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Beneficial effects of extra virgin olive oil on Type 2 diabetes

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Abstract. In contemporary society, chronic diseases become increasingly prevalent, among which is type 2 diabetes. Nowadays, daily diet is gaining growing attention and interest from the general public for its potential to prevent and improve these diseases. One of the ingredients highly recommended to be included in people's diet is extra virgin olive oil (EVOO), since substantial evidence has shown that it is helpful in reducing body weight and the risk of obesity and type 2 diabetes. Consequently, this review paper is aimed at comparing EVOO with other types of oil or low-fat diets and summarizing its health benefits to type 2 diabetes by analyzing relevant parameters, including fasting blood glucose (FBG), insulin, glycated hemoglobin (HbA1c), body weight, Homeostatic Model Assessment for Insulin Resistance (HOMA-IR), etc. A systematic literature search was conducted using Google Scholar with the year range from 2010 to 2023. After being considered against the exclusion criteria, 8 articles were eventually included. Results showed that EVOO is associated with improving some risk factors of diabetes, leading to decreased blood glucose and greater short-term weight loss compared to low-fat diets, and resulting in more body fat loss compared to soybean oil. Thus, EVOO is now expected to be clinically used in treating type 2 diabetes in the future.

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

1. Introduction

Chronic diseases, mainly comprised of cardiovascular and cerebrovascular disease, diabetes mellitus, chronic respiratory disease, cognitive dysfunction, obesity, and cancer, can cause considerable harm to human health and are the major contributing factor to global mortality and disability [1]. Thus, they have now become a significant public health challenge confronting the entire international community [1]. Based on data provided by the World Health Organization (WHO), 41 million people die of chronic diseases each year worldwide, accounting for 71 percent of the total deaths [1,2]. In China, the number of deaths resulting from chronic diseases was about 9.06 million in 2019, making up 88.46 percent of the total [1]. Under this circumstance, it is imperative that people attach great importance to preventing chronic diseases and adjust their precautionary measures.

Among the most prevalent chronic diseases is type 2 diabetes, which is often seen in patients with metabolic syndrome [3,4]. Being overweight and obese is one of the risk factors for type 2 diabetes [3]. However, there is a rising amount of evidence that daily diet plays a critical role in both the prevention and improvement of chronic diseases, including type 2 diabetes and metabolic syndrome, in the long term if used properly, as it can potentially regulate glucose and fat metabolism [2,5]. Extra virgin olive oil is a kind of promising ingredient in diet that shows various benefits. Daily consumption of EVOO

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has been proven to be efficient in short-term weight loss and long-term weight management and be inversely associated with type 2 diabetes risk [2].

EVOO is obtained from the first cold pressing of olives and offers some advantages over regular or refined olive oil, such as more vitamins and antioxidants and fewer chemicals, as it undergoes less processing [6]. It also contains more polyphenols that are naturally occurring in olives [2]. It is the polyphenols in olive oil, rather than fatty acids, that possess the beneficial effects [2]. Olive oil with higher polyphenol content tends to have more health benefits [2]. The prevention of the onset or aggravation of metabolic syndrome and decreased risk of obesity and type 2 diabetes can all be attributed to the habitual use of EVOO [2].

The objective of this review paper, therefore, is intended to summarize the health benefits of everyday consumption of EVOO to type 2 diabetes compared to other oils or a low-fat diet, by analyzing relevant parameters, including fasting blood glucose (FBG), insulin, glycated hemoglobin (HbA1c), body weight, Homeostatic Model Assessment for Insulin Resistance (HOMA-IR), and waist size.

2. Methods

This review used a systematic literature search strategy on the academic search engine Google Scholar, with combinations of relevant keywords including “olive oil”, “extra virgin olive oil”, “diabetes”, “type 2 diabetes”, “blood glucose”, “blood insulin”, “glycemia”, “glycemic control”, “insulin resistance”, “obesity”, “weight loss”, and “weight management”, published in the language of English from the year 2010 to 2023. After being retrieved, the articles were reconsidered by using the following exclusion criteria: (1) animal experiments; (2) studies that do not include experiments and data; (3) studies that focus on other types of chronic diseases, other components of olive oil including monounsaturated fat and oleic acid, improvements in symptoms of diabetes such as foot ulcer, or parameters that are not needed in this paper. Information, such as participants’ gender, age, body mass index (BMI), health condition, sample size, intervention, duration, results, and relevant data, was then abstracted.

3. Results

Table 1. The effects of EVOO on risk factors associated with type 2 diabetes.

First Author, Journal, Publication Year	Population	Intervention/Design	Results
Lasa A, Eur J Clin Nutr, 2014 [7]	N=191 people with type 2 diabetes (77 men aged 55 to 80 and 114 women aged 60 to 80) Virgin olive oil: n=67 Age: 67.4 years BMI: 29.4 ± 2.9 kg/m^2 Mixed nuts: n=74 Age: 67.1 years BMI: 30.1 ± 3.1 kg/m^2 Low-fat: n=50 Age: 67.2 years BMI: 29.8 ± 2.8 kg/m^2	virgin olive oil (VOO) vs. mixed nuts vs. low-fat 1 year follow-up	Fasting glucose: Change: - VOO: p<0.001* Nuts: p<0.001* Low-fat: p<0.001* HOMA-IR: Change: + VOO: p=0.562 Nuts: p=0.995 Low-fat: p=0.204 Waist circumference: Change: - VOO: p=0.001* Nuts: p=0.001* Low-fat: p=0.003* Body weight: Change: - VOO: p=0.003* Nuts: p=0.021* Low-fat: p=0.347

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Table 1. (continued)

Halder S, Eur J Med Health Sci, 2023 [8]	N=70 people aged 35 to 55 with metabolic syndrome EVOO: n=35 (10 men and 23 women) Age: 45.33 ± 7.41 years Control: n=35 (15 men and 20 women) Age: 47.71 ± 10.92 years	EVOO vs. Control 25mL/day 12 weeks	FBG: Change: - EVOO: p=0.003* HbA1c: Change: - EVOO: p<0.001*
Santangelo C, J Endocrinol Invest, 2016 [9]	N=11 overweight people with type 2 diabetes (7 men and 4 postmenopausal women) Age: 64.63 ± 8.52 years BMI: 29.13 ± 2.50 kg/m^2	VOO vs. High-polyphenol EVOO 15 mL/day 8 weeks	FBG: Change: - EVOO: p=0.023* HbA1c: Change: - EVOO: p=0.039* Body weight: Change: - EVOO: p=0.012* BMI: Change: - EVOO: p=0.012*
Galvão Cândido F, Eur J Nutr, 2018 [10]	N=41 women with excess body fat Age: 27.0 ± 0.9 year Control (soybean oil): n=20 Age: 27.2 ± 6.1 years BMI: 29.7 ± 0.60 kg/m^2 EVOO: n=21 Age: 26.8 ± 5.0 years BMI: 30.5 ± 0.60 kg/m^2	Soybean oil vs. EVOO 25 mL/day 9 weeks	Glucose: Change: - EVOO: p=0.811 Insulin: Change: - EVOO: p=0.06 HOMA-IR: Change: - EVOO: p=0.054 Body fat: Change: - EVOO: p=0.037*
Flynn MM, J Cancer Ther, 2017 [11]	N=18 men on active surveillance Age: 66.6 ± 5.9 years BMI: 30.9 ± 2.7 kg/m^2	EVOO vs. PCF diet 3 tablespoons/day 6 months	Body Weight: Change: - EVOO: p=0.86 Glucose: Change: - EVOO: p=0.01*

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Table 1. (continued)

Flynn MM, J Cancer Ther, 2017 [11]			Insulin: Change: - EVOO: p=0.02* HOMA-IR: Change: - EVOO: p=0.02*
Flynn MM, J Womens Health, 2010 [12]	N=28 women who were breast cancer survivors Age: 59.2 ± 6.1 years BMI: 27.9 ± 2.8 kg/m^2	EVOO vs. low-fat diet 8 weeks + 6 months of follow-up	Body weight: Change: - EVOO: p<0.01*
Carnevale R, Clin Nutr, 2017 [13]	N=30 people with impaired fasting glucose (17 men and 13 women) Age: 58.1 ± 11.4 years	EVOO vs. Control 10 g/day	Glucose: Change: - EVOO: p=0.009* Insulin: Change: + EVOO: p<0.001*
Violi F, Nutr Diabetes, 2015 [14]	N=25 healthy people (12 males and 13 females)	EVOO vs. Control 10g/day	Blood glucose: Change: - EVOO: p<0.001* Insulin: Change: + EVOO: p<0.001*

“ * “ means a statistically significant difference.

Of the eight studies, two involved type 2 diabetes patients [7,9], one included participants with metabolic syndrome [8], and one included those with impaired fasting glucose [13] (see Table 1).
As shown in Table 1, Lasa et al. in 2014 described that despite no change in HOMA-IR through the intervention of VOO, some other risk factors associated with diabetes were improved, including fasting blood glucose, body weight, and waist size [7]. Although all three groups showed a significant decrease in waist circumference, the Mediterranean diets (VOO and nuts) significantly reduced body weight, while there was no significant difference in that of the low-fat subjects [7].

The other study, which involved diabetic patients after 12 weeks, showed a statistically significant reduction in the FBG and HbA1c levels with an EVOO diet compared to VOO [9], a similar change trend to the study, which included subjects with metabolic syndrome [8]. Decreases in body weight and BMI were also found in these metabolic syndrome patients with EVOO compared to the control group [8]. Moreover, according to Flynn et al. in 2010, a study on females who survived breast cancer reported a marked weight loss with an EVOO diet in comparison to a low-fat diet [12].

Experiments by Flynn et al. in 2017 on men with prostate cancer on surveillance compared the habitual use of EVOO with the Prostate Cancer Foundation (PCF) diet, with the EVOO diet resulting in significant decreases in blood glucose, insulin, and HOMA-IR levels [11]. However, Galvão et al. reported in 2018 that daily consumption of EVOO in the population of obese women contributes to greater body fat loss compared to soybean oil while producing no significantly different effect on blood glucose, insulin, and insulin resistance [10].

Table 1 also reveals that two studies that focus on postprandial glycemia found a significant difference between the meal with and without EVOO in terms of blood glucose and insulin levels after

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two hours, with a decrease in blood glucose concentration and a pronounced increase in blood insulin [13,14].

4. Discussion

Compared to other types of oil or low-fat diets, there is convincing evidence that EVOO is an ideal ingredient that can be used and consumed in people's daily diets due to its wide range of health benefits, with particular regard to the prevention and improvement of type 2 diabetes.

A daily diet that includes EVOO can decrease the risk of type 2 diabetes by reducing the insulin level and improving insulin sensitivity [2]. Supplementing meals with EVOO also improves postprandial glycemia and parameters related to glycemic control, such as HbA1c and FBG, offering a fresh new explanation of the beneficial effects of EVOO on type 2 diabetes [7,13].

Moreover, everyday consumption of EVOO can be a potential alternative for losing weight and long-term weight management, as it may lead to greater weight loss and fat loss compared to seed oils and has better palatability so that people can more likely and easily adhere to this kind of diet in comparison to other low-fat diets [2]. Research has shown that diet adherence and compliance significantly improve long-term weight management, HbA1c, and postprandial glucose levels [2,9]. By curbing these risk factors for diabetes, people can prevent or at least delay the onset and progression of diabetes [2,13].

5. Conclusion

This review collected in total 8 articles to successfully support EVOO's effectiveness in helping prevent and treat type 2 diabetes, and there is a reasonable prospect that EVOO will be of extensive clinical use in the future. However, several studies included have a relatively small sample size, and the phenol content in olive oils was not determined. Therefore, future studies can replicate the experiments with a larger sample size, known phenol content, and longer exposure time to see if there is any change in the data that currently shows no significant difference.

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