Saudi Pharmaceutical Journal 32 (2024) 101988

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Contents lists available at ScienceDirect

Saudi Pharmaceutical Journal

journal homepage: www.sciencedirect.com

Original article

Muslim pilgrims' knowledge, attitudes, and practices regarding complementary and alternative medicine (CAM); a study conducted during Hajj season

Aljawharah A. Alqathama [a,*], Rizwan Ahmad [b]

[a] Department of Pharmaceutical Sciences, Pharmacy College, Umm Al-Qura University, Makkah 21955, Saudi Arabia
[b] Department of Natural Products, College of Clinical Pharmacy, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia

ARTICLE INFO

Keywords:
Hajj
Pilgrims
Prevalence
Disclosure
Belief
Complementary and alternative medicine

ABSTRACT

Complementary and alternative medicine (CAM) has attracted much interest, and its prevalence in both developed and developing countries has increased. During the Hajj season, millions of Muslims from many different countries travel to Makkah for the pilgrimage. In dealing with health issues during the holy season, many pilgrims prefer to self-medicate with traditional remedies instead of visiting medical practitioners, which could affect the efforts of state healthcare organizations to maintain overall public health during this mass gathering. This study aims to gauge the prevalence of CAM use during Hajj, and to assess pilgrims' beliefs and knowledge of CAM therapies, with particular reference to products available in Makkah. A cross-sectional survey was conducted in several camps and hotels occupied by Hajj pilgrims in Makkah, during Hajj 2023. CAM modalities were used by 68.8 % of the study participants during the Hajj season. There were almost equal numbers of men (53.7 %) and women (46.3 %) participants, with 88 % of the CAM users being non-Saudi and only 12 % Saudi. The majority of the CAM users belonged to two age groups, the 31–40 year group (29.9 %) and the 41–50 year group (34.5 %). The most frequent self-practice therapies were religious prayer/rituals (30.2 %), and the most popular practitioner therapies was herbal treatments (12.3 %). The most common source of CAM-related information was family/friends (29.2 %), for improving well-being reason (25.8 %). More than half of the participants (56.8 %) strongly believed that CAM therapies have the potential to cure disease, although they were unaware of possible interactions between CAM and conventional drugs (76.7 %). More than half of the participants (57.8 %) did not disclose their CAM usage to healthcare practitioners. Half of the sample said they used CAMs during Hajj because of the common belief that therapeutic products from the holy city of Makkah, such as Zamzam water, are more effective. In conclusion, CAM therapies are commonly used by Hajj pilgrims as they are presumed to be natural and therefore safe, raising concerns about the potential risks of relying on CAM without adequate consultation with healthcare providers or awareness of potential interactions between prescription drugs and CAM treatments.

1. Introduction

Complementary and alternative medicine (CAM) has been defined by the USA's National Center for Complementary and Integrative Health (NCCIH), as "a group of diverse medical and healthcare systems, practices, and products that are not presently considered to be part of conventional medicine" (Alqathama et al., 2023). It is an umbrella term for a large number of practices and therapies that are based on a variety of different theories, philosophies and experiences. CAM therapies and practices are used by many groups and individuals to improve and maintain health, as well as to prevent or treat psychological and physical illnesses (Wachtel-Galor and Benzie. 2011). CAM is classified by the National Institute of Health (NIH) into five major categories: alternative medical systems (e.g. traditional Chinese medicine, Tibetan medicine, Ayurveda, acupuncture, and naturopathy), biological therapies (e.g. herbal medicine, diet-based therapy and megavitamin therapy), mind–body interventions (such as meditation, yoga, prayer and spiritual healing by others), energy therapies (such as magnetic therapy, reiki, and other methods affecting the "bioelectric field" of the body), manipulative and body-based therapies (e.g. massage, chiropractic, the

* Corresponding author.
E-mail address: aaqathama@uqu.edu.sa (A.A. Alqathama).

https://doi.org/10.1016/j.jsps.2024.101988
Received 1 January 2024; Accepted 7 February 2024
Available online 12 February 2024

Feldenkrais method and osteopathic medicine) (Amira and Okubadejo, 2007).

Approximately 80 % of low to middle class populations in developing countries rely on CAM for their primary healthcare, and over the last four or five decades, CAM use in developed countries and the USA has risen steadily, to the point where it is now estimated that four in ten adults use at least one type of CAM therapy (Agarwal, 2018). A substantial (44 %) of the UK population use such therapies on a daily basis, as do 48 % of the German and 66 % of the Australian population (Hunt et al., 2010, Conrady and Bonney, 2017, Lederer et al., 2021). CAM is also now attracting the attention of the medical profession; for example, in Austria, the number of GPs who are trained for at least one type of CAM therapy has increased by over 136 % (Frass et al., 2012). Although interest is rising, the potential side effects of some therapies may be underestimated by users. Many people believe CAM therapies to be safe because they are "natural" and they neglect to disclose these medications to their orthodox healthcare providers (Tangkiatkumjai et al., 2020). Research in this area would be beneficial to ensure safe use of CAM therapies, especially in conjunction with orthodox medicine.

The Hajj pilgrimage is one of the main pillars of Islam, and around 2 million pilgrims annually, from more than 140 countries, visit Makkah and Al-Masha'aer, the holy areas of Saudi Arabia (Alrufaidi et al., 2023). Visitor numbers during holy seasons are expected to rise every year, especially since greater participation in Hajj is one of the goals of the Saudi vision 2030. The number of pilgrims is predicted to reach 30 million by 2030 (Alammash et al., 2021). It is important to note that pilgrims visiting Muslim holy places are of many different nationalities, ethnic backgrounds, and cultures. Many of them are likely to rely on traditional CAM practices from their own cultures, and expect to continue with them during the season; the question is whether those CAM therapies and products are effective enough to ensure health benefits, which is a concern of Hajj officials.

Our study derives its rationale from the fact that CAM practices are actively used worldwide, including in Muslim communities, where herbal and plant medicines are traditionally consumed or applied as home remedies for injury and disease. As the number of pilgrims is increasing year on year, it is clearly in the interests of public health to investigate how much CAM is used in place of orthodox healthcare and whether/how this may affect the health of pilgrims. Thus, we aim to assess the prevalence of CAM among pilgrims so that they may be provided with useful information on its safe use during their pilgrimage, and we focus on pilgrims' sources of information to identify the most common beliefs about CAM therapies. We examine the attitudes and beliefs about CAM among Hajj pilgrims, including beliefs about specific practices and products from Makkah.

2. Materials and methods

2.1. Study design

A cross-sectional study was conducted during Hajj season 2023, with data collected from Saudi Arabia's Hajj campaigns and hotels in Makkah and Al-Masha'aer. Structured questionnaires were distributed in seven different languages (Arabic, English, French, Turkish, Indonesian, Hindi and Swahili) for participants' convenience.

2.2. Sampling and participant recruitment

2.2.1. Sample size and participant recruitment

Sample size was calculated using a web-based sample size calculator (Sampsize.sourceforge.net, 2019). A variety of parameters were used, and a 95 % confidence interval, 5 % two-tailed alpha error (type one error for α value = 0.05), and 5 % precision rate were factored into the sample calculations. It was found that the research required a total of 385 participants.

2.2.2. Inclusion and exclusion criteria

The sample comprised participants from the target populations of Hajj pilgrims who satisfied the following inclusion criteria. Participants had to be (1) aged 18 or over; (2) able to fluently read and understand one of the seven questionnaire languages; and (3) willing to take part. After potential participants had been identified, the data collector explained the purpose of the study and asked if they were willing to take part. The data were collected using a questionnaire-based survey. All potential participants who did not agree to take part were excluded from the study, and all incomplete and incorrectly filled-in responses to the questionnaire were rejected.

2.2.3. Study instrument

The survey questionnaire was designed in accordance with key concepts identified in the literature review. An advisory board of two academic members of staff gave their comments on the content, ease of comprehension, and assessment quality of the first draft of the questionnaire. Checks and balances from independent reviewers are to ensure that data gathering tools are appropriate to the research questions and themes, and are of sufficiently high research standard. The draft was amended and structured to first gather demographic information such as age, marital status, education, and occupation, and then to collect data on CAM with respect to participants' use, reasons for use, attitudes, beliefs, and disclosure of use to healthcare professionals. A pilot questionnaire was initially distributed to four randomly-selected participants to gather feedback on comprehensibility and ease of reading; the collected data were then discarded and did not form part of the main study. The questionnaires were made available in seven different languages to allow a large number of participants to respond.

It was desirable that the study should conform to standards of reliability, i.e., the degree to which the findings are reproducible under as near identical conditions as possible, using the same data gathering and analysis techniques, processes, and software. The reliability of this study was ensured by documenting the collection process and following all of the steps in the protocol for the data collection. Furthermore, data were collected at the same time from the targeted population at all of the collection sites, and were subsequently analyzed together. In order to reduce the chances of inadvertent bias, closed rather than open questions were used in the survey.

2.3. Ethical approval

This study was approved by the Biomedical Research Ethics Committee of the Department of Graduate Studies and Scientific Research at Umm AlQura University, Saudi Arabia (reference no. HAPO-02-K-012-2023-02-1442) on 7 February 2023.

2.4. Statistical analysis of the data

The datasets obtained from the survey were coded and entered into the Statistical Package for Social Sciences (SPSS) v.22. The data for demographics was analyzed as N (numbers) and % (percentages). For the variances and correlations in the data i.e., the demographics vs dependent variables (DVs), bivariate correlation using Pearson's analysis and principal component analysis (PCA) were performed. For the knowledge mean (X) and standard deviation (SD), whereas for the association between demographics and DV, inferential statistics of cross tabulation was applied. All the data was evaluated at a significant level of $P < 0.05$.

3. Results

3.1. Reliability of the questionnaire

The reliability analysis for the items ($N = 27$) in the questionnaire yielded a Cronbach alpha value of 0.640. The ANOVA test resulted in a

high F-value of 512.17 with a significance of $P = 0.00$.

3.2. Participant sample

A total of 420 survey questionnaires were distributed among the pilgrims, out of which 391 were completed, resulting in a response rate of 93 %. It was found that the high percentage of the pilgrims surveyed (68.8 %) used CAM therapies and practices to support their health.

3.3. Demographics of the study

The demographics information showed that the majority of participants were non-Saudi (N = 344, 88 %) and that there was an almost equal proportion of male (N = 210, 53.7 %) and female (N = 181, 46.3 %) respondents in total. With regard to ethnic background, one third of the respondents came from Arabic regions or countries (N = 142, 36.3 %), while the two most common ages ranges were 41–50 years (N = 135, 34.5 %) followed by 31–40 years (N = 117, 29.9 %). Approximately two thirds of the respondents were employed (N = 256, 65.5 %) and just over half had health insurance (N = 228, 58.3 %), while more than half of the sample lived with others (N = 221, 56.5 %). The monthly income distribution revealed that roughly the same percentage of respondents earned less than 300 USD (N = 160, 40.9 %) or more than 300 USD (N = 160, 40.9 %). More than half of the respondents rated their own health as 'good' (N = 207, 52.9 %). The demographic data of the 391 respondents is summarized in Table 1.

3.4. The respondents' use of CAM modalities

The majority of the respondents (N = 269, 68.8 %) reported using some form of CAM to support their health. Approximately one third of respondents reported engaging in prayer or rituals as a self-practice CAM therapy (N = 118, 30.2 %) whereas among CAMs practices offered by practitioners, the most recommended therapy was herbalism (N = 48, 12.3 %). Most of the respondents (N = 102, 26.1 %) reported using more than one type of CAM therapy listed in the survey. Regarding products, the most popular among respondents were herbal remedies (N = 71, 18.2 %) as well as vitamin and mineral supplements (N = 72, 18.4 %). A quarter of the respondents reported using CAM for improving their overall health (N = 101, 25.8 %), and this was related to their strong beliefs in practices originating from traditional, cultural or religious backgrounds (N = 85, 21.7 %). The most frequently cited sources of information or recommendation for CAM were family and friends (N = 114, 29.2 %) and media resources (N = 55, 14.1 %). More than half of the respondents said they did not experience side effects as a result of using CAM therapies and practices (N = 222, 56.8 %) and more than half of the respondents didn't report side effects to orthodox healthcare practitioners (N = 226, 57.8 %). The data for frequency and type of CAM use is shown in Table 2.

Correlations between frequency/type of CAM use and demographic data was constructed using Pearson's correlation, where a bivariate correlation was revealed for the pairs. The age of the respondents showed a positive correlation ($P < 0.05$) with all the pairs except gender, previous use of CAM, whether used as an alternative or complementary practice, therapies offered by practitioners, reason for using CAM, and side effects experienced ($P > 0.05$). A positive correlation was observed between age and nationality (0.11; $P = 0.01$), race (0.11; $P = 0.02$), education (−0.09; $P = 0.05$), and CAM self-practices (0.12; $P = 0.01$). The gender of the respondents showed a high positive correlation with the type of CAM only (0.13; $P = 0.00$). The nationality of the respondents exhibited positive correlation pairs for race or ethnicity (0.39; $P = 0.00$), education (−0.10; $P = 0.04$), practices offered by practitioners (0.18; $P = 0.00$), self-practices (−0.08; $P = 0.08$), and reason for the use of CAM (0.10; $P = 0.03$). A high bivariate positive correlation was observed between race or ethnicity and education level (0.19; $P = 0.00$), therapies offered by practitioners (0.25; $P = 0.00$), reasons for using CAM (0.10; $P = 0.04$), and experiencing side effects with the use of CAM (0.17; $P = 0.00$). Previous use of CAM also showed a high bivariate

Table 1
Demographics information for the respondents ($N = 391$; 100 %) in the study.

DV	Frequency	Percentage	DV	Frequency	Percentage
Age			***Race/Ethnic background***		
<30	44	11.3	**Arabic**	142	36.3
31–40	117	29.9	**African non-Arabic**	49	12.5
41–50	135	34.5	**Southeast Asia**	79	20.2
51–60	82	21.0	**South Asia**	75	19.2
>61	13	3.3	**Turkish/European**	46	11.8
Total	*391*	*100.0*	*Total*	*391*	*100.0*
Gender			***Living arrangement***		
Male	210	53.7	**Alone**	170	43.5
Female	181	46.3	**With others**	221	56.5
Total	*391*	*100.0*	*Total*	*391*	*100.0*
Nationality			***Employment status***		
Saudi	47	12.0	**Unemployed**	135	34.5
Non-Saudi	344	88.0	**Employed**	256	65.5
Total	*391*	*100*	*Total*	*391*	*100.0*
Health insurance			***Self-rated health***		
Uninsured	163	41.7	**Good**	207	52.9
Insured	228	58.3	**Fair**	181	46.3
Total	*391*	*100.0*	**Poor**	3	0.8
Monthly income			*Total*	*391*	*100.0*
No income	71	18.2	***Have you used CAM before?***		
<300$/month	160	40.9	**Yes**	269	68.8
>300$/month	160	40.9	**No**	122	31.2
Total	*391*	*100.0*	*Total*	*391*	*100.0*

Table 2
The use, types, and practices with source of information for CAM.

DV	Frequency	Percentage	DV	Frequency	Percentage
Alternative or complementary			***CAM therapies offered by practitioners***		
Complementary	188	48.1	**Hijamah (cupping)**	30	7.7
Alternative	203	51.9	**Herbal Medicine**	48	12.3
Total	*391*	*100.0*	**Spiritual or religious healing**	24	6.1
CAM type: Self-practices			**Cauterization**	8	2.0
Yoga	24	6.1	**Acupuncture**	21	5.4
Meditation	21	5.4	**Homeopathy**	5	1.3
relaxation technique	20	5.1	**Aromatherapy**	18	4.6
Breathing exercise	26	6.6	**Chiropractic**	16	4.1
Prayers/rituals	118	30.2	**Massage**	28	7.2
Others	34	8.7	**Spinal manipulation**	10	2.6
Combinations	33	8.4	**Others**	3	0.8
None of above	115	29.4	**Combination of the above therapies**	102	26.1
Total	391	100.0	**None of above**	78	19.9
Types of CAM: Herbal medicine and dietary supplements			*Total*	*391*	*100.0*
Herbs	71	18.2	***If yes, why have you used it?***		
Vitamins/mineral supplements	72	18.4	**For acute illness/condition** (less than one month)	22	5.6
Homeopathic remedies	9	2.3	**To treat a long-term health condition** (more than one month duration)	55	14.1
Honey and products	38	9.7	**Beliefs (tradition, culture, religion)**	85	21.7
Others	23	5.9	**To improve well-being**	101	25.8
Combinations	62	15.9	**reduce side effects of medication**	21	5.4
None of above	116	29.7	**Combination of the above**	70	17.9
Total	*391*	*100.0*	**Other**	37	9.5
If yes, did you experience any side effects?			*Total*	*391*	*100.0*
No	222	56.8	***What is your source of information about CAM?***		
Mild	161	41.2	**Personal knowledge**	52	13.3
Moderate	8	2.0	**Media**	55	14.1
Total	*391*	*100.0*	**Internet**	44	11.3
Did you inform your healthcare provider?			**Family /friend**	114	29.2
Yes	165	42.2	**Physician /healthcare provider**	26	6.6
No	226	57.8	**Healers (religious, alternative, attars)**	19	4.9
Total	*391*	*100.0*	**Any of the above combination**	72	18.4
			None of above	9	2.3
			Total	*391*	*100.0*

Table 3
Descriptive statistics for belief, awareness, and use of CAM during Hajj season.

DV	Frequency	Percentage	DV	Frequency	Percentage
Do you believe CAM is able to cure disease?			***Do you expect positive change after the use of CAM?***		
Yes	222	56.8	**Definitely**	145	37.1
No	65	16.6	**May be**	188	48.1
Don't know	104	26.6	**Not at all**	58	14.8
Total	*391*	*100.0*	*Total*	*391*	*100.0*
Are you aware of drug interactions with CAM?			***Would you recommend CAM to other people?***		
Yes	91	23.3	**Yes**	313	80.1
No	124	31.7	**No**	78	19.9
Don't know	176	45.0	*Total*	*391*	*100.0*
Total	*391*	*100.0*			
CAM use during the Hajj season					
Do you continue using CAM during Hajj season?			***If yes, which products or therapies for healing purposes did you use or take with you from Makkah?***		
Yes	196	50.1	**Zamzam water**	137	35.0
No	195	49.9	**Honey**	65	16.6
Total	*391*	*100.0*	**Hijamah**	5	1.3
Do you prefer to use any of the CAM products or therapies originally from Makkah this season?			**Herbs**	26	6.6
Yes	304	77.7	**Others**	1	0.3
No	87	22.3	**Combination**	85	21.7
Total	*391*	*100.0*	**None of above**	72	18.4
			Total	*391*	*100.0*

correlation with practices offered by practitioners (0.26; $P = 0.00$) and self-practices (0.36; $P = 0.00$), type of CAM used (0.45; $P = 0.00$), and reasons for CAM use (0.24; $P = 0.00$). The use of complementary or alternative types of medicine vs experienced of side effects (0.14; $P = 0.00$), practices offered by practitioner vs type of CAM (0.28; $P = 0.00$) and CAM self-practices (0.21; $P = 0.00$), and type of CAM vs reason for use (0.14; $P = 0.00$). The level of education variable showed lack of any positive correlation. The data for bivariate Pearson's correlation is shown in Table 4. The nationality, race, type of CAM used, type of self-practices, and CAM practices offered by practitioners showed the highest positive correlation for personal use of CAM and its types.

3.5. Belief in and awareness of CAM

The majority of the respondents believed that CAM therapies and practices can cure disease (N = 222, 56.8 %) and expected to see positive changes as a result of use (N = 233, 85.2 % i.e., for definitely and may be). An overwhelming majority of the respondents said they would recommend CAM to other people (N = 313, 80.1 %). However, a large proportion of respondents reported that they had no knowledge of the possible interactions between CAM products and conventional medications (N = 300, 76.7 % i.e., no and don't know). The data for awareness and belief in CAM is presented in Table 3.

The correlations for demographics of age, gender, nationality, race, and educational level are presented above. The nationality of the respondents exhibited a high bivariate positive correlation with the belief that CAM cures disease (0.23; $P = 0.00$) and the expectation of positive change after CAM use (0.17; $P = 0.00$). The source of information (0.18; $P = 0.00$), disclosing CAM use to healthcare providers (−0.10; $P = 0.03$), belief that CAM can cure disease (0.25; $P = 0.00$), and expectation of positive change after CAM use (0.27; $P = 0.00$) showed positive correlations with the race or ethnicity of the respondents. Education level was negatively correlated (−0.18; $P = 0.00$) with respondents reporting CAM use to healthcare providers, whereas a high positive correlation was observed for the expectation of positive change after CAM use with education level (0.11; $P = 0.02$) and source of information (0.12; $P = 0.02$). Recommending CAM to other people showed a positive correlation with the belief that CAM is able to cure disease (0.21; $P = 0.00$) and expected positive change after CAM (0.36; $P = 0.00$) only. The data for association regarding the CAM belief and awareness is shown in Table 5. The belief that CAM cures disease and the expectation of positive change following CAM therapies, and the willingness to recommend CAM to others showed the highest positive correlations with the CAM belief and awareness variables.

3.6. Use and type of CAM therapies during Hajj season

CAM use during Hajj season was reported by half of the respondents (N = 196, 50.1 %) and the majority expressed interest in using CAM products or therapies originating in the Makkah region (N = 304, 77.7 %). For example, more than a third of the respondents reported drinking Zamzam water (N = 137, 35 %), which is valued not only for its chemical properties but also for its religious significance. The majority of these participants said they used products from Makkah because of a common religion-based belief that products from Makkah are more effective than others. A summary of data on the use and type of CAM during Hajj is presented in Table 3. The correlation for demographics is presented in previous sections. For CAM use during Hajj, a high negative but significant correlation was seen for age (−0.10; $P = 0.03$) and education (−0.11; $P = 0.02$). The use of CAM therapies from Makkah showed a high positive correlation w CAM use during Hajj season (0.53; $P = 0.00$) only. The reasons for using therapies or products from Makkah showed a high positive bivariate correlation with race or ethnicity (0.12; $P = 0.01$), CAM use during Hajj (0.37; $P = 0.00$), and the use of CAM therapies originating from Makkah (0.81; $P = 0.00$). Moreover, use of therapies or products from Makkah had a positive bivariate correlation

Table 4
Bivariate correlations of demographic data with personal use, with P significance $P = 0.05$.

	Age	Gender	Nationality	Race	Education	Used CAM before	Alternative or complementary	Practices offered by practitioner	CAM self-practices	Types of CAM	Reason for use	Experienced any side effect
Age	1	−0.06	0.11*	0.11*	−0.09	−0.08	−0.00	−0.02	0.12*	−0.05	0.05	0.02
Gender	0.22	1	0.01	0.02	0.05	0.11	0.87	0.58	0.01	0.29	0.30	0.58
Nationality	−0.06	0.06	1	0.01	0.05	−0.02	−0.05	0.06	−0.03	0.13**	−0.05	0.02
Race	0.22	0.18	0.73	0.25	0.58	0.31	0.17	0.45	−0.08	0.00	0.29	0.56
Education	0.11*	0.06	0.39**	−0.10*	−0.01	0.83	0.04	0.18**	0.08	0.05	0.10*	0.05
Used CAM before	0.01	0.18	0.00	0.04	0.83	0.37	0.00	0.08	0.26	0.03	0.27	
Alternative or complementary	0.11*	0.01	0.39**	1	0.19**	−0.00	0.04	0.25**	−0.02	0.06	0.10*	0.17**
Practices offered by practitioner	0.02	0.73	0.00		0.00	0.92	0.43	0.00	0.61	0.22	0.04	0.00
CAM self-practices	−0.09	0.05	−0.10*	0.19**	1	0.01	−0.04	0.02	−0.01	0.02	0.08	0.03
Types of CAM	0.05	0.25	0.04	0.00		0.81	0.43	0.64	0.72	0.59	0.09	0.50
Reason for use	−0.08	−0.02	−0.01	−0.00	0.01	1	−0.04	0.26**	0.36**	0.45**	0.24**	−0.02
Experienced any side effect	0.11	0.58	0.83	0.92	0.81		0.34	0.00	0.00	0.00	0.00	0.65
	−0.00	−0.05	0.04	0.04	−0.04	−0.04	1	−0.08	−0.06	−0.12*	−0.00	0.14**
	0.87	0.31	0.37	0.43	0.43	0.34		0.08	0.22	0.01	0.87	0.00
	−0.02	0.06	0.18**	0.25**	0.02	0.26**	−0.08	1	0.21**	0.28**	0.10*	−0.03
	0.58	0.17	0.00	0.00	0.66	0.00	0.08		0.00	0.00	0.03	0.44
	0.12*	−0.03	−0.08	−0.02	−0.01	0.36**	−0.06	0.21**	1	0.25**	0.18**	−0.09
	0.01	0.45	0.08	0.61	0.72	0.00	0.22	0.00		0.00	0.00	0.05
	−0.05	0.13**	0.05	0.06	0.02	0.45**	−0.12*	0.28**	0.25**	1	0.14**	0.06
	0.29	0.00	0.26	0.22	0.59	0.00	0.01	0.00	0.00		0.00	0.22
	0.05	−0.05	0.10*	0.10*	0.08	0.24**	−0.00	0.10*	0.18**	0.14**	1	−0.00
	0.30	0.29	0.03	0.04	0.09	0.00	0.87	0.03	0.00	0.00		0.94
	0.02	0.02	0.05	0.17**	0.03	−0.02	0.14**	−0.03	−0.09	0.06	−0.00	1
	0.58	0.56	0.27	0.00	0.50	0.65	0.00	0.44	0.05	0.22	0.94	

Table 5
Correlation of demographic data with CAM belief, awareness, and source of information.

	Age	Gender	Nationality	Race	Education	Source of information	Disclose CAM use to healthcare providers	CAM belief	Expect positive change	Aware of CAM-drug interaction	Recommend to others
Age	1	−0.06	0.11*	0.11*	−0.10	−0.04	0.05	0.08	0.03	0.10	−0.01
		0.23	0.02	0.03	0.05	0.47	0.31	0.10	0.59	0.06	0.84
Gender	−0.06	1	0.07	0.02	0.06	−0.07	0.01	0.06	0.02	0.04	0.00
	0.23		0.19	0.73	0.25	0.15	0.78	0.21	0.74	0.47	0.98
Nationality	0.11*	0.07	1	0.39**	−0.10*	0.02	−0.02	0.23**	0.17**	0.07	0.06
	0.02	0.19		0.00	0.05	0.72	0.66	0.00	0.00	0.18	0.22
Race	0.11*	0.02	0.39**	1	0.19**	0.18**	−0.10*	0.25**	0.27**	0.07	0.06
	0.03	0.73	0.00		0.00	0.00	0.03	0.00	0.00	0.14	0.25
Educational level	−0.10	0.06	−0.10*	0.19**	1	0.05	−0.18**	0.09	0.11*	−0.01	0.02
	0.05	0.25	0.05	0.00		0.31	0.00	0.07	0.02	0.86	0.72
Source of information	−0.04	−0.07	0.02	0.18**	0.05	1	−0.06	0.06	0.12*	−0.04	−0.04
	0.47	0.15	0.72	0.00	0.31		0.20	0.23	0.02	0.43	0.38
Report to healthcare providers	0.05	0.01	−0.02	−0.10*	−0.18**	−0.06	1	0.09	−0.14**	0.10*	0.08
	0.31	0.78	0.66	0.03	0.00	0.20		0.07	0.00	0.04	0.13
CAM belief	0.08	0.06	0.23**	0.25**	0.09	0.06	0.09	1	0.39**	−0.01	0.21**
	0.10	0.21	0.00	0.00	0.07	0.23	0.07		0.00	0.81	0.00
Expect positive change	0.03	0.02	0.17**	0.27**	0.11*	0.12*	−0.14**	0.39**	1	0.09	0.36**
	0.59	0.74	0.00	0.00	0.02	0.02	0.00	0.00		0.07	0.00
Aware of CAM-drug interaction	0.10	0.04	0.07	0.07	−0.01	−0.04	0.10*	−0.01	0.09	1	0.02
	0.06	0.47	0.18	0.14	0.86	0.43	0.04	0.81	0.07		0.63
Recommend to others	−0.01	0.00	0.06	0.06	0.02	−0.04	0.08	0.21**	0.36**	0.02	1
	0.84	0.98	0.22	0.25	0.72	0.38	0.13	0.00	0.00	0.63	

with CAM use during Hajj (0.25; $P = 0.00$), the use of CAM therapies or products from Makkah (0.54; $P = 0.00$), and the reason for using products or therapies originating from Makkah (0.49; $P = 0.00$). A summary of the data correlations with CAM type and reason for using products from Makkah is given in Table 6. The use of CAM during Hajj season, CAM therapies or products from Makkah region, type of product or therapy from Makkah, and reason for using products from Makkah showed the highest positive correlations.

3.7. Associations between demographics and dependent variables (DV)

The CAM variables were cross tabulated with the demographics in order to arrive at findings that were significant. P significance, i.e., $P < 0.05$, is discussed here in the format of expected (observed) count.

In terms of age groupings, CAM was used more frequently in the age groups 41–50 and 31–40 years, with observed (expected) count of N = 96 (92.9) and N = 81 (80.5), respectively. The age group of 41–50 years mostly used the complementary system for CAMs with a count of N = 78 (64.9) whereas, the alternative treatment system was used mostly by the age group of 31–40 years with a count of N = 77 (60.7). For type of CAM self-practices, prayer was the most popular form, with an observed count of N = 44 (40.7) in general in the age group 41–50 years. For the count on an individual basis, the type of CAM self-practices adopted was; meditation, count N = 10 (6.3), and breathing exercises, count N = 13 (7.8), in the age group of 31–40 years, whereas prayer, count N = 44 (40.7), and relaxation techniques, count N = 8(6.9), were observed to be more prevalent in the age group 41–50 years. The reasons for using CAM were chronic disease in the age group 31–40 years, observed count N = 33 (16.5), followed by family, religion, and cultural beliefs of the respondents for CAM use in the age group 31–40 years, with an observed count of N = 33 (29.3). Both the age groups of 31–40 and 41–50 years believed equally that CAM therapies are able to cure disease, where the respective observed counts were N = 77 (66.4) and N = 77 (76.6). The same age groups of 31–40 and 41–50 years revealed that respondents

Table 6
Bivariate Pearson's correlation of demographic data with data on CAM use during Hajj.

	Age	Gender	Nationality	Race	Education	CAM use during Hajj	CAM therapy from Makkah	If yes, why?	Type of therapy/ product from Makkah
Age	1	−0.06	0.11*	0.11*	−0.10	−0.10*	0.02	−0.01	−0.05
		0.23	0.02	0.03	0.05	0.03	0.76	0.89	0.32
Gender	−0.06	1	0.07	0.02	0.06	0.00	0.00	−0.03	0.06
	0.23		0.19	0.73	0.25	0.96	0.95	0.55	0.23
Nationality	0.11*	0.07	1	0.39**	−0.10*	−0.05	0.04	0.03	0.08
	0.02	0.19		0.00	0.05	0.35	0.41	0.51	0.09
Race	0.11*	0.02	0.39**	1	0.19**	−0.03	0.07	0.12*	0.07
	0.03	0.73	0.00		0.00	0.61	0.15	0.01	0.18
Education	−0.10	0.06	−0.10*	0.19**	1	−0.11*	0.04	0.06	0.03
	0.05	0.25	0.05	0.00		0.02	0.40	0.24	0.61
CAM use during Hajj	−0.10*	0.00	−0.05	−0.03	−0.11*	1	0.53**	0.37**	0.25**
	0.03	0.96	0.35	0.61	0.02		0.00	0.00	0.00
CAM therapy from Makkah	0.02	0.00	0.04	0.07	0.04	0.53**	1	0.81**	0.54**
	0.76	0.95	0.41	0.15	0.40	0.00		0.00	0.00
If yes, why?	−0.01	−0.03	0.03	0.12*	0.06	0.37**	0.81**	1	0.49**
	0.89	0.55	0.51	0.01	0.24	0.00	0.00		0.00
Type of therapy/product from Makkah	−0.05	0.06	0.08	0.07	0.03	0.25**	0.54**	0.49**	1
	0.32	0.23	0.09	0.18	0.61	0.00	0.00	0.00	

expected positive changes to occur following CAM use, with observed counts of N = 68 (56.3) and N = 57 (50.1), respectively. The source of CAM information was media for the age group 31–40 years and personal knowledge in the age group 41–50 years, with respective observed counts of N = 30 (16.5) and N = 26 (18). For nationality correlated to CAM belief, Saudi residents showed more observed count of N = 41 (26.7) and N = 27 (17.4) for the claim that CAM modalities are able to cure disease and produce a positive change after use. The data for association between age and nationality is shown in Table 7.

Cross-tabulation for race or ethnicity of respondents showed widespread use of complementary treatments, with Arabic N = 70 (68.3), African non-Arabic N = 32 (23.6), and South Asian inhabitants N = 41 (36.1) using this system, whereas alternative treatments were used mostly by the South East Asian N = 25(38) and European/Turkish respondents N = 20 (22.1). For the type of CAM self-practices adopted, prayers or rituals was observed more N = 51 (42.9) in general whereas, for the individual type of CAM self-practice; the Arabic respondent reported the use of meditation N = 10 (7.6), relaxation techniques N = 8 (7.3), and prayer N = 51 (42.9), while breathing exercises N = 8 (5.3) were used more by the South East Asian respondents, and yoga by the South Asian residents N = 9 (4.6). More of the respondents consulted herbalists N = 24 (17.4) and hijamah practitioners N = 22 (10.9), especially the Arabic respondents. The respondents reported on their use of different types of CAM products or remedies. Vitamin and mineral supplements were used by N = 35 (26.1) and N = 26 (25.8) took herbs, followed by honey products N = 20 (13.8) in Arabic respondents. The majority of respondents did not experience side effects N = 96 (80.6) after CAM use, and most of them did not report CAM use to their orthodox healthcare providers N = 83 (82.1). Most of the respondents (N = 50 (30.9)) said they used CAM because they held strong beliefs about its efficacy that were also shared or supported by their family, friends, culture and religion, and a another significant number (N = 30 (20.4)) said they were happy to use CAM to maintain or improve their overall health. The respondents reported that their sources of information about CAM were family and friends N = 46 (41.4), media N = 27 (20), and personal knowledge N = 22 (18.9).

With regard to awareness of and beliefs about CAM, the majority of respondents from Arabic countries indicated strong belief that CAM therapies and practices were able to cure disease, (N = 115 (80.6)), with a large proportion of the respondents expecting a positive change after CAM use as follows: Yes: N = 70 (52.7) and Maybe: N = 70 (68.3). The observed count for the respondents' awareness about CAM-drugs interaction was less than expected: Don't know: N = 53 (63.9) and No: 61 (45). Most of the respondents from Arabic countries said they had recommended CAM therapies to others, with a count of N = 119 (113.7) followed by African non-Arabic residents N = 43 (39.2), and European or Turkish respondents N = 39 (36.8).

CAM use during the Hajj season was reported by N = 34 (24.6) for African non-Arabic respondents, N = 40 (39.6) for South East Asian, and N = 28 (23.1) for European or Turkish respondents. The use of CAM products originating in Makkah due to the belief that they are more effective was reported by Arabic respondents N = 61 (50.1) and South Asian respondents N = 27 (26.5). The data for race or ethnic background correlated with the DVs is shown in Table 8.

The association analysis from the cross tabulation of respondents' educational background showed significant findings for the observed and expected counts. For CAM belief and awareness, the respondents at all educational levels expressed a firm belief that CAM practices and therapies had the ability to cure disease. The lower the educational level, the higher the belief: primary level N = 73(64.7) > graduate degree N = 65(64.7) > secondary level N = 64(68.1) > postgraduate degree N = 20 (24.4). The respondents at all educational levels, except for the postgraduates, said they expected positive changes to occur after using a CAM modality: primary level N = 58 (54.8), secondary level N = 50 (44.5), and graduates N = 60 (54.8). The respondents with primary education reported more herb use N = 31 (20.7), while N = 29 (21) graduates used vitamins and supplements and N = 17 (11.1) used honey products. Interestingly, the observed count of respondents with secondary level and postgraduate degrees who said they did not use herbal products was N = 42 (35.6) and N = 16 (12.8) respectively. The respondents with primary N = 73 (65.9) and secondary N = 80 (69.4) education did not report their CAM use to their healthcare providers, whereas respondents with graduate N = 55 (48.1) and postgraduate N = 29 (18.1) degrees did. In terms of respondents' knowledge of possible interactions between CAM treatments and conventional drugs, different counts were observed at all of the education levels: primary N = 48 (36.2), secondary N = 43 (38.1), graduate N = 57 (51.3), and postgraduate N = 21 (19.4). The data for educational background correlating with the DVs of the study are shown in Table 9.

3.8. Principle component analysis (PCA)

Eigen value-based analysis was applied to the data in order to categorize it into various components based on the %variability of the variables. The scree plot in Fig. 1 suggests nine components with a cumulative %variability of 58.98. Component 1 was seen with a major individual and cumulative variability of 12.21 % where a loading was found for the DV of; "would you recommend CAM to others?", "do you continue using CAM during the Hajj season?", "do you prefer to use CAM products originating in Makkah?", "if yes, why?", and "products or therapies for healing made or offered in Makkah". This reveals a high positive correlation for CAM use during Hajj season with dominant preference for products/therapies originating from Makkah. Moreover, respondents having religious belief in the efficacy of Makkah products also correlated positively and significantly with CAM use. The next highest variability observed for component 2 was 8.12 % on an individual basis with a cumulative variability of 20.33 % where the loaded DVs were; "nationality", "race or ethnic background", "employment status", "belief that CAM is able to cure disease", "the belief that CAM effects positive change" and "source of information about CAM". This suggests a strong correlation between respondent nationality and ethical background and beliefs/expectations surrounding CAM use. The source of information about CAM therapies, (family, friends, media, personal knowledge) also played a significant role with a high correlation between CAM use, particularly during Hajj, and beliefs such as "CAM therapies and products can cure disease". There was also a correlation regarding the type of CAM practice in terms of self-practices and practices offered by practitioners, where herbal or dietary supplements was loaded in component 3 alongside the aforementioned DVs. An individual variability of 8.01 % with cumulative variability of 28.34 % was noted for component 3. This indicates that respondents who either used self-practices or who went to herbal practitioners were mostly those who also used herbal or dietary supplements as CAM treatment. The remaining components with loaded DV are presented in Table 10. The significance of the data is evident from the Bartlett's test of sphericity with a very high chi square value (X^2) of 2356.89 and KMO measure of sampling adequacy of 0.74 at $P < 0.05$ i.e., 0.00.

3.9. Analysis of variance for the data (ANOVA)

The one-way analysis of variance was run for demographics vs DV at $P = 0.05$ in order to find the significance differences for the groups. The age of the respondents was observed to show a significant difference between and within groups for the following: use of complementary and alternative treatment ($F_{5,386} = 5.10$, $P = 0.00$), reason for using CAM ($F_{5,386} = 2.73$, $P = 0.02$), belief that CAM therapies/products can cure disease ($F_{5,386} = 2.55$, $P = 0.03$), expecting a positive change after CAM use ($F_{5,386} = 2.74$, $P = 0.02$), and type of CAM self-practice utilized by respondents ($F_{5,386} = 2.48$, $P = 0.04$). This is evident in the previous statistical model applied where the age groups 31–40 and 41–50 years revealed significant differences in terms of the CAM use, beliefs, types used, and reason for using CAM as compared to the other groups. The

Table 7
Cross tabulation of age and nationality with DVs, with observed and expected count for the 391 respondents.

DV	Have you used CAM before?		Do you use it as a complementary or an alternative method		Types of CAM-self practices								Sig
Age	**Yes**	**No**	**Yes**	**No**	**Yoga**	**Meditation**	**Relaxation technique**	**Breathing exercise**	**Prayer**	**Others**	**Combination**	**None**	*0.05*
<30	25(30.3)	19(13.7)	26(21.2)	18(22.8)	5(2.7)	6(2.4)	3(2.3)	0(2.9)	14(13.3)	3(3.8)	0(3.70	13(12.9)	
31–40	81(80.5)	36(36.5)	40(56.3)	77(60.7)	8(7.2)	10(6.3)	5(6.0)	13(7.8)	35(35.3)	4(10.2)	13(9.9)	29(34.4)	
41–50	96(92.9)	39(42.1)	78(64.9)	57(70.1)	5(8.3)	4(7.3)	8(6.9)	5(9)	44(40.7)	10(11.7)	16(11.4)	43(39.7)	
51–60	55(56.4)	27(25.6)	41(39.4)	41(42.6)	6(5.0)	1(4.4)	4(4.2)	7(5.5)	18(24.7)	13(7.1)	4(6.9)	29(24.1)	
>61	12(8.9)	1(4.1)	3(6.3)	10(6.7)	0(0.8)	0(0.7)	0(0.7)	1(0.9)	7(3.9)	4(1.1)	0(1.1)	1(3.8)	

Age	Reason for using CAM							Sig		Belief of CAM cure diseases?			*0.05*
	Acute condition (<month)	**Chronic condition (>month)**	**Beliefs (family, religion, culture)**	**Improve well-being**	**Reduce side effects of medication**	**Combined options**	**None**	*0.05*	**Yes**		**No**	**I don't know**	
<30	2(2.5)	3(6.2)	13(9.6)	13(11.4)	2(2.4)	4(7.9)	7(4.2)		20(25)		14(7.3)	10(11.7)	
31–40	4(6.6)	33(16.5)	24(25.4)	30(30.2)	6(6.3)	26(20.9)	4(11.1)		77(66.4)		18(19.5)	22(31.1)	
41–50	9(7.6)	23(19)	33(29.3)	31(34.9)	6(7.3)	20(24.2)	13(12.8)		77(76.6)		22(22.4)	36(35.9)	
51–60	6(4.6)	3(11.5)	13(17.8)	22(21.2)	7(4.4)	18(14.7)	13(7.8)		39(46.6)		11(13.6)	32(21.8)	
>61	1(0.7)	3(1.8)	2(2.8)	5(3.4)	0(0.7)	2(2.3)	0(1.2)		9(7.4)		0(2.2)	4(3.5)	

Age	Source of CAM information								Sig	Positive change after CAM use?			*0.05*
	Personal knowledge	**Media**	**Internet**	**Family /friends**	**Healthcare providers**	**Alternative (healers, attars)**	**Combination**	**None**	*0.05*	**Yes**	**May be**	**No**	
<30	5(9.5)	3(6.2)	7(5)	17(12.8)	1(2.9)	1(2.1)	8(8.1)	2(1)		14(16.3)	24(21.2)	6(6.5)	
31–40	8(15.6)	30(16.5)	6(13.2)	33(34.1)	7(7.8)	3(5.7)	29(21.5)	1(2.7)		41(43.4)	68(56.3)	8(17.4)	
41–50	26(18)	11(19)	14(15.2)	38(39.4)	12(9)	11(6.6)	20(24.9)	3(3.1)		57(50.1)	55(64.9)	23(20)	
51–60	13(10.9)	10(11.5)	17(9.2)	18(23.9)	3(5.5)	4(4)	14(15.1)	3(1.9)		24(30.4)	38(39.4)	20(12.2)	
>61	0(1.7	1(1.8)	0(1.50	8(3.80)	3(0.9)	0(0.6)	1(2.4)	0(0.3)		9(4.8)	3(6.3)	1(1.9)	

Nationality

Nationality	Do you believe CAM can cure disease?			Sig	Expect positive change after CAM use?			Sig
	Yes	No	I don't know	*0.05*	Yes	May be	No	*0.05*
Saudi	41(26.7)	6(7.8)	0(12.5)		27(17.4)	19(22.6)	1(7)	
Non-Saudi	181(195.3)	59(57)	104(91.2)		118 (127.2)	169 (165.4)	57(51)	

Table 8
The association analysis of ethnic background or race and DVs (1: Arabic, 2: African non-Arabic, 3: South East Asia, 4: South Asia, 5: Turkey/ Europe).

	Race or ethnic background									
	Used as?					Type of CAM self-practices used				
	Complementary	Alternative	Yoga	Meditation	Relaxation technique	Breathing exercise	Prayers/ prayer rituals	Others	Combination	None
1	70(68.3)	72(73.7)	5(8.7)	10(7.6)	8(7.3)	6(9.4)	51(42.9)	4(12.3)	11(12)	47(41.8)
2	32(23.6)	17(25.4)	2(3)	2(2.6)	7(2.5)	4(3.3)	9(14.8)	8(4.3)	2(4.1)	15(14.4)
3	25(38)	54(41)	5(4.8)	3(4.2)	2(4)	8(5.3)	30(23.8)	5(6.9)	5(6.7)	21(23.2)
4	41(36.1)	34(38.9)	9(4.6)	3(4)	2(3.8)	6(5)	11(22.6)	15(6.5)	12(6.3)	17(22.1)
5	20(22.1)	26(23.9)	3(2.8)	3(2.5)	1(2.4)	2(3.1)	17(13.9)	2(4)	3(3.9)	15(13.5)

	Type of CAM practices offered by practitioner											
	Hijamah	Herbalist	Healers	Cautery	Acupuncture	Homeopathy	Aromatherapy	Chiropractic	Massage	Spinal manipulation	Other	Combination	None
1	22(10.9)	24(17.4)	11(8.7)	7(2.9)	7(7.6)	0(1.8)	7(6.5)	5(5.8)	8(10.2)	2(3.6)	0(1.1)	29(37)	20 (28.3)
2	3(3.8)	8(6)	3(3)	0(1)	1(2.6)	0(0.6)	3(2.3)	3(2)	2(3.5)	3(1.3)	0(0.4)	9(12.8)	14 (9.8)
3	3(6.1)	7(9.7)	5(4.8)	0(1.6)	9(4.2)	0(1)	4(3.6)	0(3.2)	10(5.7)	0(2)	0(0.6)	26(20.6)	15 (15.8)
4	1(5.8)	3(9.2)	2(4.6)	1(1.5)	2(4)	4(1)	0(3.5)	8(3.1)	3(5.4)	3(1.9)	3(0.6)	27(19.6)	18 (15)
5	1(3.5)	6(5.6)	3(2.8)	0(0.9)	2(2.5)	1(0.6)	4(2.1)	0(1.9)	5(3.3)	2(1.2)	0(0.4)	11(12)	11 (9.2)

	Type of CAM- herbal medicine and dietary supplements?					Side effects experienced			Report use to healthcare provider			
	Herbs	Vitamins/ supplement	Homeopathic remedy	Honey & product	Others	Combined	None	No	Mild	Moderate	Yes	No
1	26(25.8)	35(26.1)	0(3.3)	20(13.8)	2(8.4)	22(22.5)	37(42.1)	96(80.6)	44(58.5)	2(2.9)	59 (59.9)	83(82.1)
2	12(8.9)	7(9)	0(1.1)	3(4.8)	2(2.9)	8(7.8)	17(14.5)	27(27.8)	21(20.2)	1(1)	17 (20.7)	32(28.3)
3	11(14.3)	15(14.5)	2(1.8)	13(7.7)	2(4.6)	9(12.5)	27(23.4)	41(44.9)	36(32.5)	2(1.6)	22 (33.3)	57(45.7)
4	10(13.6)	5(13.8)	5(1.7)	2(7.3)	14(4.4)	20(11.9)	19(22.3)	43(42.6)	29(30.9)	3(1.5)	39 (31.6)	36(43.4)
5	12(8.4)	10(8.5)	2(1.1)	0(4.5)	3(2.7)	3(7.3)	16(13.6)	15(26.1)	31(18.9)	0(0.9)	28 (19.4)	18(26.6)

	If yes, purpose for using CAM						
	For an acute illness/ condition, one that lasted less than one month	For chronic illness, one that lasted more than one month	Beliefs (family, culture, religious)	To improve well-being	To reduce side effects of medication	Combination	None of above
1	9(8)	22(20)	50(30.9)	27(36.3)	7(7.6)	23(25.4)	4(13.4)
2	1(2.8)	6(6.9)	11(10.7)	6(12.7)	0(2.6)	13(8.8)	12(4.6)
3	6(4.4)	7(11.1)	5(17.2)	30(20.4)	11(4.2)	11(14.1)	9(7.5)
4	3(4.2)	9(10.5)	15(16.3)	30(19.4)	1(4)	13(13.4)	4(7.1)
5	3(2.6)	11(6.5)	4(10)	8(11.9)	2(2.5)	10(8.2)	8(4.4)

(*continued on next page*)

Table 8 (*continued*)

	Race or ethnic background									
	Used as?					Type of CAM self-practices used				
	Complementary	Alternative	Yoga	Meditation	Relaxation technique	Breathing exercise	Prayers/ prayer rituals	Others	Combination	None
Source of information for CAM use										
	Personal knowledge	Media	Internet	Family /friend	Healthcare providers	Alternative	Combination	None		
1	22(18.9)	27(20)	15(16)	46(41.4)	8(9.4)	6(6.9)	17(26.1)	1(3.3)		
2	5(6.5)	7(6.9)	5(5.5)	22(14.3)	0(3.3)	3(2.4)	6(9)	1(1.1)		
3	13(10.5)	8(11.1)	17(8.9)	10(23)	8(5.3)	1(3.8)	15(14.5)	7(1.8)		
4	9(10)	6(10.5)	5(8.4)	21(21.9)	3(5)	7(3.6)	24(13.8)	0(1.7)		
5	3(6.1)	7(6.5)	2(5.2)	15(13.4)	7(3.1)	2(2.2)	10(8.5)	0(1.1)		
	Do you believe CAM cures disease?			Do you expect positive change after CAM use?			Are you aware of CAM-drugs interactions?			
	Yes	No	I don't know	Yes	May be	No	Yes	No	I don't know	
1	115(80.6)	24(23.6)	3(37.8)	70(52.7)	70(68.3)	2(21.1)	28(33)	61(45)	53(63.9)	
2	18(27.8)	10(8.1)	21(13)	21(18.2)	18(23.6)	10(7.3)	14(11.4)	12(15.5)	23(22.1)	
3	25(44.9)	19(13.1)	35(21)	20(29.3)	47(38)	12(11.7)	12(18.4)	32(25.1)	35(35.6)	
4	26(42.6)	11(12.5)	38(19.9)	23(27.8)	24(36.1)	28(11.1)	30(17.5)	15(23.8)	30(33.8)	
5	38(26.1)	1(7.6)	7(12.2)	11(17.1)	29(22.1)	6(6.8)	7(10.7)	4(14.6)	35(20.7)	
	Would you advise patients to use CAM?		Used CAM during Hajj season?		If yes, why?					
	Yes	No	Yes	No	Spiritual belief	Personal preference	Previous experience	Combination	None	
1	119(113.7)	23(28.3)	64(71.2)	78(70.8)	61(50.1)	24(29.1)	23(22.5)	6(7.6)	28(32.7)	
2	43(39.2)	6(9.8)	34(24.6)	15(24.4)	21(17.3)	15(10)	4(7.8)	2(2.6)	7(11.3)	
3	55(63.2)	24(15.8)	40(39.6)	39(39.4)	19(27.9)	14(16.2)	14(12.5)	6(4.2)	26(18.2)	
4	57(60)	18(15)	30(37.6)	45(37.4)	27(26.5)	19(15.3)	9(11.9)	5(4)	15(17.3)	
5	39(36.8)	7(9.2)	28(23.1)	18(22.9)	10(16.2)	8(9.4)	12(7.3)	2(2.5)	14(10.6)	

Table 9
Cross tabulation-based association of the educational background of the respondents with DVs.

Educational background	Type of CAM- herbal medicine and dietary supplements							Report CAM use to health care provider	
	Herbs	Vitamins and supplements	Homeopathic remedies	Honey and bee products	Others	Combination	None	Yes	No
Primary	31 (20.7)	15(21)	4(2.6)	7(11.1)	3(6.7)	22(18.1)	32 (33.8)	41 (48.1)	73(65.9)
Secondary	17 (21.8)	22(22.1)	2(2.8)	12(11.7)	7(7.1)	18(19)	42 (35.6)	40 (50.6)	80(69.4)
Graduate	16 (20.7)	29(21)	1(2.6)	17(11.1)	8(6.7)	17(18.1)	26 (33.8)	55 (48.1)	59(65.9)
Postgraduate	7(7.8)	6(7.9)	2(1)	2(4.2)	5(2.5)	5(6.8)	16 (12.8)	29 (18.1)	14(24.9)
	Do you believe CAM can cure disease?			Do you expect positive changes after CAM use?			Are you aware of the CAM-drugs interactions?		
	Yes	No	I don't know	Yes	May be	No	Yes	No	I don't know
Primary	73 (64.7)	13(19)	28(30.3)	44(42.3)	58 (54.8)	12(16.9)	22 (26.5)	48 (36.2)	44(51.3)
Secondary	64 (68.1)	30(19.9)	26(31.9)	50(44.5)	53 (57.7)	17(17.8)	23 (27.9)	43 (38.1)	54(54)
Graduation	65 (64.7)	14(19)	35(30.3)	39(42.3)	60 (54.8)	15(16.9)	31 (26.5)	26 (36.2)	57(51.3)
Postgraduate	20 (24.4)	8(7.1)	15(11.4)	12(15.9)	17 (20.7)	14(6.4)	15(10)	7(13.6)	21(19.4)

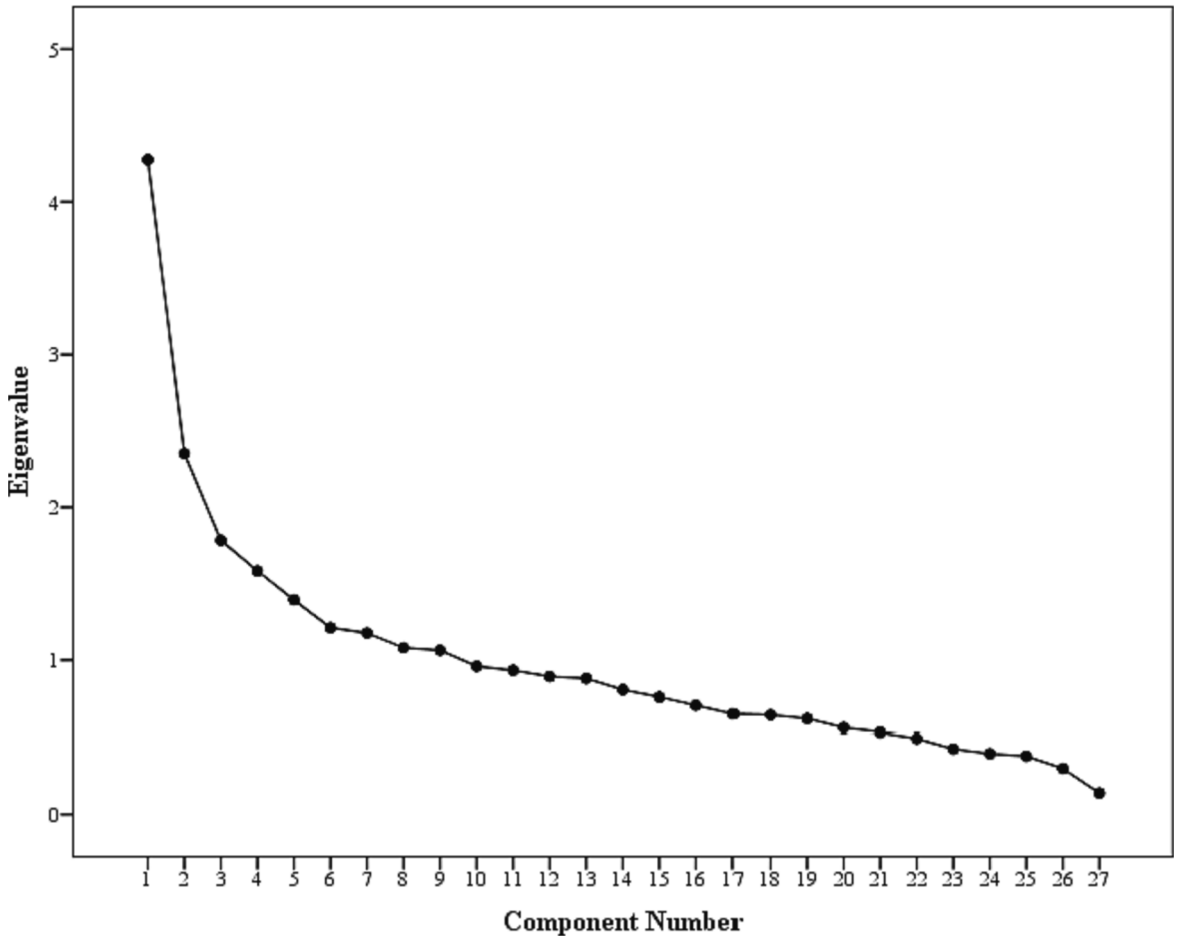

Fig. 1. The scree plot showing the components based on the Eigen value of the data.

Table 10
PCA-analysis for the dataset with %individual and cumulative variability.

	1	2	3	4	5	6	7	8	9
Age	−0.06	0.10	−0.03	−0.06	0.69	−0.09	−0.02	−0.08	0.27
Gender	−0.03	0.09	0.03	0.07	−0.06	0.02	−0.03	0.81	0.03
Nationality	−0.01	0.67	−0.01	−0.22	−0.03	−0.21	0.02	0.05	0.14
Race/Ethnic background	0.02	0.70	0.04	0.29	0.00	−0.16	0.16	−0.11	0.17
Educational level	0.07	0.05	−0.04	0.75	0.03	−0.04	−0.10	0.08	−0.11
Living arrangement	−0.08	−0.25	0.12	−0.31	0.03	0.58	−0.09	−0.16	−0.07
Employment status	0.03	0.37	−0.13	0.34	−0.28	0.36	0.16	0.03	0.18
Monthly income	−0.05	−0.07	−0.02	0.75	−0.10	0.11	0.03	−0.01	0.15
Self-rated health	−0.03	−0.07	−0.03	−0.10	0.71	0.26	0.18	0.05	−0.03
Health insurance	−0.03	−0.13	0.00	0.21	0.13	0.64	−0.24	0.08	0.12
Have you used CAM before?	0.56	−0.08	0.63	−0.03	−0.05	0.03	0.00	−0.04	0.01
If yes, used as alternative or complementary?	−0.04	−0.08	−0.06	−0.06	0.02	−0.20	0.60	−0.20	0.12
Type of CAM practices offered by practitioner?	−0.01	0.41	0.55	−0.07	−0.16	−0.10	−0.16	0.00	0.02
Types of CAM, self-practices?	0.11	−0.18	0.64	0.09	0.21	−0.12	−0.17	−0.15	0.21
Types of CAM, herbal medicine and dietary supplements?	0.19	0.13	0.66	−0.02	−0.02	0.13	0.04	0.29	−0.12
If yes, why have you used it?	0.24	0.19	0.20	0.08	0.35	−0.22	−0.21	−0.17	−0.23
If yes, have you experienced any side effect after using CAM?	0.11	0.13	−0.04	0.06	0.08	−0.03	0.74	0.16	−0.10
What is your source of information on CAM use?	−0.06	0.36	−0.05	0.08	−0.04	0.35	−0.04	−0.45	−0.20
Do you report CAM use to healthcare providers?	0.18	−0.03	−0.13	−0.44	0.10	0.09	−0.14	0.09	0.38
Do you believe CAM cures disease?	0.26	0.59	0.03	−0.06	0.23	0.04	−0.21	0.18	−0.21
Do you expect positive change after the use of CAM?	0.26	0.46	0.36	0.16	0.22	0.14	0.19	0.01	−0.20
Are you aware of the potential for drug interactions with CAM?	0.02	0.10	0.10	0.03	0.10	0.02	0.03	0.05	0.72
Would you recommend CAM to others?	0.61	0.08	0.35	−0.01	0.07	0.07	0.04	0.01	−0.01
Do you continue CAM use during the Hajj season?	0.52	−0.08	0.49	−0.17	−0.19	0.15	0.05	−0.01	0.13
Do you prefer to use CAM products originally from Makkah?	0.91	0.02	0.17	0.01	0.00	−0.02	0.01	−0.02	0.09
If yes, why?	0.86	0.09	0.00	0.05	−0.02	−0.05	0.04	−0.07	0.01
Products/therapies for healing taken from Makkah?	0.68	0.06	−0.01	−0.02	−0.01	−0.12	−0.03	0.09	−0.06
Individual variance (%)	***12.21***	***8.12***	***8.01***	***6.74***	***5.45***	***5.08***	***4.74***	***4.35***	***4.29***
Cumulative variance (%)	***12.21***	***20.33***	***28.34***	***35.09***	***40.53***	***45.61***	***50.34***	***54.69***	***58.98***
Kaiser-Meyer-Olkin Measure of Sampling Adequacy									0.74
Bartlett's Test of Sphericity						Approx. Chi-Square			2356.89
						df			351
						Sig.			0.00

gender of the respondents showed a significant difference for the type of CAM herbal medicine and dietary supplements used ($F_{1,390} = 7.15$, $P = 0.00$). The same phenomenon was observed in Pearson's correlation (Table 4), where the only positive bivariate correlation for gender was established with the type of CAM used. The nationality of the respondents revealed significant differences for the following: CAM practices offered by practitioners ($F_{2,389} = 8.85$, $P = 0.00$), CAM belief ($F_{2,389} = 12.81$, $P = 0.00$), and positive change expected after the use of CAM ($F_{2,389} = 6.41$, $P = 0.00$). The significant differences for nationality and DVs are presented in Table 7, where a high observed count was noted for Saudi nationals in terms of believing that CAM cures disease, and the expectation of positive changes after the use of CAM.

The ethnic background or race of the respondent showed the most widespread significant differences for DVs such as the following: use of complementary or alternative treatment system for treatment ($F_{4,387} = 4.15$, $P = 0.00$), type of CAM practices offered by practitioners ($F_{4,387} = 8.87$, $P = 0.00$), reason for using therapies either as a complementary or an alternative form of medicine ($F_{4,387} = 5.39$, $P = 0.00$), any side effects experienced with the use of CAM ($F_{4,387} = 3.89$, $P = 0.00$), source of information on CAM ($F_{4,387} = 3.70$, $P = 0.00$), reporting CAM use to orthodox healthcare providers ($F_{4,387} = 4.48$, $P = 0.00$), belief that CAM can cure disease ($F_{4,387} = 34.81$, $P = 0.00$), expecting a positive change after CAM use ($F_{4,387} = 10.07$, $P = 0.00$), awareness of potential interactions between CAM treatments and conventional drugs ($F_{4,387} = 4.60$, $P = 0.00$), recommending CAM to others ($F_{4,387} = 2.49$, $P = 0.04$), use of CAM during Hajj season ($F_{4,387} = 3.56$, $P = 0.00$), and reason for using CAM during Hajj season ($F_{4,387} = 4.49$, $P = 0.00$). Wide-ranging differences with regard to use of CAM, type of CAM and products used, beliefs and awareness about CAM, CAM products used, use of CAM during Hajj, and products from Makkah etc., as shown previously, are self-explanatory evidence for the significant differences among respondents of different nationalities and cultures towards the concept and applications of CAM, especially in Arabic and African non-Arabic respondents.

Educational level also revealed significant differences in relation to the following variables: expectation of positive change after CAM use ($F_{3,388} = 2.75$, $P = 0.04$) and reporting the use of CAM to healthcare providers ($F_{3,388} = 6.45$, $P = 0.00$). Living arrangements (beliefs about CAM, $F_{1,390} = 4.72$, $P = 0.03$; experience side effects, $F_{1,390} = 5.27$, $P = 0.02$), employment status (experienced side effects, $F_{1,390} = 4.02$, $P = 0.04$; source of information, $F_{1,390} = 5.08$, $P = 0.02$), and monthly income (CAM type used, $F_{2,389} = 3.21$, $P = 0.04$; experienced any side effect, $F_{2,389} = 387$, $P = 0.02$; report of CAM use to healthcare provider, $F_{2,389} = 8.56$, $P = 0.00$; use of CAM products from Makkah origin, $F_{2,389} = 3.03$, $P = 0.04$; reason for using products or therapies originating in Makkah, $F_{2,389} = 3.06$, $P = 0.04$) also revealed significant differences within and between the groups. The data for significant differences of ANOVA is presented in Table 11.

4. Discussion

This study investigates the extent and type of CAM therapies used by pilgrims visiting Makkah during the Hajj season. Gathering data on the health beliefs and practices of pilgrims during mass religious gatherings is of prime importance for public health legislation. This is the first study of its kind to investigate the prevalence and types of CAM used by pilgrims in the Hajj season, as well as to examine pilgrims' beliefs and knowledge of CAM therapies and self-treatments. The research tool used by this study was thus designed specifically to identify beliefs and knowledge about CAM as well as the type and frequency of use during the pilgrimage. The study tends to create a huge impact for the public health in general and a suggested scenario for improving the health services in particular during hajj season. The study was conducted among pilgrims who performed Hajj during this season 2023 where

Table 11
ANOVA-table for demographic and DV data, with significant differences and within the groups.

Demographics vs DV	Groups	Sum of Squares	F	Sig.
If yes, used as alternative or complementary? *Age	Between Groups	4.90	5.10	0.00
	Within Groups	92.70		
	Total	97.60		
If yes, why have you used it? *Age	Between Groups	47.15	2.73	0.02
	Within Groups	1663.23		
	Total	1710.38		
Do you believe CAM cures disease? *Age	Between Groups	7.48	2.55	0.03
	Within Groups	282.90		
	Total	290.38		
Do you expect positive change after CAM use? *Age	Between Groups	5.08	2.74	0.02
	Within Groups	178.55		
	Total	183.64		
Types of CAM-self-practices used? *Age	Between Groups	44.09	2.48	0.04
	Within Groups	1712.12		
	Total	1756.21		
Types of CAM-herbal medicine and dietary supplements? *Gender	Between Groups	39.90	7.15	0.00
	Within Groups	2168.53		
	Total	2208.44		
Type of CAM practices offered by Practitioners? *Nationality	Between Groups	340.23	8.85	0.00
	Within Groups	7456.52		
	Total	7796.76		
Do you believe CAM cures disease? *Nationality	Between Groups	17.99	12.81	0.00
	Within Groups	272.39		
	Total	290.38		
Do you expect positive change after the use of CAM? *Nationality	Between Groups	5.87	6.41	0.00
	Within Groups	177.76		
	Total	183.64		
If yes, is it used as an alternative or complementary? *Race/Ethnic background	Between Groups	4.03	4.15	0.00
	Within Groups	93.57		
	Total	97.60		
Type of CAM practices offered by practitioners? *Race/Ethnic background	Between Groups	656.89	8.87	0.00
	Within Groups	7139.86		
	Total	7796.76		
If yes, why have you used it? *Race/Ethnic background	Between Groups	90.55	5.39	0.00
	Within Groups	1619.83		
	Total	1710.38		
If yes, have you experienced any side effects after using CAM? *Race/Ethnic background	Between Groups	4.37	3.89	0.00
	Within Groups	108.501		
	Total	112.87		
What is your source of information on CAM use? *Race/Ethnic background	Between Groups	60.09	3.70	0.00
	Within Groups	1565.81		
	Total	1625.90		
Do you report CAM use to healthcare providers? *Race/Ethnic background	Between Groups	4.23	4.48	0.00
	Within Groups	91.13		
	Total	95.37		
Do you believe CAM cures disease? *Race/Ethnic background?	Between Groups	76.98	34.81	0.00
	Within Groups	213.40		
	Total	290.38		
Do you expect positive change after CAM use? *Race/Ethnic background	Between Groups	17.36	10.07	0.00
	Within Groups	166.28		
	Total	183.64		
Are you aware of the potential for drug interactions with CAM? *Race/Ethnic background	Between Groups	11.31	4.60	0.00
	Within Groups	237.20		
	Total	248.52		
Would you recommend CAM to others? *Race/Ethnic background	Between Groups	1.57	2.49	0.04
	Within Groups	60.86		
	Total	62.44		
Do you continue to use CAM during the Hajj season? *Race/Ethnic background	Between Groups	3.48	3.56	0.00
	Within Groups	94.26		
	Total	97.74		
If yes, why? *Race/Ethnic background	Between Groups	42.34	4.49	0.00
	Within Groups	909.20		
	Total	951.55		
Do you report CAM use to healthcare providers? *Educational level	Between Groups	4.54	6.45	0.00
	Within Groups	90.82		
	Total	95.37		

(*continued on next page*)

Table 11 (*continued*)

Demographics vs DV	Groups	Sum of Squares	F	Sig.
Do you expect positive change after CAM use? *Educational level	Between Groups	3.84	2.75	0.04
	Within Groups	179.79		
	Total	183.64		
If yes, have you experienced any side effects after using CAM? *Living arrangement	Between Groups	1.51	5.27	0.02
	Within Groups	111.36		
	Total	112.87		
Do you believe CAM cures disease? *Living arrangement	Between Groups	3.48	4.72	0.03
	Within Groups	286.90		
	Total	290.38		
If yes, have you experienced any side effects after using CAM? *Employment status	Between Groups	1.15	4.02	0.04
	Within Groups	111.71		
	Total	112.87		
What is your source of information about CAM? *Employment status	Between Groups	20.98	5.08	0.02
	Within Groups	1604.91		
	Total	1625.90		
If yes, do you use it as an alternative or complementary? *Monthly income	Between Groups	1.59	3.21	0.04
	Within Groups	96.01		
	Total	97.60		
If yes, have you experienced any side effects after using CAM? *Monthly income	Between Groups	2.20	3.87	0.02
	Within Groups	110.66		
	Total	112.87		
Do you report CAM use to healthcare providers? *Monthly income	Between Groups	4.03	8.56	0.00
	Within Groups	91.33		
	Total	95.37		
Do you use any CAM products originally from Makkah during the Hajj season? *Monthly income	Between Groups	1.04	3.03	0.04
	Within Groups	66.60		
	Total	67.64		
If yes, which products or therapies from Makkah do you use? *Monthly income	Between Groups	37.72	3.06	0.04
	Within Groups	2384.61		
	Total	2422.34		

questionnaires were distributed among major campions and completed ones were collected followed by data analysis by authors.

Our findings show that almost two-thirds of the pilgrims used CAM therapies or self-practices, revealing the popularity of CAM among the Muslim community. This trend has been reported in research on Muslims in other regions such as South-Asia, where Ali et al. found that 82 % of Muslims used CAM in the form of either self-practice or as a treatment by a practitioner or therapist (Ali et al., 2015). Our study found that the respondents who were interested in and used CAM most frequently belonged to the age groups 31–40 and 41–50 years. It was also the case that the majority of the Hajj pilgrims in our sample fell within these two age groups, a point supported by other research showing that 75 % of Hajj pilgrims are aged between 35 and 64 years (Azarpazhooh et al., 2013). However, previous literature has concluded that participants in the age group 45–64 years tend to use CAM more frequently (Arjuna Rao et al., 2016, Ahmad et al., 2017a,b). Our results showed that the most frequent CAM self-practice was religious prayer or ritual, while the most popular practitioner-provided therapies were herbalism and hijamah (cupping) treatment. It was expected that prayer and ritual would be the predominant form of CAM self-practice, as the Hajj is an important religious pilgrimage for all Muslims throughout the world. Moreover, the Hajj pilgrimage has an especially high religious and spiritual significance as it is one of the five pillars of Islam (Bozonelos and Raj, 2020). As stated above, the age groups 31–40 and 41–50 years used CAM the most frequently. In terms of self-practice, the younger group predominantly used meditation and breathing exercises for health benefits, while the older group tended to use religious prayer/ritual or relaxation techniques. These results could be related to research findings that older populations worldwide are more highly associated with traditional religious and spiritual practices (Zimmer et al., 2016).

In terms of ethnic background, analysis of the data revealed that prayer and ritual were the most popular self-practices among respondents from all ethnic backgrounds. Those pilgrims who were from Arabic cultures reported most interest in hijamah therapy and herbal remedies, and this group was also more inclined to use dietary supplements in the form of herbs, vitamins and minerals. These results may relate to many Arabic countries being rich in medicinal plants and having established systems of traditional herbal medicine for common ailments and conditions. In addition, firm belief in the properties of medicinal plants to treat various diseases is to be found in the Holy Qur'an and Prophetic Traditional Medicine (al-Tibb al-Nabawi), representing another considerable reason for the popular use of herbal medicine in Muslim society. Despite the huge stride for the allopathic medicine, traditional Arabic and Islamic plants remains the widely used remedies in Arab and Islamic countries, the origin for which may be traced back to the Prophetic era (Ahmad et al., 2017a,b). In terms of self-practice, the use of herbal and dietary supplements was strongly associated with educational level, where graduate and post-graduate respondents reported greater use of vitamins, minerals, herbal, and honey products. This could be due to higher curiosity levels, research skills, and general knowledge in the more highly educated participants. These participants may well be more likely to encounter courses, workshops, and literature on health related topics than less educated pilgrims. This positive association between the level of education and the use of dietary supplements has been reported previously, supporting the findings in our study (Chiba et al., 2020). The main reason for using CAM cited by all groups, especially the 31–40 and 41–50 year groups, was to improve general well-being. The next most common reason was the firm cultural and religious belief in the efficacy of CAM therapies, as recommended by family members and friends. Both of these reasons have been highlighted in previous studies of CAM in Japan and the US (Long, 2009, Rhee and Harris, 2018, Rhee et al., 2019). A plethora of research shows that most users of CAM therapies do so to improve their general well-being. Many studies confirm the effects of traditional dietary or herbal remedies; for example, research quantifying the antioxidant, anti-inflammatory and gastro-intestinal properties of ginger, a common folk remedy, as well as curcumin and green tea, lend scientific support to popular traditional remedies. There are also studies showing that manual therapies such as cupping and massage, which have been used for centuries, yield significant measurable improvements in quality-of-life and overall well-being (Khan et al., 2017, Ersoy et al., 2019, Shahrajabian et al., 2019, Truong and Jeong, 2022). With regard to CAM knowledge and its sources, multiple channels were cited by the pilgrims. Following the dominance of family and friends, the use of the media was

found to be the next important source for information and knowledge related to CAM, especially in younger age group i.e., 31–40 years. The participants in the age group 41–50 years primarily relied on their existing personal knowledge. Healthcare providers or physicians were less-commonly reported sources of CAM information. Additionally, the culture of religious and societal norms in Muslims families, along with the commonly used practices of hijamah and the use of Arabic and Islamic plant-based remedies turned out to be a major source of CAM information for these pilgrims (Ahmad et al., 2017a,b). Regarding belief and awareness about the use and safety of CAM, more than half of the sample, at all levels of education, expressed belief in the ability of CAM to cure disease, mainly those in the age groups 31–40 and 41–50 years, and those from Arabic cultures. This was highly reflected in their expectation of positive change after CAM usage (definitely: 37.1 %, maybe: 48.1 %). More than two-thirds of the respondents said they would recommend CAM to others; out of these, most were from Arabic countries or culture, followed by African non-Arabic, and lastly European or Turkish respondents. Furthermore, more than half of the study participants (56.8 %) claimed that they had never experienced side effects when using CAM therapies or practices, while less than a third of the sample at all educational levels, like those with diploma, university and post-graduate degrees, were aware of possible drug interactions with CAM treatments. This finding may raise concerns about safety issues for pilgrims during the Hajj as, depending on the health condition, the chances of toxicity and CAM-drug interaction may be high among pilgrims. The more highly-educated participants' lack of awareness of possible interactions between allopathic drugs and CAM medicines was noticeable, but perhaps not surprising if they were not from a scientific or medical background. Even so, medical education in Saudi Arabia does not necessarily include CAM studies, although there is research to show the need for integration of CAM-related courses in medical and allied health education. A broad-based course on CAM therapies would better inform healthcare providers, who could then advise on safe CAM use during the Hajj season (Ahmad et al., 2017a,b).

More than half of the sample population, at all educational levels, was found to have not disclosed their use of CAM therapies or practices to their orthodox healthcare providers. Such non-disclosure on the part of the participants may have a potentially serious effect on treatment outcomes due to possible toxicity or reactions caused by improper use of CAM, expected and unexpected side effects of CAM treatments, and interactions between, for example, herbal remedies or dietary supplements and conventional drugs. Adequate openness and honest patient–physician discussion and effective communication could prevent such undesirable consequences. The health of pilgrims is a priority for the Ministry of Hajj and the Ministry of Health, since participants may be under extra physical and mental stress due to travelling to Makkah, living collectively for the duration of Hajj, and enduring the rigors of the pilgrimage itself. Consumer awareness of health issues during Hajj, including CAM use, could be improved via lectures and workshops on the safe and effective use of CAM based on scientific evidence. Education and information is essential for public safety and public health.

As mentioned earlier, this is first study to investigate the use of CAM during Hajj season. Half of the study sample showed interest in using CAM during Hajj, with African non-Arabic and South East Asian respondents being the most predominant. This could be due to those ethnic groups arriving in Makkah before the Hajj begins and remaining in the city for a while after its conclusion. Access to conventional Saudi health services is limited for overseas pilgrims, and this may influence their reliance on CAM products and therapies during the Hajj season.

The findings show that many of the respondents held the religion-based belief that CAM products originating in Makkah are more effective. Zamzam water, for example, was used by 35 % of the respondents, and honey was consumed therapeutically by 16.6 %. These two were the most frequently purchased products from Makkah. This could be an indicator of Muslim attachment to and belief in the spiritual significance of Makkah and Zamzam water. Several studies have investigated the chemical properties and health benefits of Zamzam water, and findings show that it is more alkaline that normal drinking water (average pH was 8), and that the water quality does deteriorate for 24 months, with average NO_3 concentrations being three times higher than the standard recommended by the World Health Organization. The water has been found to contain a total of thirty-four different chemical elements, and levels of Ca, Mg, Na, and Cl, were higher in Zamzam water than in natural water. In addition, harmful elements such as arsenic, cadmium, lead, and selenium were below the risk level for human drinking water. The chemical properties of Zamzam water are highly linked to its biological activities, as due to its alkaline nature it is considered to be highly antioxidant, and has been shown to improve glycemic control, lipid profile, oxidant-antioxidant status, and general wellness in type 2 diabetes patients. It has also been shown to protect against liver toxicity caused by carbon tetrachloride in rats. Zamzam water contains larger amounts of fluoride, calcium and magnesium compounds, compared to other types of water, and has been shown to have antimicrobial, anti-inflammatory and anticancer properties. In addition, its cytotoxic effect has been shown on different cells lines such as lung, breast, and ovarian cells, as well as on tumors in animal models, via the inhibition of cancer pathogenetic pathways such as CRAF, MEK1/2, ERK1/2, and P38 phosphorylation (Omar et al., 2017, Boshra et al., 2021, Abd-Allah, 2022).

Linking and correlating specific health conditions such as chronic disease with the type of CAM therapies that are used could be a fruitful direction for future research. It would also be interesting to further analyze the reasons for CAM use in specific health conditions as well as the appropriateness of therapies to these conditions. This could be supported by assessing whether participants' CAM use is aligned with their health needs, in accordance with their medical histories. In addition, carrying out medical evaluations of participants in addition to collecting subjective data would help to objectively correlate CAM use with specific health outcomes for different pathological conditions.

5. Strengths and limitations

One of the strengths of this study is that it is the first to report the use of CAM during the Hajj season and the first to clarify the current situation regarding pilgrims' awareness of CAM therapies and practices, and their beliefs about the efficacy of CAM. Challenges of the research have included the ability to cover all pilgrimage languages during Hajj season 2023 as there are different ethnic backgrounds with different spoken languages exceeding fourteen languages. This problem was partly overcome by distributing the questionnaire in seven different languages, including English, Arabic and French, which are the most frequently spoken and understood by pilgrims. Another of the limitations of this study was its reliance on self-reported data, which can be subject to biases such as selective memory and social desirability. This problem could be overcome by choosing data collection methods that yield less subjective, and more objective, quantifiable, and measurable data.

6. Conclusion

This study has shown the statistical prevalence of different types of CAM use by pilgrims in the Hajj season, with correlations to demographic variables. Religious prayer and ritual were the most common self-practice, and herbal treatments were the most frequently used therapy, either as self-medication or in consultation with a practitioner. Gender and ethnic background were shown to potentially influence the type of CAM used by the participants. Positive perceptions of the potential for CAM therapies and practices to cure disease was reported, alongside a significant lack of knowledge about the possible interactions between orthodox prescription drugs and CAM treatments, suggesting that it would be beneficial to educate communities in general about the possible harms caused by self-medicating with CAM. Moreover, the high rate of non-disclosure of CAM use to healthcare providers indicates the

need for pilgrims to better communicate with their healthcare providers as it may affect public health on pilgrimages, one of the main targets of improvement cited by the Ministry of Health and Ministry of Hajj. Our findings indicate that educational program and campaigns on the topic of CAM is needed in Muslim communities so that pilgrims can collaborate freely with orthodox healthcare providers and make more informed healthcare choices, thus promoting overall public health during the Hajj season.

Funding

This research received no external funding.

Conflicts of interest

The authors declare no conflict of interest.

CRediT authorship contribution statement

Aljawharah A. Alqathama: Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Rizwan Ahmad:** Methodology, Formal analysis, Writing – review & editing.

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