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Effect of a Traditional Dried Fig (*Ficus carica* L.) and Extra Virgin Olive Oil Preparation on Vitamin D Status in University Students: A Preliminary Pilot Study

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تأثير مستحضر تقليدي من التين المجفف (*Ficus carica L.*) وزيت الزيتون البكر الممتاز على حالة فيتامين د لدى طلبة الجامعة: دراسة استطلاعية أولية

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Abstract:

Vitamin D deficiency is common in sunny regions and may be influenced by lifestyle and dietary factors. This preliminary pre–post pilot study assessed vitamin D status among university students and explored changes following daily consumption of a traditional dried fig–extra virgin olive oil preparation. Fifty undergraduate students from the Faculty of Science, University of Derna, Libya, underwent serum 25-hydroxyvitamin D [25(OH)D] measurement using a commercial ELISA kit and completed a demographic and lifestyle questionnaire. Vitamin D deficiency was detected in 70% of participants. Ten vitamin D-deficient participants who agreed to comply with the intervention consumed one tablespoon containing one olive-oil-soaked dried fig with the accompanying oil each morning on an empty stomach for 30 consecutive days. Mean serum 25(OH)D increased from 8.43 ± 4.89 ng/mL before intervention to 24.13 ± 3.55 ng/mL after intervention ($P < 0.001$), with individual increases ranging from 47% to 750%; 9 of 10 participants reached concentrations of at least 20 ng/mL. No statistically significant associations were observed between serum 25(OH)D and residence, skin color, sunlight exposure, or chronic disease. These findings indicate a high prevalence of vitamin D deficiency and an association between the traditional preparation and improved serum 25(OH)D concentrations. Because the study lacked a control group and included a small intervention sample, larger randomized controlled trials are required before causal or therapeutic conclusions can be drawn.

Keywords: Vitamin D deficiency; 25-hydroxyvitamin D; Ficus carica; extra virgin olive oil; university students; functional foods; Libya.

الملخص

يُعد نقص فيتامين د مشكلة شائعة حتى في المناطق المشمسة، وقد يتأثر بعوامل نمط الحياة والتغذية. هدفت هذه الدراسة الاستطلاعية الأولية ذات تصميم القياس القبلي–البعدي إلى تقييم حالة فيتامين د لدى طلبة

الجامعة واستكشاف التغيرات بعد تناول مستحضر تقليدي من التين المجفف وزيت الزيتون البكر الممتاز يوميًا. شارك خمسون طالبًا وطالبة من كلية العلوم بجامعة درنة في ليبيا، وتم قياس 25-هيدروكسي فيتامين د [25(OH)D] في المصل باستخدام عدة ELISA تجارية، إلى جانب استبيان ديموغرافي ونمط حياة. وُجد نقص فيتامين د لدى 70% من المشاركين. اختير عشرة مشاركين لديهم نقص في فيتامين د ووافقوا على الالتزام بالتدخل، وتناولوا يوميًا لمدة 30 يومًا ملعقة تحتوي على حبة تين مجفف منقوعة في زيت الزيتون مع الزيت المصاحب، صباحًا على الريق. ارتفع متوسط 25(OH)D من 8.43 ± 4.89 نانوغرام/مل قبل التدخل إلى 24.13 ± 3.55 نانوغرام/مل بعده (P < 0.001)، وتراوحت نسب الزيادة الفردية بين 47% و750%، ووصل 9 من أصل 10 مشاركين إلى تركيز لا يقل عن 20 نانوغرام/مل. لم تظهر ارتباطات ذات دلالة إحصائية مع مكان السكن أو لون البشرة أو التعرض للشمس أو الأمراض المزمنة. وتشير النتائج إلى ارتباط المستحضر بتحسن مستوى فيتامين د، إلا أن غياب المجموعة الضابطة وصغر عينة التدخل يستلزمان دراسات عشوائية محكمة أكبر قبل استخلاص استنتاجات سببية أو علاجية.

الكلمات المفتاحية: نقص فيتامين د؛ 25-هيدروكسي فيتامين د؛ التين المجفف؛ زيت الزيتون البكر الممتاز؛ طلبة الجامعة؛ الأغذية الوظيفية؛ ليبيا.

1.Introduction

Vitamin D deficiency (VDD) remains a widespread global nutritional concern affecting populations across different ages and geographical regions. A recent systematic review and meta-analysis of studies published between 2000 and 2022 estimated that 15.7% of the global population had serum 25-hydroxyvitamin D [25(OH)D] concentrations below 30 nmol/L, while substantially higher prevalence estimates were reported when less stringent thresholds were applied (Cui et al., 2023). Vitamin D plays an essential role in calcium and phosphorus homeostasis, intestinal calcium absorption, bone mineralization, and the prevention of nutritional rickets and osteomalacia. In addition to its classical skeletal functions, the vitamin D endocrine system has multiple extra-skeletal roles, although the clinical significance of many reported associations remains uncertain. Serum 25(OH)D is widely accepted as the principal biomarker for assessing vitamin D status (Bouillon et al., 2019).

Despite abundant sunlight, vitamin D deficiency remains highly prevalent in the Middle East and North Africa. A recent systematic review and meta-analysis confirmed that inadequate vitamin D status is widespread across the region (Machuron et al., 2025). This paradox has been attributed to limited sun exposure, indoor lifestyles, clothing practices, darker skin pigmentation, obesity, low dietary vitamin D intake, and avoidance of outdoor activities during periods of intense heat. Similar findings have been reported in Libya, where vitamin D deficiency affected more than half of adults in a cross-sectional study conducted in Tripoli (Ahmed et al., 2023). University students constitute another vulnerable population because of prolonged indoor activities, irregular dietary habits, and limited sunlight exposure. Consistent with this observation, only 20.3% of university students in the United Arab Emirates were reported to have sufficient vitamin D concentrations (Al Anouti et al., 2011).

Although vitamin D supplementation remains the standard strategy for preventing and treating VDD, increasing attention has been directed toward food-based nutritional approaches that complement conventional supplementation. Functional foods, which provide health benefits beyond basic nutrition through naturally occurring bioactive compounds, have attracted considerable interest because they may improve long-term adherence and overall nutritional status. Furthermore, the food matrix, particularly dietary lipids, can influence the bioaccessibility and absorption of vitamin D, emphasizing the importance of selecting appropriate food vehicles for nutritional interventions (Borel et al., 2015; Buttriss et al., 2022).

Among traditional Mediterranean foods, dried figs (*Ficus carica* L.) and extra virgin olive oil (EVOO) have received considerable scientific attention because of their nutritional value and health-promoting properties. Dried figs are rich in dietary fiber, minerals, and antioxidant phytochemicals, whereas EVOO provides monounsaturated fatty acids and phenolic compounds with well-established antioxidant and anti-inflammatory activities. In addition to its intrinsic health benefits, EVOO may serve as an appropriate lipid matrix for enhancing the bioaccessibility of fat-soluble nutrients, including vitamin D. These complementary nutritional characteristics make the combination of dried figs and EVOO a biologically plausible food-based strategy for supporting vitamin D status (Mawa et al., 2013; Sandhu et al., 2023; Schwingshackl et al., 2019; Borel et al., 2015).
Dried figs (Ficus carica L.) have been consumed for centuries as part of the traditional Mediterranean diet and are recognized as a rich source of dietary fiber, calcium, potassium, magnesium, and antioxidant polyphenols. Extra virgin olive oil, another cornerstone of the Mediterranean diet, is characterized by its high content of monounsaturated fatty acids and phenolic compounds with antioxidant and anti-inflammatory properties. Beyond their individual nutritional value, the combination of dried figs and extra virgin olive oil is widely consumed in several Mediterranean communities as a traditional food preparation, although its potential influence on vitamin D status has received little scientific attention. This traditional dietary practice provided the rationale for investigating its possible role as a supportive nutritional intervention in the present study**. (**Mawa et al., 2013; Borel et al., 2015; Gorzynik-Debicka et al., 2018; Schwingshackl et al., 2019; Sandhu et al., 2023).
Despite the growing body of evidence supporting the individual health benefits of dried figs and extra virgin olive oil, limited evidence is available regarding their combined use as a food-based nutritional intervention for improving vitamin D status. Furthermore, although vitamin D deficiency has been extensively investigated in the Middle East and North Africa, including Libya, studies evaluating culturally appropriate dietary strategies among Libyan university students remain scarce (Ahmed et al., 2023; Machuron et al., 2025; Borel et al., 2015).
Therefore, the present preliminary pre–post intervention study aimed to evaluate changes in serum 25-hydroxyvitamin D [25(OH)D] concentrations following the daily consumption of a natural preparation consisting of dried figs (*Ficus carica* L.) and extra virgin olive oil in vitamin D-deficient university students. The study also sought to explore the feasibility of this traditional food-based approach as a complementary nutritional strategy for supporting vitamin D status.

2.Materials and Methods

2.1 Study Design

This preliminary pilot study employed a pre–post intervention design to investigate the effect of a traditional food preparation consisting of dried figs (Ficus carica L.) and extra virgin olive oil (EVOO) on serum vitamin D status among vitamin D-deficient university students. The study was conducted at the Faculty of Science, University of Derna, Al-Qubbah, Libya.

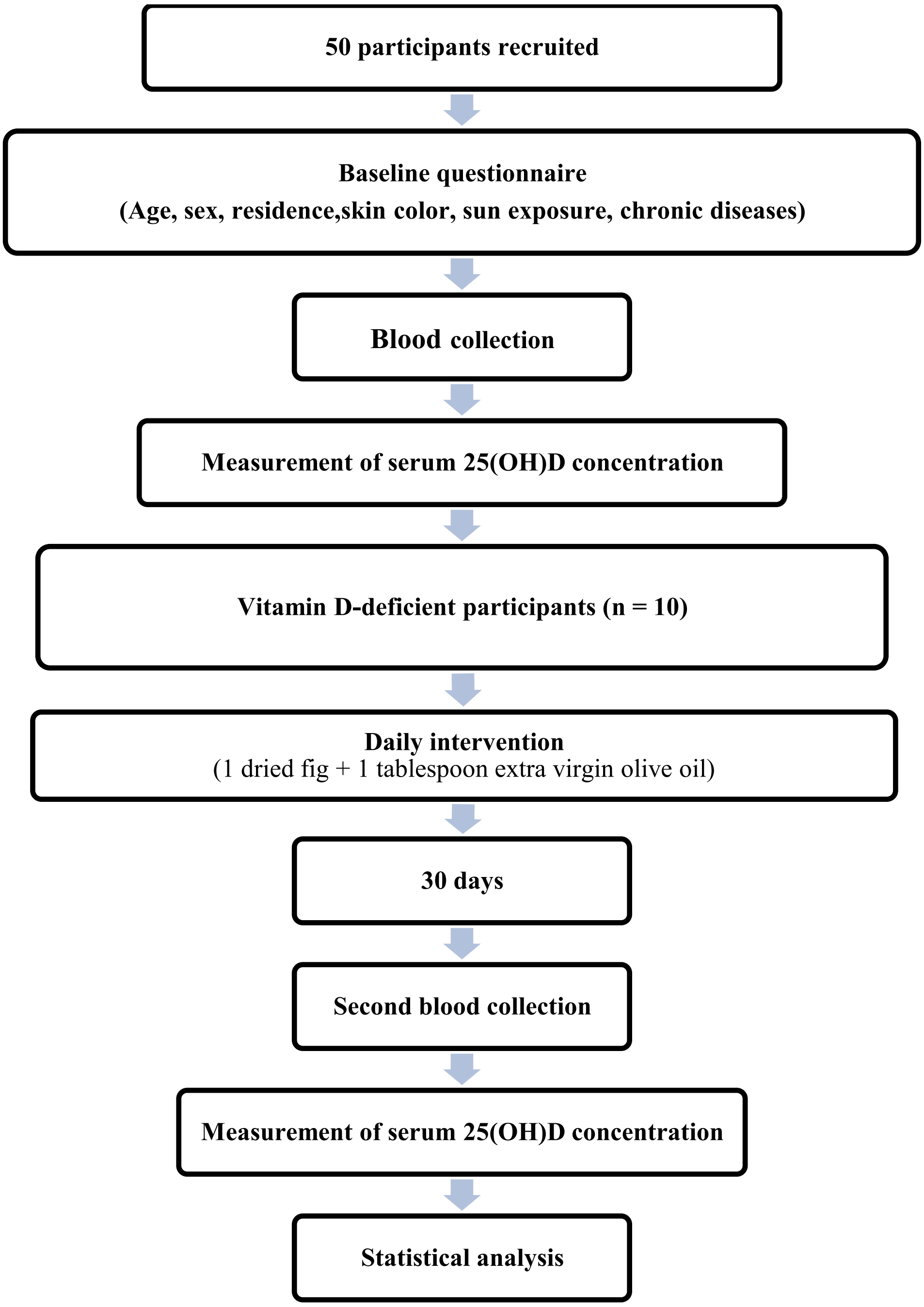

Figure 1. Flowchart illustrating participant recruitment, vitamin D screening, selection of vitamin D-deficient participants, the one-month dried fig–olive oil intervention, and post-intervention assessment of serum 25-hydroxyvitamin D [25(OH)D] concentrations.

2.2 Participants and Questionnaire

Fifty undergraduate students voluntarily participated in the study. A structured questionnaire was completed before blood collection to obtain baseline demographic and lifestyle information. The questionnaire included age (18–26 years), sex, place of residence, skin color, sunlight exposure, and the presence of chronic diseases. These variables were later evaluated for their association with serum 25-hydroxyvitamin D [25(OH)D] concentrations.

2.3 Ethical Considerations

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Participation was voluntary, informed consent was obtained from all participants, and all personal information and laboratory results were kept confidential and used exclusively for research purposes.

2.4 Blood Sample Collection

Approximately 5 mL of venous blood was collected aseptically into plain tubes. After clotting, samples were centrifuged to separate serum, which was stored at −20°C until analysis.

2.5 Determination of Serum 25-Hydroxyvitamin D

Serum 25-hydroxyvitamin D [25(OH)D] concentrations were measured using the Vit D Accubind™ ELISA Microwells kit (Monobind Inc., Lake Forest, CA, USA; Product Code: 9425-300B). The assay was performed according to the manufacturer's instructions. Absorbance was measured at 450 nm using an ELISA microplate reader, and concentrations were calculated from the calibration curve and expressed as ng/mL.

2.6 Classification of Vitamin D Status

Vitamin D status was classified as deficient (<20 ng/mL), insufficient (20–29 ng/mL), or sufficient (≥30 ng/mL).

2.7 Preparation of the Traditional Nutritional Intervention

Commercially available dried figs (*Ficus carica* L.) and extra virgin olive oil (EVOO) were used to prepare the traditional nutritional intervention. The intervention was prepared in individual clean, sterile glass jars, each containing 30 whole dried figs (approximately 620 g) immersed in 300 mL of extra virgin olive oil, ensuring that all figs were completely covered by the oil. The jars were tightly sealed, labeled with the recommended daily dose and duration of the intervention, and stored in a dark place away from direct sunlight for one week before distribution to allow complete soaking of the dried figs in the olive oil.

Following baseline assessment of serum 25-hydroxyvitamin D [25(OH)D] concentrations, 10 participants with vitamin D deficiency who provided informed consent and agreed to comply with the intervention protocol throughout the study period were enrolled in the intervention phase. Each participant received one pre-prepared jar and was instructed to consume one tablespoon containing one oil-soaked dried fig together with the accompanying olive oil once daily, in the morning on an empty stomach, for 30 consecutive days. Participants were also instructed to store the jars at room temperature away from direct sunlight throughout the intervention period.

2.8 Intervention Protocol

Participants diagnosed with vitamin D deficiency consumed the traditional preparation daily for one month. At the end of the intervention period, blood samples were collected again and serum 25(OH)D concentrations were re-evaluated using the same ELISA protocol.

2.9 Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics version 22. Continuous variables were expressed as mean ± SD, while categorical variables were presented as frequencies and percentages. Independent-samples t-test, paired-samples t-test, and one-way ANOVA were used where appropriate. A P-value <0.05 was considered statistically significant.

3.Results

3.1 Characteristics of the Study Population

A total of 50 undergraduate students from the Faculty of Science, University of Derna, participated in the study. Participants were between 18 and 26 years of age. Baseline demographic and lifestyle information was collected using a structured questionnaire prior to blood sampling. The questionnaire included age, sex, place of residence, skin color, sunlight exposure, and the presence of chronic diseases.

The baseline characteristics of the study participants are summarized in Table 1.

Table 1. Baseline characteristics of the study participants

Characteristic	**n (%)**
Total participants	50 (100)
Age (years)	
Mean ± SD	**20.9 ± 4.0***
Range	18–26
Sex	
Male	22 (44.0)
Female	28 (56.0)
Place of residence	
Al-Qubbah	24 (48.0)
Ain Mara	11 (22.0)
Al-Qayqab	4 (8.0)
Al-Bayda	3 (6.0)
Al-Dabousiya	2 (4.0)
Other locations #	6 (12.0)
Skin color	
White	16 (32.0)
Wheatish	23 (46.0)
Dark	11 (22.0)
Sun exposure	
Adequate	19 (38.0)
Moderate	20 (40.0)
Limited	11 (22.0)
History of chronic disease	
Yes	20 (40.0)
No	30 (60.0)

*** Mean age was calculated from the study dataset.**
 # Other locations included Al-Abrag, Basharah, Bayt Thamer, Tart, Al-Lili, and Lamludah.

3.2 Prevalence of Vitamin D Deficiency
Serum 25-hydroxyvitamin D [25(OH)D] concentrations were measured in all participants. Vitamin D deficiency (<20 ng/mL) was detected in 70.0% (n = 35) of the study population, while 22.0% (n = 11) had insufficient concentrations (20–29 ng/mL) and only 8.0% (n = 4) had sufficient vitamin D concentrations (≥30 ng/mL), according to the adopted classification criteria.
The distribution of vitamin D status among the participants is presented in Figure 2.

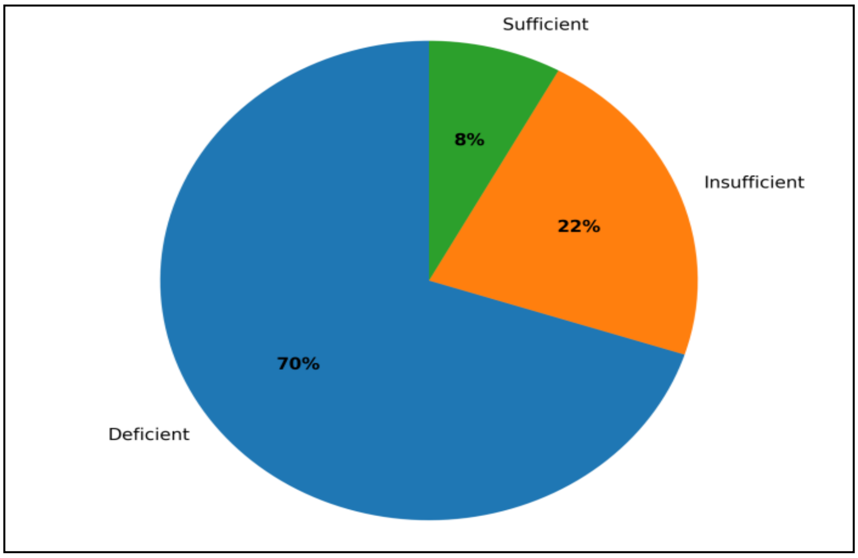

Figure 2. Distribution of serum vitamin D status among the study participants.

3.3 Factors Associated with Serum 25(OH)D Concentrations

The possible influence of demographic and lifestyle variables on serum 25(OH)D concentrations were evaluated using independent-samples t-tests or one-way ANOVA, as appropriate. The investigated variables included sex, place of residence, skin color, sunlight exposure, and the presence of chronic diseases. The results are summarized in Table 2.

Table 2. Association between participants' characteristics and serum 25 hydroxyvitamin D [25(OH)D] concentrations

Variable	Categories	Mean ± SD (ng/mL)	P-value
Sex	Male	16.69 ± 9.85	0.432
	Female	14.10 ± 12.61	
Residence	Al-Qubbah	16.90 ± 10.93	0.720
	Ain Mara	9.07 ± 14.63	
	Al-Qayqab	19.25 ± 11.37	
	Al-Bayda	17.48 ± 8.19	
	Al-Dabousiya	14.94 ± 5.47	
	Other locations*	Not calculated	
Skin color	White	18.15 ± 14.01	0.476
	Wheatish	13.83 ± 10.81	
	Dark	13.94 ± 8.37	
Sunlight exposure	Adequate	14.40 ± 10.76	0.586
	Moderate	17.23 ± 11.87	
	Limited	13.07 ± 12.29	
Chronic disease	Yes	16.51 ± 10.61	0.526
	No	14.39 ± 12.07	

Data are presented as mean ± standard deviation (SD). Comparisons between two groups were performed using the independent-samples t-test, whereas comparisons among multiple groups were performed using one-way analysis of variance (ANOVA). Statistical significance was accepted at $P < 0.05$. No statistically significant associations were observed between serum 25-hydroxyvitamin D [25(OH)D] concentrations and the investigated participant characteristics.

* Other locations included Al-Abrag, Basharah, Bayt Thamer, Tart, Al-Lili, and Lamludah; each location was represented by one participant, and therefore separate mean ± SD values were not calculated.

Female students exhibited a higher prevalence of vitamin D deficiency than male students, with severe deficiency occurring more frequently among females. However, the remaining investigated variables—including place of residence, skin color, sunlight exposure, and the presence of chronic diseases—did not show statistically significant associations with serum 25(OH)D concentrations (P > 0.05).

3.4 Effect of the Traditional Dried Fig–Olive Oil Intervention

Participants diagnosed with vitamin D deficiency consumed one tablespoon containing one dried fig soaked in extra virgin olive oil daily for 30 consecutive days. Serum 25(OH)D concentrations were measured before and after the intervention. The intervention resulted in a marked improvement in serum vitamin D concentrations in the majority of participants.

The pre- and post-intervention results are presented in Table 3.

Table 3. Changes in serum 25-hydroxyvitamin D [25(OH)D] concentrations following one month of daily consumption of dried figs soaked in extra virgin olive oil (n = 10)

Variable	Before intervention	After intervention	Mean change	P-value
Serum 25(OH)D (ng/mL)	8.43 ± 4.89	24.13 ± 3.55	15.69	<0.001

Values are presented as mean ± standard deviation (SD). Differences between pre- and post-intervention serum 25-hydroxyvitamin D [25(OH)D] concentrations were analyzed using the paired-samples t-test. Statistical significance was set at P < 0.05.

The percentage increase in serum vitamin D concentrations ranged from 47% to 750%, indicating considerable individual variation in response to the intervention. Nevertheless, paired-samples t-test analysis demonstrated a statistically significant increase in serum 25(OH)D concentrations following the one-month nutritional intervention (P < 0.05).

The changes in serum vitamin D concentrations before and after the intervention are illustrated in Figure 3.

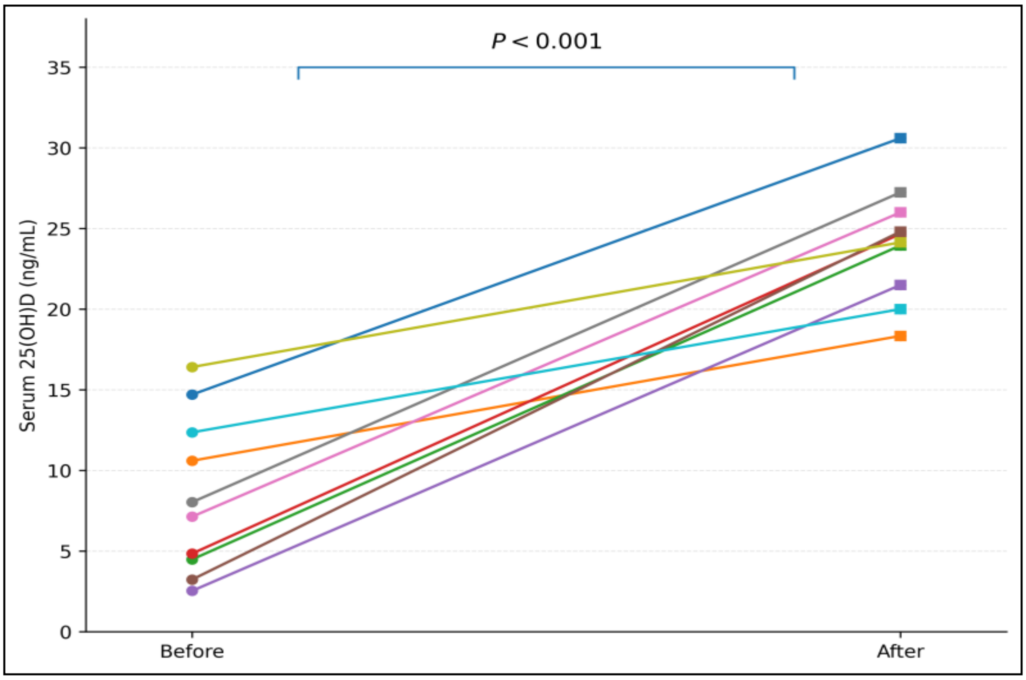

Figure 3. Individual changes in serum 25-hydroxyvitamin D [25(OH)D] concentrations before and after one month of daily consumption of dried figs soaked in extra virgin olive oil (n = 10).

4.Discussion

The present study revealed a high prevalence of vitamin D deficiency among university students, with 70% of participants having serum 25-hydroxyvitamin D [25(OH)D] concentrations below 20 ng/mL. The mean serum concentration in the total study population was 15.24 ± 11.44 ng/mL, indicating generally poor vitamin D status among the investigated students. This finding is consistent with reports describing vitamin D deficiency as a common health problem in Middle Eastern populations despite abundant sunlight (El-Hajj Fuleihan, 2009; Holick et al., 2011). Similar findings have been attributed to prolonged indoor activities, limited effective ultraviolet-B exposure, clothing habits, and inadequate dietary intake of vitamin D (Holick, 2007; Bouillon, 2017).

Severe deficiency occurred more frequently among female students than among males. Nevertheless, the overall difference in serum 25(OH)D concentrations according to sex was not statistically significant ($P = 0.432$). The greater frequency of severe deficiency among females may be related to reduced skin exposure, clothing practices, and less time spent outdoors. These factors have previously been identified as important contributors to low vitamin D status in women living in sunny regions (El-Hajj Fuleihan, 2009; Holick et al., 2011). However, the absence of a significant overall sex difference in the present study may reflect the relatively small sample size and the unequal distribution of participants between groups.

No statistically significant association was found between serum 25(OH)D concentrations and place of residence ($P = 0.720$). This may be explained by similarities in climate, dietary habits, and daily activities among students living in the same geographical region. Therefore, residence alone may not accurately represent differences in effective sun exposure or lifestyle. Likewise, reported sunlight exposure was not significantly associated with serum vitamin D concentrations ($P = 0.586$). Although cutaneous synthesis is the principal source of vitamin D, its efficiency depends not only on whether an individual reports sun exposure, but also on the time of day, duration of exposure, season, body surface area exposed, skin pigmentation, and clothing practices (Adams et al., 1982; Holick, 2007; Chalcraft et al., 2020). Consequently, the simple questionnaire classification used in this study may not have accurately quantified the effective ultraviolet-B dose received by each participant.

Skin color was also not significantly associated with serum 25(OH)D concentrations ($P = 0.476$). Melanin reduces the penetration of ultraviolet-B radiation and can consequently decrease cutaneous vitamin D synthesis (Clemens et al., 1982). However, this relationship may not have been detected in the present study because of the limited sample size, subjective classification of skin color, and relatively narrow variation in pigmentation among participants.

The presence of other diseases was not significantly associated with serum vitamin D concentrations ($P = 0.526$). Previous studies have linked low vitamin D status with several inflammatory and chronic diseases, although the direction and causality of these associations remain uncertain (Baeke et al., 2010; Bikle, 2014; Ardesia et al., 2015). The absence of a significant relationship in this study may be due to the young age of the participants, the small number reporting diseases, and the lack of detailed clinical classification.

A notable finding was the increase in mean serum 25(OH)D concentration from 8.43 ± 4.89 ng/mL before the intervention to 24.13 ± 3.55 ng/mL after one month of daily consumption of one dried fig with one tablespoon of olive oil. The mean increase was 15.69 ng/mL ($P < 0.001$), and 9 of the 10 participants achieved concentrations of at least 20 ng/mL. Individual percentage increases ranged from 47% to 750%, indicating substantial variability in response. This variability may be related to differences in baseline vitamin D concentrations, body weight, absorption efficiency, dietary intake, sun exposure, and individual metabolism. Similar variability in serum response has been reported after vitamin D supplementation, particularly according to baseline status and body weight (Drincic et al., 2012; Ekwaru et al., 2014).

Vitamin D is fat-soluble, and its intestinal absorption depends on normal lipid digestion, bile secretion, micelle formation, and incorporation into chylomicrons (Borel et al., 2015). Previous studies have shown that consuming vitamin D with a meal containing fat can improve its absorption compared with intake under low-fat or fasting conditions (Mulligan & Licata, 2010; Dawson-Hughes et al., 2015). Therefore, the olive oil component may have provided a favorable lipid matrix for the absorption of dietary vitamin D from other foods consumed during the intervention period. However, because neither dried figs nor olive oil is considered a substantial direct source of vitamin D, the observed increase cannot presently be attributed to their vitamin D content.

Dried figs provide dietary fiber, calcium, potassium, magnesium, and phenolic compounds, whereas extra virgin olive oil supplies monounsaturated fatty acids and bioactive phenolics. These components may support general nutritional and metabolic health, but current evidence is insufficient to establish that their combination independently raises serum 25(OH)D concentrations. Therefore, the observed pre–post improvement should be considered hypothesis-generating rather than proof of a therapeutic effect.

The lack of a control group is particularly important because changes in sunlight exposure, dietary intake, seasonal variation, assay variability, or regression toward the mean may have contributed to the observed increase. Therefore, the findings should be interpreted with appropriate caution. Nevertheless, the magnitude of the observed change and the normalization of vitamin D status in 9 of the 10 participants justify further investigation in larger randomized controlled trials.

5.Conclusion

The present pilot study demonstrated that vitamin D deficiency is highly prevalent among university students in eastern Libya, despite the country's abundant sunlight. Female students showed a greater tendency toward severe vitamin D deficiency, whereas no statistically significant associations were observed between serum vitamin D concentrations and place of residence, skin color, sunlight exposure, or the presence of chronic diseases.

Daily consumption of a traditional preparation consisting of dried figs soaked in extra virgin olive oil for one month was associated with a significant improvement in serum 25(OH)D concentrations among vitamin D-deficient participants. While these findings suggest that this culturally acceptable and inexpensive dietary practice may have potential as a supportive nutritional approach, the absence of a control group and the limited sample size preclude definitive conclusions regarding causality.

Further randomized controlled studies involving larger and more diverse populations, longer intervention periods, and comprehensive dietary assessments are warranted to confirm these preliminary findings and to better elucidate the mechanisms underlying the observed improvement in vitamin D status.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

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