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Comparative Efficacy of Olive Oil vs. Rapeseed Oil Supplemented Diets for the Improvement of Type 2 Diabetes

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Abstract. Type 2 diabetes (T2D) is a widespread health problem, especially in the elderly. Dietary strategies are essential for effective glycemic regulation and extra virgin olive oil is considered to improve insulin sensitivity and reduce inflammation, which could offer more advantages than other vegetable oils. This study examined the differential effects of EVOO and rapeseed oil supplementation on glycemic control and metabolic risk factors in 38 elderly Chinese women with T2D. The main detection indicators were FPG and HbA1c; and the secondary testing indicators were postprandial glucose, fasting insulin, HOMA-IR, lipid profile, and C-reactive protein. The results showed that EVOO had more significant advantages than rapeseed oil in improving blood glucose control and cardiovascular risk markers in elderly patients with type 2 diabetes.

Keywords: Type 2 diabetes, Extra virgin olive oil, Rapeseed oil, Glycemic control, Insulin resistance

1. Introduction

Type 2 diabetes is a common condition in older adults. Making changes in diet and lifestyle is an important way to prevent it, since these changes can reduce metabolic risks and help regulate blood sugar. Studies have confirmed that dietary fat influences both blood sugar regulation and cardiovascular health [1]. Due to the high polyphenol content of EVOO, it can improve lipid profiles, reduce inflammation, and enhance insulin sensitivity. Although rapeseed oil is becoming popular in China, its impact on blood sugar control remains inconclusive [2]. To find out how rapeseed oil and EVOO affected elderly female with T2D, we did a randomized controlled experiment to investigate the effects of these two oils on T2D.

2. Methods

Participants were randomly recruited for this study at the Affiliated Hospital of South China University of Technology in Guangzhou, Guangdong Province, China. Participants were recruited in different ways, such as announcements in community centers and hospitals, and by using health record databases. Participants must be Chinese women aged 60 to 75 years old with T2D who meet the World Health Organization's criteria. Participants with severe cardiovascular disease, those

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taking complex anti-diabetic medications, or those allergic to rapeseed oil or olive oil are not eligible to participate in this study.

A total of 45 elderly female participants were recruited, seven of whom were removed because they were ineligible or refused to participate. The left 38 Participants were then divided at random to either the rapeseed oil (n=19) or extra virgin olive oil (n=19) groups.

To reduce confounding variables and standardize dietary habits, this study involved a 12-week washout period before the intervention. The experimental group's daily intake was 30 milliliters of extra virgin olive oil, while the control group's daily intake was 30 milliliters of rapeseed oil during a 12-week period. Both groups either cooked the dish at low temperatures or directly applied rapeseed oil to it to prevent high-temperature frying. All participants were told to disperse the oil evenly throughout their meals and to maintain a generally consistent diet and lifestyle throughout this study.

The main detection included FPG, 2h-PG, and HbA1c. At week 12, blood samples were taken. The Secondary testing indicators included FINS, HOMA-IR, TC, TG, HDL-C, LDL-C, BMI, waist C-reactive protein. The glucose oxidase method was used to test FPG, HPLC was used to detect HbA1c, and standard clinical biochemistry techniques were used to evaluate lipid profiles [3-5].

3. Result

3.1. Basic information

At the beginning, the baseline information of the 38 participants was measured. There was no significant difference in height, weight, BMI, FPG, HbA1c, 2h-PG, lipid levels, and inflammatory markers (CRP) ($p>0.05$), indicating that the two groups were comparable before the intervention (Table 1).

Table 1. Basic information of participants (mean ± SD)

Indicator	Numerical value
Weight (kg)	68.5±9.2
Hight (cm)	165.8±8.5
BMI (kg/m²)	25.1±2.8
FPG (mmol/L)	6.8±0.6
2h-PG (mmol/L)	9.7±0.9
HbA1c: (%)	6.9±0.5
Total cholesterol (mmol/L)	5.4±0.9
HOMA-IR	3.5±0.9
TC (mmol/L)	5.5±0.8
LDL-C (mmol/L)	3.6±0.6
HDL-C (mmol/L)	1.1±0.2
TG (mmol/L)	1.9±0.4
CRP (mG/L)	3.5±1.0

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3.2. Main detection indicators

From Table 2, FPG dropped from 7.0 to 6.4 mmol/L in the EVOO group (p=0.02), while the rapeseed oil group only decreased from 6.9 to 6.7 mmol/L (p=0.28). Similarly, 2h-PG decreased by 1.1 mmol/L in the EVOO group (from 9.6 to 8.5, p=0.01), whereas the rapeseed oil group only decreased by 0.4 mmol/L (from 9.5 to 9.1, p=0.14), showing a clear advantage of EVOO (Δp=0.03). HbA1c decreased by 0.5% in the EVOO group (from 6.8% to 6.3%, p=0.02), while the rapeseed oil group decreased only by 0.2% (from 6.8% to 6.6%, p=0.22), with a significant difference between groups (Δp=0.04) (Table 2).

Table 2. Main test indicators: within-group and between-group comparison

Indicator	EVOO group (n=19)	Rapeseed oil group (n=19)	Within-group p	Between-group p
FPG (mmol/L)	7.0 → 6.4	6.9 → 6.7	0.02	0.02
2h-PG (mmol/L)	9.6 → 8.5	9.5 → 9.1	0.01	0.03
HbA1c (%)	6.8 → 6.3	6.8 → 6.6	0.02	0.04

EVOO group (n=19) Rapeseed oil group (n=19)

3.3. Secondary testing indicators

For insulin resistance, the EVOO group showed a 22.2% reduction in HOMA-IR (from 3.6 to 2.8, p=0.01), significantly superior to the rapeseed oil group's 9.4% reduction (from 3.4 to 3.1, p=0.08; Δp=0.03).

Regarding lipid profiles, the EVOO group demonstrated notable decreases in TC, LDL-C, and TG:

• TC decreased by 8.5% (from 5.6 to 5.1 mmol/L, p=0.02) vs. 3.7% in rapeseed group (from 5.4 to 5.2, p=0.36; Δp=0.06).

• LDL-C decreased by 15.4% (from 3.6 to 3.0 mmol/L, p<0.01) vs. 4.3% in rapeseed group (from 3.5 to 3.4, p=0.41; Δp=0.01).

• TG decreased by 17.6% (from 1.7 to 1.4 mmol/L, p=0.03) vs. 6.3% in rapeseed group (from 1.6 to 1.5, p=0.49; Δp=0.09).

HDL-C showed a modest 9.1% increase in the EVOO group (1.1 to 1.2 mmol/L, p=0.07), while the rapeseed group remained unchanged (p=0.95; Δp=0.08). Inflammatory markers also improved: CRP decreased by 27.6% in the EVOO group (from 3.4 to 2.5 mg/L, p=0.01), compared with 12.1% in the rapeseed oil group (from 3.3 to 2.9 mg/L, p=0.19; Δp=0.03).

Table 3. Within-group and between-group comparisons of secondary test indicators

Indicator	EVOO group (n=19)	% Change	p-value	Rapeseed oil group (n=19)	% Change	p-value	Δp
HOMA-IR	3.6 → 2.8	-22.2%	0.01	3.4 → 3.1	-9.4%	0.08	0.03
TC (mmol/L)	5.6 → 5.1	-8.5%	0.02	5.4 → 5.2	-3.7%	0.36	0.06
LDL-C (mmol/L)	3.6 → 3.0	-15.4%	<0.01	3.5 → 3.4	-4.3%	0.41	0.01
HDL-C (mmol/L)	1.1 → 1.2	+9.1%	0.07	1.1 → 1.1	0%	0.95	0.08
TG (mmol/L)	1.7 → 1.4	-17.6%	0.03	1.6 → 1.5	-6.3%	0.49	0.09
CRP (mg/L)	3.4 → 2.5	-27.6%	0.01	3.3 → 2.9	-12.1%	0.19	0.03

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It is clear that the EVOO group showed more significant improvements in blood glucose control, insulin sensitivity, lipid status and inflammatory markers.

4. Discussion

4.1. Within-group comparisons

After 12 weeks of dietary intervention, the metabolic conditions of the participants in the extra virgin olive oil group improved significantly. FPG decreased by 0.6 mmol/L (from 7.0 to 6.4 mmol/L, p=0.02), and 2h-PG decreased by 1.1 mmol/L (from 9.6 to 8.5 mmol/L, p=0.01). HbA1c also dropped by 0.5% (from 6.8% to 6.3%, p=0.02). These improvements indicate that extra virgin olive oil can enhance blood sugar regulation in both the short and long term. In addition, insulin resistance was significantly improved, and the insulin resistance index (HOMA-IR) decreased by 22.2% (from 3.6 to 2.8, p=0.01), indicating enhanced insulin sensitivity.

The extra virgin olive oil group also showed good changes in lipid metabolism. TC decreased by 8.5% (p=0.02), LDL-C dropped by 15.4% (p<0.01), and TG dropped by 17.6% (p=0.03). Although HDL-C slightly increased (+9.1%), the change was not significant (p=0.07). Meanwhile, the CRP decreased by 27.6% (p=0.01), reflecting a significant reduction in systemic inflammation.

In contrast, the rapeseed oil group only showed slight and almost insignificant changes. FPG (fasting plasma glucose) decreased by only 0.2 mmol/L (from 6.9 to 6.7 mmol/L, p=0.28), and HbA1c (glycated hemoglobin) decreased by 0.2% (from 6.8% to 6.6%, p=0.22) HOMA-IR (insulin resistance index) decreased by 9.4% (from 3.4 to 3.1 mmol/L, p=0.08). TC (-3.7%), LDL-C (-4.3%), TG (-6.3%) and CRP (-12.1%) all improved, but none of them reached statistical significance (all p >0.05).

4.2. Between-group comparisons

A direct comparison between the two groups highlighted the outstanding therapeutic effects of EVOO. The reduction in amplitudes of FPG (Δp=0.02), 2h-PG (Δp=0.03), and HbA1c (Δp = 0.04) were higher in the EVOO group. Similarly, the HOMA-IR of EVOO decreased more significantly (Δp=0.03), indicating that its insulin sensitivity improved more significantly.

In terms of lipid metabolism, compared with rapeseed oil, EVOO reduced LDL-C significantly (Δp=0.01) and enhanced the lowering effects of TC and TG slightly. There was no significant difference in HDL-C between them, while EVOO showed a positive trend. Importantly, EVOO reduced CRP by 27.6%, while the rapeseed oil group only decreased it by 12.1% (Δp=0.03), highlighting its anti-inflammatory advantage.

4.3. Explanation and significance

These results indicate that EVOO has stronger metabolic benefits for elderly women with type 2 diabetes than rapeseed oil. EVOO contains a lot of monounsaturated fatty acids (MUFA) and bioactive polyphenols, which might improve insulin signaling, blood glucose homeostasis and lower oxidative stress [6]. This is consistent with the results of earlier clinical studies: the reduction of LDL-C and CRP further highlights the cardioprotective effect of EVOO, that is, the Mediterranean diet is associated with better cardiovascular outcomes [7].

Despite the fact that rapeseed oil also includes Omega-3 and MUFA fatty acids, its consistency and impact in this study were poor. This may be because rapeseed oil has a different polyphenol content and antioxidant activity than extra virgin olive oil [8]. Overall, the evidence suggests that

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substituting extra virgin olive oil for other widely used vegetable oils may be a useful dietary approach that might assist the elderly with type 2 diabetes better regulate their blood sugar, lessen inflammation, and lower their risk of cardiovascular disease.

5. Conclusion

The study shows that in elderly female patients with T2D, continuous supplementation of EVOO for 12 weeks significantly improves blood glucose control, insulin sensitivity, lipid metabolism and inflammatory status compared with rapeseed oil. Supplementation of EVOO significantly fasting blood glucose, postprandial glucose, and HbA1c, while also lowering LDL-C and CRP, and the effect was superior to that of rapeseed oil.

Although both oils showed some beneficial effects, the improvement in the EVOO group was more significant and consistent, highlighting the potential of EVOO as a major source of dietary fat for patients with T2D. These research results indicate that long-term supplementation of EVOO may be a practical nutritional strategy for improving the metabolic health of this population and reducing cardiovascular risk factors.

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