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Original Article

Determining the correlation between olive oil consumption, BMI, and waist circumference in the adult Saudi population

Najla F. AlKhattaf, BSND [a,*,1], Areej M. Alraddadi, BSND [a], Marya A. Aljarbou, BSND [a], Mawaddah A. Arnauti, BSND [a], Aljawharah M. Alfaleh, BSND [a] and Sahar A. Hammouda, PhD [b]

[a] *Taibah University, Almadinah Almunawwarah, KSA*
[b] *Clinical Nutrition Department, Faculty of Applied Medical Sciences, Taibah University, Almadinah Almunawwarah, KSA*

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الملخص

أهداف البحث: تهدف هذه الدراسة إلى استكشاف العلاقة بين التناول الغذائي لزيت الزيتون، ومؤشر كتلة الجسم ومحيط الخصر.

طرق البحث: في هذه الدراسة المقطعية، قمنا بتوظيف ٢٠٠ مشارك في الفئة العمرية من ٢٠ إلى ٣٠ عاما باستخدام معايير الإدراج والاستبعاد المحددة مسبقا. تم جمع البيانات الديموغرافية عن طريق استبانة، في حين تم جمع البيانات الغذائية عن طريق الاسترجاع الغذائي لمدة ٢٤ ساعة لمدة يومين. تم قياس البيانات الأنثروبومترية لمؤشر كتلة الجسم ومحيط الخصر، وأخيرا، تم إدخال جميع المعلومات في برامج للتحليل الإحصائي.

النتائج: لم نجد فرقا كبيرا في مؤشر كتلة الجسم ومحيط الخصر بين المستهلكين لزيت الزيتون بشكل مرتفع أو منخفض. كان تناول الكربوهيدرات أعلى بشكل ملحوظ بين المستهلكين زيت الزيتون بشكل منخفض. على الرغم من أن المستهلكين لزيت الزيتون بشكل مرتفع يستهلكون كمية أعلى من السعرات الحرارية، إلا أنهم لديهم مؤشر كتلة جسم مماثل مقارنة بمستهلكين زيت الزيتون بشكل منخفض.

الاستنتاجات: توفر هذه الدراسة بيانات خط الأساس حول تناول زيت الزيتون بين مجموعة سعودية تتراوح أعمارهم بين ٢٠ إلى ٣٠ سنة. تشير الدراسة إلى أن تناول كمية كبيرة من زيت الزيتون قد يكون له دور في الحفاظ على وزن الجسم.

الكلمات الرئيسية: مؤشر كتلة الجسم؛ دراسة مقطع عرضي؛ زيت الزيتون؛ بدانة؛ محيط الخصر

Abstract

Objective: This study aimed to explore the correlation between dietary intake of olive oil, body mass index (BMI), and waist circumference (WC).

Methods: In this cross-sectional study, we recruited 200 participants aged 20–30 years using pre-determined inclusion and exclusion criteria. Demographic data was collected via a questionnaire, while dietary data was collected for two days using a 24-hour dietary recall. Anthropometric data such as BMI and WC were collected, and all the information was entered into the Diet Organizer software and statistical package for social sciences (SPSS) software for statistical analysis. The test results were assessed on the basis of a significance level of 95% ($p < 0.05$).

Results: We did not find a significant difference in BMI and WC between high and low olive oil consumers. Carbohydrate intake was significantly higher among low olive oil consumers. Although high olive oil consumers had a significantly higher caloric intake, they had a similar BMI compared to low olive oil consumers.

Conclusion: This study provides baseline data on the intake of olive oil in a Saudi cohort aged 20–30 years. This study suggests that high olive oil intake may have a role in maintaining body weight.

Keywords: Body mass index; Cross-sectional study; Obesity; Olive oil; Waist circumference

* Corresponding address: 3688 Nawar Valley, AlMalqa District. Unit No 422, Riyadh 13521–7639, KSA.
E-mail: najlakhattaf@gmail.com (N.F. AlKhattaf)

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[1] Postal address: 3688 Nawar Valley, AlMalqa District. Unit No 422, Riyadh, 13521–7639, KSA.

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Introduction

There are extensive health benefits of olive oil consumption, including the prevention of Cardio Vascular Diseases (CVD), Type Two Diabetes Mellitus (T2DM), cancer, and the degeneration of the neurological system.[1–3]

Despite its health benefits, it has been suggested that high-fat food consumption may contribute to obesity due to the high-calorie content.[4] Thus, olive oil was implicated in allegedly being a risk factor for overweight and obesity. However, studies have found that an olive oil-rich diet can facilitate longer-lasting weight loss compared to a low-fat diet.[5]

Recent experimental studies concluded that olive oil consumption could reduce the risk of obesity. A randomised clinical trial reported a reduction in the BMIs and WCs of individuals who followed a Mediterranean diet enriched with extra virgin olive oil and a controlled low-fat diet after a one-year intervention.[6] A study investigating the association between the prevalence of obesity and the types of dietary fat consumed in 168 countries found that countries with a higher Mono Unsaturated Fatty Acid (MUFA) consumption were strongly associated with low obesity prevalence.[7] Similar results were reported from a six-year cohort study that monitored participants on a diet with a high content of different types of fatty acids. This study found that the group that consumed sunflower oil had a higher incidence of weight gain than did the group that consumed olive oil.[8] A review reported the effectiveness of olive oil consumption in decreasing the risk of metabolic syndrome and central obesity.[9]

Another cross-sectional study of 798 adults reported a significant inverse association between Mediterranean diet, obesity, and visceral adipose tissue content.[10]

Nevertheless, some studies reported a lack of association between olive oil consumption and obesity. A cross-sectional study conducted on Spanish adults showed no association between olive oil consumption and obesity.[11] On the contrary, there are many explanations for the role of olive oil in weight reduction, one of which is a positive thermogenesis effect on the body. The higher the thermogenesis, the more calories the body can burn and consequently lead to weight reduction. The MUFA in olive oil increases the oxidation rate, inhibiting lipogenesis, and stimulating lipolysis.[7,12]

Studies on dietary fat-gene interaction have reported that the regular consumption of MUFA, including those found in olive oil, affects the expression of nuclear receptors called peroxisome proliferator-activated receptors, which are important for weight regulation and fat utilisation.[13,14] Other studies focused on the active ingredients of olive oil that promote weight reduction. Olive oil is composed of phenolic compounds that limit lipid and Carbohydrate (CHO) digestion and macronutrient absorption and uptake.[9,15–17] Moreover, phenolic compounds in olive oil, especially extra virgin olive oil, have an antioxidant effect that helps in decreasing oxidative stress, which is higher in obese individuals.[18]

There is a proven relationship between olive oil consumption and weight regulation. However, the mechanism of this regulation is not well understood and requires further research.

This study aimed to explore the associations between the dietary intake of olive oil, BMI, and WC in Saudi adult males and females.

Materials and Methods

Study design and subjects

This cross-sectional observational study conducted in Almadinah Almunawwarah, KSA, included 200 participants. The inclusion criteria were as follows: healthy males and females aged 20–30 years who agreed to participate. Exclusion criteria were as follows: pregnancy, lactation, patients with chronic diseases such as arthritis, CVD, T2DM, hypothyroidism, hypertension, and intake of drugs that can affect weight, e.g., corticosteroids, anti-depressants, and insulin.

A convenient sample population was chosen for the selection of participants who were mainly graduate students from Taibah University as well as their relatives and friends.

Data collection tools and techniques

A questionnaire on demographic data, family history of obesity, physical activity level, and the age of introduction of olive oil in the dietary pattern was administered during face to face interviews.

Anthropometric measurements were obtained according to a standardised procedure by a trained team. Body weight was measured using an electronic weighing scale, while height was measured using a stadiometer. According to the World Health Organization (WHO) criteria,[19] a BMI of less than 18.5 kg/m^2 is considered underweight, 18.5–24.9 kg/m^2 is normal, 25–29.9 kg/m^2 is overweight, and 30 kg/m^2 and above is obese. WC was measured using a flexible measuring tape. Participants were asked to stand with their backs straight. Heavy clothing was removed from the waistline. The tape was aligned at the top of the hip bone (iliac crest) parallel with the edge of the last palpable rib (nearly 2 cm above the navel). WC measurement was taken at the end of a normal expiration and approximated to the nearest 0.5 cm. The WC cutoffs were based on ethnic-specific values for European, Sub Saharan African, Eastern Mediterranean, and Middle Eastern (Arab), which are >94 cm for men and >80 cm for women. Obese and underweight participants, classified in accordance with the definition of WC, were excluded.[20]

Habitual intake of olive oil was estimated for two days using detailed 24-hour recall, and the mean level was calculated. The dietary intake was assessed with a particular emphasis on olive oil consumption. Total olive oil consumption per day included green and black olive intake. According to Diet Organizer analysis, three olives contain one gram of olive oil. Nutritional supplement intake was considered in the diet analysis.

Sample size

Based on olive oil intake as a predictor and BMI as the primary outcome, the sample size was calculated to be 176

for a power of 80% with a two-sided 95% confidence level. The effect size was 0.32.[21] The sample size was approximated to 200 participants.

Statistical analysis of the data

Data on dietary intake were analysed using Diet Organizer and added to an Excel sheet and imported to SPSS version 23. Participants were classified as group 1 and group 2 in accordance with the median level of consumption (12.5 g olive oil per day). Group 1: consume (<12.5 g/d, n = 99). Group 2: consume (≥12.5 g/d, n = 101).

The log function was obtained for all skewed distributed variables in order to normalize the data. Thereafter, the parametric T-test was used to compare the mean levels of BMI, WC, and macronutrients among the two groups of olive oil consumers. The statistical chi-square test was used to compare two categorical data, which were olive oil with BMI and WC, as well as demographic data. The non-parametric one-way ANOVA test was used to compare BMI categories and energy intake with and without the energy derived from olive oil. In addition, multiple linear regression and logistic regression were used to adjust physical activity, energy intake, age, and sex with BMI, WC. A P-value of less than 0.05 was considered significant.

Abbreviations: BMI, Body Mass Index; WC, Waist Circumference; CVD, Cardio Vascular Disease; MUFA, Mono Unsaturated Fatty Acid; PUFA, Poly Unsaturated Fatty Acid; WHO, World Health Organization; T2DM, Type 2 Diabetes Mellites; CHO, Carbohydrate.

Results

The study participants were classified into high and low olive oil consumers in accordance with the median level of consumption (12.5 g/d). Among the low consumers, 28.5% reported no intake of olive oil. Among the high consumer, only 19.5% consumed >35 g of olive oil per day.

The demographic characteristics of the studied participants are presented in Table 1.

The mean level of olive oil consumption among males was 19.2 ± 15.0 g/day, whereas the mean level among females was 17.4 ± 21.0 g/day. The levels of olive oil consumption between males and females were not significantly different (p = 0.322), as shown in Figure 1 (see Tables 2–4).

Olive oil intake was significantly associated with higher energy intake. The difference in the level of energy derived from olive oil and that from other food sources and their relationship with BMI was tested using non-parametric one way ANOVA. The results indicate a statistical difference among the BMI groups when the energy intake was derived from food sources other than olive oil (p = 0.04), and no statistical difference among the BMI groups when the energy intake was derived from olive oil (p = 0.28).

Table 1: Demographic characteristics of the study sample in relation to olive oil intake.

	Low olive oil consumers n = 99	High olive oil consumers n = 101	P value
Sex			
- males	46 (46.5%)	54 (53.5%)	0.322
- females	53 (53.5%)	47 (46.5%)	
Marital status			
- single	82 (82.8%)	80 (79.2%)	0.514
- married	17 (17.2%)	21 (20.8%)	
Occupation			
- student	72 (72.7%)	70 (69.3%)	0.184
- employee	14 (14.1%)	23 (22.8%)	
- none	13 (13.1%)	8 (7.9%)	
Level of maternal education			
- illiterate	5 (5.1%)	4 (4%)	0.044[a]
- elementary	11 (11.1%)	7 (6.9%)	
- junior high	8 (8.1%)	14 (13.9%)	
- high school	18 (18.2%)	34 (33.7%)	
- higher	57 (57.6%)	42 (41.6%)	
Level of paternal education			
- illiterate	3 (3%)	2 (2%)	0.849
- elementary	6 (6.1%)	7 (6.9%)	
- junior high	4 (4%)	4 (4%)	
- high school	15 (15.2%)	21 (20.8%)	
- higher	71 (71.7%)	67 (66.3%)	
Family income level			
- less than 3000 SR	2 (2%)	2 (2%)	0.686
- 3000–5999 SR	10 (10.1%)	13 (12.9%)	
- 6000–9999 SR	17 (17.2%)	13 (12.9%)	
- 10,000–15,000 SR	26 (26.3%)	34 (33.7%)	
- more than 15,000 SR	44 (44.4%)	39 (38.6%)	

The parametric T-test was used to analyse the data in this table.
[a] P value < 0.05 with 95% confidence level.

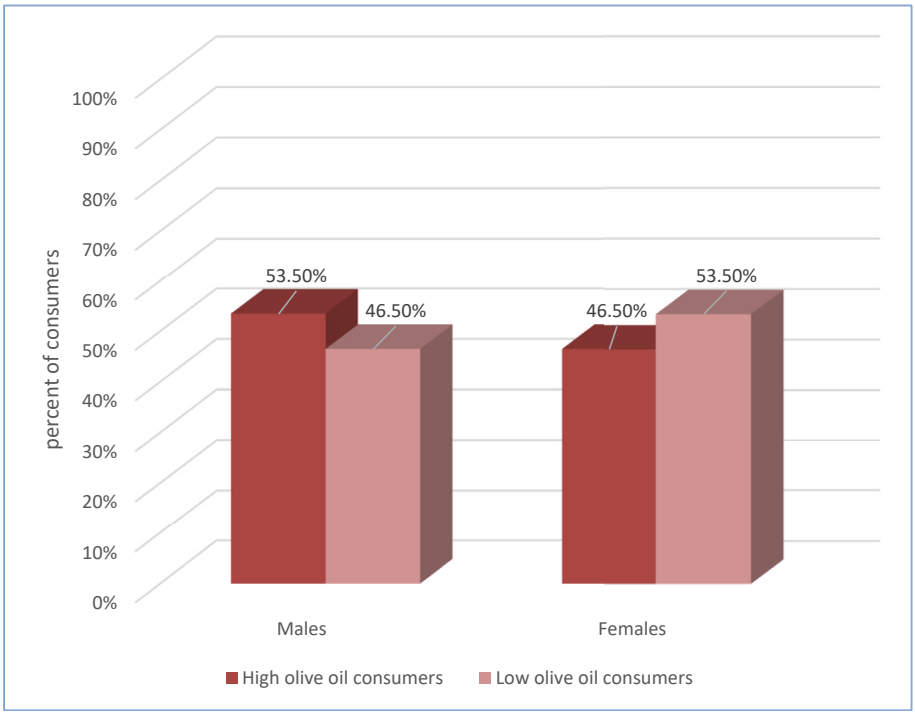

Figure 1: Distribution of the studied participants according to the categories of olive oil consumption.

Table 2: Statistical comparison between high and low olive oil consumers regarding BMI categories.

BMI categories	Low consumers n = 99	High consumers n = 101
-Underweight	11 (11.1%)	9 (8.9%)
-Healthy weight	55 (55.5%)	56 (55.4%)
-Overweight	16 (16.2%)	24 (23.8%)
-Obese	17 (17.2%)	12 (11.9%)
[a]P value	0.449	

The statistical chi-square test was used to analyse the data in this table.
[a] P value < 0.05 with 95% confidence level.

Table 3: Statistical comparison between high and low olive oil consumers regarding WC categories among males and females (n = 151).

WC categories	Males		Females	
	Low consumers n = 34	High consumers n = 45	Low consumers n = 37	High consumers n = 35
Normal	n = 27 (79%)	n = 40 (88%)	n = 22 (59%)	n = 25 (71%)
Central obesity	n = 7 (21%)	n = 5 (11%)	n = 15 (41%)	n = 10 (29%)
[a]P value	0.245		0.286	

The statistical chi-square test was used to analyse the data in this table.
[a] P value < 0.05 with 95% confidence level.

Table 4: Statistical comparison in the mean level of nutrient intake between the studied groups of olive oil consumers.

	Low consumers n = 99	High consumers n = 101	P-value
- Energy (kcal/d)	1830 ± 769	1943 ± 646	0.041[a]
- CHO (g/d, %)	225 ± 109, 49	209 ± 82, 43	0.040[a]
- Fat (g/d, %)	76 ± 37, 37	91 ± 36, 42	<0.001[a]
- Protein (g/d, %)	64 ± 29, 14	77 ± 56, 15	0.085
- Saturated fat (g/d)	21.4 ± 12.3	21.3 ± 9.4	0.681
- PUFA[b] (g/d)	13.1 ± 13.9	16.9 ± 11.4	0.841
- MUFA (g/d)	24.8 ± 13.4	40.1 ± 17.2	<0.001[a]

T-test was used to analyse the data in this table.
[a] P value < 0.05 with 95% confidence level.
[b] PUFA: Poly Unsaturated Fatty Acid.

The multinomial regression revealed that a higher olive oil intake was associated with being overweight (OR 1.02, [95% CI, 1.00−1.04], p = 0.017). The reference category of BMI was the preferred BMI category (18.5−24.9 kg/m^2). A binary logistic regression showed no association between olive oil intake and waist circumference (p = 0.17). Another model for the olive oil intake and BMI adjusted for factors like age, sex, physical activity, and energy intake did not show an association between olive oil intake any BMI group.

Physical activity levels among low and high olive oil consumers were 67.7% vs. 56.4%, sedentary activity level was 23.2% vs. 21.8%, low active, and 9.1% vs. 21.8% highly active respectively with significant difference (P = 0.04). The adjustment of physical activity with other factors showed no significant association (p > 0.05), as shown in Table 5. Olive

Table 5: ***Association between olive oil intake and BMI and WC, unadjusted and adjusted models.***

		B	SE	P-value	R square
- Unadjusted model					
BMI	Olive oil	0.026	0.018	0.149	0.010
WC		0.087	0.045	0.054	0.019
- Adjusted model					
BMI	Olive oil	0.015	0.017	0.369	0.167
	Gender, Male = 0, female = 1	−0.709	0.817	0.387	
	Age	0.503	0.128	<0.001[a]	
	Energy	0.002	0.001	0.002[a]	
	Physical activity, highly active = 0, moderate active = 1, sedentary = 2	0.129	0.467	0.782	
WC	Olive oil	0.041	0.038	0.280	0.314
	Gender, Male = 0, female = 1	−6.99	1.84	<0.001[a]	
	Age	1.36	0.288	<0.001[a]	
	Energy	0.004	0.001	0.001[a]	
	Physical activity, highly active = 0, moderate active = 1, sedentary = 2	0.519	1.05	0.623	

B; beta coefficient, SE; standard error.
A Multi-regression test was used to analyse the data in this table.
[a] P value < 0.05 with 95% confidence level.

oil consumption was a health habit from childhood among 44.5% of the high consumers.

Discussion

The study aimed to explore the relationship between the dietary intake of olive oil and BMI and WC. Neither BMI nor WC showed a significant difference between high and low olive oil consumers, whereas the energy intake, CHO, total fat, and MUFA were significantly associated with the olive oil intake. Moreover, other studies with a larger sample size of 7368 with a comparable age group have reported similar results regarding the relationship between weight and olive oil consumption.[22] In addition, a study on 6352 adult participants adjusted for energy intake reported no association between high olive oil intake and BMI.[11] Further, it has been reported that irrespective of a change in BMI, olive oil may modify the body composition of obese individuals by increasing lean body mass and fat-free mass and decreasing the percentage of body fat.[23] On the contrary, other studies have reported significant weight reduction associated with high olive oil consumption. However, those studies were conducted among individuals following the Mediterranean diet, which has some dietary characteristics other than being high in olive oil (high in fibre, fish, and low in red meat).[10]

In our study, although high olive oil consumption led to a significantly high intake of energy, it was not associated with higher BMI or WC. Another study found that high sugar drinks intake was associated with overweight and obesity.[24] These results indicate that obesity is associated with energy quality than quantity. Further, high energy intake is significantly associated with obesity. This reflects that olive oil consumption may maintain body weight.[25]

The age group of 20−30 years is associated with a lower risk of obesity and metabolic syndrome compared to older ages.[26] This may explain the non-significant difference in WCs in the current study.

CHO intake was significantly higher among the low olive oil consumers. This indicates a higher susceptibility to many health risks, including metabolic syndrome and T2DM.[5] Thus, consuming a high amount of olive oil has a protective effect against T2DM.[27] Considering that high olive oil consumption was negatively associated with CHO intake and positively associated with the level of physical activity, high olive oil consumers tend to follow a healthier lifestyle.

In our study sample, the mean level of olive oil consumption was lower (18.5 g/day) than that in high olive oil consumption countries, such as Greece, who reported 35 g and Spain, who reported 25.5 g as the mean daily intake. Furthermore, the daily intakes of olive oil in Saudi males and females in the current study were 19.2 g and 17.4 g, respectively, whereas the daily intakes of a high consumption population are 40.6 g and 29.4 g among males and females, respectively.[28] Further, no known data on olive oil consumption at an individual level in the Arabic region were found.

Although this study did not aim to explore the demographic characteristics of olive oil consumers, we observed a negative association between maternal education level and olive oil consumption. However, this observation requires further investigation, as other studies have reported converse finding.[29,30]

To the best of our knowledge, this is the first study to examine the relationship between olive oil consumption and obesity in the Saudi population. Our study included WC measurements along with BMI rather than BMI alone for a better evaluation of obesity.

Limitations of the study

The cross-sectional design does not reflect the cause and effect relationship between olive oil consumption and obesity. Therefore, a longitudinal design over a long period is required.

The group of overweight and obese participants was small compared to the total study sample.

A more accurate measurement of the total body fat percentage, such as dual-energy x-ray absorptiometry was unavailable.

Conclusion

In conclusion, this study provides baseline knowledge on the intake of olive oil among the Saudi population aged 20−30 years living in Almadinah Almunawwarah. Although olive oil consumption was not associated with increasing BMI or WC, it may help in maintaining body weight.

Low consumers of olive oil consume more CHO, which may expose them to different health risks.

Recommendations

Longitudinal studies are required to examine the effect of olive oil consumption on BMI and WC as well as waist to height ratio in the Saudi population.

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Conflict of interest

The authors have no conflict of interest to declare.

Ethical approval

A consent form was signed by all the participants included in the study. Ethical approval (approval number CLN201810) was obtained from the ethical committee of the College of Applied Medical Sciences, Taibah University.

Authors contributions

SAH conceived, designed the study, acquired ethical approval, supervised the clinical work, analysis, interpretation of the results, and wrote the manuscript. NFK,AMR, MAA and JMF collected and organised data, analysed and interpreted data, wrote the initial and final draft of the article. MAJ collected and organised data, wrote the initial and final draft of the article. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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