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# Could complementary health approaches improve the symptom experience and outcomes of critically ill adults? A systematic review of randomized controlled trials

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ABSTRACT

*Objective:* The purpose of this systematic review was to critically evaluate the safety and effectiveness of various complementary health approaches (CHAs) in treating symptoms experienced by critically ill adults.
*Methods:* The review was completed using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Statement. Electronic databases (PubMed, Web of Science, Scopus, Cumulative Index of Nursing and Allied Health Literature (CINAHL), Education Resources Information Center, Medline, PsychInfo) were searched for studies published from 1997–2017. Randomized controlled trials (RCTs), in English with terms ICU/critical care, music, Reiki, therapeutic touch, healing touch, aromatherapy, essential oil, reflexology, chronotherapy, or light therapy were eligible for inclusion. Studies conducted outside the ICU, involving multiple CHAs, or enrolling pediatric patients were excluded. Data were extracted and assessed independently by two authors and reviewed by two additional authors. The Cochrane risk of bias tool was used to assess study quality.
*Results:* Thirty-two RCTs were included involving 2,987 critically ill adults. CHAs evaluated included music (n = 19), nature based sounds (NBSs) (n = 4), aromatherapy (n = 3), light therapy (n = 2), massage (n = 2), and reflexology (n = 2). Half of all studies had a high risk of bias for randomization but had low or unclear biases for other categories. No study-related adverse events or safety-related concerns were reported. There were statistically significant improvements in pain (music, NBSs), anxiety (music, NBSs, aromatherapy, massage, reflexology), agitation (NBSs, reflexology), sleep (music, aromatherapy, reflexology), level of arousal (music, massage), and duration of mechanical ventilation (music, reflexology).
*Conclusions:* Evidence suggests CHAs may reduce the symptom burden of critically ill adults.

## 1. Introduction

Millions of adults admitted to intensive care units (ICUs) annually are at risk for poor short and long-term physical, cognitive, and psychological outcomes.[1–6] Evidence generated over the past decade suggests these outcomes are often related to the way ICU symptoms are assessed and managed.[7] Pain, anxiety, delirium, sleep disturbances, and weakness are particularly prevalent and distressing conditions experienced by the critically ill. As outlined in the Society of Critical Care Medicine's 2018 Clinical Practice Guidelines for the Prevention and Management of Pain, Agitation/Sedation, Delirium, Immobility, and Sleep Disruption (PADIS) in Adult Patients in the ICU, nearly all patients will experience one of these symptoms during an ICU stay due to preexisting conditions, regular ICU activities, and/or discrete invasive procedures.[8]

A variety of factors complicate effective ICU symptom assessment, prevention, and management. Adults experiencing a serious or life-threatening illness often experience fluctuations in their level of consciousness, are voiceless due to the effects of mechanical ventilation, and are unable to communicate their needs due to intubation and/or physical restraint use. This vulnerable population is also commonly exposed to multiple, potent, and high-risk medication classes (e.g., opioids, sedatives, and antipsychotics).[7] While often given for well-intentioned reasons, these medications are often associated with harm.[9,10] Finally, it is important to note that patients often differ in their response to pharmacologic symptom management interventions. This variability is important considering multiple studies have demonstrated the harmful effect of deep sedation on patient outcomes (e.g., higher hospital and 180-day mortality, prolonged mechanical ventilation).[8,11,12]

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Several professional societies are now recommending that non-pharmacologic interventions be administered before medications to persons at-risk of or experiencing ICU-related PADIS.[8,13] The use of evidence-based non-pharmacologic symptom management interventions in the ICU is currently limited.[8] This is particularly true for non-traditional complementary health approaches (CHAs) such as music, aromatherapy, chronotherapy, guided imagery, reflexology, and Reiki. This study provides the first Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) compliant systematic review to evaluate randomized controlled trials (RCTs) comparing the safety and effectiveness of various CHAs in treating the distressing symptoms experienced by critically ill adults.

## 2. Methods

### 2.1. The review question

The question that guided this systematic review was, "What effects do CHAs including music, aromatherapy, light therapy, massage, therapeutic touch, guided imagery, reflexology, or Reiki have on critically ill adults?"

### 2.2. Data sources

The data search was performed during the interval from April 1, 2017 to July 1, 2017. Databases searched were PubMed, Web of Science, Scopus, Cumulative Index of Nursing and Allied Health Literature (CINAHL), Education Resources Information Center (ERIC), Medline, and PsychInfo. The following keywords were used: (ICU OR 'intensive care' OR 'critical care') AND (music OR Reiki OR 'therapeutic touch' OR 'healing touch' OR aromatherapy OR 'aroma therapy' OR 'essential oil' OR reflexology OR chronotherapy OR 'light therapy') AND NOT (NICU OR infant OR preterm OR pediatric OR child OR adolescent).

### 2.3. Study selection

Selection criteria were as follows: 1) publication date from 1997 to 2017; 2) adult participants; 3) written in English; and 4) RCT design. Excluded were studies conducted outside the ICU setting or involving more than one CHA.

The PRISMA schema was used to describe the step-by-step literature search and selection process in detail (Fig. 1).[14]

### 2.4. Data extraction

Two reviewers (KH and PD) independently screened all titles and abstracts for studies according to the predefined eligibility criteria. Results of these screenings were then reviewed by two additional study team members (ST and MB). Disagreements among all four reviewers in screening results were resolved by group consensus. After removing duplicate publications, KH and PD then reviewed full texts of the studies that were deemed potentially eligible for inclusion. These studies underwent a final review by ST and MB to ensure eligibility criteria were fully met.

Data were extracted from the included studies and put into an electronic spreadsheet by KH and PD while ST and MB checked all the extracted data for accuracy. Criteria for data extraction from studies were adapted from the Cochrane Collaboration Handbook for Systematic Reviews.[15] Extracted data included: 1) authors, 2) publication year, 3) type of CHA, 4) name and number of study arms, 5) intervention description, 6) measures, 7) outcomes, 8) study findings, 9) whether the sample included persons on mechanical ventilation, 10) inclusion/exclusion criteria, 11) randomization scheme, 12) ICU type, 13) who provided the intervention, 14) qualitative findings, and 15) any important study-related issues.

### 2.5. Risk of bias in individual studies

The Cochrane Collaboration's tool for assessing risk of bias in randomized trials was used to evaluate the quality of the studies selected for inclusion.[15]

## 3. Results

### 3.1. Study selection

Out of 477 studies initially identified, 32 articles met the eligibility criteria as described in the Methods section (Fig. 1).

### 3.2. Study characteristics

Characteristics of the 32 included studies are summarized in Table 1. Studies were published in 24 discrete journals representing a variety of specialties including nursing, critical care, medicine, and complementary therapies. A total of 2,987 (range 10–734) participants were involved in the studies. Participants were generally older and admitted to various medical, surgical, cardiac, and neurologic ICUs. Over 70% (23/32) of the included studies involved persons who required mechanical ventilation. Music therapy was the most commonly studied CHA (n = 19), followed by nature based sounds (NBS) (n = 4), aromatherapy (n = 3), light therapy (n = 2), massage (n = 2), and reflexology (n = 2). The included studies explored the effect CHAs had on a variety of symptoms, biomarkers, and clinical outcomes. Multiple instruments/methods were used to measure these variables of interest (Supplementary Table 1).

None of the studies reviewed reported any adverse events or safety related concerns associated with the administration of CHAs. Twenty studies reported the effect a CHA had on participants' vital signs and/or oxygen saturation levels (Supplementary Table 2). No consistent trend in these parameters was noted, with some reporting a significant effect and others reporting no effect.

### 3.3. Risk of bias within studies

The risk of bias screening were completed using the Cochrane risk of bias tool (Table 2).

### 3.4. Effect of music

Nineteen of the included RCTs involved music.[16–34] Music "type" varied among studies, most often being described a classical, slow rhythmic, relaxing, easy listening, or folk/traditional. All of the studies delivered the music interventions to participants via ear/headphones. In the majority of studies (11/19), participants were provided the opportunity to "self-select" the type of music. The length and number of music sessions varied among studies. Most commonly, study participants received a single session (12/19 studies); lasting 20 (n = 1), 30 (n = 4), 45 (n = 1), or 52–60 (n = 4) minutes in length or longer (n = 2). The remaining studies delivered the music at various time points and lengths, with some allowing participants to use music as often as desired. Control group conditions similarly varied, with most being described as participants receiving either standard care or rest periods. In 11/19 of the music studies the control group did not have ear/headphones applied, 4/19 had ear/headphones in place, and 4/19 studies had control/attention groups with and without ear/headphones. Table 3 summarizes the effect music had on select ICU symptoms/conditions.

#### 3.4.1. Anxiety

Nine studies explored the effect music had on anxiety levels of critically ill adults.[16,20,26,27,29,31,34–37] The majority of studies (6/9) report statistically significant reductions in anxiety when this

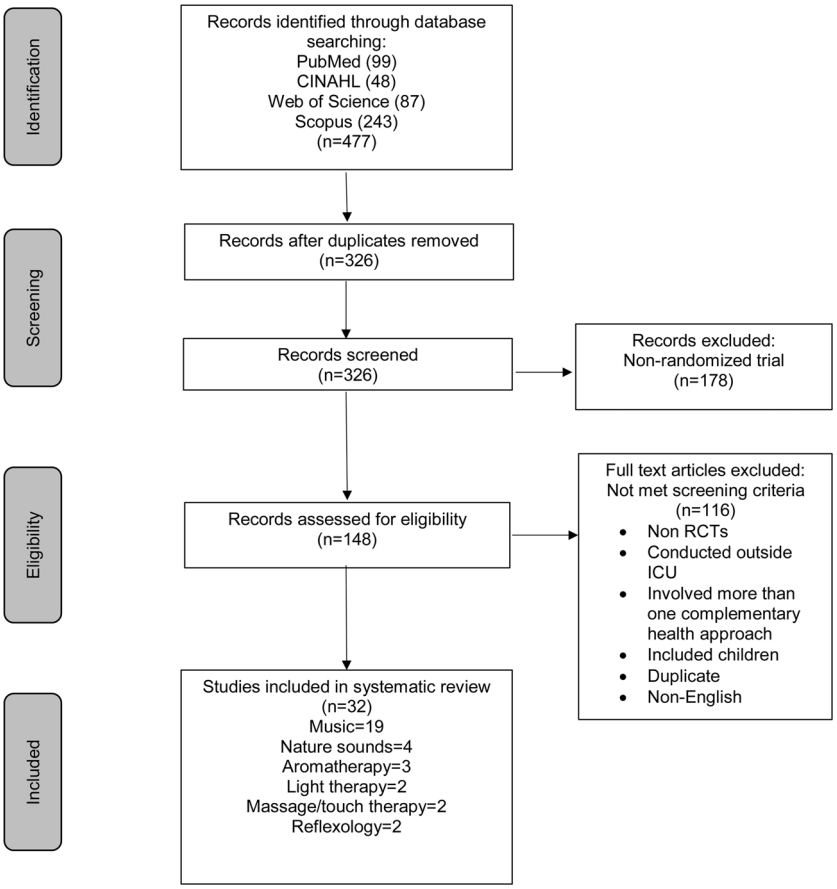


**Fig. 1.** Process of study selection.

intervention was used in the ICU setting.[26,27,29,34,36,37] No difference in anxiety levels between intervention and control patients was reported in three studies.[16,20,31]

### 3.4.2. Biomarkers of stress

Five studies[18,21,28,30,32] explored the effect music had on biomarkers associated with the stress response. Compared to controls, statistically significant changes were noted in dehydroepiandrosterone,[32] growth hormone,[32] IL-6,[32] and serum cortisol[21] levels. No statistically significant differences were noted in corticotropin,[28] cortisol assays,[18,28,32] norepinephrine,[28,32] urinary free cortisol,[29] ACTH,[32] prolactin,[32] prolactin monomere,[32] and 6-SMT[18] levels. The effect of music on epinephrine levels was unclear, with one study found significant changes[32] and another found no change[28] in this biomarker when music was applied.

### 3.4.3. Pain

Four studies[16,17,19,31] explored the effect music had on pain. Two studies[17,31] reported significantly lower pain scores and less pain perception in patients treated with music compared to control patients. Another study[16] was equivocal, finding no significant differences in pain scores between music and control groups during the first four interventions but, when pre- and post-intervention scores at the first time point were examined, significantly less pain was experienced in the music group. In the final study,19 no significant differences in pain were found among five experimental groups (i.e., listening to music with and without headphones upon arrive to the ICU, listening to music with and without headphones when discontinuing sedation, and control group). When patients received music immediately post-operatively statistically significant *increases* in pain in the operated area were noted. There was also a statistically significant results for "time of intervention" (early vs. late) with pain in the operated area *improving* when music intervention was applied early.[19]

### 3.4.4. Medication administration

The effect music and sedative medication exposure was explored in four studies.[16,29,31,32] Two studies[29,31] reported significant reductions in the amount of analgesics administered[31] and sedation intensity/frequency[29] in patients treated with music compared to controls. Another[32] found that compared to controls, the music group received significantly less sedative drugs in order to achieve a comparable degree of sedation. The final study reported no difference in opioid intake when music was applied.[16]

### 3.4.5. Sleep

Three studies[18,22,23] explored the effect music had on sleep. All three studies reported significant improvements in one of the measured aspects of sleep. Hu et al.[18] found significantly improved subjective sleep quality, sleep depth, and number of awakenings when relaxing music, earplugs, and eye masks were applied compared to those receiving standard care. Ryu22 reported significantly improved sleep quality and quantity in patients treated with music and eyeshields compared to those with eyeshields, earplugs, and no music. Finally Su[23] found significant improvements in subjective sleep quality, shorter stage N2 sleep, and longer stage N3 sleep in the first hours of the nocturnal sleep than the control group. No significant changes, however, were noted by these researchers in the mean total sleep time between groups. The effects of music on sleep onset latency (time to fall asleep) and sleep efficiency (percent time awake) was equivocal with Hu reporting significant improvements and Su reporting no differences in patients treated with music compared to controls.

**Table 1**
Characteristics of Included Studies (N = 32).

| | Author, Year | Intervention | Sample Size (#Grps) | Outcomes | Age range | ICU Type | MV |
|---|---|---|---|---|---|---|---|
| 1 | Aghaie, 2014 | NBS | 120 (2) | Agitation, anxiety, VS | 45–65 | SICU | Y |
| 2 | Akin Kohran, 2014 | Reflexology | 60 (2) | VS, consciousness, agitation, anxiety, sleep, and patient-MV synchrony | 18–70 | ICU | Y |
| 3 | Ames, 2017 | Music | 41 (2) | Opioid use, pain, distress, anxiety | 27–83 | ICU-PS | N |
| 4 | Bikmoradi, 2015 | Aroma. | 60 (2) | Mental stress, VS | 54–78 | ICU | Y |
| 5 | Chan 2007 | Music | 43 (2) | Pain, VS | 35–75 + | ICU | N |
| 6 | Chlan,1998 | Music | 54 (2) | Relaxation, anxiety, VS | 40–77 | ICU | Y |
| 7 | Chlan, 2007 | Music | 10 (2) | Biomarkers of stress | 53–79 | MICU | Y |
| 8 | Chlan, 2013 | Music | 373 (3) | Anxiety, sedative medications | 45–75 | ICU | Y |
| 9 | Chlan, 2013 | Music | 65 (2) | Cortisol levels | 25–93 | ICU | Y |
| 10 | Cigerci 2016 | Music | 68 (2) | Anxiety, pain, sedative medications | 28–75 | ICU | Y |
| 11 | Conrad, 2007 | Music | 10 (2) | Sedative medications, VS, GH, IL 6, epinephrine | 45–77 | ICU | Y |
| 12 | Dijkstra, 2010 | Music | 20 (2) | Physiologic response, sedation scores | 19–83 | MICU SICU | Y |
| 13 | Ebadi 2015 | Reflexology | 96 (3) | Physiologic response, VS, MV weaning time | 25–75 | CCU | Y |
| 14 | Han, 2010 | Music | 137 (3) | Physiologic stress, anxiety, VS | 18–84 | ICU | Y |
| 15 | Heidari, 2015 | NBS | 60 (2) | Anxiety, cardiovascular indices | 42–69 | CCU | N |
| 16 | Henricson, 2008 | Massage | 44 (3) | Anxiety, glucose metabolism, VS, sedative medications | 21–83 | ICU | Y |
| 17 | Hu, 2015 | Music | 45 (2) | Cortisol, sleep, melatonin | 45–68 | CICU | Y |
| 18 | Iblher, 2011 | Music | 126 (5) | Pain, delirium, memory, thirst, nausea, satisfaction with care | 43–84 | CTICU | Y |
| 19 | Karadag, 2017 | Aroma. | 60 (2) | Sleep quality, anxiety | 38–62 | CICU | N |
| 20 | Lee, 2005 | Music | 64 (2) | VS, anxiety | 19–90 | ICU | Y |
| 21 | Lee, 2017 | Music | 85 (2) | VS, anxiety, serum cortisol | 18–85 | MICU, SICU | Y |
| 22 | Mirbastegan, 2016 | Aroma. | 60 (2) | Anxiety, VS | 30–70 | CCU | N |
| 23 | Ryu, 2012 | Music | 58 (2) | Quantity and quality of sleep | 20–80 | CCU | N |
| 24 | Saadatmand 2013 | NBS | 60 (2) | Agitation, anxiety, VS, physiologic response | 18–65 | ICU | Y |
| 25 | Saadatmand 2015 | NBS | 60 (2) | Pain | 26–63 | ICU | Y |
| 26 | Simons, 2016 | Light | 734 (2) | Delirium | 50–79 | ICU | Y |
| 27 | Su, 2013 | Music | 28 (2) | Sleep stage, sleep quality | 39–78 | MICU | Y |
| 28 | Taguchi, 2007 | Light | 11 (2) | Delirium, time to ambulation, circadian rhythm | 29–71 | ICU | N |
| 29 | To, 2013 | Music | 50 (2) | Spontaneous awakening trials, VS, sedation scores | 31–69 | ICU-NT | Y |
| 30 | Twiss, 2006 | Music | 60 (2) | Anxiety, intubation time | 65–89 | SICU | Y |
| 31 | Vahedian-Azimi, 2014 | Massage | 180 (2) | VS, GCS score | 50–71 | ICU | N |
| 32 | White, 1999 | Music | 45 (3) | Anxiety, VS, physiologic indicators | Mean 63 | ICU | N |

#### 3.4.6. Level of arousal/sedation scores

Three studies[25,32,33] explored the effect music had on level of arousal. Conrad[32] found significant differences in level of arousal between music and control patients; with controls rated as having an inadequate degree of sedation. Dijkstra[33] found no statistically significant changes in level of arousal as measured by two different instruments before and after music/rest sessions on three separate sessions except for a change in one level of arousal measure after the first session where the music group experienced a deeper level of sedation. No between group changes were noted in sedation scores when comparing the music and control groups in the To study.[25]

#### 3.4.7. Delirium, memory, thirst, nausea, and satisfaction with care

The single study that examined the effect music had on delirium, memory, thirst, nausea, and satisfaction with care[19] found significant differences as the music group experienced increased thirst, nausea, and memory in the immediate post-operative timeframe as well as a statistically significant improvement for discomfort and satisfaction with the perioperative course when the music intervention was applied immediately upon arrival in the ICU.

#### 3.4.8. Mechanical ventilation duration

One study[26] explored the effect of music listening on intubation time in patients undergoing cardiovascular surgery. These researchers reported that older adults who listened to music had significantly fewer minutes of postoperative intubation (mean 390.6 ± 236 min' music vs. mean 590.8 ± 489.6 min' control, $p = 0.048$).[26]

### 3.5. Effect of nature based sounds (NBS)

Four of the included RCTs involved the delivery of NBS.[38–41] A variety of NBS were used, including bird songs, sea sounds, rainfall sounds, waterfall sounds, or sounds of the forest. All of the studies delivered the NBS via ear/headphones. In the majority of studies (3/4), participants were able to "self-select" the NBS. All of the studies delivered a single session ranging in length from 20 to 90 minutes. Control group participants wore headphones with silence in three of the studies while the remaining control group participants received usual care with no headphones, telephones, radio, or television allowed. Table 4 summarizes the effect NBS had on select ICU symptoms/conditions.

#### 3.5.1. Anxiety

Three studies explored the effect NBS had on anxiety levels.[38–40] All three studies found participants receiving this intervention had significantly lower levels of anxiety compared to control patients.

#### 3.5.2. Agitation

Two studies[38,40] explored the effect NBS had on agitation levels. Both studies report significantly reduced agitation levels in patients treated with NBS compared to controls.

#### 3.5.3. Pain

The sole study[41] examining the effect of NBS on pain levels found pain scores in the intervention arm decreased and were significantly lower than the control arm at 30, 60, 90, and 120 min after the intervention.

### 3.6. Aromatherapy

Three RCTs involved the use of aromatherapy.[42–44] All of the studies used lavender essential oil in their experimental arm. Two of the studies used distilled water in their control arms, with the remaining control group reported as not receiving lavender oil. The length and number of aromatherapy sessions varied among studies. In two studies,

**Table 2**
Summary of Risk of Bias of Included Randomized Controlled Trials.

| | a. | b. | c. | d. | e. | f. | g. |
|---|---|---|---|---|---|---|---|
| Aghaie, 2014 | | | | | | | |
| Akin Korin 2014 | | | | | | | |
| Ames, 2017 | | | | | | | |
| Bikmoradi, 2015 | | | | | | | |
| Chan, 2007 | | | | | | | |
| Chlan, 1998 | | | | | | | |
| Chlan, 2007 | | | | | | | |
| Chlan, 2013 | | | | | | | |
| Chlan, 2013 | | | | | | | |
| Cigerci, 2016 | | | | | | | |
| Conrad, 2007 | | | | | | | |
| Dijkstra, 2010 | | | | | | | |
| Ebadi, 2015 | | | | | | | |
| Han, 2010 | | | | | | | |
| Heidari, 2015 | | | | | | | |
| Henricson, 2008 | | | | | | | |
| Hu, 2015 | | | | | | | |
| Iblher, 2011 | | | | | | | |
| Karadag, 2017 | | | | | | | |
| Lee, 2005 | | | | | | | |
| Lee, 2017 | | | | | | | |
| Mirbastegan, 2016 | | | | | | | |
| Ryu, 2012 | | | | | | | |
| Saadatmand, 2013 | | | | | | | |
| Saadatmand, 2015 | | | | | | | |
| Simons, 2016 | | | | | | | |
| Su, 2013 | | | | | | | |
| Taguchi, 2007 | | | | | | | |
| To, 2013 | | | | | | | |
| Twiss, 2006 | | | | | | | |
| Vahedian-Azimi, 2014 | | | | | | | |
| White, 1999 | | | | | | | |

| | |
|---|---|
| **High risk of bias** | |
| **Unclear risk of bias** | |
| **Low risk of bias** | |

participants received the therapy once a day (for 2 and 15 days respectively). The third study delivered the intervention three times a day for two days. Table 4 summarizes the effect aromatherapy had on select ICU symptoms/conditions.

### 3.6.1. Anxiety

Two studies[43,44] explored the effect lavender essential oil had on anxiety levels of critically ill adults. Both studies found participants receiving this intervention had significantly lower levels of anxiety compared to control patients.

### 3.6.2. Sleep

Only one study[44] explored the effect lavender essential oil had on sleep and found improved sleep quality in intervention patients compared to controls.

### 3.6.3. Mental stress

Inhalation aromatherapy with lavender essential oil was found to have no significant effects on “mental stress” levels in patients following cardiac arterial bypass graft (CABG) surgery.[42]

## 3.7. Light therapy

Two RCTs involved the use of light therapy.[45,46] The first study compared dynamic light application to normal lighting. This study was terminated prematurely[45] after an interim analysis revealed no difference in the primary outcome (cumulative incidence of ICU-acquired delirium in light treated patients) or in any of the secondary outcomes.

The second RCT[46] compared bright light therapy (5000 lx light intensity) versus natural lighting. While a significant difference was observed in the delirium scores between the study group and control group on the morning of day three of bright light therapy, no significant differences were noted between groups in delirium incidence, time to ambulation, or circadian rhythm.

## 3.8. Effect of massage

Two RCTs explored the effect of massage.[47,48] The first compared effleurage massage provided by trained nurses for one hour, once a day, for 5 days to a similarly timed rest period.[47] Patients treated with massage experienced significantly lower levels of anxiety, higher requirements for noradrenalin, more insulin, and higher blood glucose levels compared to the control group. No significant difference in sedative medication administration was noted.

The second RCT compared a 60-minute effleurage massage delivered by a family member to routine care.[48] Patients treated with massage experienced significantly greater increases in level of consciousness compared to patients receiving standard care.

## 3.9. Effect of reflexology

The final two studies reviewed involved reflexology.[49,50] The first study had three arms: (1) foot reflexology given for 20 min (10 min each foot) one hour after ICU admission by trained RNs, (2) (placebo)

**Table 3**
Effect of Music on Critically Ill Adults.

| Study | Pain | Meds. | Anxiety | Delirium | Stress Bio-markers | Sleep | Level of Arousal | Distress | Memory | Thirst | Nausea | Sat. | MV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ames, 2017 | - ! | – | – | | | | | – | | | | | |
| Chan, 2007 | + | | | | | | | | | | | | |
| Chlan,1998 | | | + | | | | | | | | | | |
| Chlan, 2007 | | | | | – | | | | | | | | |
| Chlan, 2013 | | + | + | | | | | | | | | | |
| Chlan, 2013 | | | | | – | | | | | | | | |
| Cigerci, 2016 | + | + | – | | | | | | | | | | |
| Conrad, 2007 | | + @ | | | +/− | | + | | | | | | |
| Dijkstra, 2010 | | | | | | | +/− | | | | | | |
| Han, 2010 | | | + | | | | | | | | | | |
| Hu, 2015 | | | | | +/− | +/− | | | | | | | |
| Iblher, 2011 | - $ | | | – | | | | | - $ | - $ | - $ | - $ | |
| Lee, 2005 | | | – | | | | | | | | | | |
| Lee, 2017 | | | + | | + | | | | | | | | |
| Ryu, 2012 | | | | | | + | | | | | | | |
| Su, 2013 | | | | | | +/− | | | | | | | |
| To, 2013 | | | | | | | – | | | | | | |
| Twiss, 2006 | | | + | | | | | | | | | | + |
| White, 1999 | | | + | | | | | | | | | | |

*Note:* Meds = Medications; Sat. = Satisfaction with care; MV = Mechanical Ventilation.
! No significant difference in pain in intervention vs. control except for at the first time point; @ Differences noted by researcher but statistical significance not noted; $ NS difference in pain overall among the five intervention groups, however, when the researchers focused on the factor music immediately post-operative (music vs. no music) statistically significant *increases* in pain in the operated area, thirst, nausea and remembrance were noted in the music group. These researchers also noted statistically significant results for the factor "time of intervention" (early vs. late) with pain in the operated area, discomfort, and satisfaction with the perioperative course *improving* when music intervention was applied early.
+ better than baseline or pre-intervention; - no improvement or worse than baseline or pre-intervention.

had their feet touched for 20 min with no pressure, and (3) standard care. The researchers found statistically significant differences between groups for length of mechanical ventilation (MV) weaning time. Reflexology significantly reduced the length of MV weaning by 39.11 min compared to the control group.

In the second study, patients in the experimental group received reflexology therapy on their feet, hands, and ears bilaterally. Two, 30-minute reflexology sessions were carried out daily for 5 days. The control group received standard care. In both groups, sedation was stopped daily for 30-minutes before the assigned intervention. Statistically significant differences were observed between patients in the treatment and control group for agitation, anxiety, sleep, and patient-ventilator synchrony.

## 4. Discussion

This article provides the first PRISMA-compliant systematic review of RCTs exploring the effect of various CHAs on the symptom

**Table 4**
Effect of Other Complementary Health Approaches on Critically Ill Adults.

| Intervention Study | Pain | Meds. | Anxiety | Delirium | Agitation | Stress Bio-markers | Sleep | Level of Arousal | MV | Mental Stress | ICU and Hospital LOS and Mortality | Time To Ambulate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Nature Based Sounds** | | | | | | | | | | | | |
| Aghaie, 2014 | | | + | | + | | | | | | | |
| Heidari, 2015 | | | + | | | | | | | | | |
| Saadatmand, 2013 | | | + | | + | | | | | | | |
| Saadatmand, 2015 | + | | | | | | | | | | | |
| **Aromatherapy** | | | | | | | | | | | | |
| Bikmoradi, 2015 | | | | | | | | | | | | |
| Karadag, 2017 | | | + | | | | + | | | | | |
| Mirbastegan, 2016 | | | + | | | | | | | – | | |
| **Light Therapy** | | | | | | | | | | | | |
| Simons, 2016 | | | | – | | – | | | | | – | |
| Taguchi, 2007 | | | | -/+! | | | – | | | | | – |
| **Massage** | | | | | | | | | | | | |
| Henricson, 2008 | | – | + | | | -/+ | | | | | | |
| Vahedian-Azimi.2014 | | | | | | | | + | | | | |
| **Reflexology** | | | | | | | | | | | | |
| Akin Korhan, 2014 | | | + | | + | | + | – | + | | | |
| Ebadi, 2015 | | | | | | | | | + | | | |

*Note:* Meds = Medications; MV = Mechanical Ventilation; LOS = Length of Stay; ! A statistically significant difference in delirium was noted on morning on day 3 of bright light therapy. No difference in incidence of delirium.
+ better than baseline or pre-intervention; - no improvement or worse than baseline or pre-intervention.

experience of critically ill adults. Analysis of the 32 included studies involving 2987 participants revealed significant improvements in anxiety (music, NBS, aromatherapy, massage, and reflexology), pain levels (music, NBS), sleep quality/quantity (music, aromatherapy, reflexology), and level of arousal (music, massage, NBSs, reflexology). No CHA positively effected all symptoms or outcomes. Moreover, one daily dose of a CHA intervention will not result in long-term decreases in symptoms. Reductions in sedative and analgesic medication exposure occurred with music and in duration of mechanical ventilation with music and reflexology. Importantly, no adverse events or safety related concerns were reported in any of the reviewed RCTs. These findings indicate that CHAs can be a viable option in the management of a number important, common, and consequential ICU symptoms.

While there is some evidence suggesting various biomarkers associated with the stress response may be effected by CHA administration, less clear is the influence these therapies have on vital signs (VS). Multiple studies demonstrated conflicting results for VS as an indicators of changes in symptoms.[17,20,39,40,42,43,47–49,51,23,25,27,32–34,36,37] While VS are easy to measure, it is difficult to take into account the many confounding factors including age, illness, medications, comorbidities, and physiologic instability when comparing vital signs between patients or between groups of critically ill patients.

The quality of the studies included in this review was mixed. Several had bias issues including randomization, blinding, allocation, and attrician. Several studies had very small (5–10 per group) to small sample sizes (11–19 per group) although slightly more than half had at least 30 per group. The majority of the studies (81%) used a two group design. Only 4/32 studies used a three group design that included a placebo.[29,34,37,49] Using a three group RCT design, comparing an intervention to a similar sham (placebo) intervention and usual care is the strongest design for CHA intervention research. The intervention must achieve statistical significance compared to the sham intervention to be considered a strong result. Future studies examining CHA therapies should use a three group design powered to detect differences between groups.

The strengths of the review include careful following of PRISMA and Cochrane guidelines by four investigators leading to double and triple checking of searches, article inclusion, and data abstraction. A further strength of this review is the inclusion of only RCTs, the gold standard of research design and the highest level of research evidence. The total number of studies and number of participants in the studies gives credibility to symptom management using CHA modalities. The outcomes examined by the various studies including anxiety, agitation, pain, stress, distress, sleep, delirium, sedative and opioid exposures are common and important outcomes in the ICU environment. Finally, we examined only CHA interventions that can be easily implemented by nurses and are within nursing scope of practice.

## 5. Limitations

This review has some important limitations. Some of the studies suffered from low quality and bias. We limited our search to studies published in English and did not use grey literature. The longer-term efficacy of CHAs could not be evaluated because studies incorporated relatively short term follow-up. Small sample sizes in some studies yield low statistical power. Fully half of the studies reviewed had a high risk for bias in randomization strategies, slightly over half were either unclear or had a high risk of bias for both personnel and participant blinding. Finally, the instruments used to measure symptoms across studies varied and even newer studies did not use the assessment tools recommended in the PADIS Guidelines.[7,8]

## 6. Conclusions

This systematic review of 32 eligible RCTs demonstrates CHAs may be a benficial approach to managing the symptoms experienced by critically ill adults. Future RCTs are needed that are high quality, involve longer follow-up periods and increased sample size to fully verify efficacy.

## Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.ctim.2019.07.025.

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