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The effect of mindful eating on dietary behaviour and fasting blood glucose in type 2 diabetes mellitus patients

Rizki Andriani,¹ Aghnia Kamila,² Roofi Asma Putri,¹ Arif Fadhillah,¹ Sabrina Helmi,³ Delia Septiani¹

¹Sekolah Tinggi Ilmu Kesehatan Medika Seramoe Barat Meulaboh, West Aceh; ²Zainoel Abidin Aceh General Hospital, Banda Aceh; ³Cot Seumeureung Public Health Center, West Aceh, Indonesia

Correspondence: Rizki Andriani, Sekolah Tinggi Ilmu Kesehatan Medika Seramoe Barat Meulaboh, West Aceh, Indonesia.

E-mail: rizkiandriani.qq@gmail.com

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Abstract

Diet plays a pivotal role in the comprehensive therapy for individuals with type 2 diabetes mellitus, contributing significantly to maintaining stable glycemic control. Mindful Eating, as an intervention, focuses on enhancing dietary behavior by directing attention, thoughts, and feelings towards eating activities. This study aimed to investigate the impact of mindful eating on dietary behavior and fasting blood glucose levels in individuals with type 2 diabetes mellitus. Employing a quasi-experimental method with a pretest-posttest control group design, the study included a sample of 63 participants (selected through convenience sampling). Data collection utilized the Personal Diabetes Questionnaire (PDQ) and a glucometer. Statistical analysis involved Wilcoxon, Mann-Whitney, and Independent T-tests. The findings revealed that mindful eating exercises had a significant influence on dietary behavior ($p = 0.025$) and fasting blood glucose levels ($p = 0.033$). The practice of mindful eating led to notable improvements in dietary behavior and ensured controlled fasting blood glucose levels by the study's conclusion. Incorporating mindful eating exercises into eating patterns is recommended as a crucial aspect of diabetes management, aiming to enhance dietary behavior and sustain stable glycemic control.

Introduction

Diabetes is a health problem that has reached a very worrying level and requires proper treatment so that this disease does not get worse.¹ About 60% of diabetic patients have difficulty following the

recommended diet because it must be carried out for a lifetime.² Dietary management in diabetes is challenging as patients often feel bored with lifelong diet programs, struggle with perceptions of healthy foods and portion sizes, favor specific food types, and have difficulty following dietary recommendations daily.^{3–5} Various modifications to the diet program are needed to improve dietary behaviour to be more adaptive and maintain glycemic control as recommended.^{6,7}

Diet is the most critical component of the overall therapy plan for T2DM people.⁸ Currently, 537 million people worldwide are living with diabetes.⁹ Indonesia occupies the fifth position as a country with a prevalence of 19.5 million adults diagnosed with diabetes, and type 2 diabetes mellitus (T2DM) accounts for 90% of diabetes incidence worldwide.¹⁰ Obstacles in diet have the potential to trigger behavioural changes in doing the recommended diet.¹¹ Diet education and medication control have been provided and understood by most diabetic patients. However, the inability to control dietary behaviour plays a role in the glycemic control of T2DM patients becoming worse and causing complications.^{5,12,13}

Interventions related to dietary behavior have an impact on better glycemic control.^{14,15} Mindful Eating exercise is one intervention that DM2 patients can apply during eating activities; this exercise can focus on eating activities that involve the mechanism of stimulating alertness from within oneself. Mindfulness practice during eating activities increases the body's physiological cue response when hungry or full and increases self-awareness, which contributes to the preparation of adaptive dietary behavior patterns.¹⁶ This result can be seen in a study of 304 adult respondents who were given Mindful Eating exercises, where respondents showed better self-control in eating behavior and had the willingness to arrange regular eating patterns.¹⁷

Attention to sensations, thoughts, and feelings during eating activities related to regulation, emotions, and self-acceptance can reduce problematic eating behaviors so that T2DM patients are able to make their own decisions about what, when, and how much food to consume.^{18–20} Mindful eating exercises indirectly make it easier for diabetic patients to achieve portion adjustments based on adequacy and satisfaction that arise during meals and have an impact on daily calorie intake so that it can potentially affect glycemic control in DM clients. This intervention is expected to establish adaptive control of eating behavior, adherence to the recommended diet, and controlled patient glycemic, including adequate nutritional intake in patients.^{21,22} A case study by Jordan *et al.*²³ on 246 respondents and Arch *et al.* studies²⁴ conducted experimentally on 319 respondents showed a positive relationship between mindfulness and healthy eating behavior, reduced impulsive eating behavior, low consumption of unhealthy foods, and increased comfort in enjoying food.

Mindfulness eating practice has been widely studied in aspects of diet and obesity; however, in the case of DM2, the effect of mindful eating practice on diet behavior and glycemic control is not very varied, and the explanation related to its effect is also not widely known so further research is needed on it.

This study aimed to evaluate the effect of mindful eating exercises on dietary behavior and glycemic control in T2DM patients.

Materials and Methods

Research design

This study used a quasi-experimental research design with a pretest-posttest control group approach, which means that the samples in this study were collected 2 (two) times, namely before treatment (pretest) and after treatment (posttest).²⁵ This study explained the demographics of respondents and the effect of mindful eating exercises on dietary behavior and fasting blood glucose levels in respondents.

Study participants

This research was conducted at Cot Seumeureung Public Health Center, which has the highest number of diabetics and hosts a chronic disease management program (*Prolanis*) that is quite active; this program has educated patients regarding the diet recommended for T2DM patients. The chronic disease management program (*Prolanis*) was established by the National Health Insurance in Indonesia to provide a program aiming to improve the quality of life for chronic disease sufferers through cost-effective and efficient health services. The respondents of this study were T2DM patients who have actively participated in routine *Prolanis* activities for the last three months, are adults aged 18-60 years, willing to take part in the study, with fasting blood glucose levels >130 mg/dl, cooperative, and able to communicate clearly and understand instructions in Indonesian. The exclusion criteria included individuals with hearing loss, dental and oral problems, intellectual and cognitive disorders, and patients who are pregnant or breastfeeding. A total of 64 T2DM patients participated in the research between July and September 2023. These subjects were then randomly divided into two groups, each consisting of 32 respondents.

Instrument

Data collection in this study consisted of demographic data such as age, sex, education, duration of diabetes, employment, body mass index, and food intake. Dietary behavior and fasting blood

glucose level data in the treatment and control groups before and after the mindful eating intervention were also collected. Measurement of dietary behavior data was carried out through the Personal Diabetes Questionnaire (PDQ) questionnaire, which includes four domains from the entire questionnaire: diet knowledge and skills, diet decision-making, eating problems, and diet adherence barriers. The questionnaire, consisting of 25 items, is rated on a six-point Likert scale (Never, 1 time per month or less, 2–3 times per month, 1–2 times per week, 4–6 times per week, 1 or more times per day). The total score for this questionnaire can range from 3–56, and these scores were categorized into two groups: bad (below the median) and good (above the median).

This questionnaire has undergone translation and back-translation by commercial translation agencies to maintain the content's accuracy, and was modified by researchers with the help of one diabetes educator. The PDQ questionnaire was then tested for validity and reliability at a community health center with similar characteristics to the research site. The validity test on 17 question items showed that the calculated r -value > 0.444 , which means all the questionnaire items are declared valid. The reliability test showed that the Cronbach's alpha value for the PDQ questionnaire is 0.825, where an r -value for Cronbach's alpha > 0.444 indicates that the questionnaire is reliable.

Measurement of fasting blood glucose levels (FBG) was conducted using the Sinocare Safe-Accu 2® glucometer, which was new from the manufacturer and had received usage approval from the Indonesian Ministry of Health with number AKL 20101027017. Additionally, it came with a stick stored in standard packaging. This glucometer was validated by a health analyst from the health center regarding tool calibration, strip suitability, results, and battery capacity before use. Blood collection followed gold standard operational procedures, and fasting blood glucose was categorized as controlled if it was <130 mg/dl. Daily calorie intake was evaluated using a 24-hour food recall form that a nutritionist assessed.

Procedure

Pre-test data collection, including dietary behavior and FBG level one week before the research process began, was carried out in conjunction with diet education conducted by nutritionists based on personal calorie needs. The research team conducted regular home visits for 4 exercise sessions to train respondents in mindful eating. The researcher divided the team into 4 groups, with each group consisting of two people responsible for 16 respondents (8 respondents in the treatment group and 8 in the control group).

In the treatment group, home visits occurred once a week for four weeks, following a contractual agreement with the respondents. During these visits, which lasted 20-30 minutes, researchers taught mindful eating exercises. Instructions for the exercises were provided through voice recordings with a rate of 44100 Hz and 16-bit resolution, stored on MP3 players. Each respondent in the treatment group received an MP3 player, which they could use to listen to the 6-minute voice recording through a headset during daily eating activities.

In the control group, standard education related to dietary patterns was given in 4 group sessions. Post-test data collection on dietary behavior and FBG levels occurred one week after the last exercise session. At the study's conclusion, the control group was also taught mindful eating exercises and received MP3 players with voice recordings of the exercise guides.

Data analysis

The data analysis employed in this study used the Statistical Package for Social Sciences (SPSS) version 20 software. Descriptive analysis identified age, sex, education, duration of diabetes, employment, body mass index, and food intake with frequency and percentage. The inferential analysis utilized the Wilcoxon Difference Test, Mann-Whitney, and Independent T-tests. A 95% confidence level with a standard error of 0.05 was the criterion for significance.

Ethical clearance

The research has received ethical approval from the Health Research Ethics Commission, Universitas 'Aisyiyah Bandung, based on ethical certificate 657/KEP.01/UNISA-BANDUNG/VIII/2023. During the research, the researcher pays attention to the ethical principles of information to consent, respect for human rights, beneficence, and non-maleficence.

Results

Respondent characteristics

Table 1 showed that the characteristics of respondents based on the age of majority are respondents aged 46-60 years (62.5%), with the majority of respondents being female (67.2%). Generally, respondents are employed (71.9%) with the final education level at the elementary level (37.5%). The average respondent (60.9%) has suffered from T2DM > 5 years, where the body mass index of the majority of respondents is in the abnormal category (62.5%), and it can be seen from the status of calorie adequacy per day the majority of respondents exceed the standard calorie intake (57.8%).

The effect of mindful eating exercise on dietary behavior and fasting blood glucose level

Table 2 showed changes in the frequency of dietary behavior of respondents in the treatment group, where before the intervention only 28.1% of respondents had good dietary behavior to 65.6% of respondents who had good dietary behavior after the intervention. Meanwhile, before the pretest, 65.7% of respondents had poor dietary behavior in the control group and after the posttest, 53.1% of respondents were still in the bad dietary behavior category. Table 2 also showed that before the intervention, the majority of respondents in the treatment group (87.5%) and the control group (78.1%) showed uncontrolled fasting blood glucose (FBG) levels. After the intervention and posttest there were not too many changes, it was still seen that the majority of respondents in the treatment group (62.5%) and the control group (65.6%) showed uncontrolled FBG levels.

The differences of dietary behavior and fasting blood glucose level on T2DM patients

Table 3 showed the post-test difference test between treatment group and control group using the Mann-Whitney U Test showed a value of $p = 0.025$ ($p < 0.05$), which means that there was a significant influence on the level of dietary behavior in the treatment group compared to the control group after being given mindful eating exercise for four weeks. Besides that, analysis of blood glucose levels using an Independent t-test on FBG levels obtained p value = 0.033 ($p < 0.05$), which means there was a significant influence on the treatment group compared to the control group after being given a mindfulness eating intervention for four weeks on FBG levels.

Discussion

Mindfulness eating exercises and dietary behavior

The results showed a significant improvement in dietary behavior in the treatment group compared to the control group after being given mindfulness eating practice with a 4-week approach. The increase in dietary behavior is characterized by an increase in category values, namely from the level of moderately poor dietary behavior to the level of good dietary behavior. Diet management in diabetic clients can be seen from dietary knowledge and ability, decisions in diet selection, eating behavior, and dietary barriers.^{26,27} The use of mindfulness skills is now increasingly popular and increasing, one of which is through mindfulness-based eating management interventions. Mindfulness practices can encourage healthier eating behaviors where mindful eating activities make a person pay attention to detailed food cues from outside factors and hinder emotional eating habits, impulsivity, and excessive food consumption. Through regular exercise, mindfulness can prevent impulsive reactions in the process of eating.^{28,29}

Respondents have never known or done mindfulness eating exercises. Hence, researchers guide respondents in doing mindfulness exercises with direct visits to respondents and assisted by tools through audio that can be heard with mp3 players. The client's knowledge and ability to follow the diet program increased due to the process of providing information and instruction about mindfulness eating exercises as one of the techniques for conducting a diet program for DM clients. High knowledge and information correlated with better and predictable behavior contribute to improving and sustaining behavior change in diabetes management.³⁰ This result is similar to the research of Miller *et al.*,²¹ which explores aspects of knowledge, self-efficacy, and outcome expectations in mindfulness eating interventions in diabetes self-management education (DSME) programs.

Different things shown by a study of 277 people with diabetes³¹ showed that although 77% of respondents had high knowledge of diabetes management, this did not always depend on good behavior, which is thought to have happened because the diabetes management education process was not carried out in a coordinated, regular and sustainable. The study found that active participation in the Prolanis chronic disease management program led to improved dietary behavior in respondents, correlating with enhanced diabetes management after receiving ongoing education and support.

Although in this study, it appears that the majority of respondents aged 46-60 years who are feared will be slightly constrained in receiving information due to cognitive factors, this can be helped by the existence of audio aids that make it easier for respondents to do this exercise. Chaumhari *et al.*³² mentioning shows that older respondents have more ability to understand and carry out mindful eating behavior than respondents who are still in productive age (p-value 0.01).

Mindfulness eating practice instructions were delivered at the researchers' visit through a process of discussion and direct interaction. Respondents were asked to follow instructions via mp3 audio, which provided an opportunity for respondents to assess hunger and satiety cues, train attention focus, and provide a certain level of comfort after eating. The focus of attention while eating was trained by the way respondents set a more regular eating rhythm with pauses between each bite of food. Adjustments to the rhythm of eating will have an impact on the intake or number of servings of food consumed. Respondents said mindfulness eating exercises helped them achieve adequacy and satisfaction in eating smaller portions of food than usual.³³ These results, according to a literature study of 68 publications conducted by Warren *et al.*³⁴ and a randomized clinical trial study of 150 respondents conducted by Kristeller *et al.*³⁵ demonstrate the practice of mindfulness in eating activities controlling individuals who tend to overeat, increasing appreciation of smaller portions of

food and controlling food cravings through sensitivity to hunger and satiety cues. Mindfulness interventions focus on the eating process whereby by eating more mindfully, using a slower pace, and with an increased focus on the sensation of eating, a person indirectly reduces their daily caloric intake and can control excessive appetite.³⁶

The results of this study are in line with a quasi-experimental study by Harmiardillah *et al.*³⁷ and Rohmawati *et al.* studies³⁸ which states that respondents who are given mindfulness eating exercises influence changing dietary behavior for the better so that eating activities are done only because the response of hunger cues and satiety signals and not the response of eating patterns automatically. Through eating behavior based on greater awareness and attention, individuals can regulate their diet according to their health goals and needs regardless of impulsivity. Mindfulness in eating activities gives an opportunity for individuals with diabetes to think more about the consequences if he does not eat regularly, which will result in pain and suffering. Mindful eating can also be a new approach and integrated with DSME programs where people with diabetes have more options to meet their needs³⁹.

Mindfulness eating exercises and fasting blood glucose

Glycemic control is one of the essential things to maintain in reducing pain levels and reducing diabetes complications, although HbA1c measurement is the gold standard for glycemic control assessment, when HbA1c testing is not possible, fasting blood sugar testing can be a good predictor of glycemic control.⁴⁰ The results of the study showed that the average value of fasting blood glucose (FBG) levels in the treatment group after being given mindfulness eating exercise for four weeks experienced a significant decrease compared to the control group. Treatment group had an average value of FBG levels that decreased at the end of the intervention (post-test) compared to the conditions before the intervention (pre-test). Although the decrease in blood glucose levels was not able to reach the average figure, compared to the control group, the treatment group had a lower average value of blood glucose levels, indicated by a higher value of the difference between before and after, meaning a decrease in blood glucose levels in the treatment group was significantly more than the control group.

Several studies have shown a statistically significant association between appropriate dietary practices or behaviors and glycemic, especially fasting blood glucose, in diabetic patients.⁴¹ Study of a randomized controlled trial in 194 adults by Mason *et al.*³⁵ mentioning mindful eating exercises affects the reduction of fasting blood glucose levels and consumption of sweet foods significantly. Awareness and mindfulness during eating activities will facilitate compulsive reduction in the

quantity of eating so as to reduce excessive calorie intake through increased individual sensitivity to respond to interceptive cues and decreased sensitivity to environmental triggers.³⁵

Food consumption has a direct impact on the nutrients and energy that sustain human needs. In contrast, the total calories obtained through eating activities have a direct effect on blood glucose levels and glycemic control.⁴² Optimization of nutrients should be integrated into the glycemic control of diabetic patients. If a T2DM patient consumes excessive amounts of food in one meal, the insulin secreted by the pancreas is not enough to transport glucose from the bloodstream into the cells. Ha *et al.*⁴³ mentioned in their research that the diet of diabetic patients must be correct where diabetic patients should eat more often but with small portions per day (rather than eating rarely but with large portions) because this will help the body's total energy intake not change and control blood glucose levels better.

Miller *et al.*^{5,21} in their study, stated that respondents who received mindfulness eating practice reported having a more remarkable ability to minimize overeating in various situations and eat less after receiving satiety cues, helping people with diabetes develop healthier eating patterns.

Mindfulness eating practice is an exercise that aims to shape adaptive eating behavior through physiological mechanisms so that a mindful eating pattern is formed that increases the ability to identify one's own needs, reduces impulsivity in food consumption, and reduces stress.⁴⁴

The study's limitation lies in its rural setting, which differs from urban lifestyles, necessitating further research in varied contexts with larger sample sizes to generalize the results. Moreover, future studies should include participant exercise patterns and physical activity, as these factors may influence glycemic control.

Conclusions

Mindful eating exercises significantly improved the dietary behaviors of diabetic patients.

Healthcare providers should include these exercises in diabetes management to maintain glycemic control. Nurses are key in encouraging these eating patterns and in monitoring blood glucose levels regularly, which benefits the overall health of diabetic patients and improves diabetes care effectiveness.

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Table 1. Demographic characteristics of respondents.

Characteristics	Control		Treatment		Total	
	frequency (n)	percentage (%)	frequency (n)	percentage (%)	n	%
Age (years)						
18-45	13	40.6	11	34.3	24	37.5
46-60	19	59.4	21	65.7	40	62.5
Sex						

Male	9	28.1	12	37.5	21	32.8
Female	23	71.9	20	62.5	43	67.2
Education						
No School	4	12.5	1	3.2	5	7.8
Primary School	10	31.3	14	43.7	24	37.5
Middle & High School	13	40.6	9	28.1	22	34.4
Bachelor	5	15.6	8	25.0	13	20.3
Employment						
Employed	26	81.2	20	62.5	46	71.9
Unemployed	6	18.8	12	37.5	18	28.1
Duration Of Diabetes						
< 5 year	10	45.5	15	46.9	25	39.1
> 5 year	22	54.5	17	53.1	39	60.9
Body Mass Index						
Normal	13	40.7	11	34.3	24	37.5
Abnormal	19	59.3	21	65.7	40	62.5
Food Intake						
Do not exceed standard caloric intake	15	46.9	12	37.5	27	42.2
Exceeding standard calorie intake	17	53.1	20	62.5	37	57.8
Total	32	100	32	100	64	100

Table 2. The effect of mindful eating exercise on dietary behavior and fasting blood glucose level.

Variable	Category	Group			
		Treatment		Control	
		Pre-Test	Post Test	Pre-Test	Post-Test

		n	%	n	%	n	%	n	%
Dietary	Poor	23	71.9	11	34.4	21	65.7	17	53.1
Behavior	Good	9	28.1	21	65.6	11	34.3	15	46.9
Fasting	Uncontrolled	28	87.5	20	62.5	25	78.1	21	65.6
Blood	(≥ 130 mg/dl)								
Glucose	Controlled	4	12.5	12	37.5	7	21.9	11	34.4
	(< 130 mg/dl)								

Table 3. The differences of dietary behavior and fasting blood glucose level on T2DM patients.

Variable	Group	n	Pre-Test	Post Test	p-value
			Mean	Mean	
Dietary	Treatment	32	53.28	78.66	0.00 ^a
Behaviour	Control	32	43.32	44.05	0.07 ^a
Fasting	Treatment	32	197.93	165.84	0.033 ^a
Blood	Control	32	204.81	198.89	
Glucose					

a=Wilcoxon test result; b=Mann Whitney test result

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