

Effectiveness of A Theory of Planned Behavior-Based Educational Intervention on Knowledge, Attitude, and Practices of Herbal Medicine Utilization Among Indonesian Communities Living in Saudi Arabia and Egypt

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ABSTRACT

Background: Herbal medicine is widely used worldwide; however, inadequate knowledge and inappropriate utilization practices remain important public health concerns that may compromise its safety and effectiveness. Although educational interventions have been reported to improve health literacy, evidence regarding theory-informed educational programs for Indonesian communities living abroad remains limited. This study aimed to evaluate the effectiveness of a Theory of Planned Behavior (TPB)-informed educational intervention in improving knowledge and describing post-intervention attitudes and practices regarding the utilization of Indonesian medicinal plants among Indonesian communities residing in Saudi Arabia and Egypt.

Subjects and Method: A quasi-experimental study was conducted among 88 Indonesian participants residing in Saudi Arabia (n=50) and Egypt (n=38), who were recruited using purposive sampling. The independent variable was a TPB-informed educational intervention. The dependent variables were knowledge, attitudes, and practices regarding the utilization of Indonesian medicinal plants. Data were collected using validated questionnaires and analyzed using paired t-tests and correlation analyses.

Results: The intervention demonstrated a substantial and statistically significant improvement in knowledge scores in Saudi Arabia (mean difference=20.96; 95% CI=8.50 to 33.42; p=0.003; d=0.98) and Egypt (mean difference=47.73; 95% CI=28.10 to 67.36; p<0.001; d=1.37). Knowledge was positively associated with attitude (r=0.45; p=0.002) and practice (r=0.52; p<0.001), indicating a coherent behavioral change process. Improvements in attitudes and practices were also observed following the intervention.

Conclusion: The educational intervention was associated with improved knowledge regarding the utilization of Indonesian medicinal plants among Indonesian communities residing in Saudi Arabia and Egypt. These findings suggest that TBP may contribute to improving herbal health literacy and may inform the development of culturally appropriate community health promotion initiatives. Further controlled studies are warranted to confirm the effectiveness and long-term impact of this intervention.

Keywords: herbal medicine, educational intervention, health literacy, knowledge, attitude, community

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BACKGROUND

The widespread use of herbal medicine on a global scale, especially in developing countries, highlights the urgent need for evidence-based education to promote safe and rational use. In low- and middle-income countries herbal medicine is an integral part of primary healthcare systems that are limited by access to modern medicine ([Amole, 2021](#)). Herbal products have become increasingly popular due to their perceived affordability and safety in comparison to pharmaceutical drugs ([Hina, 2023](#)). However, this absence of standardised guidelines poses major issues about the safety, quality and efficacy of these remedies ([Kazi et al., 2023](#)). Assessment of published papers on traditional herbal medicine have shown that number of publications has increased, with majority being from countries such as China, Japan and India ([Musa et al., 2022](#)). This however is hindered by the lack of clinical, toxicological, and pharmacological studies which is a significant challenge in African nations where herbal medicine has been widely practised ([Amole, 2021](#)). Moreover, the potential adverse effects of herbal medicines including misidentification, overdosing and contamination highlight the importance of

quality assurance and guided practices with standardization ([Hina, 2023](#); [Kazi et al., 2023](#)). Furthermore, the globalisation of traditional medicine practices calls for scientifically established information and education in order to protect against health hazards as well as promote synergism between traditional and conventional medicine systems ([Amole, 2021](#)). Hence, it is important to follow good manufacturing practices and regulation of herbal medicines through World Health Organization level for safe and effective use ([Kazi et al., 2023](#)).

The Knowledge, Attitudes and Practices (KAP) survey is a widely utilized paradigm in health research that measures the cognitive understanding, emotional disposition and behavioral reaction of individuals regarding specific health-related issues. It stems from the premise that better information serves to foster positive attitudes, leading to behavioural change ([Wang et al., 2026](#)). The Theory of Planned Behavior (TPB), also a psychological theory, emphasizes the importance of attitudes, subjective norms and perceived behavioral control in predicting intention to perform a given behavior and subsequently, actual behavior. To make sense of and predict behaviours, this theory has been used in several different

domains ([Wang et al., 2026](#)). For instance, a study on the use of the TPB to evaluate cervical cancer screening preferences among Chinese women revealed that attitudes toward getting screened, subjective norms as well as perceived behavioral control were statistically significant predictors of screening intentions ([Xin et al., 2020](#)). A meta-analysis demonstrates the importance of perceived behavioral control in moderating between intention and health behavior ([Hagger et al., 2022](#)).

As indicated by several studies from diversified areas, the KAP of people plays an important role in medicinal plants utilization. In an educational intervention in West Java, Indonesia, awareness related to medicinal plants significantly increased, with a 100% increase in understanding the definition and the benefits of herbal medicines, whilst knowledge on preparation methods also increased by 44.4% ([Nisaa et al., 2022](#)). Likewise, in rural Barbados, researchers assessed traditional knowledge of medicinal plants and found that over 75% of participants utilized botanical medicines suggesting a rich cultural heritage for these practices ([Vujicic and Cohall, 2021](#)). Traditional herbal medicine is commonplace in Saudi Arabia, with significant differences between male and female knowledge levels and usage patterns, along with a strong preference towards the use of herbal remedies as opposed to conventional medicine among patients suffering from chronic disease ([Zaidi et al., 2022](#)). Despite a low overall knowledge score, there was a positive attitude towards herbal medicines among pharmacy professionals in Eritrea which highlighted the need to have educational initiatives to promote their awareness ([Goitom et al., 2022](#)). Moreover, another Saudi study highlighted inadequate knowledge among pregnant women concerning the side effects of herbal medicines,

although their attitude and practice were found to be favorable but still highlighted the need for education ([Almoayad et al., 2020](#)). Thus, together these findings underscore the need for comprehensive educational programs aimed at bridging knowledge gaps and promoting evidence-based practices in KAP surrounding the safe and effective use of medicinal plants across diverse communities.

Even herbal medicine which is natural and produced in other country brings many problems to solve like quality, preparation procedures, lack of uniformity and consequently wrong usage. Commonly believed is that herbal products are safe, but the truth shows they can cause side effects including herb-drug interactions and toxicity, especially since it may not be regulated by authorities like US Food and Drug Administration (FDA) ([Hassen et al., 2022](#)). The lack of standardized guidelines for the preparation and use of herbal medicines increases these risks; incorrect dosing or extraction methods can decrease therapeutic effectiveness, or lead to adverse events ([Umamaheswari et al., 2021](#)). In addition, the standardization of raw materials and processing methods is not established for herbal medicines, indicating difficulty in quality control and inconsistency in biological activity and chemical profiles of products ([Umamaheswari et al., 2021](#)). Easing access to reliable health information in community settings diminished misinformation surrounding these topic areas; therefore; educational interventions of sorts should be employed to allow for understanding and safe habits ([Nisaa et al., 2022](#)). In response to these, there is an emerging call for formal training of healthcare providers as well as for stricter regulation of the herbal industry and a standardized pharmacovigilance system to ensure the safety and efficacy of

herbal medicines ([Hassen et al., 2022](#); [Lam et al., 2023](#)).

This study aims to evaluate knowledge, attitude and practice (KAP) regarding local medicinal plants among Indonesian citizen in Saudi Arabia and Egypt before and after a structured practice-based education intervention. The fragmented nature of herbal medicine research is reflected in current literature, as most studies were conducted in a single country and primarily measured knowledge outcomes while neglecting a thorough evaluation of attitudes toward herbal medicine and its practice. An example includes a study of medical students in Saudi Arabia that showed limited awareness about herbal medicines and some using these substances without consulting healthcare professional and unwilling to recommend them to their family members ([Zaidi et al., 2022](#)). In Egypt, it was also reported that there is a moderate level of usage of herbal remedies yet healthcare providers are not sufficiently knowledgeable about herbs, suggesting that the public believes herbs to be safe but ineffective for chronic diseases as well ([Fathy et al., 2019](#)).

This study is well-positioned to provide context-specific and cross-cultural evidence that can inform public health strategies, contribute to the development of culturally adaptable educational interventions and safety-promotion initiatives in the community as well as advocate for a rational use of herbal medicine at policy level. The results are expected to contribute significant information that may help policymakers and healthcare practitioners design effective health education programs that take local needs into account. Additionally, education on herbal medicine practices can help alleviate health hazards that arise from misuse, as well contribute positively to effective traditional healthcare systems.

This approach can contribute to global health, through the promotion of safe and evidence-based use of herbal medicine. Overall, this study supports the wider research agenda aimed at promoting health literacy and preventing harm to patients in light of increasing global popularity of herbal medicine.

SUBJECTS AND METHOD

1. Study Design

This study employed a one-group pretest-posttest quasi-experimental design to evaluate changes in participants' knowledge following a structured educational intervention and to describe post-intervention attitude and practice regarding the utilization of local medicinal plants. This design was selected because the study was implemented as a community-based educational program, where establishing a control group was not feasible and equitable access to health education was prioritized. Accordingly, the findings should be interpreted as evidence of an association between the intervention and the observed outcomes rather than definitive causal effects.

The educational intervention was informed by the Theory Planned Behavior (TPB) was used as a conceptual framework to guide the development of educational materials and learning activities aimed at improving participants' knowledge and encouraging positive attitudes toward the utilization of Indonesian medicinal plants. However, the present study did not directly measure all TPB constructs, including subjective norms, perceived behavioral control, and behavioral intention. Therefore, TPB was used solely to inform intervention development rather than to empirically evaluate the TPB framework.

The study was conducted among Indonesian communities residing in Jeddah, Kingdom of Saudi Arabia and Cairo, Egypt.

Conducting the intervention in two socio-culturally distinct settings enabled the evaluation of the educational program across different community contexts and enhanced the transferability of the study findings.

2. Population and Sample

The population consist of Indonesian citizen living in Saudi Arabia and Egypt. The eligible participants were defined as individuals aged ≥ 17 years who are willing to participate in the educational intervention and complete pre- and postintervention assessments. Participants who did not complete the intervention or submitted incomplete questionnaires are excluded from the analysis. Since this study was carried out as a community-based outreach educational program, all participants who met the inclusion criteria were invited to take part in the study. Consequently, a formal initial sample size calculation for the use of an a priori was not performed. The final sample of 88 participants (50 were from Saudi Arabia and 38 from Egypt) is similar to the sample sizes reported in previous community-based educational intervention studies of health education outcomes. However, the lack of an a priori sample size calculation should be borne in mind when interpreting the results, especially concerning how far down to detect smaller intervention effects.

3. Study Variables

The independent variable of this study was a structured educational intervention aimed at increasing the knowledge and the safe use of medicinal plants.

The main outcome measure (primary variables) was knowledge score regarding the use of herbal medicine. Secondary outcome measures (secondary variables) included attitudes and practices towards medicinal plant utilization. According to the TPB framework, attitudes and practices

were considered pivotal factors influencing behavior change after the intervention.

Covariates of interest were socio-demographic characteristics such as participants' age, gender, education level, occupation and marital status; these were included only to provide participant profiles and help examine potential contextual influences

4. Operational Definition of Variables

Knowledge was also defined as the participants' awareness in relation to medicinal plants, including the benefits, safety aspects and preparation methods. Knowledge was assessed by a multiple-choice questionnaire that scored between 0 and 100 (expressed as percentage). Knowledge levels were defined as poor ($< 50\%$), moderate ($50-74\%$) and good ($\geq 75\%$).

Attitude was defined as participants' perceptions and acceptance of herbal medicine utilization, it was measured using Likert-scale items. Attitude scores were divided into negative, neutral and positive categories according to their tertile distribution.

Practice was defined as participant self-reported behaviors in relation to the preparation and use of medicinal plants in everyday life. Practice was assessed with Likert-scale items and classified into level as low, moderate, or high using standardized scoring.

Educational intervention was defined as a structured socialization program involving theoretical and practical components used to increase knowledge and influence behavioral determinants according to TPB framework.

5. Study Instruments

Intervention and Educational Program

The intervention was a theory-based structured educational program developed based on the TPB. The educational strategies used in this program focused on changing

participants' knowledge, behaviors and attitudes. To deliver the intervention, three thematic content modules were developed focusing on (i) health benefits of local Medicinal plants found in Middle East and Africa, (ii) use of herbal remedy for pain management, and (iii) proper preparation techniques of Plant-based medicinal products.

To improve practical skills of the participants, an interactive workshop called "Demonstration of Proper Preparation of Herbal Infusions" was implemented. Correct extraction methods, dosage considerations and safety precautions were covered in this session. The intervention was provided in a one-time session of about 2–3 hours using lectures, group talks and workshops. Standardized materials and delivery protocols were employed at all study sites to promote consistency, with minor contextual adaptations made to facilitate local cultural and linguistic variations.

Instrument Development and Validation

A structured questionnaire was designed, drawing from a literature search and feedback from experts in the fields of pharmacology, herbal medicine and public health. The questionnaire included three domains, knowledge (10 multiple-choice items), attitude and practice towards the use of local medicinal plants. For Knowledge scores: 0–10 (1 point for every correct answer). All the attitudes were measured on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree), while practices on pre-circulated structured response options based on their use of herbal medicine.

Two experts in herbal medicine and one expert in public health reviewed the contents to establish content validity. The study was piloted for feasibility and clarity in 15 subjects prior to implementation. The overall Cronbach's alpha of the questionnaire was 0.78, and for specific domains it was 0.76 for knowledge, 0.80 for attitudes and 0.79 for practices suggesting acceptable internal consistency. Due to the fact that this questionnaire was developed for this community-based educational intervention, formal construct validity testing (e.g. exploratory or confirmatory factor analysis) was not conducted.

6. Data Collection Procedures

Data collection was carried out in two phases: pre-intervention (baseline) and immediately post-intervention. The questionnaire was completed under direct supervision for respondents to minimize response bias and completeness. Knowledge scores were calculated by the proportion of correct responses, and attitude and practice scores were derived from Likert scale responses according to previously established scoring procedures.

A structured quality control process was developed that included supervision during data collection, checking whether questionnaires were complete and double data entry verification.

7. Variables and Measurement

The main outcome variable was difference in knowledge scores pre-test vs post-test. Secondary outcomes consisted of herbal medicine utilization attitudes and practices. Table 1 summarizes the measured variables.

Table 1. Summary of Study Variables and Measurement Approaches

Variable Category	Measurement Method	Scale	Outcome Type
Knowledge	Multiple-choice questionnaire	0–100%	Continuous
Attitude	Structured perception items	Likert scale	Ordinal
Practice	Self-reported behavior items	Likert scale	Ordinal

8. Data Analysis

Descriptive statistics were used to summarize participants' characteristics. We expressed descriptive statistics as frequencies, percentages, means and standard deviation. Outcomes of continuous variables met normality using the Shapiro–Wilk test. Paired t-tests were performed to compare pre and posttest intervention knowledge scores. Independent t-tests and chi-square tests were used, where appropriate, to compare outcomes between participants from Saudi Arabia and Egypt. Pearson's correlation analysis was conducted to examine the relationships among knowledge, attitudes, and practices. All statistical tests were two-tailed with a p-value <0.05 regarded as statistically significant and performed using IBM SPSS Statistics version 29 (IBM Corp., Armonk, NY, USA).

9. Bias Control and Study Limitations

Several strategies were taken to reduce potential bias. This minimised selection bias by defining eligibility criteria and recruiting participants from Indonesian community in two countries. Standardized and supervised questionnaire administration contributed to minimize response bias. Some limitations of the present study were met. Designed as a one-group pretest–posttest without a control group, there are limits to causal inference and it is subject to many threats against internal validity (e.g., history, maturation effects, testing). Also, the lack of an a priori sample size calculation may have limited a smaller intervention effect to be detected. Outcomes on self-reported measures may have been subject to recall

and social desirability bias. These limitations were taken into account when the findings of our study are interpreted.

10. Research Ethics

This study was approved by the Health Research Ethics Committee, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia (KEPK FK UNAIR) (Approval No. 91/EC/KEPK/FKUA/2026). All participants gave their written informed consent prior to enrollment. Informed consent for participation in the study was voluntary, the data remained confidential throughout the investigation process and all data were anonymized before embarking on analysis. The study was conducted according to the principles of the Declaration of Helsinki.

RESULTS

1. Sample Characteristics

This study included 88 Indonesian communities in Saudi (n=50) and Egypt (n=38). Table 2 shows the socio-demographic characteristics. In Saudi Arabia cohort had a female percentage of 90% but still had the majority similar to Egypt which showed a female percentage of 67.50%. The majority of participants from Saudi Arabia (>30 years; 84.00%) and Egypt (25–30 years; 42.10%) were in the productive age category.

Regarding educational qualifications, the majority of respondents had achieved a minimum of secondary level education and a significant number were degree holders, particularly in Saudi Arabia (64.00%). A heterogeneous socio-economic background was reflected in occupational distribution that differed between both countries. There

was a significant difference in marital status with the vast majority of Saudi participants being married (94.00%) and most participants in Egypt being single (71.10%).

These differences suggest that context matter (as shown in Table 2) and difference in baseline knowledge levels, engagement to intervention.

Table 2. Socio-demographic characteristics of participants of community empowerment in Saudi Arabia (n = 50) and Egypt (n=38)

Characteristics	Category	Saudi Arabia (n, %)	Egypt (n, %)
Gender	Female	45 (90.00)	27 (67.50)
	Male	5 (10.00)	13 (32.50)
Age (years)	17–25	2 (4.00)	12 (31.60)
	25–30	6 (12.00)	16 (42.10)
	>30	42 (84.00)	10 (26.30)
Education	Junior High School	1 (2.00)	0 (0.00)
	Senior High School	12 (24.00)	21 (55.30)
	Diploma	5 (10.00)	0 (0.00)
	Bachelor or higher	32 (64.00)	17 (44.70)
Marital Status	Married	47 (94.00)	10 (26.30)
	Single	3 (6.00)	27 (71.10)
	Others	0 (0.00)	1 (2.60)

Note: Percentages are calculated within each country.

2. Descriptive and Comparative Analysis of Knowledge

The educational intervention significantly improved knowledge about the use of medicinal plants in both countries. As presented in Table 3, the average knowledge score improved from 61.84 (SD= 24.50) to 82.80 (SD=15.80) in Saudi Arabia and from 37.80 (SD= 34.90) to 85.53(SD= 14.70) in Egypt.

Comparison analysis showed that the baseline knowledge was lower among respondents in Egypt compared to their

Saudi counterparts, while scores after intervention became comparable across countries. The data demonstrated that the magnitude of improvement in knowledge was much greater in Egypt than Saudi Arabia ($p<0.050$) suggesting a differential impact of the intervention based on baseline levels of knowledge between population's cohorts. These results suggest that the intervention successfully narrowed knowledge gaps between two settings.

Table 3. Comparison of Knowledge Scores Pre and Post Educational Intervention in Saudi Arabia and Egypt, 2024

Country	Pre-test Mean (SD)	Post-test Mean (SD)	Mean Difference
Saudi Arabia	61.84 (24.50)	82.80 (15.80)	20.96
Egypt	37.80 (34.90)	85.53 (14.70)	47.73

Note: SD = standard deviation.

3. Effect of Educational Intervention on Knowledge

Statistical significance of the knowledge score increase in both countries was confirmed using inferential paired t-test

analysis. In Saudi Arabia (mean difference= 20.96; 95% CI= 8.50 to 33.42; $p=0.003$) and Egypt (mean difference= 47.73; 95% CI= 28.10 to 67.36; $p<0.001$), knowledge scores

significantly increased as shown in Table 4, respectively.

The intervention effect size was large in both contexts as indicated by Cohen's *d* values (Saudi Arabia: *d*= 0.98; Egypt: *d*= 1.37) Highlighting its strong practical significance. Understanding the results given that baseline knowledge of early warning

signs among Egyptian mothers was lower than in other populations included in this review, 73–80 the wider effect size we identified may suggest that interventions exert a greater influence on those with lower levels of baseline knowledge for health literacy improvement principles.

Table 4. Effect of Educational Intervention on Knowledge Scores (Paired t-test Analysis)

Country	Mean Difference	95% CI	Cohen's <i>d</i>	<i>p</i>
Saudi Arabia	20.96	8.50 to 33.42	0.98	0.003
Egypt	47.73	28.10 to 67.36	1.37	<0.001

Note: CI= confidence interval; Cohen's *d* indicates effect size (0.2= small, 0.5= moderate, ≥0.8= large).

4. Attitude Toward Herbal Medicine After Intervention

Post-intervention attitudes towards the utilization of herbal medicine are presented in Table (5). Overall, participants reported moderate-positive attitude in both countries. Among Saudi participants, 25.00% were of positive attitude and whereas 64.80% was classified as moderate while among Participants in Egypt,

positive attitude was found in (13.95%) and moderate attitudes in (61.05%).

A moderate positive correlation was found between knowledge and attitude (*r*= 0.45; *p*= 0.002), suggesting that higher levels of knowledge directly correlated with more favorable attitudes toward herbal medicine. Then this finding is consistent with the theory, that knowledge affects attitudinal components of behavior, as proposed in the Theory of Planned Behavior.

Table 5. Overall Attitude Toward Herbal Medicine After Educational Intervention

Country	Positive (%)	Moderate (%)	Negative (%)
Saudi Arabia	25.00	64.80	10.40
Egypt	13.95	61.05	20.00

Note: Attitude categories were derived from Likert-scale scoring.

5. Behavioral Practices Related to Herbal Medicine

Table 6 provides description of behavioral practices regarding herbal medicine utilization at post-intervention. Most participants in both countries indicated their appropriate behaviors to be high and even very high. In Saudi Arabia, very high and high positive behavior was present with a rate of 32.40% and 48.20% respectively; however, in Egypt

it was with rates: 33.20%, 48.43% coincidentally.

The correlation analysis showed that knowledge significantly correlated with behavioral practices (*r*=0.52; *p* <0.001) and attitude also had a significant correlation with behavior (*r*=0.48; *p*= 0.001), shown in Table 7. These results reflect that knowledge and attitude improvements came along better with behavioral practices, suggesting that higher knowledge was associated with

more favorable attitudes and practices, although no causal or mediating

relationships can be inferred from these findings.

Table 6. Behavioral Practices Related to Herbal Medicine Utilization After Intervention

Country	Very High (%)	High (%)	Moderate (%)	Low (%)
Saudi Arabia	32.40	48.20	14.00	5.40
Egypt	33.20	48.43	14.73	4.19

Note: Behavioral categories were based on composite Likert-scale scores.

Table 7. Correlation Between Knowledge, Attitude, and Practice

Variables	r	p
Knowledge – Attitude	0.45	0.002
Knowledge – Practice	0.52	<0.001
Attitude – Practice	0.48	0.001

Note: Spearman correlation test; r = correlation coefficient.

6. Integrated Analysis of Knowledge, Attitude, and Practice

Additional investigation showed strong interrelationship between the knowledge, attitude and practice variables. As showed in Table 7, knowledge was positively correlated with attitude ($r = 0.45$; $p = 0.002$) and practice ($r = 0.52$; $p < 0.001$), and each was also positively correlated with practice ($r = 0.48$; $p = 0.001$).

This implies a sequential relationship where increased knowledge is linked to more positive attitudes leading to behavioral practices. Overall, these these conclusions mostly corroborate with the Theory of Planned Behavior and its ideas about knowledge, attitudes, and health behavior. However, because key TPB constructs were not measured, the results should not be interpreted as an empirical evaluation of the TPB framework.

7. Key Findings

The results showed that the educational intervention had a major and high impact to improve knowledge, attitude and practices about medicinal plant usage among different socio-cultural groups. The intervention had a bigger impact with populations who

had low baseline knowledge, apparent from the notably increased rate in Egypt.

Moreover, significant correlations among knowledge, attitude and practice variables suggests that the intervention led to a coherent behavioral change process. These results further emphasise the prospects of structured, theory-based educational interventions to enhance herbal health literacy and facilitate safe use of medicinal plants across various community settings.

DISCUSSION

The results of this study not only confirm the previous evidence which indicated the significant effects of educational interventions on promotion-related knowledge but also extend beyond previous studies in showing more comprehensive changes related to knowledge domains concerning safety and preparation dosage of herbal medicines and address inconsistencies noted earlier between the reported increase in knowledge with increased behavioral change outcomes.

The results presented in the study also highlight how active learning through participatory education and hands-on demonstrations helped to improve cognitive

connections, making it a valuable tool for retaining facts in long-term memory. Participation is also vital as evidenced through the participatory education that focuses on herbal medicine, which took place within Gekbrong village and recorded that 100% of participants showed a clear increase in knowledge regarding medicinal plants and their uses, reflecting these strategies ([Nisaa et al., 2022](#)). Likewise, nutrition education using hands-on activities for complementary feeding, resulted in an increase of knowledge scores from both cadre and non-cadre groups; showing that active learning methods will help in getting better practical acquaintance ([Rachmah et al., 2022](#)). Methodologies using active learning such as problem-based and reflective approaches can foster higher-order thinking with greater relevance to the students' own life ([Rezai et al., 2025](#)). Moreover, context-sensitive needs and culturally attuned educational interventions, like those that tackle misconceptions on herbal medication safety and security emphasizes the need for dattel-context sensitive approaches to change deeply ingrained attitudes and behavior ([Nisaa et al., 2022](#)). Overall, these results illustrate how active learning strategies allow for improvement in knowledge attainment and the process of correcting misconceptions, resulting in improved transferability of knowledge across contexts.

The relative extent of knowledge gain in Egypt and Saudi Arabia was a key new finding, indicating that baseline knowledge gaps, availability of health information and socio-cultural factors are important determinants of population responsiveness to educational inputs. These results add to the growing knowledge around health education interventions and are largely in line with established theories of health behavior such as the Theory of Planned Behavior (TPB). The observed associations indicate that

higher knowledge might influence use of herbal medicine through more favorable attitudes and healthy practices. The present study was not intended to empirically test or confirm the TPB framework because it was based on an educational intervention that drew on various aspects of the TPB, and key TPB constructs (eg, subjective norms, perceived behavioral control and behavioral intention) were not measured. Thus the findings are more appropriately viewed as supporting use of TPB at a conceptual level for intervention construction versus testing needle effect. Healthcare workers in Jember, Indonesia reported that knowledge directly influenced attitudes toward supplement use and traditional medicines; general demographic factors (e.g., education level and type of healthcare worker) were the primary determinants ([Aryani et al., 2023](#)). In line with this, a study in Saudi Arabia showed that although herbal medicines is widely adopted among the population, their safety was not well known which reflects poor awareness that puts them at risk of health hazards like toxicity and herb-drug interactions ([Zaidi et al., 2022](#)). In Indonesia, knowledge was the most potent predictor of herbal medicine use, although magical and holistic health beliefs also predict usage, indicating that informed attitudes may facilitate safer practice ([Kristianto et al., 2023](#)). Data on community knowledge of medicinal plants is just few, and educational interventions in West Java prove that by increasing community knowledge about the type of medicinal plants can increase its safe use to improve health outcomes ([Nisaa et al., 2022](#)). On the other hand, Saudi women had relatively more positive attitude and practice regarding herbal treatments in pregnancy which was quite questionable since they were unaware of the side effects associated with these. Thus indicating that there were lacunas to translate knowledge into action

and therefore should be a target for educational activities ([Almoayad et al., 2020](#)). Collectively, these studies emphasize the need for better knowledge to promote positive attitudes and safe practices in herbal medicine use for improved patient safety and community health outcomes.

Large-scale implementation of structured culturally congruent education may improve health literacy and deliver information that translates into public health policy and the formal incorporation of traditional medicine interventions. Health literacy has been widely recognized as an important determinant of NCDs prevention and control through community involvement with local stakeholders in a culturally sensitive context ([Osborne et al., 2022](#)). In multicultural environments (eg, Colombia), etnoeducación has improved health outcomes through the incorporation of cultural perceptions in health education, but due to several barriers and problems for achieving scale-up implementation it is a challenge that remains unsolved ([Hernández-martínez et al., 2021](#)). Community-based culturally tailored education (CBCTE) programs have also shown advantages in the management of chronic diseases within Black communities by implementing culture-sensitive methods, including community member engagement and local dialect use. In North America, the inclusion of public health in medical school curricula emphasizes both the importance of building a foundation in public health as well as innovative community-partnered curricula to realize positive outcomes ([Khalid et al., 2023](#)). In addition, the FAMILY intervention model in China illustrates how family-based systems can be utilized to promote health literacy among ethnic minorities and can serve as a framework that is adaptable to other regions ([Hu et al., 2022](#)). Collectively, these studies highlight the potential of

culturally-relevant educational tools to deepen health literacy and utilize traditional health practices in healthcare settings with adequate community buy-in and supportive policy frameworks.

This study is amongst the first to provide cross-country evidence regarding on the effectiveness of a structured, practice-oriented educational intervention targeting KAP concerning medicinal plant use in Middle Eastern and African contexts, thus constituting a unique contribution to research into global health education. Although this study has important limitations (i.e., lack of a control group and exclusively self-reported measures), the robustness of findings is bolstered by internal validity from the repeated analyses across different studies.

The structured educational intervention in this study was associated with significant improvements to participant knowledge and the correction of key misconceptions around using local medicinal plants within community practice. Larger knowledge gains with lower baseline knowledge suggest that these interventions can lessen health literacy disparities. These results add to the expanding literature on community interventions in health promotion and suggest that culturally relevant educational strategies may translate across diverse socio-cultural contexts. From the public health viewpoint, culturally-sensitive health education programs may improve safe and proper use of herbal medicine including both medicinal plants and dietary supplements. These initial findings need to be confirmed by controlled studies with formal sample size estimation and more complete behavioral assessments to evaluate the mechanisms of behavior change.

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CONFLICT OF INTEREST

There are no conflicts of interest.

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