



Knowledge, attitudes, perceptions, and use of clove (*Syzygium aromaticum*) among adults in Jordan: A cross-sectional online survey

[Conocimientos, actitudes, percepciones y uso del clavo de olor (*Syzygium aromaticum*) entre adultos en Jordania: una encuesta transversal en línea]

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Abstract

Context: Clove and clove oil are commonly used for culinary and traditional health purposes, although unsafe use and potential interactions remain concerns.

Aims: Knowledge, attitudes, perceptions, and reported patterns of clove use were assessed among respondents in Jordan.

Methods: A descriptive cross-sectional online survey was completed by 384 participants recruited through convenience sampling via Facebook and WhatsApp. The questionnaire was developed after a literature review, assessed for face validity by three academics, and pilot-tested. Internal consistency of the knowledge domain was assessed using Cronbach's alpha. Descriptive statistics, multiple linear regression, and binary logistic regression analyses were used.

Results: Previous use of clove or clove oil was reported by 229 participants (59.6%). Traditional or cultural practice was the most frequently reported influence on use (56.8% of users). Whole clove was the most common form (89.5%), and toothache or oral pain was the most common indication (89.1%). The mean knowledge score was 5.13 ± 2.85 (observed range, -2 to 10). Female sex ($B = 1.445$, $p < 0.001$) and health-sector employment ($B = 1.567$, $p < 0.001$) were associated with higher adjusted knowledge scores. Previous clove or clove oil use was also significantly associated with female sex ($OR = 1.889$, $p = 0.005$). Natural remedies were perceived as safer than pharmaceutical treatments by 63.5% of respondents.

Conclusions: Clove use was common in this online convenience sample, but important misconceptions concerning dilution, adverse effects, pediatric safety, and drug interactions were identified. Targeted public education and pharmacist counseling should be evaluated in representative samples.

Keywords: cross-sectional studies; health knowledge, attitudes, practice; Jordan; phytotherapy; *Syzygium aromaticum*; traditional medicine.

Resumen

Contexto: El clavo de olor y el aceite de clavo se utilizan comúnmente con fines culinarios y en la medicina tradicional, aunque su uso inadecuado y las posibles interacciones siguen siendo motivo de preocupación.

Objetivos: Se evaluaron los conocimientos, las actitudes, las percepciones y los patrones declarados de consumo de clavo entre los encuestados en Jordania.

Métodos: Se realizó una encuesta descriptiva transversal en línea en la que participaron 384 personas reclutadas mediante muestreo por conveniencia a través de Facebook y WhatsApp. El cuestionario se elaboró tras una revisión de la literatura, fue evaluado por tres académicos en cuanto a su validez aparente y se sometió a una prueba piloto. La consistencia interna del dominio de conocimientos se evaluó mediante el alfa de Cronbach. Se utilizaron análisis de estadística descriptiva, regresión lineal múltiple y regresión logística binaria.

Resultados: Un total de 229 participantes (59,6 %) reportaron haber utilizado previamente clavo de olor o aceite de clavo. Las prácticas tradicionales o culturales fueron la influencia sobre el uso reportada con mayor frecuencia (56,8 % de los usuarios). El clavo entero fue la forma más utilizada (89,5 %), y el dolor dental u oral fue la indicación más frecuente (89,1 %). La puntuación media de conocimientos fue de $5,13 \pm 2,85$ (rango observado: -2 a 10). El sexo femenino ($B = 1,445$; $p < 0,001$) y el empleo en el sector sanitario ($B = 1,567$; $p < 0,001$) se asociaron con puntuaciones ajustadas de conocimientos más altas. El uso previo de clavo de olor o aceite de clavo también se asoció significativamente con el sexo femenino ($OR = 1,889$; $p = 0,005$). El 63,5 % de los participantes consideró que los remedios naturales eran más seguros que los tratamientos farmacéuticos.

Conclusiones: El uso del clavo de olor fue frecuente en esta muestra de conveniencia reclutada en línea, pero se identificaron importantes conceptos erróneos relacionados con la dilución, los efectos adversos, la seguridad pediátrica y las interacciones farmacológicas. La educación pública dirigida y el asesoramiento por parte de farmacéuticos deberían evaluarse en muestras representativas.

Palabras Clave: conocimientos, actitudes y práctica en salud; estudios transversales; fitoterapia; Jordania; medicina tradicional; *Syzygium aromaticum*.

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Abbreviations: CI: confidence interval; IRB: Institutional Review Board; OR: odds ratio; SPSS: Statistical Package for the Social Sciences; VIF: variance inflation factor.

INTRODUCTION

Traditional herbal medicine plays an important role in healthcare worldwide, particularly in countries rich in medicinal plant diversity (Lev & Amar, 2002).

The use of spices such as cloves, oregano, mint, thyme, and cinnamon has been part of human culture for centuries, serving a dual purpose as natural preservatives in food products and traditional medicines. Numerous spices have been reported to contain compounds with antioxidant and antimicrobial activities (Shan et al., 2005).

Clove, *Syzygium aromaticum* (syn. *Eugenia caryophyllata*), is the flower bud of a tree belonging to the *Myrtaceae* family and is native to the Maluku Islands in Indonesia. Eugenol is one of the main bioactive constituents of clove, which has been reported to contain phenolic compounds and essential oil (Neveu et al., 2010).

Clove has been used traditionally for several health purposes, particularly for oral discomfort and toothache. Eugenol and other constituents of clove have demonstrated analgesic, antioxidant, and antimicrobial activities in experimental studies (Daniel et al., 2009; Kamatou et al., 2012). However, these experimental findings should not be interpreted as establishing clinical efficacy. Moreover, the inappropriate use of concentrated clove oil may raise safety concerns.

The use of herbal medicines is common in Jordan, although reported prevalence varies by population. A cross-sectional study including 378 Jordanian adults reported that 80.2% of participants were using herbal products (El-Dahiyat et al., 2020). A previous study conducted in northern Jordan reported that 87.3%, 84.7%, and 66.7% of the lay public, pharmacists, and physicians, respectively, use herbal medicine for minor ailments (Khader et al., 2008). No previous studies have specifically reported the prevalence of clove use in Jordan or included clove-focused KAP surveys.

Although the use of herbal medicine in Jordan has been studied, knowledge, patterns of use, and safety perceptions specific to clove have not been adequately characterized. Understanding these aspects is important given the potential for inappropriate use and interactions with conventional medications.

Therefore, the current study aimed to assess knowledge, attitudes, and perceptions regarding clove, investigate patterns of clove and clove oil use among respondents in Jordan, and explore demographic factors associated with clove knowledge.

MATERIAL AND METHODS

Study design and participants

A descriptive cross-sectional online survey was conducted in Jordan to address the study's objectives. Data were collected from 20 November 2025 to 17 February 2026. Participants were eligible if they were aged ≥ 18 years, residing in Jordan, and able to read and understand Arabic. Individuals who did not meet the eligibility criteria were excluded.

Participants were invited to complete an anonymous online questionnaire. At any point before submitting the questionnaire, participants could withdraw from the study by simply closing the survey without submission. Submission of the completed questionnaire was considered evidence of informed consent.

Survey development

An initial draft of the questionnaire was developed following a comprehensive literature review. Questionnaire items were developed based on previously published literature addressing clove, herbal-product use, knowledge, attitudes, practices, and perceptions (Abdel-Qader et al., 2020; El Aich et al., 2025; El-Dahiyat et al., 2020).

To ensure face validity, three independent academics with expertise in pharmacognosy, clinical pharmacy, and survey-based research assessed the initial draft of the questionnaire for relevance, item clarity, domain coverage, and clinical accuracy. The research team incorporated the experts' comments and suggestions, and the questionnaire was revised accordingly to produce the final version.

The questionnaire was pilot-tested among approximately 10% of the target sample size ($n = 40$). Pilot participants met the same eligibility criteria as participants in the main study and were recruited through social media during the preliminary testing phase. The pilot was used to assess the clarity, comprehensibility, and feasibility of the questionnaire. Responses obtained during pilot testing were excluded from the final study sample ($n = 384$). The questionnaire content was not changed. However, minor wording and formatting modifications were made to ensure clarity and comprehension.

The questionnaire was administered in Arabic (Appendix A). The initial English version (Appendix B) underwent forward translation into Arabic, followed by backward translation into English to ensure

linguistic and conceptual equivalence between the two versions.

Four major parts covering different topics of interest comprised the final version of the questionnaire. Items for collecting demographic information were provided in the first section. Participants' attitudes were evaluated in the second section. This section included questions on previous clove use, frequency of use, adherence to guidelines, factors influencing use, forms and sources of clove, indications for use, perceived improvement, and sources of recommendations. Response options varied according to the question and included binary (yes/no), categorical, and frequency-based options. For questions assessing forms of clove used and purposes of use, each listed item was assessed individually using a yes/no response.

Participants' knowledge of cloves and their oil was evaluated in the third section. This part contained 10 items with possible options: true, false, and I do not know. The 10 knowledge items were scored as +1 for a correct response, -1 for an incorrect response, and 0 for an "I do not know" response. This scoring approach, which has been used in previous knowledge assessments (Massad et al., 2025), was used to distinguish incorrect beliefs from uncertainty or lack of knowledge, as an incorrect response reflects endorsement of a misconception, whereas an 'I do not know' response indicates absence of knowledge without endorsement of misinformation. Accordingly, the theoretical total knowledge score ranged from -10 to +10, with higher scores indicating greater knowledge.

Participants' perceptions of herbs, particularly clove, were evaluated in the fourth section. This section consisted of four individual perception questions addressing perceived health benefits, willingness to recommend clove, perceived safety of natural remedies compared with pharmaceutical treatments, and preference regarding concurrent or separate use of natural remedies and pharmaceutical treatments. The first item was assessed using a five-point Likert scale ranging from strongly disagree to strongly agree. The second and third items used binary yes/no response options, while the fourth item included three categorical response options: preference for separate use, preference for concurrent use, or not using both together.

Internal consistency was assessed separately for the multi-item knowledge domain. Corrected item-total correlations were also examined to assess item performance. Given the -1/0/+1 scoring structure of the knowledge items, Cronbach's alpha was considered an initial measure of internal consistency rather than a comprehensive assessment of the psychometric properties of the knowledge domain. In addition, item difficulty was assessed as the proportion of participants

who answered each knowledge item correctly. Corrected item-total correlations were used as an indicator of item discrimination.

Questionnaire implementation

The survey was administered electronically using Google Forms. Participants were recruited using a non-probability convenience sampling strategy through social media platforms (Facebook and WhatsApp). The survey link was distributed through public posts, academic groups, and personal networks on Facebook, as well as direct messaging on WhatsApp.

To prevent duplicate responses, the survey platform was configured to limit submissions to one response per Google account. All questionnaire items were mandatory; therefore, no incomplete questionnaires were recorded. No incentives were provided for participation. Because recruitment was conducted through open social-media distribution, the number of individuals who viewed or received the survey invitation could not be determined; therefore, view and participation rates could not be calculated.

The survey was anonymous, and collected data were stored in a password-protected account accessible only to the research team to maintain data confidentiality and security. Those interested in taking part could click a link to first review ethics committee-approved information about the study, including investigator contact details, then proceed to the questionnaire.

Sample size

The sample size was determined using OpenEpi, with a margin of error of 5%, a confidence level of 95%, and a response distribution of 50%. The calculation was based on a large population; therefore, the finite population correction was not used. Under these assumptions, a minimum sample size of 384 participants was needed.

Ethical approval

Ethical approval for this study was obtained from the Institutional Review Board Committee at the Faculty of Pharmacy, Applied Science Private University (Approval Number: 2025-PHA-34; approval date: 17 November 2025). The study adhered to the ethical guidelines outlined in the World Medical Association Declaration of Helsinki.

Statistical analysis

Following data collection, participant responses were coded using the Statistical Package for the Social Sciences (SPSS), Version 28.0 (IBM Corp., Armonk,

New York, USA). Descriptive statistics were presented as means $\pm$ standard deviation for continuous variables. Categorical variables were presented as frequencies and percentages [n (%)]. For multiple-response questions, percentages were calculated using the relevant eligible participants as the denominator.

The independent variables associated with the study participants' knowledge of cloves were identified using multiple linear regression. Following simple linear regression, multiple linear regression was performed for any independent variable with $p < 0.25$. This screening threshold has been used in previously published studies to identify candidate variables for multivariable regression analysis (Abu Farha et al., 2021; Saleh et al., 2021). In the multiple regression, $p < 0.05$ was considered statistically significant. Regression coefficients were reported with 95% confidence intervals. There were no missing data for the variables included in the analysis; therefore, no missing-data imputation or exclusion was required.

Binary logistic regression was also performed to identify factors associated with previous clove or clove oil use (yes/no). Odds ratios (ORs) with 95% confidence intervals were reported, and $p < 0.05$ was considered statistically significant.

Multicollinearity was assessed using variance inflation factor (VIF) and tolerance values, with VIF < 5 and tolerance > 0.2 considered acceptable. The assumptions of multiple linear regression, including linearity, normality of residuals, homoscedasticity, independence of errors, and absence of influential observations, were assessed and considered acceptable. Model fit was assessed using R^2 , adjusted R^2 , and the overall F-test.

RESULTS

Demographics

A total of 384 respondents were included. The mean age was 30.77 ± 10.45 years (range, 18-69 years). Women accounted for 61.5% of the sample ($n = 236$), and 59.4% were single ($n = 228$).

Most respondents held at least a bachelor's degree (88.2%, $n = 339$), 31.5% were students ($n = 121$), and 91.1% ($n = 350$) resided in central Jordan (Supplementary Table S1).

Medical health insurance was reported by 69.5% of respondents ($n = 267$), and 65.6% were non-smokers ($n = 252$). In addition, 10.7% reported a chronic disease, while 10.7% ($n = 41$) reported using chronic medications (Supplementary Table S1).

Attitude and practice toward clove use

Previous use of clove or clove oil was reported by 229 respondents (59.6%; 95% CI: 54.6%–64.5%). Among these users, 11 (4.8%) reported daily use, 16 (7.0%) reported use most of the time, 70 (30.6%) reported occasional use, and 132 (57.6%) reported rare use.

Specific guidelines for use were followed by 32.3% of the clove users ($n = 74$), while 67.7% did not follow any guidelines ($n = 155$).

Traditional practice was the principal reason for clove use (56.8%, $n = 130$). This was followed by perceived effectiveness (14.4%, $n = 33$), and recommendations from healthcare professionals (13.1%, $n = 30$). Less common factors included media or advertisements (6.6%), availability (3.1%), price (1.3%), and other reasons (4.8%).

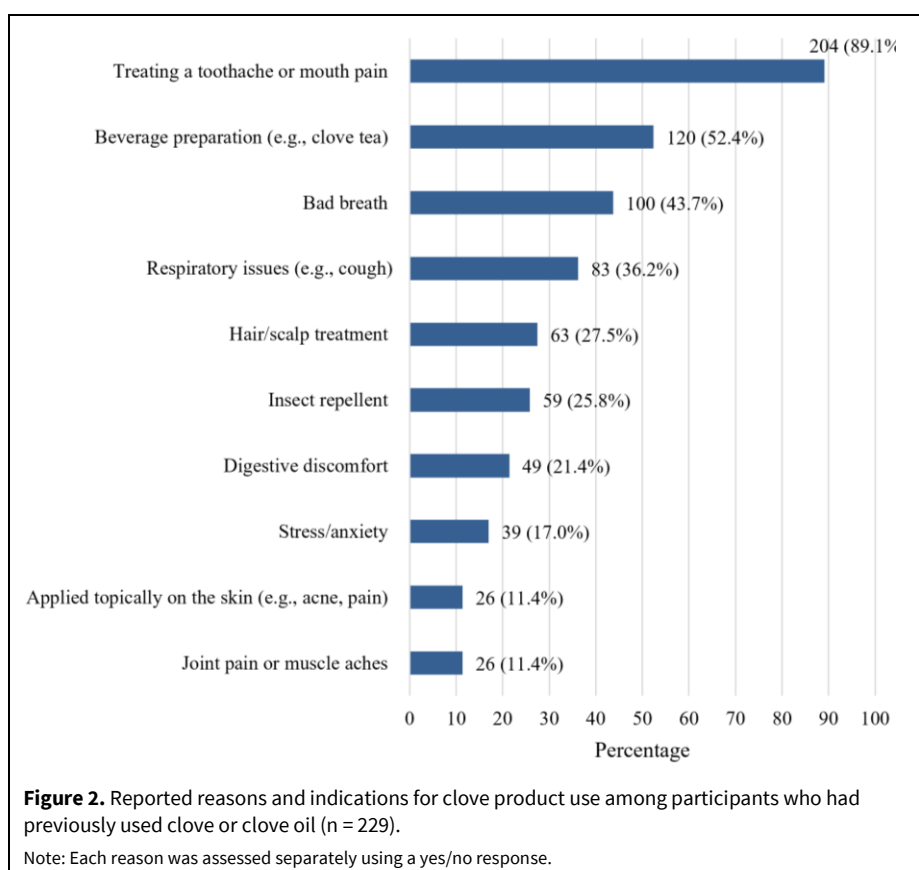
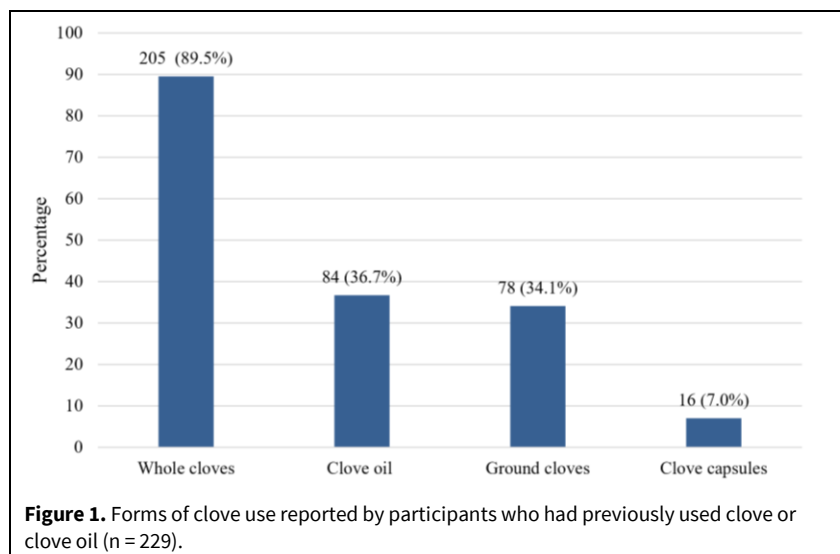
Whole clove was the most commonly reported form of use among participants who reported previous use of clove or clove oil. This was followed by clove oil (89.5% and 36.7%, respectively) (Fig. 1).

Grocery stores represented the most common source of clove products (45.4%). This was followed by the herbalist (38.0%) and the pharmacy (10.9%). Less common sources included growing it at home (1.7%), online stores (0.9%), and other reasons (3.1%).

Participants reported a wide range of reasons for using clove products. Toothache or mouth pain was the most commonly reported indication (89.1%), followed by beverage preparation (52.4%) and use for bad breath (43.7%). Respiratory issues and hair or scalp treatment were also commonly reported, whereas topical use for skin conditions or pain and use for joint pain or muscle aches were less frequently reported (Fig. 2).

More than half of the participants (55.0%) reported that friends and family recommended clove use to them. Furthermore, 12.7% decided independently. Other sources of recommendations included social media (11.4%), pharmacists (7.0%), doctors (5.7%), scientific articles (5.7%), nurses (0.4%), and others (1.3%). The majority of the participants (90.0%) reported perceived improvement following clove use.

According to the multiple logistic regression analysis (Table 1), sex was significantly associated with previous clove or clove oil use. Females had higher odds of previous clove or clove oil use than males (OR = 1.889, $p = 0.005$).



Knowledge about clove

The 10-item knowledge domain showed moderate internal consistency (Cronbach's $\alpha = 0.656$). Corrected item-total correlations, used as an indicator of item discrimination, ranged from 0.220 to 0.457, and

removal of individual items did not improve the overall Cronbach's alpha.

Assessing participants' knowledge of clove revealed a mean score of 5.13 ± 2.85 , with individual scores ranging from a minimum of -2 to a maximum of 10 (Fig. 3).

Table 1. Assessment of factors associated with previous clove or clove oil use among participants (n = 384).

Parameter	Previous clove or clove oil use [0: No, 1: Yes]				
	Simple logistic regression OR	p-value [#]	Multiple logistic regression OR	P value [§]	CI
Age	1.015	0.143 [^]	1.021	0.052	0.999 -1.043
Sex					
• Male	Reference				
• Female	1.828	0.005 [^]	1.889	0.005*	1.211 -2.947
Marital status					
• Single, Divorced, and Widowed	Reference				
• Married	1.016	0.943	-----	-----	-----
Educational level					
• < Bachelor's degree	Reference				
• ≥ Bachelor's degree	0.794	0.485	-----	-----	-----
Occupation					
• Not a health sector employee	Reference				
• Health sector employee	0.824	0.424	-----	-----	-----
Permanent Residence Location					
• North and South Jordan	Reference				
• Central Jordan	0.907	0.791	-----	-----	-----
Smoking status					
• Non-smoker	Reference				
• Smoker	0.726	0.142 [^]	0.849	0.476	0.542-1.329
Do you have any chronic disease/s?					
• No	Reference				
• Yes	0.950	0.879	-----	-----	-----
Do you use chronic medications?					
• No	Reference				
• Yes	0.950	0.879	-----	-----	-----

[#]Using simple logistic regression. [§] Using multiple logistic regression. [^] Eligible for entry in multiple logistic regression (significant at the 0.25 significance level). *Significant at the 0.05 significance level. CI: 95% confidence interval.

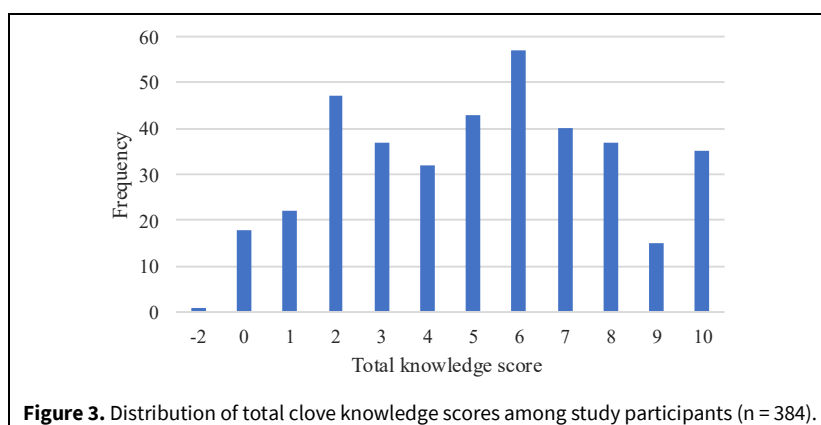


Table 2. Knowledge about the medicinal uses of clove among the study participants (n = 384).

Statements	True n (%)	I do not know n (%)	False n (%)	Mean [#]	Difficulty index
1. Clove has antioxidant properties	235 (61.2)[*]	143 (37.2)	6 (1.6)	0.60	0.612
2. Clove can help relieve a toothache	351 (91.4)[*]	27 (7.0)	6 (1.6)	0.90	0.914
3. Clove oil should be used undiluted directly on the gums	82 (21.4)	174 (45.3)	128 (33.3)[*]	0.12	0.333
4. Eating large quantities of cloves has no side effects	53 (13.8)	114 (29.7)	217 (56.5)[*]	0.43	0.565
5. Clove helps with bad breath	306 (79.7)[*]	66 (17.2)	12 (3.1)	0.77	0.797
6. Clove can cure all types of cancer	29 (7.6)	200 (52.1)	155 (40.4)[*]	0.33	0.404
7. Clove can be used as a spice in cooking	356 (92.7)[*]	27 (7.0)	1 (0.3)	0.92	0.927
8. Cloves, in any form, are completely safe for children to consume	60 (15.6)	156 (40.6)	168 (43.8)[*]	0.28	0.438
9. Clove may interact with blood-thinning medications	147 (38.3)[*]	212 (55.2)	25 (6.5)	0.32	0.383
10. Clove oil can cause skin irritation if not diluted	196 (51.0)[*]	174 (45.3)	14 (3.6)	0.47	0.510

[#]Mean values were calculated using the following scoring: correct response = +1, incorrect response = -1, and "I do not know" = 0. ^{*}Correct response.

The highest levels of knowledge were observed for the use of clove as a culinary spice (92.7%) and for toothache relief (91.4%). Most participants also correctly recognized its use for bad breath (79.7%) and antioxidant properties (61.2%), while 51.0% recognized that undiluted clove oil may cause skin irritation. Knowledge was lower for safety-related items, particularly the potential interaction with blood-thinning medications, which was correctly identified by only 38.3% of participants. Recognition of the four incorrect statements as false ranged from 33.3% to 56.5% (Table 2).

According to the multiple linear regression analysis (Table 3), sex and health-sector employment were significantly associated with the clove knowledge score. Females had higher knowledge scores than males ($B = 1.445$, 95% CI: 0.860–2.031, $p < 0.001$), while health-sector employees had higher knowledge scores than those who were not employed in the health sector ($B = 1.567$, 95% CI: 0.924–2.209, $p < 0.001$). The overall regression model was statistically significant ($F(6,377) = 9.231$, $p < 0.001$), with $R^2 = 0.128$ and adjusted $R^2 = 0.114$.

Perception toward clove and natural products

Regarding the statement "Clove has many health benefits," the majority of participants agreed (53.6%) or strongly agreed (39.1%), while 6.8% were neutral, 0.3% disagreed ($n = 1$), and 0.3% strongly disagreed ($n = 1$).

When asked "Would you recommend clove to others for health purposes?", most participants reported that they would recommend clove for health purposes to others ($n = 334$, 87.0%). Moreover, when asked, "Do you believe that natural remedies such as clove are safer than pharmaceutical treatments?", 63.5% responded yes ($n = 244$), while 36.5% responded no ($n = 140$).

Participants' preferences regarding the use of natural remedies in combination with conventional medicine indicated that 42.4% preferred using them separately (one at a time) ($n = 163$), 39.6% preferred concurrent use ($n = 152$), and 18.0% reported that they did not use both together ($n = 69$).

DISCUSSION

In this online convenience sample, clove or clove oil use was reported by approximately three-fifths of respondents. Previous clove or clove oil use was also significantly associated with female sex. In addition, female participants and those employed in the health sector had significantly higher knowledge scores. Use was primarily associated with traditional practice and recommendations from family or friends, whereas healthcare professionals were less frequently identified as sources of advice. Whole clove was used more often than concentrated oil, and oral pain was the most frequently reported indication. These findings are consistent with the broader observation that family tradition, accessibility, and perceived naturalness influence herbal-product use; however, direct comparison with population estimates should be avoided because the present sample was not probability-based. Several important gaps in knowledge were identified regarding clove safety.

The majority of the current study participants reported using clove for toothache or mouth-related problems, including bad breath. Clove and its oil contain eugenol, β -caryophyllene, eugenyl acetate, and other flavonoids (Kamatou et al., 2012; Viciomini et al., 2021).

Table 3. Assessment of factors associated with knowledge about cloves among the study's participants (n = 384).

Parameter	Knowledge score					
	Simple regression B	p-value [#]	Multiple regression B	p-value [§]	CI	SE
Age	-0.026	0.066 [^]	-0.010	0.556	-0.045-0.024	0.018
Sex						
• Male	Reference					
• Female	1.491	<0.001 [^]	1.445	<0.001 [*]	0.860-2.031	0.298
Marital status						
• Single, Divorced, and Widowed	Reference					
• Married	-0.667	0.026 [^]	-0.265	0.485	-1.012-0.482	0.380
Educational level						
• < Bachelor's degree	Reference					
• ≥ Bachelor's degree	0.553	0.222 [^]	0.295	0.492	-0.549-1.139	0.429
Occupation						
• Not a health sector employee	Reference					
• Health sector employee	1.396	<0.001 [^]	1.567	<0.001 [*]	0.924-2.209	0.327
Permanent residence location						
• North and South Jordan	Reference					
• Central Jordan	0.436	0.395	-----	-----	-----	-----
Smoking status						
• Non-smoker	Reference					
• Smoker	-0.630	0.040 [^]	-0.313	0.298	-0.903-0.277	0.300
Do you have any chronic disease/s?						
• No	Reference					
• Yes	-0.203	0.667	-----	-----	-----	-----
Do you use chronic medications?						
• No	Reference					
• Yes	-0.476	0.313	-----	-----	-----	-----

[#]Using simple linear regression. [§] Using multiple linear regression. [^]Eligible for entry in multiple linear regression (significant at the 0.25 significance level).

^{*}Significant at the 0.05 significance level. B: unstandardized regression coefficient. SE: standard error. CI: 95% confidence interval.

Multiple linear regression model: F(6,377) = 9.231, p<0.001; R² = 0.128; adjusted R² = 0.114.

Preclinical and *in vitro* studies have reported anti-septic, antioxidant, anti-inflammatory, bactericidal, and fungicidal activities of clove and its constituents, suggesting potential relevance to oral health (Ridzuan et al., 2024). However, these findings should not be interpreted as establishing clinical efficacy for periodontal disease.

Over one-third of the participants reported using clove to treat respiratory problems. Preclinical and *in vitro* studies have reported antiviral activity of clove and its constituents against several viruses, including those affecting the respiratory tract; however, this evidence does not establish clinical efficacy for treating respiratory infections (Vicidomini et al., 2021). Additionally, clove use was reported during the COVID-19

era, and experimental studies have described anti-inflammatory, antithrombotic, immunomodulatory, and antibacterial properties that may provide a biological rationale for its traditional use (Ridzuan et al., 2024; Vicidomini et al., 2021).

The use of clove to improve hair health was also mentioned by 27.5% of the study participants. Preclinical evidence regarding the effects of clove on hair health remains limited. An animal study reported increased hair growth following topical application of clove preparations (Abdul Ghany & Qasim, 2025). *In vitro* studies have also reported antimicrobial activity against scalp-associated microorganisms (Almuziny, 2024). However, these findings do not establish clinical

effectiveness for improving hair growth or scalp health in humans.

Herbal medicine use is also common in neighboring countries, although reported prevalence varies considerably. Studies from Saudi Arabia reported use ranging from 42% to 94%, while a recent UAE study found generally high knowledge and favorable practices regarding medicinal plant use (Al Akeel et al., 2018; Al Raish et al., 2026; Alkhamaiseh & Aljofan, 2020; Zaidi et al., 2022). In Turkey, a study found that 18.3% of older adults used herbal products. The use was higher in the rural sample compared to the urban sample (Taneri et al., 2021). In Malaysia, 55.5% of women used herbs for health purposes (Tengku Mohamad et al., 2019). These findings provide a broader regional context for the substantial clove use observed in the present study.

Family and friends were frequently reported as important influences on herbal medicine use, including in studies conducted in Jordan (Abdel-Qader et al., 2020; El-Dahiyat et al., 2020). Moreover, in several studies conducted in Jordan, it was found that family and friends influence people's choice of using herbal products (Abdel-Qader et al., 2020; El-Dahiyat et al., 2020), which emphasizes the need to enhance communication between the general public and healthcare providers, as these natural products can also have side effects or adverse interactions with conventional medications (Abdel-Qader et al., 2020; Thiab et al., 2021). The predominance of grocery stores as sources of clove may reflect its dual role as a widely available culinary spice and a traditional remedy, making it readily accessible outside healthcare settings.

Several safety-related knowledge gaps were identified, including the use of undiluted clove oil directly on the gums, potential adverse effects associated with consuming large quantities, safety in children, and possible interactions with blood-thinning medications. Of particular concern, only 38.3% of participants recognized that clove may interact with blood-thinning medications, highlighting an important safety-related knowledge gap given the potential for herb-drug interactions. This finding highlights the importance of pharmacist counseling and patient education regarding potential herb-drug interactions, particularly among individuals using anticoagulant or antiplatelet medications, given the reported antiplatelet activity of eugenol and clove oil (Huang et al., 2024). Additional safety concerns should be considered with concentrated clove oil and eugenol. Excessive ingestion may cause serious toxicity, including hepatic injury (Carvalho et al., 2022). In addition, caution may be warranted with concentrated clove preparations during pregnancy (Da Silva et al., 2019). These concerns

further emphasize that the perception of herbal products as inherently safe may lead to inappropriate use.

The relatively frequent '*I do not know*' responses for some items indicate gaps in knowledge, whereas incorrect responses reflect specific misconceptions; distinguishing between these response patterns is important because educational interventions may need to address lack of knowledge differently from established misconceptions.

Sex differences in the use and knowledge of herbal and natural products have also been reported in previous studies conducted in Lebanon and Saudi Arabia (El Khoury et al., 2016; Zaidi et al., 2022). The higher knowledge scores observed among females may partly reflect gender-related differences in exposure to and use of herbal medicines. Previous studies have suggested that women's greater involvement in family health-related roles, medicinal-plant knowledge, and the transmission of traditional and culinary knowledge may contribute to greater familiarity with herbal remedies (Torres-Aviles et al., 2016). However, the observed association in the present study should not be interpreted causally.

Female sex was associated with a higher clove knowledge score in the multiple linear regression analysis, with an adjusted difference of approximately 1.45 points on the knowledge scale. Therefore, the practical magnitude of this association should be interpreted alongside its statistical significance. Health-sector employment was also associated with a higher clove knowledge score. This may be related to greater exposure to health-related education and information. Previous research among healthcare professionals, including pharmacists in Jordan, has highlighted the role of professional knowledge and education in the appropriate use and counseling of herbal products (Jalil et al., 2022). However, the observed association should not be interpreted causally.

Additionally, there is a common perception among natural products users that they are safer than conventional medications, and this was the case in this study as well. Participants also expressed different preferences regarding the concurrent use of natural remedies and conventional medications. These findings highlight the importance of raising awareness about potential adverse effects and interactions between herbal products and conventional medications.

These findings support the need for community education on the safe use of clove along with other herbal products. Also, pharmacists can play an important role in counseling patients on appropriate uses, dosing, and herb-drug interactions. Clear product labeling and appropriate regulation of herbal products may also help promote safer use.

The present study has limitations. Participants were recruited through online convenience sampling, with most respondents from central Jordan and a relatively high level of education. The high educational level of the sample may have contributed to higher knowledge scores compared with the general population. This sampling approach may have introduced selection bias. Therefore, the findings may not be representative of the Jordanian population as a whole. Volunteer bias is also possible, as individuals with greater interest in clove or herbal medicine may have been more likely to participate. The survey was self-selecting as it was conducted online; only people who use the internet and social media were able to participate. The response rate could not be calculated due to open social-media recruitment. Therefore, potential non-response bias could not be assessed. Self-reported clove use may have been subject to recall or social-desirability bias. Social-desirability bias may also have influenced participants' responses to knowledge-related items. Future studies should avoid absolute wording in knowledge items to minimize potential response bias.

In addition, although the questionnaire underwent expert review, translation, pilot testing, and assessment of internal consistency for the knowledge domain; formal quantitative content-validity indices, cognitive interviews, test-retest reliability, construct-validity analyses, and sensitivity analyses using alternative knowledge-score specifications were not performed. Therefore, the psychometric properties of the questionnaire require further evaluation in future studies.

CONCLUSION

This study found that clove and clove oil use was commonly reported among respondents to an online survey in Jordan, primarily for oral health and respiratory purposes and, to a lesser extent, hair care. The findings also identified important misconceptions regarding the safe use of clove and clove oil. Female sex was associated with greater odds of previous clove or clove oil use, while female sex and health-sector employment were associated with higher knowledge scores. Although participants commonly perceived natural remedies, such as clove, as safer than pharmaceutical treatments, preferences regarding their concurrent use with conventional medications varied. Given the online convenience sampling and predominance of respondents from central Jordan, the findings should not be interpreted as national prevalence estimates. Representative studies using more fully validated questionnaires are needed. Overall, these results highlight the potential need for improved public education and strengthened communication between healthcare providers and the community to promote

the safe and informed use of clove and other herbal products; the effectiveness of such interventions should be evaluated in future studies.

CONFLICT OF INTEREST

The research was conducted entirely free from any involvement in commercial, financial, or personal matters that might be perceived as a possible conflict of interest or that could have influenced the outcomes or interpretation of the study.

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GENERATIVE ARTIFICIAL INTELLIGENCE (AI)

The authors used ChatGPT (OpenAI) to improve the language and readability of the manuscript. The authors reviewed and edited the content and take full responsibility for its accuracy. No images were generated or manipulated using AI tools.

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AUTHOR CONTRIBUTION:

Contribution	Nassar RI	Thiab S	Al-adwan R	Aboqubo A	Alostath M	Shanteer J	Nassar N	Alashqar MT
Concepts or ideas	x			x	x	x		
Design	x	x						x
Definition of intellectual content	x							
Literature search	x			x	x	x		
Experimental studies								
Data acquisition	x		x	x	x	x	x	
Data analysis	x							
Statistical analysis	x							
Manuscript preparation	x	x	x				x	x
Manuscript editing	x	x	x	x	x	x	x	x
Manuscript review	x	x	x	x	x	x	x	x

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Supplementary data

Supplementary Table S1. Demographic characteristics of the participants (n = 384).

Parameter	n (%)
Sex	
Male	148 (38.5)
Female	236 (61.5)
Marital status	
Single	228 (59.4)
Married	147 (38.3)
Divorced	5 (1.3)
Widowed	4 (1.0)
Level of education	
High school	15 (3.9)
Diploma	29 (7.6)
Bachelor's degree	277 (72.1)
Postgraduate degree (Master's-PhD)	62 (16.1)
Did not complete my studies	1 (0.3)
Occupation	
Health sector employee	91 (23.7)
Non-health sector employee	49 (12.8)
University faculty member	35 (9.1)
Freelancer/business owner	19 (4.9)
Retired	7 (1.8)
Student	121 (31.5)
Unemployed	38 (9.9)
Other	24 (6.3)
Permanent residence location	
North Jordan	30 (7.8)
Central Jordan	350 (91.1)
South Jordan	4 (1.0)
Health insurance	
Uninsured	117 (30.5)
Insured	267 (69.5)
Do you smoke?	
No	252 (65.6)
Yes	132 (34.4)
Do you have any chronic diseases?	
No	343 (89.3)
Yes	41 (10.7)
Do you use chronic medications?	
No	343 (89.3)
Yes	41 (10.7)

Appendix A. Survey (Arabic)

عزيزي المشارك/عزيزتي المشاركة،

تقوم مجموعة من الباحثين بإجراء دراسة لتقييم المعرفة والاتجاهات والتصورات وأنماط استخدام القرنفل وزيت القرنفل بين البالغين في الأردن. المشاركة في هذه الدراسة طوعية ولا تنطوي على أي مخاطر متوقعة. الاستبيان مجهول الهوية، وستستخدم جميع المعلومات التي يتم جمعها لأغراض البحث العلمي فقط؛ كما سيتم الحفاظ على سرية إجاباتك ولن يطلع عليها سوى فريق البحث.

عند المتابعة، فإنك تؤكد ما يلي:

- أنك قرأت وفهمت المعلومات الواردة أعلاه.
- أنك توافق طوعاً على المشاركة في الدراسة.

الموافقة الإلكترونية

- أوافق على المشاركة.
- لا أوافق على المشاركة

القسم 1: الخصائص الديموغرافية

1. الجنس:

ذكر
أنثى

2. العمر: _____

3. الحالة الاجتماعية:

أعزب/عزباء
متزوج/متزوجة
مطلق/مطلقة
أرمل/أرملة

4. المستوى التعليمي:

ثانوية عامة
دبلوم
درجة البكالوريوس
دراسات عليا (ماجستير - دكتوراه)
لم أكمل دراستي

5. المهنة:

موظف في القطاع الصحي
موظف في قطاع غير صحي
عضو هيئة تدريس جامعية
عمل حر / صاحب عمل خاص
متقاعد
طالب
عاطل عن العمل
أخرى

6. مكان الإقامة الدائمة:

شمال الأردن
وسط الأردن
جنوب الأردن

7. التأمين الصحي:

غير مؤمن صحياً
مؤمن صحياً

8. هل تدخن؟

نعم
لا

9. هل تعاني من أي مرض مزمن؟

نعم
لا

10. هل تتناول أدوية لأمراض مزمنة؟

نعم
لا

القسم الثاني: الاتجاهات والممارسات المتعلقة باستخدام القرنفل

1. هل سبق لك استخدمت القرنفل او زيت القرنفل لأي غرض ؟

نعم
لا *

* انتقل إلى القسم التالي (القسم 3)

2. ما مدى تكرار استخدامك للقرنفل في حياتك اليومية؟

دائماً
معظم الأوقات
أحياناً
نادراً

3. إذا كنت قد استخدمت زيت القرنفل، هل اتبعت أي إرشادات محددة لاستخدامه؟

نعم
لا

4. ما ما هو العامل الرئيسي الذي أثر على قرارك باستخدام زيت القرنفل؟

توصيات من متخصصي الرعاية الصحية
الاستخدام الثقافي أو التقليدي
الفعالية
السعر
التوفر
وسائل الإعلام أو الإعلانات
أخرى

5. ما هو الشكل الذي استخدمته للقرنفل؟

قرنفل كامل	نعم
القرنفل المطحون	لا
زيت القرنفل	
كبسولات القرنفل	

6. من أين حصلت على القرنفل/زيت القرنفل؟

عطار
متجر بقالة
متجر إلكتروني

زرعته في المنزل

صيدلية

أخرى

7. ما هي الأغراض التي استخدمت من أجلها القرنفل أو زيت القرنفل؟

نعم	تحضير مشروبات (مثل شاي القرنفل)
لا	مشاكل الجهاز التنفسي (مثل السعال)
	علاج ألم الأسنان أو ألم الفم
	الاستخدام الموضعي على الجلد (مثل حب الشباب، الألم)
	علاج الشعر/فروة الرأس
	اضطرابات الجهاز الهضمي
	ألم المفاصل أو العضلات
	التوتر/القلق
	رائحة الفم الكريهة
	طارد للحشر

8. هل لاحظت تحسناً بعد استخدام القرنفل؟

نعم

لا

9. من نصحك باستخدامه؟

طبيب

صيدلي

ممرضة

العائلة/الأصدقاء

وسائل التواصل الاجتماعي

مقالة علمية

قررت بنفسني

أخرى

القسم الثالث: المعرفة بالقرنفل

1. أي من العبارات التالية صحيحة؟

لا أعرف	خطأ	صحيح	
☐	☐	☒	يتمتع القرنفل بخصائص مضادة للأكسدة
☐	☐	☒	يمكن أن يساعد القرنفل في تخفيف ألم الأسنان
☐	☒	☐	يجب استخدام زيت القرنفل مباشرة على اللثة دون تخفيف
☐	☒	☐	لا يترتب على تناول كميات كبيرة من القرنفل أي آثار جانبية
☐	☐	☒	يساعد القرنفل على التخلص من رائحة الفم الكريهة
☐	☒	☐	يمكن للقرنفل علاج جميع أنواع السرطان
☐	☐	☒	يمكن استخدام القرنفل كتوابل في الطهي
☐	☒	☐	يُعد القرنفل -بأي شكل من أشكاله- آمناً تماماً لاستهلاك الأطفال
☐	☐	☒	قد يتفاعل القرنفل مع الادوية المميعة للدم
☐	☐	☒	يمكن أن يسبب زيت القرنفل تهيجاً للجلد إذا لم يتم تخفيفه

القسم الرابع: التصورات تجاه المنتجات الطبيعية

1. للقرنفل فوائد صحية عديدة.

أوافق بشدة

أوافق
محايد
لا أوافق
لا أوافق بشدة

2. هل توصي الآخرين باستخدام القرنفل لأغراض صحية؟

نعم
لا

3. هل تعتقد أن العلاجات الطبيعية مثل القرنفل أكثر أمانًا من العلاجات الدوائية؟

نعم
لا

4. ما رأيك في استخدام العلاجات الطبيعية (مثل القرنفل) بالتزامن مع الطب التقليدي أو الأدوية؟

أفضل استخدامهما معًا

أفضل استخدامها بشكل منفصل (كلٌّ على حدة)

لا أستخدم كليهما معًا

Appendix B. Survey (English)**Dear Participant,**

A group of researchers is conducting a study to assess knowledge, attitudes, perceptions, and patterns of clove and clove oil use among adults in Jordan.

Participation is voluntary and involves no anticipated risks. The questionnaire is anonymous, and all information collected will be used for research purposes only. Your responses will be kept confidential and accessible only to the research team.

By proceeding, you confirm that:

- You have read and understood the information provided above.
- You voluntarily agree to participate in the study.

Electronic Consent

- I agree to participate.
- I do not agree to participate

Section 1: Demographic Characteristics**1. Sex:**

Male
Female

2. Age: _____**3. Marital Status:**

Single
Married
Divorced
Widowed

4. Level of Education:

High school
Diploma
Bachelor's degree
Postgraduate degree (Master's - PhD)
Did not complete my studies

5. Occupation:

Health sector employee
Non-health sector employee
University faculty member
Freelancer/business owner
Retired
Student
Unemployed
Other

6. Permanent Residence Location:

North Jordan
Central Jordan
South Jordan

7. Health Insurance:

Uninsured
Insured

8. Do you smoke?

Yes
No

9. Do you have any chronic disease?

Yes
No

10. Do you use chronic medications?

Yes
No

Section 2: Attitude & Practice Toward Clove Use**1. Have you ever used clove or clove oil for any purpose??**

Yes
No *

* Go to the next section (Section 3)

2. How often do you use cloves in your daily life?

Always
Most of the time
Occasionally
Rarely

3. If you have used clove oil, did you follow any specific guidelines for its use?

Yes
No

4. What factor primarily influenced your decision to use clove oil?

Recommendations from healthcare professionals
Cultural or traditional use
Effectiveness
Price
Availability
Media or advertisements
Other

5. What form did you use?

Whole cloves	Yes
Ground cloves	No
Clove oil	
Clove capsules	

6. Where did you get the clove/clove oil?

Herbalist
 Grocery market
 Online store
 Grew it at home
 Pharmacy
 Others

7. For what purposes have you used clove or clove oil?

Beverage preparation (e.g., clove tea)	Yes
Respiratory issues (e.g., cough)	No
Treating a toothache or mouth pain	
Applied topically on the skin (e.g., acne, pain)	
Hair/scalp treatment	
Digestive discomfort	
Joint pain or muscle aches	
Stress/anxiety	
Bad breath	
Insect repellent	

8. Did you see improvement after clove usage?

Yes
 No

9. Who recommended its use to you?

Doctor
 Pharmacist
 Nurse
 Family/friends
 Social media
 Scientific article
 Decided by myself
 Others

Section 3: Knowledge About Clove**1. Which of the following statements is True?**

Statement (n=10)	True	False	I Don't Know
Clove has antioxidant properties	✓	☐	☐
Clove can help relieve a toothache	✓	☐	☐
Clove oil should be used undiluted directly on the gums	☐	✓	☐
Eating large quantities of cloves has no side effects	☐	✓	☐
Clove helps with bad breath	✓	☐	☐
Clove can cure all types of cancer	☐	✓	☐
Clove can be used as a spice in cooking	✓	☐	☐
Cloves, in any form, are completely safe for children to consume	☐	✓	☐
Clove may interact with blood-thinning medications	✓	☐	☐
Clove oil can cause skin irritation if not diluted	✓	☐	☐

Section 4: Perception Toward Natural Products**1. Clove has many health benefits.**

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

2. Would you recommend clove to others for health purposes?

Yes

No

3. Do you believe that natural remedies such as clove are safer than pharmaceutical treatments?

Yes

No

4. How do you feel about using natural remedies like clove in combination with traditional medicine or pharmaceuticals?

I prefer to use them together

I prefer to use them separately (one at a time)

I do not use both together