Diabetes, Metabolic Syndrome and Obesity

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ORIGINAL RESEARCH

Effects of Diacylglycerol Oil on Overweight or Obese Patients with Diabetes or Prediabetes: a Single-Arm Trial

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Objective: The annual incidence of overweight or obesity and abnormally elevated blood glucose levels in China is increasing. According to research, diacylglycerol oil offers effective lipid-lowering and weight-loss properties. This study aimed to elucidate the effects of diacylglycerol oil on overweight and obese patients with unusually high blood glucose levels.

Methods: This is a single-arm trial. A total of 75 overweight or obese subjects with abnormally elevated blood glucose levels were included in this study. Subjects were requested to use diacylglycerol oil to cook food daily for two months and to maintain their daily eating habits and drug treatment regimen. Study-related parameters were assessed, respectively, during the screening period, one month, and two months following DAG oil consumed.

Results: Fasting blood glucose (FBG), body weight, body mass index (BMI), waist circumference, and hip circumference decreased compared with baseline after consuming diacylglycerol oil for two months. FBG and glycosylated hemoglobin (HbAlc) levels decreased in prediabetic subjects (FBG decreased at visit 2 months: −0.31 mmol/l; at visit 1 month: −0.28 mmol/l; HbAlc decreased at visit 2: −0.10%; $P < 0.05$), but there were no significant difference changes in diabetic subjects. In diabetic participants, triglyceride (TAG) levels reduced by 0.17 mmol/l, whereas in prediabetic subjects, total cholesterol (TC) and low-density lipoprotein cholesterol (LDL-C) levels decreased by 0.27 mmol/l and 0.28 mmol/l, respectively ($P < 0.05$). There were no significant differences in the changes in high-density lipoprotein cholesterol (HDL-C) and uric acid (UA) between two groups. Compared to baseline, diabetic participants' body weight, BMI, and waist-to-hip ratio (WHR) dropped by 0.54 kg, 0.20, and 0.01 kg, respectively ($P < 0.05$). And prediabetic participants' BMI, waist circumference, and hip circumference dropped by 0.43, 1.43, and 1.53 cm, respectively ($P < 0.05$).

Conclusion: Diacylglycerol oil may help to prevent diabetes and delays its progression in overweight or obese patients.

Clinical Trial Registry: ChiCTR2000028888 at www.chictr.org.cn.

Keywords: diacylglycerol oil, overweight, obese, prediabetes, diabetes

Introduction

Owing to changes in the dietary structure and unhealthy eating habits of residents, the prevalence of obesity and diabetes is increasing annually. According to a report on nutrition and chronic diseases in Chinese residents in 2020, the overall prevalence of overweight or obesity in Chinese adults exceeds 50%, and the prevalence of diabetes is 11.9%.[1] It is estimated that, by 2030, the prevalence of overweight and obesity in Chinese adults will increase to 61%.[2] An unhealthy diet can lead to obesity and diabetes, and overweight and obesity are risk factors for diabetes.[3] Research indicates that eating a healthy diet can help prevent obesity, diabetes, and other conditions, which can cut the risk of cardiovascular and cerebrovascular illnesses in half.[4] Therefore, it is important to have a healthy diet.

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A crossover study has found that four-week high carbohydrate/low fat diet may help with weight loss and insulin resistance.[5] The increasing prevalence of obesity and diabetes may be caused by the progressive shift in Chinese people' dietary patterns from a traditional high-carb, high-fiber, and low-fat diet to a western model that is heavy in calories, fat, and animal protein.[6] The primary sources of dietary fat include animal products, nuts, beans, and cooking oil. The energy supply ratio of dietary fat has increased, and the per capita dose of cooking oil has reached 43.2 g/day, which is much higher than the recommended value of 25–30 g/day in the guidelines.[1,7] Research has indicated that the effects of various types of oil on lowering insulin sensitivity and fat accumulation vary.[8–10] Therefore, in addition to changing the dietary structure, the choice of dietary oil is important.

Diglycerides are extensively present in natural plant and animal oils and are acknowledged as acceptable food additives, but natural edible oils only contain 10% or less of them.[11] Kao manufactured diglyceride edible oil in 1999 with an 83% diglyceride concentration. The Ministry of Health, Labor, and Welfare of Japan authorized it as a "special health use food" in 1999, and the Food and Drug Administration of Japan approved it in 2000. The general public is well aware of the "high energy and low accumulation" benefits of diglyceride oil, which is rich in diglycerides, whereas ordinary edible oil is mostly made up of triglycerides.[11,12] Studies have found that, in addition to olive oil,[13,14] diacylglycerol oil can reduce body weight and fat accumulation[15] and may be beneficial in reducing Fasting blood glucose (FBG) levels in diabetic patients.[16]

In China, most studies on diacylglycerol oil have focused on the purification of diacylglycerol, and there have been few clinical studies. This study aimed to investigate the effects of diacylglycerol in overweight or obese patients with abnormally elevated blood glucose levels.

Materials and Methods

Study Design and Participant

This is a single-arm trial. From May 2020 to December 2021, patients who qualified the inclusion criteria were recruited at the Guangdong Province Traditional Medical Hospital. Laboratory and anthropometric indicators were measured in overweight or obese adults with abnormally elevated blood glucose levels during the screening period, 1st month and 2nd month. Our study complies with the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee of Guangdong Provincial Hospital of Chinese Medicine, and all participants provided written informed consent prior to their participation.

The diagnostic criteria were overweight or obese patients with abnormally elevated blood glucose levels. According to the Multidisciplinary Clinical Consensus on Diagnosis and Treatment of Obesity (2021 edition), $24kg/m^2 \leq$ body mass index (BMI) $< 28kg/m^2$ indicates overweight and BMI $\geq 28kg/m^2$ indicates obesity.[17] Abnormally elevated blood glucose levels include diabetes and prediabetes (impaired fasting glucose levels and/or impaired glucose tolerance). Referring to the diagnostic criteria of the American Diabetes Association in 2019, prediabetes: FBG 5.6–6.9 mmol/l or 2-hour plasma glucose 7.8–11.0 mmol/l or glycosylated hemoglobin (HbAlc) 5.7–6.4%; diabetes: FBG ≥ 7.0 mmol/l or oral glucose tolerance test (OGTT) 2 hours blood glucose > 11.1 mmol/l or HbAlc ≥ 6.5% or typical symptoms and random blood glucose ≥ 11.1 mmol/l.[18]

Inclusion criteria were as follows: Adult aged 18–75 years, without gender restriction; understanding and cooperating with our experiment and signing a voluntary informed consent form; overweight or obese; and abnormally elevated blood glucose (HbAlc ≥ 5.7% or FBG ≥ 5.6 mmol/l).

The exclusion criteria were as follows: familial hyperlipidemia or hypertriglyceridemia (triglycerides > 4.5 mmol/l); diagnosis of type 1 diabetes or serious diabetic complications, such as diabetic foot, diabetic nephropathy, etc; systolic blood pressure > 180 mmHg or diastolic blood pressure > 110 mmHg at the latest blood pressure measurement; severe cardiovascular and cerebrovascular disease or arteriosclerotic disease; severe liver disease (alanine aminotransferase (ALT), aspartate aminotransferase (AST), or total bilirubin (TBIL) > 2 times the upper limit of normal) or kidney disease (Creatinine (Cr) > 1.5 × the upper limit of normal); blood and tumor disease; pregnancy or prepares for pregnancy; mental illness; inability or disagreement to sign informed consent; and participation in other clinical studies within the first 30 days.

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Progress of the Study

Participants who met the inclusion criteria used diacylglycerol oil to cook food every day for two months. Participants were requested to use the Peppermint Health app to track their daily meals for seven days prior to the experiment and during the trail in order to determine how many calories they consumed. During this period, the subjects needed to maintain their daily eating habits and medication regimen, and should not use or take any weight loss products. If subjects need to change their medication regimen, they should notify the researchers as soon as possible. Professional doctors used their judgment to decide whether to continue the research or withdraw from it based on the particular conditions. The participant should be removed from the study if the DAG oil has a significant negative impact on their health; if not, the trial should proceed. The subjects were required to complete relevant laboratory tests and anthropometric tests, including blood glucose, blood lipids, uric acid, liver function, kidney function and weight, waistline, and other related indicators, at screening, one and two months after consuming diacylglycerol oil. Participants were asked to have blood test in a fasting state to complete laboratory tests and following that, using the conventional detection procedure, the laboratory department of Guangdong Provincial Hospital of Chinese Medicine finished detecting associated laboratory indicators. FBG was detected by hexokinase method, fasting INS by chemiluminescence method, UA by uricase-peroxidase method, TAG and TC by enzymatic method, LDL-C and HDL-C by enzymatic colorimetry. The diacylglycerol oil used in this study was provided by Guangzhou Yonghua Special Medical Nutrition Technology Co. Ltd.

Assessment of Glycemic and Weight Control

We assessed changes in glucose metabolism by observing changes in FBG, fasting INS, and HbAlc, and calculated the homeostasis model assessment-insulin resistance (HOMA-IR).[19] Changes in blood lipid metabolism were assessed by observing changes in total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), and triglyceride (TAG) levels. Anthropometric changes were assessed by observing changes in weight, BMI, waist circumference, hip circumference, and waist-to-hip ratio (WHR). BMI can be used to assess the degree of obesity in different individuals, waist circumference and hip circumference can reflect the degree of subcutaneous fat accumulation in individuals, and WHR can be used to assess the degree of subcutaneous fat in different populations.[20]

Statistical Analysis

Data were entered using EpiData software (version 3.0) and analyzed using SPSS software (version 26.0). All data collected throughout the study would be included in the analysis set. The expectation maximization algorithm was used to fill in the missing data. The normality of the quantitative variables was analyzed using the Shapiro–Wilk test. Normally distributed data were described using the mean ± standard deviation ($\overline{X} \pm S$); otherwise, the median ± interquartile range (M [Q]) was used. For HbA1c values collected twice, a paired sample *t*-test was used if the data were normally distributed; otherwise, a nonparametric test was used. The other indicators collected three times were calculated as dependent variables using the Generalized Estimation Equation (GEE) and analyzed for the effects of time, group, and the interaction between time and group. Age and gender had been adjusted in the model. It is deemed statistically significant when P values are less than 0.05.

Results

A total of 75 participants were included in our study, including 53 patients with prediabetes and 22 with diabetes. There was no significant difference in calorie intake before and during the trial. Five subjects did not return to the hospital as scheduled at visit point 1, and three subjects fell off at visit point 2. All data were included in the analysis to ensure integrity and authenticity. The subjects were predominantly female (62.67%), with a mean BMI of 27.41 kg/m2 and age of 58 years. No significant differences were observed between the prediabetic and diabetic groups (Table 1). There was no significant difference in disease or medication use between the two groups ($P < 0.05$).

We found that diacylglycerol oil contributed to reducing FBG, body weight, waistline, and hipline levels in subjects. Using generalized estimation equation analysis, diacylglycerol oil was found to reduce the blood lipid levels in different subjects (Table 2).

Table 1 Comparison of Basic Conditions Among Overweight or Obese Patients with Diabetes or Prediabetes [a]

	Prediabetes (n=53)	Diabetes (n=22)	All (n=75)	P [b]
Age (years)	60.00 (15.50)	62.00 (12.00)	61.00 (15.00)	0.28
Sex (female)	34 (64.15)	13 (59.09)	47 (62.67)	0.68
BMI (kg/m^2)	26.01 (4.73)	25.94 (2.67)	26.01 (2.86)	0.38
Hypertension	45 (84.91)	14 (63.64)	59 (78.67)	0.08
Hyperlipidemia	24 (45.28)	8 (36.36)	32 (42.67)	0.48
Hyperuricemia	12 (22.64)	6 (27.27)	18 (24.00)	0.67
Coronary heart disease	11 (20.75)	4 (18.18)	15 (20.00)	1.00
Antihypertensive drugs	45 (84.91)	14 (63.64)	59 (78.67)	0.08
Lipid-lowering drugs	29 (54.72)	12 (54.55)	41 (54.67)	0.99
Uric acid reduction drugs	4 (7.55)	3 (13.64)	7 (9.33)	0.70
Antiplatelet drugs	14 (26.42)	5 (22.73)	19 (25.33)	0.74

Note: [a]Values are median ± interquartile range; [b]*P* =*P* values for between-group differences calculated using Wilcoxon rank sum test in nonparametric tests or chi-squared test.

Changes in the Metabolic of Glucose

Compared with the screening period, FBG decreased by 0.22 mmol/l at visit 1 (P=0.013<0.05) and 0.28 mmol/l at visit 2 (P=0.007<0.01). Intra-group analysis revealed that the levels of FBG and HbAlc in the diabetes were higher than those in the prediabetes at each time point (P < 0.01). Intra-group analysis revealed that in the prediabetes the FBG decreased by 0.31 mmol/l at visit 1 (P=0.000 < 0.01) and 0.28 mmol/l at visit 2 (P=0.000 < 0.01), and the level of HbAlc decreased by 0.10% at visit 2 in group of prediabetes (P=0.022 < 0.05) compared with baseline. As for INS and HOMA-IR, we found no statistically significant differences between or inside the groups at each time point (P > 0.05). The changes in each index are shown in Figure 1.

Changes in the Metabolic of Lipid

Without dividing the groups, we found no statistical differences at any time point or index. But we found that the average level of triglyceride decreased in visit 2 (0.17 mmol/l, P=0.042<0.05) in diabetes and the mean of TC and LDL-C were lower in visit 2 (0.27 mmol/l, P=0.049<0.05; 0.28 mmol/l, P=0.030<0.05) in prediabetics compared with baseline. No statistically significant difference was found in the HDL-C level intragroup or between the groups at each time point, and the changes in each index are shown in Figure 2.

Changes in Uric Acid (UA)

No statistically significant difference was found in the intra-group or between the groups at any time point. The changes in UA levels are shown in Figure 3.

Changes in Anthropometric Indicators

Without dividing groups, we found that weight, BMI, waistline and hipline decreased in visit 2 (−1.96 kg, P=0.021<0.05; −0.55, P=0.004<0.01; −1.64 cm, P=0.006<0.01; −1.29 cm, P=0.005<0.01), while there was no significant statistical difference on WHR. The results of intragroup analysis showed that in diabetics the average level of weight, BMI and WHR at visit 1 decreased (−0.54 kg, P=0.011<0.05; −0.24, P=0.011<0.05;-0.01, P=0.024<0.05) compared with baseline. In patients with prediabetes, the average BMI, waistline, and hipline at visit 2 decreased (−0.43, P=0.027 < 0.05; −1.43 cm, P=0.030 < 0.05; −1.53, P=0.005 < 0.01, respectively) compared to baseline. In addition, in prediabetes, the average levels of waistline and hipline decreased at visit 2 (−1.68 cm, P=0.030 < 0.05; −1.23 cm, P=0.021 < 0.05) compared with visit 1, and in diabetes, the mean hipline decreased at visit 2(−1.43 cm, P=0.011 < 0.05) compared with visit 1. The changes in each index are shown in Figure 4.

Table 2 Changes of Diacylglycerol Oil Consumption with Time in Overweight or Obese Patients with Diabetes or Prediabetes [a]

Index	Prediabetes (n=53)[b]			Diabetes (n=22)[b]			All (n=75)[c]		
	Baseline	**Visit 1**	**Visit 2**	**Baseline**	**Visit 1**	**Visit 2**	**Baseline**	**Visit 1**	**Visit 2**
FBG (mmol/l)	6.00 (0.95)	5.78 (0.93) *	5.59 (0.87) *	6.79 (1.4)	6.82 (1.04)	7.02 (1.21)	6.28 (1.11)	6.11 (1.21) #	6.04 (1.39) *
INS (pmol/l)	87.66 (79.53)	84.33 (78.62)	77.07 (61.44)	65.63 (77.70)	56.86 (40.96)	58.16 (52.99)	82.31 (78.06)	73.90 (72.80)	74.80 (56.14)
HOMA-IR	3.19 (3.18)	3.00 (2.86)	2.74 (2.93)	3.50 (3.3)	2.64 (2.94)	3.08 (2.08)	3.37 (3.15)	2.99 (2.84)	2.85 (2.64)
HbA1c[d] (%)	6.00 (0.55)	/	6.00 (0.40) #	6.45 (0.90)	/	6.40 (1.05)	6.20 (0.60)	/	6.10 (0.60)
TC (mmol/l)	4.53 (1.86)	4.17 (1.64)	4.17 (1.69) #	4.22 (1.09)	4.36 (1.28)	4.25 (2.11)	4.48 (1.69)	4.18 (1.44)	4.21 (1.78)
TAG (mmol/l)	1.56 (0.74)	1.57 (0.64)	1.48 (0.55)	1.59 (1.02)	1.45 (0.92)	1.21 (0.72) #	1.58 (0.79)	1.55 (0.69)	1.45 (0.62)
LDL-C (mmol/l)	3.05 (1.84)	2.31 (1.40)	2.44 (1.59) #	2.84 (1.30)	2.96 (1.51)	2.82 (2.07)	2.96 (1.64)	2.49 (1.53)	2.52 (1.65)
HDL-C (mmol/l)	1.24 (0.44)	1.22 (0.47)	1.23 (0.40)	1.18 (0.18)	1.22 (0.18)	1.22 (0.21)	1.21 (0.30)	1.22 (0.35)	1.23 (0.32)
UA (μmol/l)	402.00 (131.50)	395.50 (107.00)	403.00 (91.00)	414.00 (203.75)	385.50 (171.25)	369.50 (146.75)	402.00 (149.00)	395.50 (130.75)	399.00 (100.00)
Weight (kg)	69.90 (15.85)	69.20 (16.45)	68.85 (13.55)	68.00 (13.73)	67.18 (14.55) #	67.20 (12.22)	69.00 (14.25)	68.80 (15.15)	68.15 (13.26) #
BMI (kg/m^2)	26.01 (4.73)	25.85 (5.96)	25.70 (4.41) #	25.94 (2.67)	25.57 (2.34) #	25.55 (2.20)	26.01 (2.86)	25.80 (3.67)	25.63 (2.48) *
Waistline (cm)	94.50 (11.25)	94.65 (11.47)	93.50 (7.50) #	93.75 (10.88)	91.75 (10.75)	90.00 (9.20)	94.50 (11.00)	93.75 (11.13)	93.00 (8.25) *
Hipline (cm)	101.30 (9.00)	101.00 (9.00)	100.00 (9.50) *	100.00 (5.25)	99.75 (6.38)	100.00 (5.15)	101.00 (8.50)	100.00 (8.47)	100.00 (8.17) *
WHR	0.92 (0.10)	0.93 (0.07)	0.93 (0.07)	0.93 (0.10)	0.92 (0.09) #	0.91 (0.08)	0.92 (0.09)	0.93 (0.08)	0.93 (0.07)

Note: a Values are median (interquartile range); b *P* values for the timepoint × group interaction calculated using generalized estimation equation; c *P* values for the timepoint calculated using generalized estimation equation; d *P* values for the timepoint calculated using paired-samples *t* test or nonparametric test; # indicates a significant difference compared with baseline, $P < 0.05$; *indicates a significant difference compared with baseline, $P < 0.01$.).

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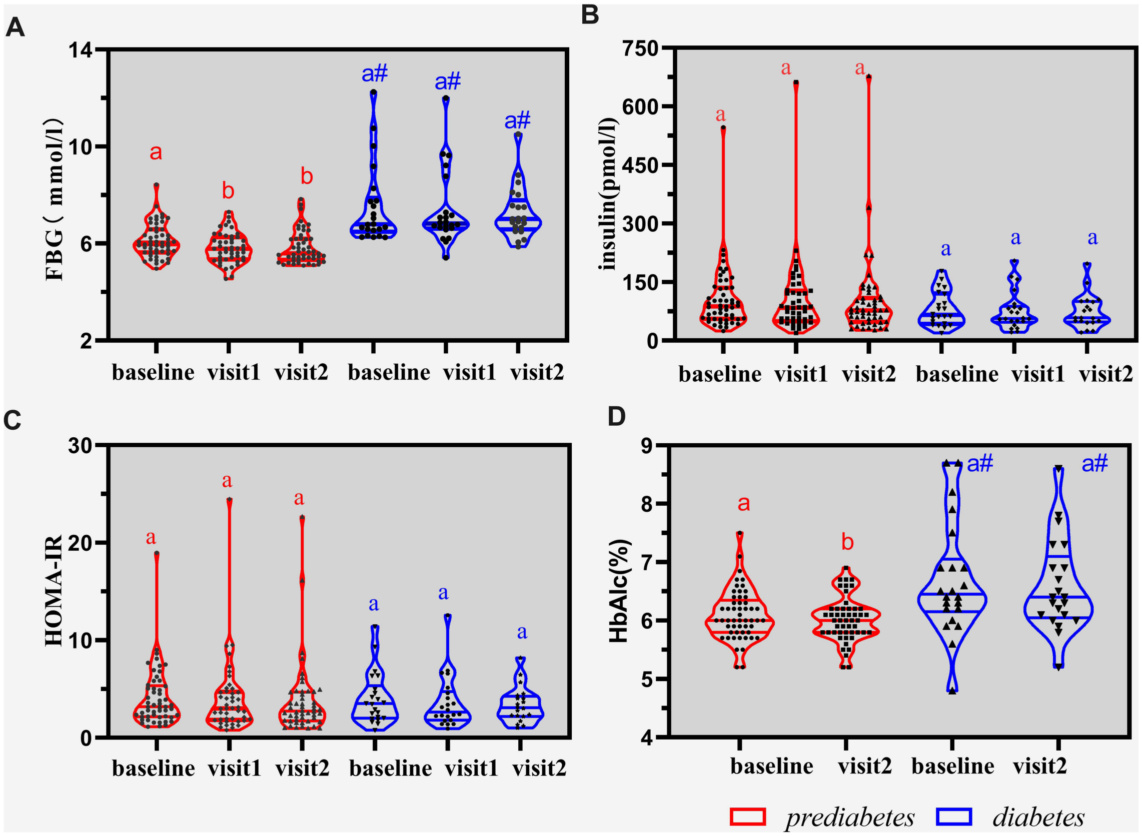

Figure 1 Violin plot of changes in blood glucose related indicators.
Note: (**A**) shows the changes in FBG levels in prediabetes and diabetes. (**B**) shows the changes in insulin levels in prediabetes and diabetes. (**C**) shows the changes in HOMA-IR levels in prediabetes and diabetes. (**D**) shows the changes in HbAlc levels in prediabetes and diabetes. # Indicates a statistically significant difference between the two groups ($P < 0.05$); ab is the letter marking method for comparing each time point in the group).

Safety Evaluation

During this period, no adverse reactions or adverse events occurred in the subjects consuming diacylglycerol oil.

Discussion

This study explored the effects of diglyceride oil on subjects by observing changes in related indicators after consuming diacylglycerol oil in overweight or obese subjects with abnormally elevated blood glucose levels. Following two months of diacylglycerol oil consumption, we found that DAG oil may help to reduce fat accumulation, including their body weight, BMI, waist circumference and hip circumference. Similarly, Kawashima H et al discovered that after a year of consuming diacylglycerol oil ad libitum as part of a regular diet, there was a slight reduction in body weight compared to triacylglycerol oil, and it appears the participants who were obese at baseline experienced the highest weight loss.[21] Maki KC et al found that consuming diacylglycerol oil significantly decreased body weight and fat mass more than consuming triacylglycerol in participants who were overweight or obese.[22] However, according to Hansen V. H. et al, overweight individuals who took DAG for 12 weeks did not decrease body weight, although they did see slight improvements in their trunk fat mass and total fat percentage.[23] There are conflicting findings about the impact of diglycerides on weight loss. However, a meta-analysis conducted in 2008 by Xu T C et al revealed that DAG oil reduced body weight in both diabetic and healthy individuals, and that the effect was dose-correlated.[24]

DAG oil intake was found to enhance lipid metabolism in a variation of individuals, including those with diabetes who had lower TAG levels and those with prediabetes who had lower TC and LDL-C levels. According to earlier research, DAG oils can prevent the rise in postprandial blood triglycerides, residual lipoprotein cholesterol, and triglycerides in individuals with healthy people,[25] type 2 diabetes[26] and insulin resistance[27] and this effect was connected

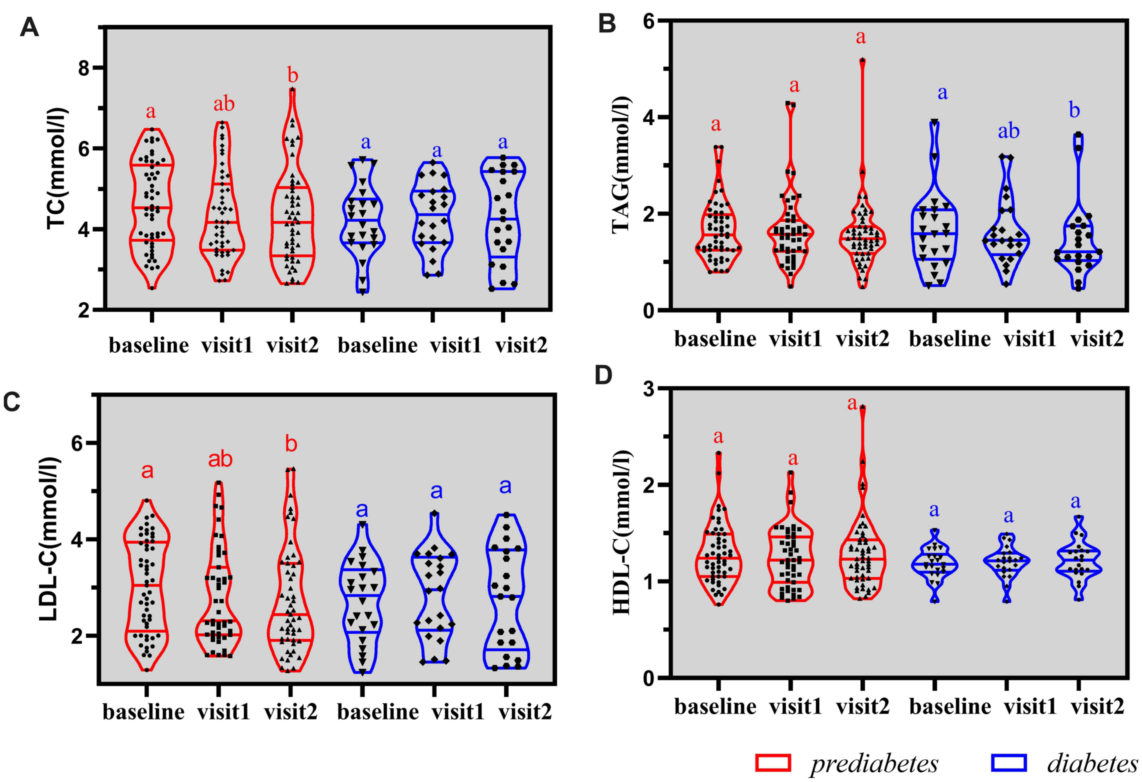

Figure 2 Violin plot of changes in blood lipid related indicators.

Note: (**A**) shows the changes in TC levels in prediabetes and diabetes. (**B**) shows the changes in TAG levels in prediabetes and diabetes. (**C**) shows the changes in LDL-C levels in prediabetes and diabetes. (**D**) shows the changes in HDL-C levels in prediabetes and diabetes. a and b are the letter marking methods for comparing each time point in the group).

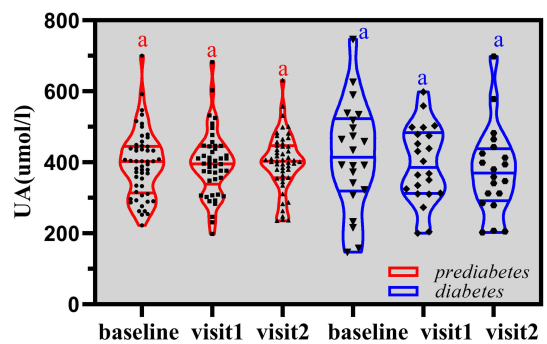

Figure 3 Violin plot of changes in uric acid.

Note: a is the letter-marking method for comparing each time point in the group).

with the levels of fasting serum triglycerides.[25] However, some researchers believed that DAG oil helps to prevent the body from accumulating fat, but it has no effect on liver lipogenesis, blood lipid profiles, or fat oxidation.[28] Nagao T et al also found that after four months of consuming various dietary oils, it was discovered that DAG oil could significantly prevent the accumulation of visceral fat in healthy men, but blood lipid levels, including TG and total cholesterol, as well as related metabolites, such as glucose and insulin, did not significantly change.[15] Conclusions on DAG oil's impact on lipid metabolism were similarly controversial. According to the results of a meta-analysis, DAG oil significantly decreased participants' blood TAG concentrations at 2, 4, and 6 hours after meals when compared to TAG oil, and it was positively linked with dosage.[29]

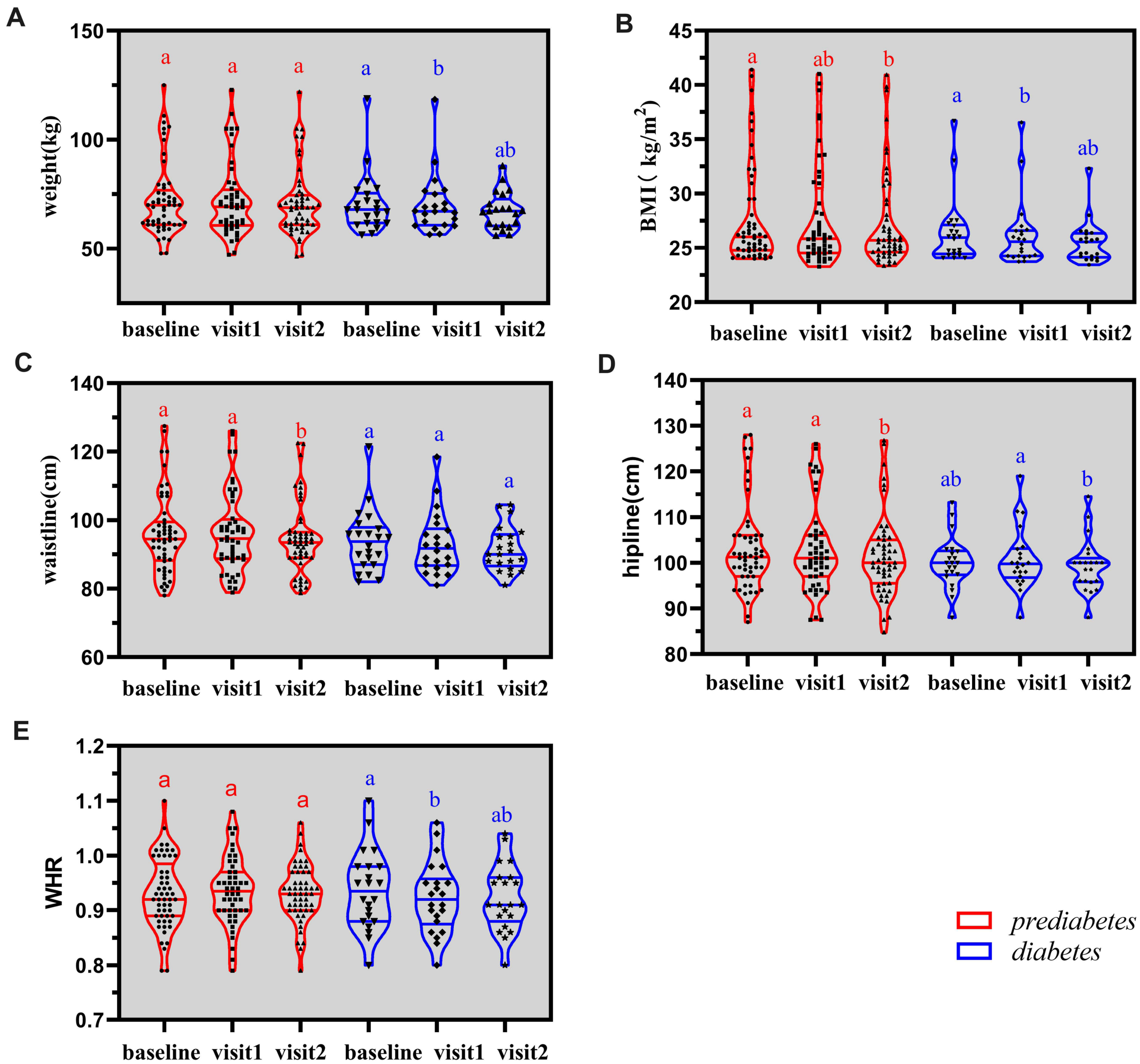

Figure 4 Violin plot of changes in anthropometric indicators.

Note: (**A**) shows the changes in weight levels in prediabetes and diabetes. (**B**) shows the changes in BMI levels in prediabetes and diabetes. (**C**) shows the changes in waistline levels in prediabetes and diabetes. (**D**) shows the changes in hipline levels in prediabetes and diabetes. (**E**) shows the changes in WHR levels in prediabetes and diabetes. [#] Indicates a statistically significant difference between the two groups ($P < 0.05$); a, b is the letter marking method for comparing each time point in the group).

DAG oil may boost the metabolism of blood glucose. FBG and HbAlc levels dropped in prediabetic subjects after two months of DAG oil consumption, however there were no significant improvements in diabetic patients. Yamamoto K et al discovered that after 3 months of DAG oil consumption, diabetics' blood triglyceride and HbAlc levels dropped. In comparison to the TAG oil, the DAG oil resulted in considerably lower postprandial concentrations of insulin, glucose-dependent insulinotropic polypeptide.[30] However, some certain studies showed that DAG oil was unable to enhance glucose metabolism in diabetes[25,31] or overweight diabetics.[32] Meta-analysis's findings demonstrated that DAG intake decreased INS and FBG levels and that the length of the intervention had a substantial impact on blood glucose levels.[33]

It is still unclear how exactly diglyceride oil works in the human body, although it is generally accepted that it lowers cholesterol and that this is due to its distinct structure and metabolic pathway. In terms of structure, DAG is water soluble and hydrophilic. Though DAG has a similar energy value and digestibility to TAG, it consumes more energy and oxidizes lipids given that the fatty acid content is the same.[34] The primary form of DAG is 1, 3-DAG, which is difficult to hydrolyze during metabolism and hence inhibits or delays the synthesis of TAG.[35] Some studies also found that diacylglycerol oil inhibits the expression of inflammatory factors, fatty acid-metabolizing enzymes, and genes.[36–41] Some researchers pointed that the levels of blood glucose or lipids in diabetics or prediabetics may be related to their insulin resistance,[42,43] and DAG oil may improve insulin resistance, which may have an impact on blood lipid and glucose metabolism. It has also been suggested that diacylglycerol oil affects glucose metabolism by affecting the production of the intermediate dihydroxyacetone phosphate during lipid metabolism and glycogenesis.[44] In contrast to prior research, we tracked calories consumed rather than restricting oil usage to mimic real-world oil use, to track how variations in cooking oil affect blood lipid and glucose metabolism while maintaining a mostly regular diet.

In conclusion, diacylglycerol oil may help to improve glucose and lipid metabolism in overweight and obese patients with abnormally elevated blood glucose levels. However, there was a small-sample clinical trial with no control group in this single-arm experiment, which restricts how broadly the findings may be applied. Further high-quality studies are needed to demonstrate the effects of diacylglycerol oil in humans.

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Disclosure

The authors declare that they have no conflicts of interest.

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