati, 2021). Additionally, patients' weakened condition due to inadequate nutrition in the hospital is often attributed to those requiring nutritional therapy, such as patients with diabetes mellitus (DM). Rafisa (2020) adds that based on the 2023 Indonesian Health Survey data, the prevalence of diabetes mellitus among residents aged 15 years and older, as determined by blood glucose levels, reached 11.7%, up from 10.9% in 2018. The prevalence of diabetes mellitus based on a doctor's diagnosis among the general population of all ages is 1.7% (Riviani et al., 2025).

Calorie-controlled dietary adjustments for individuals with diabetes mellitus serve as a preventive measure against DM and provide positive benefits for those with DM. Therefore, nutritional care for patients with diabetes mellitus is crucial, as dietary management is a key factor in controlling blood glucose levels (Rafisa, 2020). Consequently, ensuring that patients with DM can consume all types of meals served in the hospital is the first step for them to obtain adequate nutrition with the assistance of

a dietitian who addresses their dietary needs in accordance with the type and condition of their disease (Khalishah & Meganingrum, 2023).

Food waste (Nisak et al., 2019) is an indicator that can be used to assess hospital food management. Clearly, if patient food waste exceeds the 20% standard, the hospital can be considered to have failed in providing food to the patients. Food waste refers to meals served to inpatients that are not fully consumed (Septidiantari et al., 2023). Typically, food waste data are used to assess the effectiveness of food services and meal delivery in hospitals (Lestari et al., 2023).

Initial observations at Klaten Islamic General Hospital (RSU) revealed that food waste among patients with diabetes mellitus (DM) was higher than that of other inpatients at the hospital. According to information from several interviewed patients regarding food waste, patients stated that the food provided by the hospital did not meet their tastes; they were also unaware that the nutritional content in the hospital-served meals offered benefits for restoring their physical condition, and the nutritional intake served did not always align with their preferences.

Proper nutritional management can reduce the complications and mortality associated with diabetes mellitus. However, most patients living with diabetes do not optimally manage their nutritional needs because they view it as the most difficult aspect of controlling the condition (Opoku-Addai et al., 2022). As more patients with DM are hospitalized, the amount of leftover food from diabetic patients also increases. This affects the blood glucose levels of patients with diabetes (Dalimunthe et al., 2023; Mardianingsih et al., 2020; Sofiadila et al., 2025; Al-Rahmad et al., 2026). It has been found that patients' behaviors regarding managing blood sugar levels through diet can be modified through counseling. One counseling method that can be employed is *cognitive behavioral therapy (CBT)*. Nutritional

counseling using the CBT method is a form of nutritional consultation aimed at addressing psychological issues by changing the patient mindset. Counseling aims to support clients in becoming healthier. Thus, another goal of counseling is to help patients gain experiences that align with their personal goals, especially if they wish to achieve a specific future outcome. This implies that a patient can also be “helped” by adopting new thought patterns and specific behaviors (Hanan, 2018).

In CBT, the counselor collaborates with the patient to change the thought patterns and behaviors that cause physical or emotional distress related to non-compliance with the diet. The focus of this therapy is on changing the patient’s thought patterns to commit to the required diet and fostering self-motivation to implement positive changes. As indicated by Dewi et al. (2025), self-motivation is a psychosocial factor influencing dietary behavior change.

Research on Cognitive Behavioral Therapy has been conducted by Mendrofa et al. (2022), Yang et al. (2020), and Tunsuchart et al. (2020). Research on patients’ food waste in hospitals has been conducted by Dewi & Djokosujono (2022), Mahmoudifar et al. (2025), and Schiavone et al. (2019). Research on the effect of cognitive-behavior therapy on lowering blood sugar levels has been conducted by Hanan (2018), Koochaksaraee et al. (2022), and Zhang et al. (2021).

A research gap in previous studies lies in the separation of research between psychological behavioral aspects and nutritional interventions, where studies related to *Cognitive Behavioral Therapy* (CBT) have largely focused on psychological aspects or blood glucose reduction alone, while studies on food waste among hospital patients are generally descriptive in nature without structured behavioral interventions. Furthermore, no study has comprehensively tested the effectiveness of CBT-based nutritional counseling on two outcomes simultaneously—food waste and blood glucose levels—using an experimental design involving control and comparison groups.

CBT has not been widely used in clinical nutrition services in hospitals because this approach originates from the field of clinical psychology, which requires specialized competencies; there is a shortage of nutritionists trained in CBT techniques; and psychological-behavioral approaches have not yet been

integrated into nutrition counseling practice standards, which have traditionally focused more on informative dietary education rather than deep behavioral changes in patients.

The novelty of this study lies in the fact that nutritional counseling using Cognitive Behavioral Therapy (CBT) techniques is rarely conducted in hospitals or other healthcare facilities. Additionally, this study employs a Pretest-Posttest Control Group Design, utilizing three groups: a group receiving nutritional counseling with CBT techniques, a group receiving standard nutritional counseling, and a control group—a methodology that has not been previously implemented. To date, CBT counseling has not been implemented in the field of nutrition by adopting behavioral counseling to help patients with DM, particularly type 2 DM, modify their behavior to improve their diet, thereby reducing food waste and controlling blood sugar levels.

Given the high incidence of uneaten food among patients with type 2 diabetes mellitus in hospitals and the importance of blood sugar control during treatment, an intervention approach is needed that is not only educational but also capable of sustainably modifying patient behavior. Therefore, nutrition counseling based on *Cognitive Behavioral Therapy* (CBT) is considered a potential alternative approach to improve patients’ dietary adherence, thereby reducing food waste and aiding in blood sugar control. In line with this, this study aims to analyze the effectiveness of CBT-based nutritional counseling compared to standard nutritional counseling on food waste and blood glucose levels in patients with type 2 diabetes at Klaten Islamic General Hospital by identifying respondent characteristics, measuring levels of food waste and blood glucose, and evaluating changes in these two variables before and after the intervention in each treatment group.

Methods

Study Design

This study employed a quantitative approach with a quasi-experimental design. This design was selected because the intervention was administered without full randomization of the study participants. Therefore, participant allocation was conducted based on predetermined research criteria rather than complete random assignment.

A pretest–posttest control group design was employed. This design enabled a comparison of the baseline conditions between the intervention and control groups through pre-intervention assessments. A pretest was conducted to determine whether significant differences existed between the groups prior to the intervention. Baseline equivalence was considered satisfactory when no statistically significant differences were observed between the groups.

Population and Sample

The study sample consisted of patients with type 2 diabetes mellitus (T2DM) who were hospitalized in Class II and III wards at Klaten Islamic General Hospital and received meals provided by the hospital nutrition department. The sample was selected to represent the target population of this study.

Sample size determination was performed using the hypothesis-testing formula for experimental studies involving multiple treatment groups: $(t - 1)(r - 1) > 15$, where t represents the number of treatment groups, and r represents the number of replications. Based on this calculation, the minimum required sample size was 15 participants per group. Accordingly, a total of 45 participants were included, comprising 15 participants in the CBT-based nutrition counseling group, 15 participants in the standard nutrition counseling group, and 15 participants in the control group.

To minimize selection bias, eligible participants who met the inclusion criteria and did not meet the exclusion criteria were identified through an initial screening process. Subsequently, participants were selected using a simple random sampling technique and assigned to the study sample.

The inclusion criteria were as follows: (1) hospitalized patients prescribed a diabetic diet who did not have gastrointestinal disorders; (2) patients who had previously received nutrition counseling; and (3) patients who were able to communicate effectively, had adequate cognitive function, and provided informed consent to participate in the study.

The exclusion criteria were as follows: (1) patients with complications such as renal failure or hypertension; (2) patients discharged from the hospital before the completion of the study; and (3) patients who died before the completion of the study.

Variables and Operational Definitions

Food waste was defined as the portion of hospital-provided meals that remained uneaten by the patients. Food waste was assessed using the Comstock visual estimation method, following the procedure described by Setiawati et al. (2024), which demonstrated satisfactory validity and reliability, with Cronbach's alpha coefficients ranging from 0.89–0.96. Food waste was scored as follows: score 0 = no food remaining (100% consumed); score 1 = approximately 75% consumed; score 2 = approximately 50% consumed; score 3 = approximately 25% consumed; score 4 = approximately 5% consumed or nearly untouched; and score 5 = no food consumed (100% remaining). Food waste was further categorized into two groups: low food waste (<25% remaining) and high food waste (>25% remaining).

Blood glucose level was defined as the concentration of glucose in blood. Measurements were performed using a GlucoDR glucometer. Prior to data collection, the device was calibrated according to the standard operating procedures to ensure measurement accuracy and validity. Blood glucose levels were expressed in mg/dL (fasting blood glucose). The results were categorized into three levels: poorly controlled (>126 mg/dL), moderately controlled (100–125 mg/dL), and well controlled (<100 mg/dL).

Data Analysis

Statistical analyses were performed using parametric and nonparametric tests, depending on the data distribution. Paired-samples t -tests were used for normally distributed data, whereas the Wilcoxon signed-rank test was applied to non-normally distributed data to evaluate differences in food waste and blood glucose levels before and after the intervention within each group.

Between-group comparisons among the CBT-based nutrition counseling, standard nutrition counseling, and control groups were conducted using one-way analysis of variance (ANOVA) for normally distributed data and the Kruskal–Wallis test for non-normally distributed data. Statistical significance was set at $p < 0.05$.

Result and Discussion

Results

Baseline homogeneity was assessed prior to hypothesis testing. The results are shown in Table 1.

Table 1. Results of the baseline homogeneity test

Variable	Test of Homogeneity of Variance	Levene Statistic	df1	df2	p-value
Blood glucose before intervention	Based on mean	1.73	2	42	0.190
	Based on median	1.26	2	42	0.294
	Based on median with adjusted df	1.26	2	39.64	0.295
	Based on trimmed mean	1.703	2	42	0.194
Food waste before intervention	Based on mean	0.106	2	42	0.900
	Based on median	0.069	2	42	0.933
	Based on median with adjusted df	0.069	2	36.84	0.933
	Based on trimmed mean	0.067	2	42	0.935

Based on Levene's test for homogeneity of variance, as shown in Table 1, the significance value for pre-intervention blood glucose was 0.190 based on the mean, while the significance value for pre-intervention food waste was 0.900. All significance values based on the mean, median, and trimmed mean were greater than 0.05. These results indicate that the variances

across the three groups, namely the CBT counseling, standard nutrition counseling, and control groups, were homogeneous. Therefore, the baseline conditions of the participants were relatively comparable before the intervention.

The next step after the homogeneity test was the normality test using the Shapiro-Wilk test (Table 2).

Table 2. Results of the normality test

Variable	Treatment Group	Shapiro-Wilk Statistic	df	p-value
Food waste before intervention	CBT counseling	0.792	15	0.003
	Standard nutrition counseling	0.909	15	0.131
	Control	0.917	15	0.176
Food waste after intervention	CBT counseling	0.704	15	<0.001
	Standard nutrition counseling	0.901	15	0.097
	Control	0.939	15	0.372
Blood glucose before intervention	CBT counseling	0.942	15	0.404
	Standard nutrition counseling	0.944	15	0.441
	Control	0.92	15	0.195
Blood glucose after intervention	CBT counseling	0.892	15	0.072
	Standard nutrition counseling	0.919	15	0.189
	Control	0.898	15	0.087

The normality test showed that food waste data before and after the intervention in the CBT counseling group were not normally distributed ($p < 0.05$). In contrast, food waste data in the standard nutrition counseling and control groups were normally distributed ($p > 0.05$). Blood glucose data before and after the intervention were normally distributed across all groups, as indicated by p-values greater than 0.05.

The frequency distribution of respondent characteristics by sex, age, food waste, and blood glucose level among patients in Groups I (CBT counseling), II (standard nutrition counseling), and III (control) is presented in Table 3. As shown in Table 3, the

characteristics of patients with diabetes mellitus in Groups I, II, and III showed a slightly higher proportion of female participants (51.11%) than male participants (48.89%). By age, most respondents were in the 51–60-year and 61–70-year age groups, each accounting for 33.33% of the total sample. Before the intervention, food waste was predominantly categorized as high across all three groups. After the intervention, Groups I and II shifted predominantly toward the low food waste category, whereas Group III was dominated by high food waste. Before the intervention, blood glucose levels in all groups were predominantly categorized as poorly controlled. After the intervention, Group I,

which received CBT-based nutrition counseling, was predominantly categorized as well controlled, whereas Groups II and III

remained predominantly categorized as poorly controlled.

Table 3. Frequency distribution of characteristics of patients with diabetes mellitus at Klaten Islamic General Hospital

Variable	Group I: CBT Counseling, n (%)	Group II: Standard Nutrition Counseling, n (%)	Group III: Control, n (%)	Total, n (%)
Sex				
Male	8 (53.33)	8 (53.33)	6 (40.0)	22 (48.9)
Female	7 (46.67)	7 (46.67)	9 (60.0)	23 (51.1)
Age (years)				
21-30	0 (0.00)	1 (6.67)	0 (0.0)	1 (2.2)
41-50	3 (20.00)	2 (13.33)	3 (20.0)	8 (17.8)
51-60	6 (40.00)	5 (33.33)	4 (26.7)	15 (33.3)
61-70	3 (20.00)	6 (40.00)	6 (40.0)	15 (33.3)
71-80	3 (20.00)	1 (6.67)	2 (13.3)	6 (13.3)
Food waste before intervention				
Low	3 (20.00)	2 (13.30)	5 (33.3)	10 (22.2)
High	12 (80.00)	13 (86.70)	10 (66.7)	35 (77.8)
Food waste after intervention				
Low	15 (100.00)	10 (66.70)	7 (46.7)	32 (71.1)
High	0 (0.00)	5 (33.30)	8 (53.3)	13 (28.9)
Blood glucose level before intervention, mg/dL				
Poorly controlled	15 (100.00)	15 (100.00)	14 (93.3)	44 (97.8)
Moderately controlled	0 (0.00)	0 (0.00)	1 (6.7)	1 (2.2)
Well controlled	0 (0.00)	0 (0.00)	0 (0.0)	0 (0.0)
Blood glucose level after intervention, mg/dL				
Poorly controlled	0 (0.00)	12 (80.00)	13 (86.7)	26 (57.8)
Moderately controlled	6 (40.00)	2 (13.30)	2 (13.30)	9 (20.0)
Well controlled	9 (60.00)	1 (6.70)	0 (0.00)	10 (22.2)

Effect of CBT-Based Nutrition Counseling on Food Waste and Blood Glucose Levels

The results of this study (Tables 4 and 5) demonstrate that CBT-based nutrition counseling had a substantial impact on reducing food waste among hospitalized patients compared with standard nutrition counseling and the control condition. Prior to the intervention, there was no statistically significant difference in food waste among the three groups ($p = 0.050$), indicating that participants started from relatively comparable conditions. However, descriptive analysis showed that the CBT counseling group (mean = 57.78) and the standard nutrition counseling group (mean = 54.68) had higher levels of food waste than the control group (mean = 33.70).

Following the intervention, significant differences emerged among the groups ($p =$

0.001). The CBT counseling group demonstrated the most pronounced improvement, with mean food waste decreasing dramatically from 57.78 to 3.11. In comparison, the standard nutrition counseling group also experienced a reduction, although the improvement was less substantial, with food waste decreasing to 16.76. Meanwhile, the control group showed only a modest decline, reaching 26.19 after the observation period.

The within-group analysis further supports the effectiveness of the intervention. Both the CBT counseling group ($p = 0.001$) and the standard nutrition counseling group ($p = 0.000$) exhibited statistically significant reductions in food waste, whereas the control group did not show a significant change ($p = 0.130$). These findings suggest that counseling interventions can positively influence patients' eating behaviors and meal consumption.

Nevertheless, CBT-based nutrition counseling produced the greatest improvement, likely because it addresses not only nutritional knowledge but also cognitive and behavioral factors that influence food intake. Overall, the

results indicate that CBT-based nutrition counseling is a more effective strategy for reducing food waste among patients than standard nutrition counseling or the absence of counseling intervention.

Table 4. Differences in food waste measurements among patients with diabetes mellitus at Klaten Islamic General Hospital

Variable	CBT Group	Standard Nutrition Counseling Group	Control Group	p-value
Food waste before intervention				0.050 ^a
Mean	57.78	54.68	33.7	
SD	24.94	22.62	19.99	
Food waste after intervention				0.001 ^a
Mean	3.11	16.76	26.19	
SD	4.45	15.4	17.16	
95% CI	40.40–68.93	23.36–52.48	–2.49–17.50	
p-value	0.001 ^{b**}	0.000 ^{c**}	0.13	

^aKruskal–Wallis test. ^bWilcoxon signed-rank test. ^cPaired-samples t-test. ** Highly significant ($p < 0.01$).

Table 5. Differences in blood glucose measurements among patients with diabetes mellitus at Klaten Islamic General Hospital

Variable	CBT Group	Standard Nutrition Counseling Group	Control Group	p-value
Blood glucose before intervention				0.328 ^a
Mean	331.33	277.13	331.53	
SD	105.43	99.47	132.84	
Blood glucose after intervention				0.000 ^{a**}
Mean	95.53	157.4	290.67	
SD	21.27	29.71	103.06	
95% CI	177.84–293.76	61.32–178.45	13.18–68.56	
p-value	0.000 ^{b**}	0.001 ^{b**}	0.007 ^{**}	

^aOne-way ANOVA. ^bPaired-sample t-test. ** Highly significant ($p < 0.01$).

As shown in Table 5, the analysis showed no significant difference in blood glucose levels before the intervention among the three groups ($p = 0.328$), with relatively high mean blood glucose levels in the CBT (331.33), standard nutrition counseling (277.13), and control (331.53) groups. However, after the intervention, a highly significant difference was observed between the groups ($p = 0.000$). The CBT group showed the greatest reduction in mean blood glucose level, decreasing to 95.53, followed by the standard nutrition counseling group at 157.40, while the control group remained relatively high at 290.67 mg/dL. Within-group analysis also showed highly significant reductions in blood glucose levels in all three groups: the CBT ($p = 0.000$), standard nutrition counseling ($p = 0.001$), and control groups ($p = 0.007$). These findings indicate that CBT-based nutrition counseling is more effective

in reducing blood glucose levels than standard nutrition counseling or no intervention.

Food Waste among Patients with Diabetes Mellitus at Klaten Islamic General Hospital

The findings showed that before the intervention, food waste among patients with diabetes mellitus at Klaten Islamic General Hospital was predominantly high across all groups. Based on the interview findings, the high level of food waste among patients with diabetes mellitus was mainly attributed to hospital meals not matching patients' preferences. Patients also lacked awareness that the nutrients provided in hospital meals were beneficial for their physical recovery. In addition, not all meals served were compatible with the patients' individual tastes. Several factors may contribute to food waste, including internal factors, such as physical condition, psychological state, and eating habits; external factors, such as

food appearance and taste; and environmental factors, including meal timing, food brought from outside the hospital, eating utensils, and the friendliness of the food service staff (Syauqiyatullah et al., 2020; Putra et al., 2025).

Food waste is a complex problem involving both system- and individual-level determinants. From a system perspective, contributing factors include diverse therapeutic dietary requirements, long intervals between ordering and meal service, insufficiently supportive service models and kitchen designs, portion control practices, and limited resources. At the individual level, contributing factors include poor appetite, short hospital stays, and dissatisfaction with hospital food and services (Porter & Collins, 2021).

More than half of the respondents were female, totaling 23 participants (51.11 %). Previous studies have reported that female patients tend to leave more food uneaten than male patients do (Wani et al., 2019). Other recent studies have also shown that women discard more food than men do (Brizi & Biraglia, 2021; Schiavone et al., 2019). Another study found that food waste was consistently higher among female than male patients across all meal types. Although the exact reason remains unclear, one commonly suggested factor is the greater selectivity among women in food consumption (Moorthy et al., 2024).

Changes in meal provision and routine feeding modifications may also affect food intake and satisfaction in patients with diabetes mellitus. Inadequate portion sizes, unattractive food presentation, chewing difficulties, and lack of assistance during meals are frequently associated with high levels of food waste among older adults (Keller et al., 2017; Lee & Mo, 2019; McAdams et al., 2019; Schiavone et al., 2019; Simzari et al., 2017).

Blood Glucose Levels among Patients with Diabetes Mellitus at Klaten Islamic General Hospital

The findings showed that before the intervention, blood glucose levels among patients with diabetes mellitus at Klaten Islamic General Hospital were predominantly classified as poorly controlled. This high proportion of poorly controlled blood glucose levels may be attributed to several factors, including endogenous factors such as hormones and cellular receptors and exogenous factors such as diet and physical

activity. Insufficient insulin activity may lead to glucose accumulation in the blood, and excess glucose beyond the renal threshold may be excreted in the urine.

Bivariate selection using logistic regression in this study showed that age did not significantly affect blood glucose levels. However, cross-tabulation indicated that patients aged 61–70 years were more likely to have high or poorly controlled blood glucose levels. This finding is consistent with other laboratory-based studies showing that the prevalence of diabetes mellitus increases with age, particularly after 60 years, and decreases in younger age groups (Asiimwe et al., 2020). Aging is associated with declining body function that may affect dietary intake and nutrient absorption. Nutritional problems among older adults often begin with nutritional imbalance, including excessive intake, which may contribute to obesity and degenerative diseases, particularly diabetes mellitus (DM).

With increasing age, some individuals lose the ability to maintain glucose levels within the normal range, a condition that may begin earlier in life and increase the risk of developing diabetes. An oral glucose tolerance test can be used to identify abnormal glucose status in older adults. The prevalence of diabetes among individuals aged > 60 years has been reported to be more than twice that of individuals aged < 30 years. Blood glucose monitoring in older adults is generally similar to that in younger adults. However, HbA1c values tend to increase by approximately 0.1% per decade, independent of changes in blood glucose levels, which should be considered when interpreting glycemic control in older patients (Nurgajayanti et al., 2024).

The cross-tabulation in this study showed that men and women had the same proportion of blood glucose distribution, each accounting for 50% of the subjects. However, compared with other studies, men and women in Indonesia may show similar metabolic patterns, including impaired endocrine functions. Nevertheless, men have been reported to have higher blood glucose levels than women (Chia et al., 2018). Among women, this risk increases with age, elevated blood glucose levels, increased blood pressure, and high blood cholesterol levels. An increased risk has also been reported among women with a high body mass index (Fikriana & Devy, 2018).

Effect of CBT-Based Nutrition Counseling on Food Waste among Patients with Diabetes Mellitus at Klaten Islamic General Hospital

The findings of this study indicate that CBT-based nutrition counseling was more effective in reducing patient food waste than standard nutrition counseling or no intervention. This finding was supported by significant differences in the frequency distribution, probability values, and between-group analyses. CBT may help patients improve their behavior, regulate their thoughts, and restructure maladaptive patterns of thinking, feeling, and acting. Consequently, patients may become more consistent in following the hospital's dietary recommendations. The results suggest that CBT-based nutrition counseling had a positive effect on food waste among patients with diabetes mellitus by improving their dietary behavior after the intervention. According to Mendrofa et al. (2022), CBT is useful for improving food consumption behavior because it is relatively inexpensive, accessible, feasible for many individuals, capable of producing rapid results, and effective in increasing patient motivation to sustain behavioral changes (Tunsuchart et al., 2020).

This finding is also supported by Hanan (2018), who reported that after receiving CBT counseling, patients were better able to regulate their eating patterns and meal portions according to their needs. Another study reported that CBT counseling helped patients develop better mindful eating practices by increasing their knowledge of the benefits of appropriate eating behavior and enabling them to understand the reasons for following dietary recommendations more appropriately (Darusman et al., 2025).

Effect of CBT-Based Nutrition Counseling on Blood Glucose Levels among Patients with Diabetes Mellitus at Klaten Islamic General Hospital

The findings indicate that CBT-based nutrition counseling was more effective in reducing blood glucose levels than standard nutrition counseling or no intervention. This finding is supported by Hanan (2018), who reported that CBT affected blood glucose levels. Similar findings have been reported in other studies (Koochaksaraee et al., 2022; Pan et al., 2023; Tunsuchart et al., 2020; Yang et al., 2020; Zhang et al., 2021), showing that CBT interventions contributed to a

reduction in blood glucose levels among patients with diabetes mellitus. Dietary attitudes among patients with type 2 diabetes mellitus may also be influenced by CBT-based modifications, enabling patients to control and consciously determine appropriate food portions, which, in turn, affects blood glucose levels.

The CBT process includes identifying unhealthy beliefs, recognizing the relationship among thoughts, emotions, and behaviors, examining evidence that supports or contradicts thoughts, restructuring distorted thoughts, and replacing maladaptive cognitions with healthier beliefs (Fuenmayor & de Fernandez, 2021). Through this therapeutic process, patients with diabetes mellitus are expected to modify their behavior, regulate their dietary patterns, maintain their blood glucose levels, and adhere to the diabetic diet prescribed by the hospital.

The reduction in blood glucose levels observed in this study may be explained by patients' adherence to the education delivered through CBT-based nutrition counseling. Numerous studies have demonstrated the benefits of CBT. Cognitive-behavioral interventions may support recovery in patients with type 2 diabetes during or after treatment. In addition, systematic cognitive-behavioral approaches may help optimize immune function. In group settings, CBT promotes the restructuring of maladaptive thoughts and feelings, helps patients manage discomfort, encourages greater activity, and facilitates strategies such as successful patient experiences, modeling, and social reinforcement. Accordingly, HbA1c levels in patients with type 2 diabetes mellitus may decrease after CBT (Koochaksaraee et al., 2022).

CBT-based nutrition counseling for patients with diabetes may help identify the barriers and challenges experienced by individuals, as well as the strategies needed to overcome them. Appropriate early intervention may improve outcomes in patients with diabetes. Since its implementation, CBT has been shown to be effective in treating depression. Patients with diabetes often experience comorbid depression, which may worsen their health outcomes. Therefore, the benefits of CBT extend beyond the treatment of depression (Mansour et al., 2022).

Several factors may explain the reduction in blood glucose levels among the participants in the intervention group. One factor is the strengthened educational component, which is

essential for CBT interventions (Yasin et al., 2025). As diabetes-related knowledge increased, participants in the intervention group received informative materials on various diabetes-related topics during each therapy session, which were expected to be learned and applied to their daily lives.

This study had several potential sources of bias. Selection bias may have occurred because the quasi-experimental design did not involve full randomization; therefore, baseline characteristics across groups may not have been completely balanced, although homogeneity testing was performed. Information bias may also have occurred due to possible inaccuracies in measurement, either in food waste recording or glucometer use, although procedural standardization and device calibration were performed to minimize measurement errors. In addition, the Hawthorne effect may have occurred, in which changes in patient behavior were not solely attributable to the intervention but also to participants' awareness of being observed during the study. This may have influenced the dietary adherence and measurement outcomes. Therefore, the findings should be interpreted with consideration of these biases.

Study Limitations

This study had several limitations. First, the use of a quasi-experimental design without full randomization may have introduced an imbalance in baseline characteristics across groups, potentially affecting the study outcomes. Second, the relatively small sample size of 45 respondents limited the statistical power to detect subtle differences between groups.

Third, the study was conducted at a single hospital, which limits the generalizability of the findings and prevents the direct representation of patients with type 2 diabetes mellitus in other healthcare settings with different characteristics. Further studies with stronger experimental designs, larger sample sizes, and broader study settings are needed to obtain more comprehensive evidence.

Conclusion

CBT-based nutrition counseling was more effective than standard nutrition counseling in reducing food waste and blood glucose levels in hospitalized patients with type 2 diabetes

mellitus at Klaten Islamic General Hospital. However, these findings should be interpreted cautiously because of the quasi-experimental design, relatively small sample size, and single-center setting, which may limit the generalizability of the results.

Hospitals are encouraged to integrate CBT-based nutrition counseling into clinical nutrition services through nutritionist training, development of behavior-based counseling guidelines, and routine evaluation of patient food waste. Hospital menus should also be adjusted to patient preferences without compromising the principles of a diabetic diet. Patients are encouraged to improve adherence to prescribed dietary recommendations during hospitalization as part of the glycemic control. Future studies should use randomized experimental designs, larger sample sizes, and multicenter settings to strengthen the validity and generalizability of the findings.

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