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Development of the TREATS-RG, the Transparent Reporting for Essential oil and Aroma Therapeutic Studies Reporting Guideline: A Delphi Study

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Abstract

Background

Aromatherapy research in humans has grown rapidly, yet methodological limitations and inconsistent reporting have hindered the integration of findings into clinical practice and policy. To address these gaps, the Aromatic Research Quality Appraisal Taskforce initiated the development of the Transparent Reporting for Essential oil and Aroma Therapeutic Studies Reporting Guideline (TREATS-RG) through an international consensus process.

Methods

A modified Delphi survey was conducted with international aromatherapy researchers and academics (authors), as well as aromatherapy and health care professionals. Participants were recruited via literature review, professional associations, and snowball sampling. Over four survey rounds, participants rated the importance of reporting items derived from the original 38 items in the Transparent Reporting for Essential oil and Aroma Therapeutic Studies (TREATS) checklist, as well as 10 newly suggested items. Consensus was defined as ≥ 80% of participants rating an item as very or extremely important.

Results

Of 369 invited, 123 consented, and 93 completed the first round, representing 23 countries. Retention was high (89% through four rounds). Participants had substantial experience in aromatherapy and research, with 60% having over 10 years in the field. These items cover essential oil characterization, the rationale for the study design, safety, application methods, and participants' olfactory capacity. Items related to sustainability and storage did not reach consensus, highlighting ongoing challenges in these areas. After four rounds, 25 reporting items reached consensus for inclusion in TREATS-RG.

Conclusions

The TREATS-RG provides a consensus-based, internationally informed reporting guideline for aromatherapy research in humans. Strengths include broad geographic representation and high participant retention. Limitations include overrepresentation from the United States and potential positive bias due to participant familiarity with the original TREATS checklist. Adoption of TREATS-RG is expected to improve the clarity, reproducibility, and ethical standards of future aromatherapy clinical studies, supporting more robust evidence synthesis and clinical application.

Registration

TREATSRG was accepted as a guideline under development by the Equator Network on January 5, 2024.

1. BACKGROUND

Interest in aromatherapy-focused research in humans has increased substantially in recent years, with a notable rise in published studies examining its application across various health conditions [1, 2]. Despite this surge, multiple reviews have consistently highlighted that most aromatherapy studies have suffered from methodological limitations or inadequate reporting, making it difficult to draw definitive conclusions about efficacy [3–5].

Low-to-moderate-certainty evidence presents several challenges, including undermining the integration of aromatherapy into evidence-informed clinical practice, impeding reproducibility, hampering the synthesis of findings and inclusion of aromatherapy in health policy, and complicating the development of safety and sustainability guidelines. The 2019 report commissioned by the United States Department of Veterans Affairs, concluded that while there was moderate confidence evidence of aromatherapy's benefit for several health-related conditions, there was insufficient evidence for a myriad of other conditions [6]. The Natural Therapies review, commissioned in 2024 by the Australian government, led by Cochrane Australia and the National Health and Medicine Research Council (NHMRC), corroborated these concerns by concluding that despite reviewing over 320 studies, confidence in any effects of aromatherapy remained low to very low across all assessed health conditions [3].

Moreover, aromatherapy-focused research has unique complexities not typically encountered in clinical research of conventional medications and treatments. Factors such as the olfactory stimuli on mood, memory, and neurological function—as well as participants' prior experience and reflexive responses to scents—were recognized as potential sources of bias that needed to be accounted for in study design and reporting [7–9].

In response to these issues, the Aromatic Research Quality Appraisal Taskforce (ARQAT) was founded in 2021. The ARQAT published its White Paper outlining concerns about the state of aromatherapy research reporting, and its vision for the future [10]. In 2024, ARQAT published the Transparent Reporting for Essential oil and Aroma Therapeutic Studies (TREATS) checklist. This quality appraisal checklist guides the critique of aromatherapy-focused studies [11].

The TREATS checklist was developed using a convenience sample primarily drawn from a small group of American and Australian researchers. While TREATS has been well received, to bolster credibility, ARQAT chose to develop this formal reporting guideline using the rigor of a Delphi method. Delphi surveys are used in clinical research to determine consensus based on anonymous participants' professional and personal experiences and input shaped by feedback from several survey rounds [12–15].

In addition to enhancing the rigor of the design, the current TREATS checklist does not address salient concerns regarding the ethical sourcing and sustainable use of essential oils. At least 30% of plant species sourced for essential oils face extinction, with serious implications for environmental and

cultural sustainability and ethical sourcing practices in aromatherapy-focused research [16, 17]. It is imperative for researchers to consider conservation impacts when selecting essential oils for studies. Without clear sourcing information on origin, cultivation methods, and extraction processes, research results/findings may become difficult to interpret or replicate. Essential oils sourced from threatened species are at greater risk of adulteration, and a lack of quality control impacts human safety and efficacy [18].

2. METHODS

2.1 Aim

The aim of the Delphi consensus study was to determine an optimal set of reporting criteria and create a reporting guideline for aromatherapy-focused studies in humans. This study followed the protocol published open-access by these same authors [19].

2.2 Study design and setting

The study was a modified Delphi survey. The modifications included incorporating the 38 items from TREATS in addition to 10 new items, an in-person and online meeting to introduce the survey, and an online format for all rounds. The setting was online.

Participants were invited via email with study information and a Participant Information Sheet (PIS), which explained all objectives and processes. Participants were informed that there could be up to four rounds of surveys and that they were free to withdraw at any time without repercussions.

Informing and preparing Delphi survey participants is considered an important step for robust Delphi studies [14, 20]. ARQAT held a hybrid (in-person and online) introductory meeting at the Alliance of International Aromatherapists' biennial conference (September 2024). In-person attendees received $100 USD towards accommodation. The meeting familiarized potential Delphi survey participants with the processes and provided an opportunity to ask questions. All attendees who met the inclusion criteria were invited to participate. Those who did not attend this meeting, but met the inclusion criteria, were sent a follow-up email including the PIS, a Cover Letter, and a unique survey link.

2.3 Participants

Eligible participants were those proficient in reading and writing English and who were also 1) aromatherapy researchers or academics (authors); and/or 2) aromatherapy and healthcare professionals. Participants were identified by several methods, including literature review, contact with professional organizations, and snowball sampling, in which participants could identify others for consideration.

2.4 Identification of researchers and academics (authors)

Authors M.E.R. and E.J.B. conducted a literature review to identify the corresponding authors of English-language systematic reviews involving aromatherapy-focused research published in the Cochrane network between 2018 and 2023 [19]. Forty-four articles included comments expressing concern about the reporting quality of aromatherapy research, including a lack of Latin binomials and documentation of quality-control parameters, such as safe application and storage of essential oils. Additional corresponding authors were identified through web searches of peer-reviewed publications between 2018 and 2024. Corresponding authors were invited to ask their colleagues to participate, also known as snowball recruitment.

2.5 Identification of aromatherapy and health care professionals

ARQAT contacted international professional aromatherapy associations and educational institutions and asked them to invite members to participate. More can be found in the open-access protocol article [19].

2.6 Consent

Consent was provided by using the unique link and commencing the survey. Participation was voluntary, and data were deidentified prior to analysis. Demographic information was collected in Round 1 (R1). Those completing R1 were assigned a unique identifier and sent further personalized emails designed to strengthen retention. The PIS and the Cover Letter are available in the open-access study protocol [19].

2.7 Sample size

The sample size was based on recruitment and attrition rates from similar studies; for example, Ward et al. (2022) had a 75% attrition rate [21]. Nasa et al. (2021) suggested that 30–50 participants completing the final round of health care Delphi studies should be a sufficient number for a robust consensus [22]. Therefore, our study aimed to recruit at least 150 participants.

2.8 Survey items

As previously noted, the Delphi survey items were mainly derived from the 38-item TREATS checklist [11], with two sustainability-focused items and eight additional items. These initial 48 items were pilot tested by ARQAT members for clarity prior to the study.

The 48 items were grouped into sections including, 1) Core or key words in the title, 2) characterization of essential oil(s)/volatile extract(s), 3) rationale for study design and choice of plant materials, 4) aromatherapist involvement and safe handling of essential oils, 5) topical application methods and dosage regime, 6) inhalation methods and dosage regime, and 7) participant olfactory capacity and experience.

2.9 Survey format and timeline

The online survey was created using REDCap through West Virginia University (WVU) [23, 24]. Participants were emailed unique links for access to the survey. A comprehensive Explanatory

Document was provided to add meaning and context for items, and could be downloaded throughout the survey process.

Each subsequent survey round consisted of items from the previous round where consensus had not been reached. Time allotted for each round was contingent on the number of items, with the start date of October 23, 2024, and the end date of May 1, 2025. Each Round lasted three weeks, with the time between rounds decreasing as analysis became quicker: eight weeks between R1 and Round 2 (R2), six weeks between R2 and Round 3 (R3), and three weeks between R3 and Round 4 (R4). Round 4 signaled the final survey, and no time limit was set. Participants were notified by email when each round was complete and again when the next began. Participants could save and download their responses.

2.10 Rating process

During each round, participants were asked to rate each item on a 5-point Likert scale. Relevance for inclusion meant the item was considered necessary for minimum clear and complete reporting. The Likert scale responses categories were: 1) of no importance, 2) of little importance, 3) important, 4) very important, 5) extremely important. They could also select 6) not my area of expertise. Only responses ranging from 1 to 5 were included in the consensus analysis.

2.11 Analysis, consensus, and termination criteria

Data were analyzed by E.J.B. using Microsoft Excel and double-checked by M.Q. for accuracy. At the end of each round, data were anonymized, aggregated, and shared with participants. In R1 and R2, space was provided for comments. Qualitative, free-text comments from R1 and R2 were grouped as general comments, and new items from R1 were considered for inclusion in R2. In R2, participants were presented with items to rate that had not reached consensus in R1, as well as the newly suggested items. Round 2 comments were accepted, but no new items were permitted in R3. Participants did not have to score items the same as in R1 if their opinion had changed. Items that did not reach consensus in R2 were presented again in R3. Items that did not reach consensus in R3 were considered in R4.

2.11.1 Consensus criteria

The *a priori* consensus criterion for automatic inclusion was that the item was rated ‘Very important’ or ‘Extremely important’ by ≥ 80% of participants. The criterion for automatic exclusion was a rating of ‘Of no importance’ or ‘Of little importance’ by ≥ 50% of participants. Items scored as ‘Important’, ‘Very important’, or ‘Extremely important’ by less than 75% of participants were excluded. Items not reaching consensus on inclusion or exclusion, but rated as ‘Important’, ‘Very important’ or ‘Extremely important’ by ≥ 75% participants were forwarded to the subsequent round for re-rating [25]. As some participants selected the “Not my area of expertise” response, the number of responses for each item was taken into account when calculating the inclusion/exclusion criteria. To summarize each round, Likert ratings were analyzed quantitatively and expressed as percentages for each of the five Likert categories, along with quartile and median scores [25].

2.11.2 Termination criteria

From R2, the median and quartile scores for any items that did not reach consensus on inclusion or exclusion were compared with those from the previous round. If either the median and/or quartile scores decreased or remained unchanged between the current and previous rounds, the item was excluded; if either increased, the item was forwarded to the subsequent round for rating.

2.11.3 Qualitative data analysis

During R1, qualitative analysis was used to identify patterns of repetition and key themes of comments. Recommendations for new items were considered, and relevant ones were included in R2 of the survey. Participants could also provide feedback during R2, although no new items could be added in R3.

2.12 Data management

Electronic records were handled and stored in accordance with the WVU Data Protection plan, overseen by the Principal Investigator. The Principal Investigator is the administrator of the electronic data and the only person able to provide access to these files.

2.13 Potential risks and risk management

Potential study risks were considered minimal. Inconvenience due to the survey process may have been a risk factor. Participants were informed that the survey involved multiple rounds. Risk was mitigated by a clear presentation of the project scope and aims. The REDCap system allowed participants to pause and save survey responses, access the Explanatory Document, and return to complete the survey as many times as needed.

2.14 Ethical considerations

Participants were provided with the PIS and the opportunity to attend the hybrid introductory meeting. Consent was implied when a participant started the survey, consistent with standard practice for online survey research. Participants could discontinue participation at any time without repercussion. Ethical approval was granted from the WVU Institutional Review Board (IRB) #2205571104.

3. RESULTS

3.1 Participant flow

The flow of participants and items through the four rounds of the Delphi survey is displayed in Fig. 1. Of the 369 invited participants, 33% (123) consented to participate; 93 completed R1 (76% of those who consented), 86 completed R2, 85 completed R3, and 83 completed R4 (89% of those who completed R1). The attrition rate of those who completed R1 to those who completed R4 was 10.7% (Fig. 1).

Ninety-three participants contributed to R1, representing 23 countries and geographical regions across North America (61%), Europe & UK (19%), Asia (8%), South America (5%), Oceania (3%), Middle East (2%), and Central America (2%) (Fig. 2).

As shown in Table 1, 27% (25/93) of participants primarily identified as researchers and academics (authors), and 73% (68/93) identified primarily as aromatherapists and health care professionals. Although 90% (84/93) reported having some aromatherapy training, 99% (92/93) reported at least two years of experience working with aromatherapy, and 46% (43/93) reported more than 15 years of experience (Table 1).

Table 1
Demographics of the 93 participants commencing the Delphi Study

Participant Demographics	**N (%)**
Primary Designation	
Researchers & Academics (Authors)	25 (27%)
Aromatherapy & Health Care Professionals	68 (73%)
Gender	
Female	83 (90%)
Male	9 (10%)
Declined to answer	
Academic Qualifications	
Doctorate	25 (27%)
Masters	19 (20%)
Bachelors	25 (27%)
Other	24 (26%)
Research Experience	
Yes	65 (70%)
No	28 (30%)
Years of aromatherapy research in humans	
None	38 (41%)
Less than 1 year	10 (11%)
2 to 5 years	23 (25%)
6 to 10 years	6 (6%)
11 to 15 years	6 (6%)
More than 15 years	10 (11%)
Author of peer-reviewed scientific publication	
Yes	32 (34%)
No	61 (66%)
Note: *Transparent Reporting of Essential oil & Aroma Therapeutic Studies checklist	

Participant Demographics	N (%)
Primary Designation	
Aromatherapy training	
Yes	84 (90%)
No	9 (10%)
Years of aromatherapy work	
None	0 (0%)
Less than 1 year	1 (1%)
2 to 5 years	18 (19%)
6 to 10 years	18 (19%)
11 to 15 years	13 (14%)
More than 15 years	43 (46%)
Familiar with TREATS*	
Yes	67 (72%)
No	26 (28%)
Note: *Transparent Reporting of Essential oil & Aroma Therapeutic Studies checklist	

Regarding research experience, 65/93 (70%) of participants reported some research experience, with 45/93 (48%) having two or more years of experience in aromatherapy research in humans. The participants were well educated: 25/93 (27%) held a doctorate, 19/93 (20%) held a master's degree, and 27/93 (25%) held a bachelor's degree. Thirty-four percent (32/93) said they were an author on a peer-reviewed scientific publication. Seventy-two percent (67/93) reported being familiar with the TREATS checklist, which was developed and trialed prior to the design of this study's protocol (Table 1).

Regarding aromatherapy experience, 60.2% (56/93) of participants reported working in aromatherapy for more than 10 years, and only one participant had less than one year of experience. In terms of aromatherapy research experience, 48.4% (45/93) had at least one year, while 23.7% (22/93) had more than six years of experience. Sixty-nine (74.2%) participants had a bachelor's degree or higher, with 26.9% (25/93) at the doctoral level (Table 1).

Of the 49 authors identified via the literature review (see Recruitment), six participated. Of the remaining 11 authors found through general searches, none participated (Fig. 1).

3.2 Item generation and rating

Over four survey rounds, 25 items reached consensus for inclusion (Table 2) in the TREATS Reporting Guideline (TREATS-RG) and the TREATS-RG Explanatory document (Supplements 1 and 2). The inclusion, forwarding, and exclusion of items during the four rounds are outlined in Table 3. For raw data, see Supplement 3.

Table 2
Transparent Reporting for Essential oil & Aroma Therapeutic Studies – Reporting Guideline

Section 1: Title & Essential oils (EO)	
1	Title: Common and Latin binomial
2	Essential oil (EO) binomial (botanical) name (*Genus species)*
3	Production method
4	Plant part
5	Identification of plant constituents
Section 2**A: Topical Application- Complete ONLY if topical delivery method used**	
6	Dilution of EO (if applicable)
7	Dose of EO
8	Body surface area EO contacts
9	Frequency of EO
10	Duration of EO
11	Description of control or placebo
12	Adherence to dosage regime
13	Diluent common and Latin binomial
Section 2**B: Inhalation- Complete ONLY if inhalation delivery method used**	
14	Mode of inhalation and delivery device
15	Dose of EO
16	Frequency of EO
17	Duration of EO
18	Description of control or placebo
Section 3: **Aromatic Intervention**	
19	A clear description of aromatherapy interventions, outcome measures, and adherence to the researcher's protocol
20	The rationale for EO(s)
21	A professional aromatherapist consulted
22	Safety considerations
23	Report of allergic and adverse reactions

Section 1: Title & Essential oils (EO)	
Section 4: **Olfactory function questions** (Asked prior to trial)	
24	Anosmia
25	Nasal health

Table 3
Four Rounds of the Delphi Survey: Included, Excluded, and New Items Generated from Round 1 Comments

Original & New Items	Section Heading & Item Content	Status & Round
Section 1	Core or Key Words in the Title	
01	Include the word "aromatherapy" in the publication title.	Excluded R2
02	Include the words "essential oil" or "volatile extract" in the title.	Excluded R2
03	Include the common and the botanical name of the essential oil(s)/volatile extract used for the intervention in the publication title.	**Included R1**
Section 2	Characterization of essential oil(s)/ volatile extract(s)	
04	Include the common and full binomial (botanical, scientific) name (and chemotype if relevant) of all plant extracts used in the study.	**Included R1**
05	Include the production method (steam distillation, carbon dioxide extraction, solvent extraction, cold-pressed extraction) of the essential oil/volatile extract.	**Included R1**
06	Include information about the plant part used to create the essential oil/volatile extract.	**Included R1**
07	Include the cultivation method that provides farming method details	Excluded R2
08	Include the country of origin where the essential oil plant was grown and harvested	Excluded R3
09	Include the name of the company that manufactured and/or sold the essential oil/volatile extract.	Excluded R2
10	Include the batch number(s) of the essential oil/volatile extract or identify that it was extracted in the researcher's lab.	Excluded R2
11	Include the identification of major or complete essential oil/volatile extract constituents listed as percentages and which analysis was performed, e.g. GC/FID, GC/MS, with Chiral Analysis, Isomeric composition, Headspace Analysis including analysis parameters, and which MS library was used for identification.	**Included R2**
11A New in R2	The description of the GC-MS and other analytical/measurement parameters are adequately described for replication by future researchers.	Excluded R3
11B New in R2	Describe the precision, accuracy, and validation of other equipment used.	Excluded R4

Note R1, R2, R3, R4 denotes Rounds of the Delphi survey. **Bold** = Included items

Original & New Items	Section Heading & Item Content	Status & Round
Section 3	Rationale for study design and choice of plant materials	
12	The aromatherapy definition, rationale for the definition, and the source of the definition used for the intervention are provided.	Excluded R2
13	Describe the theoretical or conceptual framework as it relates to using aromatherapy in research in humans.	Excluded R3
14	Describe the rationale for determining the selected essential oil(s) and application methods that are appropriate for the age and demographics of the participant population and that support the research study hypothesis.	**Included R1**
15	The report contains a statement on whether the extract(s) used were obtained from species not classified as threatened or CITES-protected.	Excluded R2
16	For extracts sourced from threatened and/or CITES-protected species, the report contains the steps for the CITES exemption process, and a summary of the measures implemented to maintain ethical sourcing standards.	Excluded R2
Section 4	Aromatherapist involvement and safe handling of essential oils	
17	Include a clear description of, and rationale for, the outcome measures used for aromatherapy-focused research.	**Included R1**
18	Identify that a qualified, registered, or certified aromatherapist is consulted in the design of the aromatic intervention.	**Included R3**
19	Describe the aromatherapy expertise, background, and training of those planning and providing the aromatic intervention.	Excluded R2
20	Describe the safety considerations of the essential oil(s) relevant to the application method and dosage.	**Included R1**
21	Provide information of any allergic, idiosyncratic or adverse reactions to the essential oil or control, including actions taken, or acknowledge that no adverse reactions are reported.	**Included R1**
22	Describe how the essential oils are stored during the trial and how participants are instructed on storage.	Excluded R2
Section 5	Topical application methods and dosage regimen	
23	Provide the dilution of the essential oil, including the volume or weight per volume, and the name of the diluent.	**Included R1**
24	Provide the dose of the essential oil (amount given at one time).	**Included R1**
25	Describe the body part and surface area to which the essential oil is applied (e.g. hands, 10 cm)	**Included R1**

Note R1, R2, R3, R4 denotes Rounds of the Delphi survey. **Bold** = Included items

Original & New Items	Section Heading & Item Content	Status & Round
26	Provide the frequency of the essential oil dose.	**Included R1**
27	Describe the duration of the intervention in days, weeks, or months.	**Included R1**
28	Describe the control or placebo used in the intervention.	**Included R1**
29	Patient adherence with dosage regime is reported (where relevant).	**Included R1**
30	Provide the diluent common and binomial name.	**Included R2**
31	Provide the source of the diluent or carrier of the delivery system.	Excluded R2
Section 6	Inhalation methods and dosage regime	
32	Describe the mode of aromatic inhalation and the delivery device used.	**Included R1**
33	Provide the total dose of the essential oil(s)/volatile oil(s), including the approximate distance the device is from the nose e.g., micro liters per inhalation.	**Included R1**
34	Provide the frequency of the essential oil dose.	**Included R1**
35	Provide the duration of the intervention. Example: exposed to essential oil vapor for 20 minutes.	**Included R1**
35A New in R2	The timing of the trial treatments is reported to account for variations in response caused by circadian hormonal rhythms.	Excluded R3
36	Describe the placebo or control used in the intervention, including the aroma (if any) and volume used.	**Included R1**
37	Provide the diluent common and binomial name (if applicable), and state what odor it has, if any.	Excluded R2
38	State the suppliers of the diluent, carrier, and delivery system.	Excluded R2
Section 7	Participant olfactory capacity and experience	
39	Participants are asked if they are experiencing anosmia (loss of smell), parosmia, hyposmia, or other olfactory disorders.	**Included R2**
39A New in R2	Participants are asked if they have blocked nasal passages or other nasal/olfactory health issues at the time of receiving the aromatherapy	**Included R2**

Note R1, R2, R3, R4 denotes Rounds of the Delphi survey. **Bold** = Included items

Original & New Items	Section Heading & Item Content	Status & Round
	treatment.	
40	Participants are asked about any previous use of essential oils.	Excluded R3
41	Participants are asked about their preferences or aversions to any essential oils.	Excluded R2
41A New in R2	Participants' negative spatial-temporal interactions with scent are reported (if any).	Excluded R3
42	Test environment odor control is described.	Excluded R3
43	Prior to the intervention, participants are asked about their expectations of the essential oil(s) used in the intervention.	Excluded R3
44	Prior to the intervention, participants are asked about their odor preference and their like or dislike of the essential oil(s) aroma used in the intervention.	Excluded R2
45	Participants are asked about odor recognition related to the essential oil(s) used in the intervention.	Excluded R3
46	Participants are asked about their perceived aroma intensity of the essential oil(s) used in the intervention, and variations are described.	Excluded R2
47	Discuss olfactory fatigue (experience losing sensitivity to odors after prolonged exposure, habituation) if applicable to the study.	Excluded R2
48	Adverse effects from olfaction testing are reported as "none" or with a description.	Excluded R2
49 New in R2	Where possible, studies of aromatherapy treatments against microbial pathologies should also present the results of the aromatogram analysis.	Excluded R3
Note R1, R2, R3, R4 denotes Rounds of the Delphi survey. **Bold** = Included items		

3.2.1 Round 1

Ninety-three participants completed the 48-item R1 survey. Based on the *a priori* thresholds, 20 items reached consensus for inclusion in the final list of the final 25. The items were arranged in seven sections. Section 1) Title, to include the common and the Latin binomial name of the essential oil(s)/volatile extract used for the intervention. Section 2) Characterization of essential oils/volatile extracts, to include the common and full Latin binomial name (and chemotype if relevant) of all plant extracts used in the study, the production method and plant part, and major constituents. Section 3) Rationale for study design, including an explanation of why the essential oils and application methods in the study were chosen. Section 4) Aromatherapist involvement and safety, including a clear description of outcome measures; the aromatherapist consulted; safety related to application and dosage; and any

allergic reactions. Section 5) Topical application, eight of the nine items reached consensus, including dilution, dosage, body surface area, frequency, duration, control or placebo, adherence, and diluent common and Latin binomial name. Section 6) Inhalation included mode of inhalation, dosage, frequency, duration, and description of the placebo or control. Section 7) Olfactory capacity and experience.

Twenty items met the *a priori* automatic inclusion criterion, while the remaining 28 items were forwarded to R2 for re-rating (Table 3). During R1, 33 participants provided free-text comments, which were used to refine the wording of some of the R1 items or to create new items. Several of the comments related to existing items and were not considered. Based on thematic analysis, six new items were generated for rating in the R2 survey, including (11A & B) related to analytical precision for essential oil quality; (35A) report on hour of the day of treatment delivery; (39A) the establishment of nasal health; (41A) the impact of prior negative olfactory experience; (49A) the use of aromatograms (A test for the antibacterial activity of essential oils, especially those used in aromatherapy) to determine appropriate treatment regime (Table 3).

3.2.2 Round 2

Eighty-six participants completed the 34-item R2 survey (retention rate of 92.5% from R1). Four of the 34 items reached consensus for inclusion, and 18 items were excluded after termination criteria analyses. The remaining 12 items were forwarded to R3 for re-rating. Twenty-seven participants provided free-text comments, but no new items were added to R3. Free-text comments addressed the refinement of terminology and definitions, including a broader classification of "professionals" beyond the scope of aromatherapists. Comments emphasizing the need for identity, traceability, and comprehensive characterization of essential oils were presented. Participants suggested clarification on olfactory health and the impact of scent interaction. Importance of research design, specifically comments centered on study-specific application methods and inclusion criteria, as well as strategies for limiting bias and mitigating the placebo effect, were discussed. Concerns about the word limits in publications and overlapping questions in the checklist were raised, and a new suggestion was introduced regarding the disclosure of participant age to ensure demographic clarity (Table 3).

3.2.3 Round 3

Round 3 consisted of 12 items, with 85 participants completing the survey (98.8% retention from R2). Eleven items were excluded based on analyses of termination criteria. The remaining item (11B), one of the new items at R2, was forwarded to R4 as the median and upper quartile had unexpectedly increased between R2 and R3, indicating a shift in opinion towards a more likely acceptance of the item. (Table 3).

3.2.4 Round 4

Eighty-three participants completed the 1-item R4 survey (retention of 97.6% from Round 3). The overall retention rate of participants from R1 to R4 was 89.2% (83/93). The final item (11B), regarding the need to report precision of analytical equipment, was excluded using the *a priori* termination criteria, as the median and upper quartile decreased between R3 and R4 (Table 3).

4. DISCUSSION

This Delphi study engaged 93 participants, including academics and researchers (authors) and aromatherapy and health care professionals from 23 countries and geographic regions, resulting in an aromatherapy-focused research reporting guideline comprising 25 items.

Twenty of the 25 items included in the final guidelines were included during R1. No items were excluded from R1, which is unusual, but could be because many of the items (38 of 48) in the first round were drawn from the TREATS checklist. The TREATS has been in use for about two years, and the items were refined by experts, including aromatherapy practitioners, researchers, and chemists, providing a solid foundation for this survey.

Four of the final 25 items were ultimately included despite initially showing less certainty than the R1 group of 20. These items were item (11), section 2, GC/MS characterization of oil constituents; item (30), section 5, common and binomial name of the diluent; and item (39), section 7, asking about pre-existing anosmia/hyposmia, all of which reached consensus in R2. Notably, item (11) narrowly missed being included in R1 but was included in R2. This illustrates how additional review rounds in the Delphi process help shape the final product and lead to the inclusion of and exclusion of items. Item (18) in section 4, about whether a qualified aromatherapist was consulted in the design, only reached consensus in R3, indicating that participants were more equivocal about its inclusion than the other items in the reporting guideline.

4.1 Strengths

Strengths of the study included a high response rate and low attrition rate; strong representation of aromatherapy, advanced degrees, and research experience among participants; and items from the TREATS checklist, from which a majority of survey items were drawn.

The response rate to invitations was 33%, with 123 of 369 invited participants commencing the study. Despite not recruiting the intended 150 participants, retention of participants who completed R1 (93 people) and stayed through to R4 (83 people) (89.2% retention) indicated the strength of participants' commitment, and the study had sufficient numbers for the reporting guidelines to be considered robust. Ward et al. (2022) experienced a retention of about 60% of the initial respondents at the end of their study [21]. Our maximum attrition, between R1 and R2, was 7.5%. Ogletree et al. (2026) report 5–15% attrition between rounds in aging-related Delphi studies [26].

As shown in the results, strong representation of aromatherapy, advanced degrees, and research experience among participants was observed, with 60.2% (56/93) having worked in aromatherapy for > 10 years and 48.4% (45/93) having at least one year of experience. Seventy-four percent (69/93) of participants held a bachelor's degree or higher, with 26.9% (25/93) at the doctoral level. In addition, 34% (32/93) were published authors in peer-reviewed aromatherapy research. This enhances confidence that

our participants were sufficiently well qualified to appraise the Delphi survey items and that the results are likely to be a fair representation of the global aromatherapy community's opinion.

4.2 Commentary on excluded items

4.2.1 Sustainability

Several statements underlying ethical sourcing did not reach consensus for inclusion in the TREATS-RG, including cultivation method (07), country of origin (08), manufacturer/supplier (09), batch number (10), gas chromatography-mass spectrometry (GC-MS) analytical replicability (11A), and diluent identity and supplier (37, 38). Each represents a component of a healthy supply chain on which ethical sourcing, and therefore sustainability, of essential and carrier oils depends [27]. Yet, in their comments, some participants named these very concerns: R1 highlighted material transparency, including sourcing and integrity of essential oils, and R2 emphasized the need for identity, traceability, and characterization. This misalignment suggests the items were not rejected because they weren't important, but because their direct relationship to research integrity is not yet broadly recognized [16].

Interestingly, items (15) and (16), the two statements contributed by Airmid Institute, were designed specifically to address sustainability by requiring disclosure of conservation and CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) status, the steps taken for CITES exemption, when applicable, and ethical sourcing. Their exclusion, alongside the aforementioned statements, underscores the need to strengthen education within the aromatherapy and academic research communities. Engagement with universities and professional associations that govern curricula can be instrumental in raising awareness of this issue, so that conservation statuses, CITES status, and ethical sourcing are understood as a single overlapping system, a critical foundation for replicable, safe, and clinically interpretable aromatherapy-focused research [28].

4.2.2 Storage

Exclusion of item (22), "Describe how the essential oils are stored during the trial and how participants are instructed on storage," initially surprised the research team. Storage is critical because improper storage of essential oils will alter their chemistry, affecting their safety, efficacy, and overall reproducibility of studies. Professional aromatherapy training teaches aromatherapists the proper storage of essential and carrier oils, and 90% of the study participants reported receiving such training. Perhaps the exclusion of item (22) was related to the inclusion of item (18), "Identify that a qualified, registered, or certified aromatherapist is consulted in the design of the aromatic intervention". The inclusion of item (18) may have been assumed to address storage- related issues. However, qualified consultation in methodology design does not guarantee that storage conditions are controlled or transparently reported, which may limit reproducibility regardless of the aromatherapy practitioner's expertise.

4.3 Limitations

One limitation is that 55 of 57 participants from North America were from the United States, representing more than half of the 93 participants and potentially biasing our results. However, overall, participants came from 23 countries and geographic regions, suggesting that the survey responses were representative of a global perspective. This contrasts with the original TREATS checklist, which was created by researchers from only two countries. Consistent with the literature, the recent reporting guideline, CheckList stAndardizing the Reporting of Interventions For Yoga (CLARIFY), shows overrepresentation from North America, with 59.4% of respondents from North America, despite participants from 11 countries [21].

Another limitation is the potential bias of having 72.6% of participants already familiar with the TREATS checklist items. During R1, no items were excluded, and 42% (20/48) reached consensus for inclusion. These twenty items identified in R1 (most from the original TREATS checklist), make up the majority of items included in the final TREATS-Reporting Guideline. In contrast, in the CLARIFY Delphi study [21], only 26% (15/58 items) met consensus for inclusion in R1, while 10% (6/58) met consensus for exclusion. The fact that none of the R1 items were excluded suggests a positive bias.

4.4 Next steps

ARQAT registered TREATS-RG as a “Reporting guideline under development” on January 5, 2024, and will complete the process for publication of this guideline on the Equator Network website [29]. TREATS-RG is a consensus-based reporting guideline, designed to be used as an extension to other reporting guidelines such as the Standard Protocol items: recommendations for Interventional Trials and the CONsolidated Standards Of Reporting Trials (SPIRIT-CONSORT) [30], Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) [31], and Case Reports (CARE) [32].

4.5 Impact of global aromatherapy-focused research

Use of TREATS-RG in aromatherapy-focused research in humans will allow researchers to clearly identify items needed to better design, conduct, and report their work. Studies using TREATS-RG will be easier to replicate and compare. This will help establish a robust evidence base for aromatherapy as a valid healthcare modality.

5. CONCLUSIONS

Participants in this Delphi study were academics, aromatherapists, and researchers from 23 countries, indicating a good attempt to attain a global consensus. Eighty-six percent of initial participants completed all four rounds of the survey, a very high retention rate, indicating participant dedication. After four rounds, 25 items reached consensus for inclusion in TREATS-RG. These 25 items are the core set for clear, complete, reproducible reporting of aromatherapy-focused research in humans. The TREATS-RG, in conjunction with the TREATS-RG Explanatory Document, can be used as an extension to existing research reporting guidelines for aromatherapy-focused research in humans. Future studies will evaluate the user-friendliness of the TREATS-RG and its usefulness in promoting robust reporting and high-quality research.

ABBREVIATIONS

ARQAT Aromatic Research Quality Appraisal Taskforce

CARE CAse REports

CITES Convention on International Trade in Endangered Species of Wild Fauna and Flora

CLARIFY CheckList stAndardizing the Reporting of Interventions For Yoga

GC-MS gas chromatography-mass spectrometry

IQR Interquartile range

IRB Institutional Review Board

NHMRC National Health and Medicine Research Council

PIS Participant Information Sheet

RG Reporting Guideline

REDCap Research Electronic Data Capture

SPIRIT-CONSORT Standard Protocol Items: Recommendations for Interventional Trials and the CONsolidated Standards Of Reporting Trials

STROBE Strengthening the Reporting of Observational Studies in Epidemiology

TREATS Transparent Reporting for Essential oil & Aroma Therapeutic Studies

WVU West Virginia University

DECLARATIONS

Ethics approval

Ethical approval was granted from the WVU Institutional Review Board (IRB) #2205571104. The research was conducted according to ethical principles set forth in the report of the National

Consent to participate

All participants consented to participate and to have their names published in acknowledgments.

Clinical trial number

Not applicable

Competing Interests

Author Marian Reven is a Guest Editor for the Special Edition, Aromatherapy in Integrative Care. No other authors have conflicts of interest.

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Author Contribution

M.E.R., K.A., E.J.B., D.J. ,A.M-F., M.P-C., B.U. wrote the main manuscript. E.J.B. and M.E.R. created Supplementary materials. B.U. and M.E.R. created tables 2 and 3. E.J.B. created Figure 1. B.U. created Figure 2. M.E.R. wrote the abstract. E.J.B and M.Q were responsible for data analysis. D.J. and M.E.R. acquired funding for publication. M.E.R. managed software for the survey. All authors reviewed and contributed to revisions to the manuscript. All co-authors reviewed and approved the manuscript before submission.

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Data Availability

Additional data from this study is available from the corresponding author upon reasonable request.

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Figures

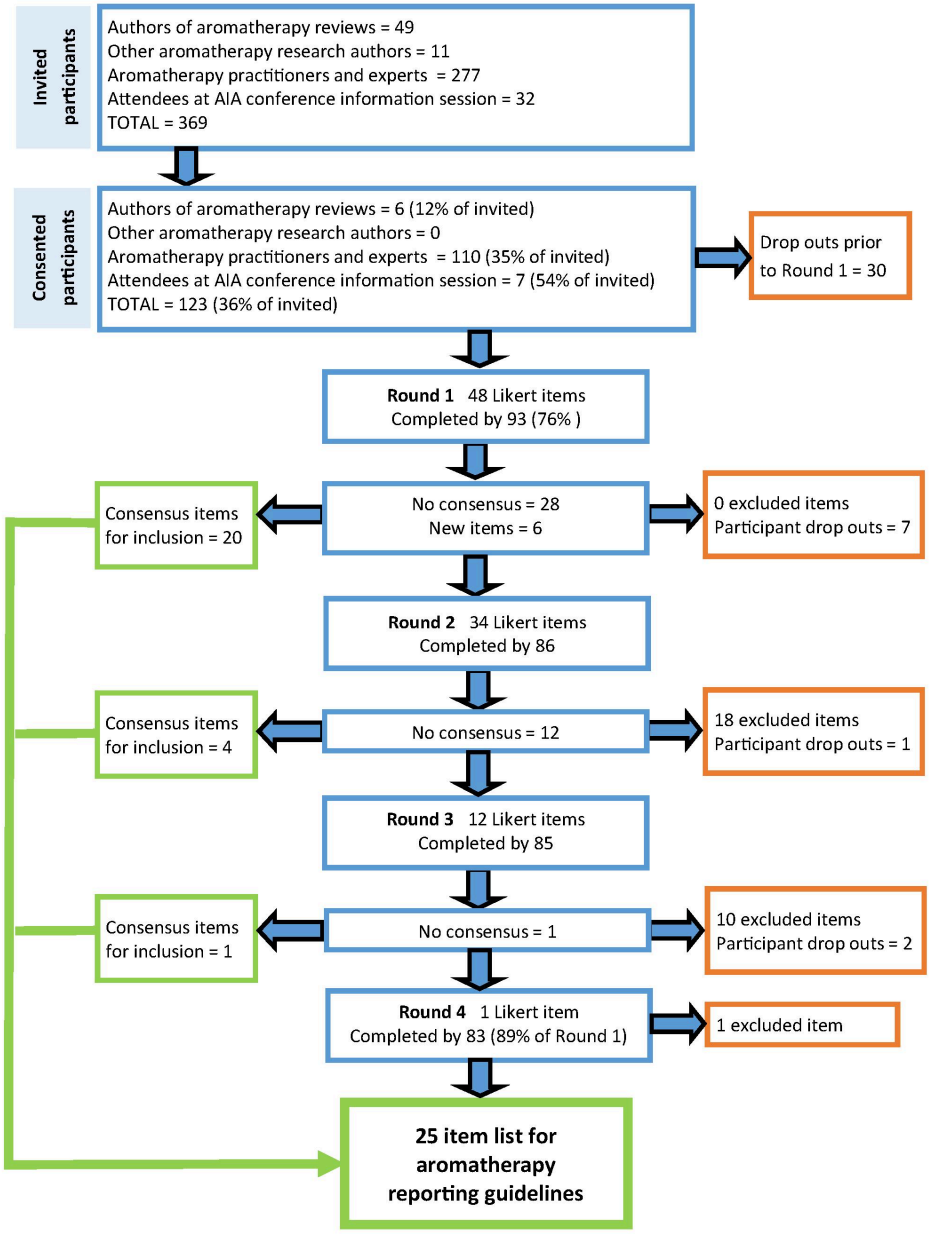


Figure 1

Participant Flow Diagram for Aromatherapy Research Reporting Guidelines Delphi Study

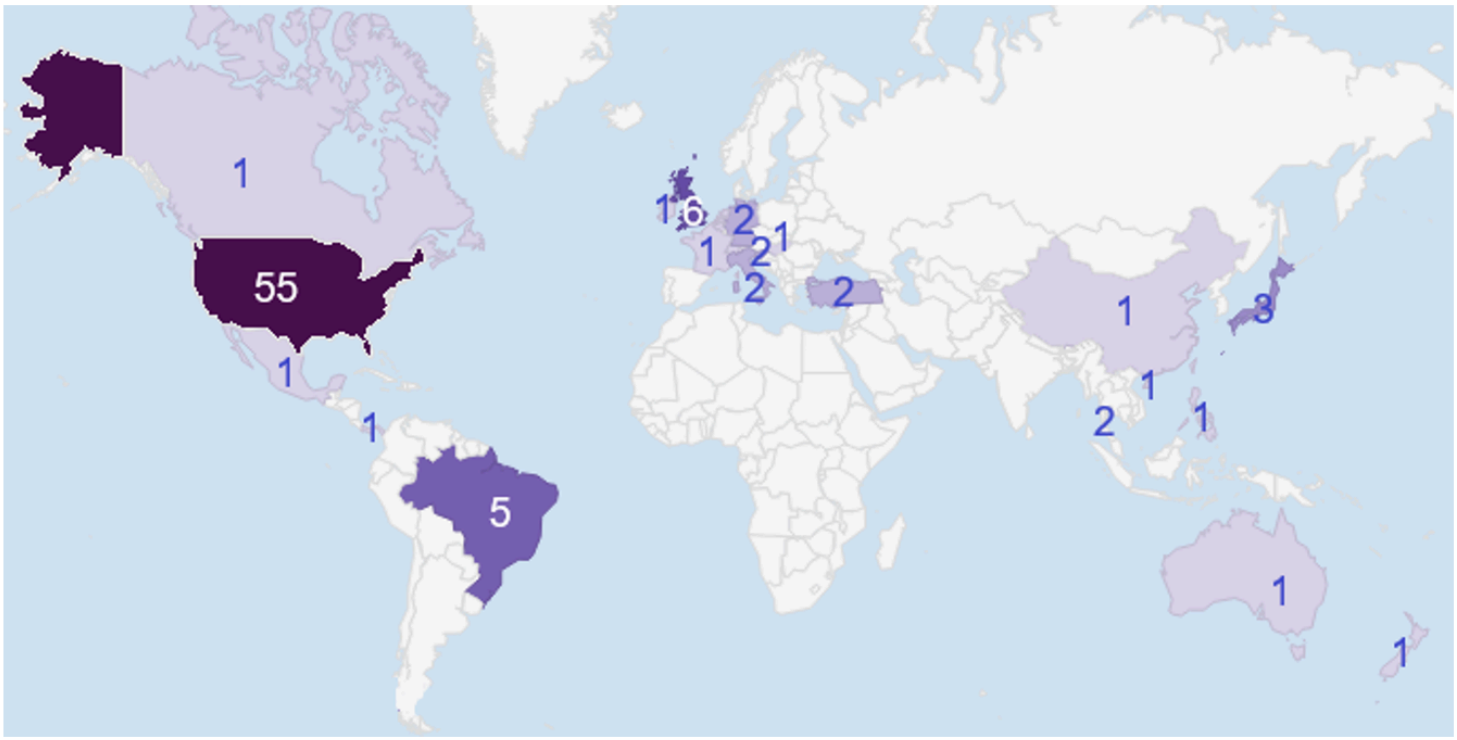


Figure 2

Global Participation in the Delphi study

Note: Numbers represent participants in the Delphi survey R1. With 55 in the United States, 6 in the UK, 5 in South America, and either 1 or 2 participants in the remaining countries or geographical regions.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- 1SUPPTREATSRGwith25itemsupdate07142026.docx
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