ORIGINAL ARTICLE

Effect of dates and 7dates on blood glucose levels among adolescent girls: A randomized controlled trial

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ABSTRACT

Background. The Muslim community is recommended to consume dates routinely. Its sweet flavor, however, inflicts public concern related to the risk of diabetes. Not just adults, but also adolescents are at risk of experiencing blood glucose (BG) problems.
Aim: To evaluate the effect of 4 weeks of consumption of date fruits and packaged date drinks (7dates) on the changes in BG levels among adolescent girls.
Methods. This was a 4-week randomized controlled trial with parallel-group to a Muslim community in Bojong Kulur village. Twenty-three 23 non-diabetic subjects aged 16-24 years were randomly assigned to consume dates (N=11) or 7dates (N=12) for four weeks. Only ten subjects in each group were involved in the entire research process. The main outcomes measures were 2-hour postprandial blood glucose and weekly fasting blood glucose.
Results. All respondents in both groups had normal fasting blood glucose (FBG) levels at the beginning and end of the intervention. However, there were significant differences in BG levels between the initial reading and 2 hours after consuming dates or 7dates. There were no significant correlations between feeding frequency, dietary fiber, and 2-h postprandial BG levels. There was no adverse effects reported by the participants.
Conclusion. Consuming dates or 7dates in a recommended amount for four weeks tends to be safe and has no increase on the risk of diabetes among adolescent girls. Date fruit consumption is more advisable than a packaged date drink.
Keywords: Dates, 7dates, postprandial blood glucose, fasting blood glucose, adolescent girls

INTRODUCTION

Diabetes mellitus is a health problem in the world. From 2000 to 2030, the world population is estimated to rise by 37%, and the number of people with diabetes will increase by 114%. In Indonesia, the number of diabetics is predicted to increase approximately twofold from 8.4 million in 2000 to 21.3 million in 2030[1].

The American Diabetes Association (ADA) and the National Institutes of Health have recommended diabetic patients to consume complex carbohydrates rather than simple carbohydrates due to the assumption that sugars can be digested and absorbed faster than starches so that they can further aggravate the condition of hyperglycemia[2]. However, this recommendation is no longer considered suitable because the response of blood sugar to each type of complex carbohydrate foods is different. The difference in metabolic response to carbohydrates can be classified based on the glycemic index (GI)[3]. GI food is classified into three groups: low (GI ≤ 55), medium (GI = 56-69), and high (GI ≥ 70)[4]. The higher the GI value, the greater the effect on insulin and blood glucose (BG) levels.

BG levels in humans tend to increase with age and become deviated from the standard limits set for young adults. This is because aging is associated with resistance to stress, which can affect blood glucose [5]. Not just adults, but also adolescents are at risk of experiencing BG problems. “Adolescent” has been defined as someone aged 10-24 years[6]. Normal puberty is related to the interference of insulin-stimulated glucose metabolism. This impairment will worsen in adolescents with diabetes[7]. Rapid growth, puberty development[8], and hormonal changes may contribute to poor glycemic control[9], particularly in late adolescents and females (at 18-19 years of age)[10].

Consequently, the adolescents become vulnerable to type 1 diabetes due to the increased insulin resistance as a result of physiological changes during puberty[8]. Compared to boys, adolescent girls showed a constant increase in the mean level of glycated hemoglobin (HbA1c) with a predicted increase from pra-postpuberty of 0.92%, a sharp increase in body mass index (BMI)[11], and an

increased tendency of growth hormone concentrations following their growth spurt in puberty[12]. Excess growth hormone causes insulin resistance, whereas growth hormone deficiency causes insulin sensitivity[13]. Moreover, a study by Bryden et al. proved that adolescent behavior problems were significantly correlated with the higher mean HbA1c level over the next eight years while the lower mean HbA1c level has been associated with adolescent emotional problems[10].

Diabetes can be diagnosed with a fasting blood glucose (FBG) level[5], the 2-hour postprandial blood glucose (2-h PP BG) value, or glycated hemoglobin (A1C) criteria. The ADA has set limits on the standard criteria of BG[14], as described in Table 1.

Table 1: Diagnostic test for diabetes

Test	Normal	Prediabetes	Diabetes
FBG	less than 100 mg/dl	100 mg/dl to 125 mg/dl (5.6-6.9 mmol/L)	126 mg/dl or higher (7.0 mmol/L)
2-h PP BG value during a 75-g OGTT	less than 140 mg/dl	140 mg/dl to 199 mg/dl (7.8-11.0 mmol/L)	200 mg/dl or higher (11.1 mmol/L)
A1C	less than 5.7%	5.7% to 6.4%	6.5% or higher

FBG: Fasting blood glucose; 2-h PP BG: 2-hour postprandial blood glucose; OGTT: oral glucose tolerance test; and A1C: glycated hemoglobin.

In clinical practice, health practitioners commonly encourage diabetic patients to consume green vegetables and fruits[15] and to avoid consuming dates to control their glycemic levels[16, 17]. However, this advice contradicts previous studies that show dates have low to medium GIs[16]. Dates are even used as a therapy for diabetic patients[16, 18]. Moreover, for Muslim communities, consuming dates is not only as a food and herbal medicine but also following Islamic shari'a. For practical reasons, some Muslim communities prefer to consume a packaged drink of dates (7dates) than eat date fruits. Next, the issue of the safety of date consumption towards the risk of diabetes emerged due to its sweet flavor[19]. This study was designed to evaluate the effect of 4 weeks of consumption of dates and 7dates on the changes in BG levels among adolescent girls.

MATERIAL AND METHODS

Design: This study was a 4-week randomized controlled trial, parallel-group, with two groups: dates-consumers and 7dates-consumers. A total of six midwives were recruited and trained for supporting and ensuring that the trial conducted according to the research protocol. Two midwives were responsible for randomization, examining subjects' health status, and blood glucose tests while four other midwives for distributing and accompanying subjects while they were consuming dates or 7dates every day as well as filling out the daily intake of the subjects.

Subjects: Participants were unmarried adolescent girls aged 16-24 years. This research was carried out after obtaining approval from the Ethics of Health Study Committee, The Faculty of Medicine of Universitas Padjadjaran, number 29/UN6.C10/PN/2018, and the research subjects (based on the Declaration of Helsinki).

The inclusion criteria were healthy subjects with normal blood pressure (BP) (80-120 mmHg for systolic and 60-80 mmHg for diastolic), normal BMI for the Asian-Pacific (18.5-22.9), and FBG level (<100 mg/dl). For those who have a history of diabetes and those who still suffer from diabetes, those with a BMI other than normal (underweight, overweight, and obese), and FBG level ≥100 mg/dl were excluded from the study.

Subject recruitment was undergone through three stages. First, interviewing all of volunteers about demographic data, current complaints related to diabetes, current and previous medical history, information about date consumption, food and beverage intake, and activity patterns from morning to night. Second, each subject was physically examined, including blood pressure (BP), height, weight, and body mass index (BMI). The BMI classification used was based on the standard for Asia Pacific region population[20] instead of World Health Organization (WHO) standard for the general population[21] (see Table 2). Third, subjects who had normal BP and BMI, no complaints leading to diabetes, and no history of diabetes, were asked to fast overnight. Then, their FBG levels were measured the following morning[16].

Table 2: The BMI classification

Classification	General	Asia-Pacific
Underweight	<18.5	<18.5
Normal	18.5-24.9	18.5-22.9
Overweight	25-29.9	23-24.9
Obese	≥30	≥25

There were 30 eligible subjects (all females) but only 23 of them agreed to involved in the study. They were then randomly assigned to dates-group (N=12) or 7dates-group (N=11). Randomization was performed using an alternating method. Participants in the odd order list were included in the dates-group while other participants in the even-order list were allocated to the 7dates-group. Subjects were excluded from the study if they missed consuming dates or 7dates in a day. Two subjects from the dates-group and a subject from the 7dates-group were excluded from this study because they traveled out of town for quite a long

time, so it was difficult to monitor their adherence and check their BG levels (see Figure 1). Finally, ten subjects in each group were involved in the entire research process. The baseline characteristics of the two groups can be seen in Table 3.

Study setting: Subject recruitment was undertaken at the Klinik Sehat, Bojong Kulur Village while the trial was conducted in a Muslim community, which is located in Bojong Kulur village, Gunung Putri district, Bogor regency, West Java province, Indonesia.

Intervention: The eligible subjects were asked to consume dates or 7dates for four weeks. 7dates is a date packaged drink that has been often consumed by the Muslim community[19]. Its composition is only dates and water. It has been certified by the Assessment Institute for Food, Drugs, and Cosmetics of Indonesian Ulema Council[19, 22].

Table 3: Baseline characteristics of the two groups

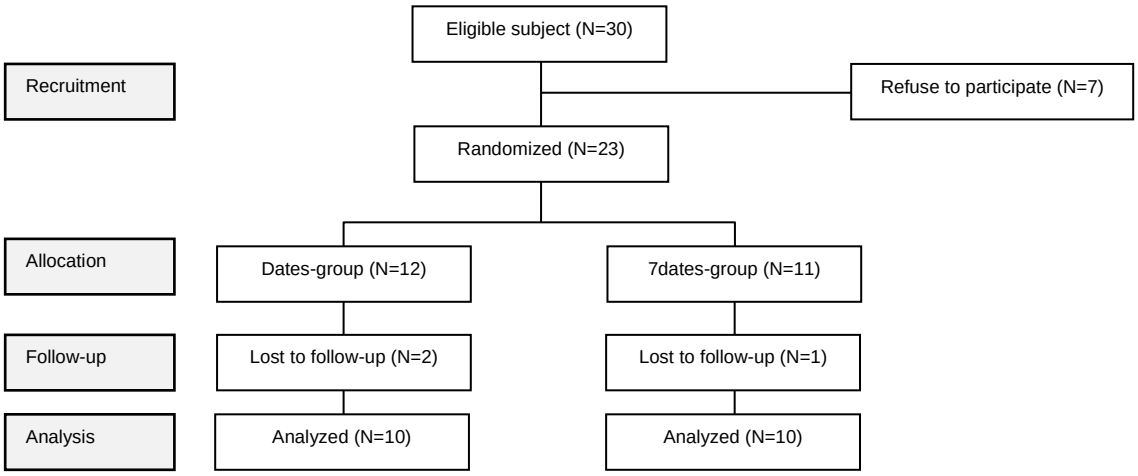
Variable	Mean (SD)	
	Dates (N=10)	7dates (N=10)
Age	19.2 (0.8)	18.5 (0.7)
Systolic BP	103.0 (10.6)	107.0 (6.7)
Diastolic BP	77.0 (4.8)	71.0 (7.4)
BMI	22.1 (1.3)	22.1 (0.8)

The determination of dates' doses was based on the Islamic recommendations to consume seven-date fruits per day (Hadith narrated by Bukhari no. 356) and previous studies[22]. Meanwhile, the determination of 7dates' doses was based on the most frequent and the highest amount usually consumed by the community[19]. Determination doses of both treatments have also considered the safety aspect where a lethal dose of 50 extract dates is more than 5000 mg/kg[23].

In the dates group, subjects were given 75 gr date fruits divided into two doses per day (2x37.5 gr per day) for the morning and afternoon[22] for four weeks. Dates' cultivar used in this study was Sayer dates. While in the 7dates group, subjects were asked to consume two bottles of 7dates per day (in the morning and afternoon) for two weeks, then the dose was raised to three bottles per day (in the morning, afternoon, and evening) for two weeks.

Measurements: BG was measured using capillary blood samples with one prick of a digital BG test (quick-check BG testing system) Easytouch. BG for each subject was measured six times: once during screening (FBG), once 2 hours after consuming dates or 7dates (2-h PP BG), and every Saturday or Sunday morning in each week of the study period (FBG). Every day, officers explored the information about food and beverage consumed by the subjects in the previous day.

Figure 1: Flow chart of the participants



Statistical analysis: Data was analyzed using the Sign test and the Spearman test. The Sign test was used to assess the difference in BG levels before and after the interventions. Meanwhile, the Spearman test was used to assess the correlation between confounding variables (feeding frequency and dietary fiber) and the dependent variable (BG levels). Significant levels of both tests were set at alpha equals 0.05.

RESULTS

Statistic results in Table 4 shows that there were significant differences in BG levels between the initial reading and 2 hours after consuming dates or 7dates. All respondents in both groups experienced an increase in 2-h PP BG levels with a median (range) increase of 24.5 (19-106) for the date group and 35.0 (5-90) for the 7dates group. However, there were no

significant differences in FBG levels between the initial reading and 1, 2, 3, and 4 weeks after consuming dates or 7dates.

The Spearman test was carried out to assess the correlation between feeding frequency, dietary fiber, and 2-h PP BG levels. The results showed that there was no significant correlation between feeding frequency, dietary fiber, and 2-h PP BG levels (Table 5). This means that factors other than feeding frequency and dietary fiber might influence the increase in the 2-h PP BG of the research subjects.

BG levels of all respondents in both groups of dates and 7dates were at normal levels at the beginning and end of the intervention. However, it was found that two respondents were at the level of prediabetes 2 hours after consuming dates and 7dates and 2 weeks after consuming 7dates, and one of the respondents from each group was at the level of pre-diabetes (dates group) and diabetes (7dates group) after 3 weeks of interventions (Table 6). In the first day of intervention, respectively two participants either from dates-group or 7dates-group suffered mild dizziness but the complaint then disappeared in the next day. There was no adverse effects that reported by the participants.

The further Sign test was performed to assess the difference in FBG levels between the initial reading and after consuming two and three bottles of 7dates. Table 7 shows that there were no significant differences in FBG levels between the initial reading and 1 and 2 weeks after consuming two or three bottles of 7dates.

Table 4: Sign test results

	Date fruits				7dates			
	Differences		Ties	*p*	Differences		Ties	*p*
	Negative	Positive			Negative	Positive		
2-h PP BG – Initial	0	10	0	.002[a]	0	10	0	.002[a]
1st-week FBG – Initial	3	4	3	1.000[a]	2	8	0	.109[a]
2nd-week FBG – Initial	7	3	0	.344[a]	3	7	0	.344[a]
3rd-week FBG – Initial	3	7	0	.344[a]	4	6	0	.754[a]
4th-week FBG – Initial	7	2	1	.180[a]	1	7	2	.070[a]

a) Binomial distribution used; b) Sign test.

Table 5: Frequency (percentage) and Spearman rank correlation coefficients

Variables	Frequency (%)		Corr.	*p*
	Normal	Pre-diabetes		
Feeding frequency				
A time per day	4 (25.0)	2 (50.0)	-.283	.226
2 times per day	8 (50.0)	2 (50.0)		
3 times per day	4 (25.0)	0 (0.0)		
Dietary fiber				
None	5 (31.3)	1 (25.0)	.022	.926
A day per week	0 (0.0)	1 (25.0)		
2 day per week	2 (12.5)	0 (0.0)		
3 day per week	2 (12.5)	0 (0.0)		
4 day per week	3 (18.8)	1 (25.0)		
5 day per week	2 (12.5)	0 (0.0)		
Almost Everyday	2 (12.5)	1 (25.0)		

Table 6: Changes in BG levels after four weeks of interventions (N=20)

Group	Initial FBG	2-h PP BG	1st-week FBG	2nd-week FBG	3rd-week FBG	4th-week FBG
Dates group	Normal (N=10)	Normal (N=8) Prediabetes (N=2)	Normal (N=10)	Normal (N=10)	Normal (N=9) Prediabetes (N=1)	Normal (N=10)
7dates group	Normal (N=10)	Normal (N=8) Prediabetes (N=2)	Normal (N=10)	Normal (N=8) Prediabetes (N=2)	Normal (N=9) Diabetes (N=1)	Normal (N=10)

Notes: Normal FBG: <100 mg/dl; Prediabetes FBG: 100-125 mg/dl; Diabetes FBG: ≥126 mg/dl
Normal 2-h PP BG: <140 mg/dl; Prediabetes 2-h PP BG: 140-199 mg/dl; Diabetes 2-h PP BG: ≥200 mg/dl

Table 7: Sign test results of 7dates consumption between 2 bottles and 3 bottles

	2 bottles				3 bottles			
	Differences		Ties	*p*	Differences		Ties	*p*
	Negative	Positive			Negative	Positive		
1st-week FBG – Initial	2	8	0	.109[a]	5	4	1	1.000[a]
2nd-week FBG – Initial	3	7	0	.344[a]	7	3	0	.344[a]

a) Binomial distribution used; b) Sign test.

DISCUSSION

The consumption of dates or even 7dates increased 2-h PP BG levels, but it then stabilized FBG levels after 4-week consumption. Rapid and significant increases in BG levels that remained within the normal threshold were found in both treatment groups 2 hours after consuming dates or 7dates. This finding is in line with the Alkaabi et al. study that found date consumption in recommended amounts by healthy and diabetic subjects had no risk of unwanted postprandial glucose increases[16]. The dominant sugar contained in ripe dates is the simple reducing sugar, namely glucose and fructose[24, 25]. Glucose is a type of sugar that is easily absorbed by the human body during the digestion process so that it can rapidly increase BG levels[26, 27]. Meanwhile, fructose is a type of sugar that can induce a feeling of satiety and reduce total calorie intake compared to fat-rich foods[26]. It is likely one of the scientific bases of Islamic recommendation for encouraging the Muslim communities to break their fast and sahur with dates as narrated in the hadith of Tirmidhi no. 631 and Abu Daud no. 1998, 2008 and 2009[19].

The Sign test results revealed the significant differences in 2-h PP BG levels in both groups of dates and 7dates. However, the Spearman test results showed that feeding frequency and dietary fiber had no significant correlation with the changes in 2-h PP BG levels. This means that other factors besides feeding frequency and dietary fiber might increase PP BG levels. The explanation of this finding requires further investigation.

On the other hand, although dates have a sweet taste, the FBG levels of all respondents remained at normal levels after four weeks of consumption. This finding is strengthened by previous studies that show date consumption did not cause the erratic increase in BG levels[28] owing to its low glycemic index (≤ 55)[16, 17]. The sweet taste of dates comes from its fructose content. Fructose has a taste that is twice as sweet as glucose[16, 26]. A low GI diet proved to reduce the risk of diabetes[3], coronary heart disease[3, 29], gallbladder disease, breast cancer[29], and obesity[3]. It has also been proven to increase high-density lipoprotein cholesterol, reduce A1C levels[30], reduce postprandial glucose and insulin response, increase lipid profiles, and improve insulin sensitivity[3]. A Zangiabadi et al. study indicated that date consumption by diabetic patients can provide protection against peripheral nerve damage and can be used as potential prevention for peripheral diabetic neuropathy[18]. The advice for diabetic patients to refrain from eating dates is inappropriate and not based on scientific evidence. The previous studies revealed that dates were safe to be consumed by either healthy subjects[16] or diabetic patients[16, 28]. It is even recommended for diabetic patients' diets[28]. Agbon et al. study emphasized that routine date consumption is relatively safe and does not cause toxicity or death effects[23].

We conclude that consuming seven-date fruits or drinking 2-3 bottles of 7dates every day for four weeks was relatively safe and not associated with a risk of diabetes among adolescent girls. Consumption of date fruits is more advisable than consuming a packaged date drink (7dates) because some nutrients contained in date fruits may be damaged during the production and packaging process. However, for those who have difficulty consuming date fruits[19], they could still consume 7dates as an alternative. The results of this study supported the findings of the previous studies. However, since this study involved a small number of subjects, we recommend further studies to recruit more respondents with varied ages and to identify other factors that influence BG levels.

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