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Are Prayer-Based Interventions Effective Pain Management Options? A Systematic Review and Meta-analysis of Randomized Controlled Trials

Margarida Jarego[1] · Alexandra Ferreira-Valente[1,2,3] · Inês Queiroz-Garcia[1] · Melissa A. Day[2,4] · José Pais-Ribeiro[1,5] · Rui M. Costa[1] · Filipa Pimenta[1] · Mark P. Jensen[2]

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Abstract

This review examined the effects of private and communal participatory prayer on pain. Nine databases were searched. Six randomized controlled trials were included. For private prayer, medium to large effects emerged for 67% to 69% of between-group comparisons; participants in the prayer condition reported lower pain intensity ($0.59 < d < 26.17$; 4 studies) and higher pain tolerance ($0.70 < d < 1.05$; 1 study). Pre- to post-intervention comparisons yielded medium to large effects ($0.76 < d < 1.67$; 2 studies); pain intensity decreased. Although firm conclusions cannot be made because meta-analysis was based on only two studies, the analysis suggested prayer might reduce pain intensity (SMD = −2.63, 95% CI [−3.11, −2.14], $I = 0\%$). (PROSPERO: CRD42020221733).

Keywords Systematic review · Meta-analysis · Prayer-based intervention · Pain · Pain outcomes

Introduction

Inadequate pain management has the potential to negatively impact individuals' health (Sinatra, 2010). Therefore, pain management is a priority (Breivik et al., 2006; Dunwoody et al., 2008; Morlion et al., 2008; Sinatra, 2010).

Pain is associated with biopsychosocial variables that influence its impact (Abbott et al., 2011; Eriksen et al., 2008; Gatchel et al., 2007; Hughes, 2006; Linton & Shaw,

Margarida Jarego and Alexandra Ferreira-Valente have contributed equally to this work and share co-first authorship.

✉ Alexandra Ferreira-Valente
mafvalente@gmail.com

Extended author information available on the last page of the article

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2011), and multimodal pain treatment programs addressing biopsychosocial factors (e.g., pain-related beliefs and pain coping responses) are more effective than exclusively biomedical treatments (Driscoll et al., 2021; Eccleston et al., 2013; Morley & Williams, 2015; Roditi & Robinson, 2011; Vervoort et al., 2018; Vowles et al., 2020; Williams et al., 2012). Recent research has also highlighted the relevance of spirituality/religiosity and spiritual/religious practices in influencing pain experience (Baetz & Bowen, 2008; Büssing et al., 2009; Dezutter et al., 2011; Ferreira-Valente et al., 2020, 2022; Hatefi et al., 2019; Illueca & Doolittle, 2020; Lysne & Wachholtz, 2010). Specifically, the evidence suggests that some religiosity/spirituality dimensions may be associated with lower pain and better psychological function in adults with chronic pain (Ferreira-Valente et al., 2022). For example, religious service attendance, bible study, and spiritual well-being seem to be negatively correlated with depressive symptom severity and pain intensity, and the spirituality dimensions of transcendence, symbolic inclusion/exclusion, daily spiritual experiences, forgiveness, meaning in life, and sense of purpose are all positively associated with better psychological function (Almeida et al., 2020; Dezutter et al., 2015, 2016; Ferreira-Valente et al., 2022). In addition, spiritual/religious practices appear to be effective in increasing pain tolerance (Dezutter et al., 2011; Lysne & Wachholtz, 2010). One of such practices is prayer. Prayer has the potential to explain why spirituality/religiosity may be beneficial for people experiencing pain. For this reason, spirituality/religiosity, as well as spiritual/religious practices—such as prayer—may be regarded as viable treatment targets in multimodal pain treatment programs.

Prayer—either focused on the object of prayer (generally a deity), on self-(re) assurance, on others, or on one's struggles—is often used by people to cope with their personal struggles, connect with a sense of meaning and hope, and improve psychological function, such as, for example, increased resilience in face of a chronic health condition (Jors et al., 2015). It is a manner of communication between a person and an object of prayer (Anderson & Nunnelley, 2016), and a complex multidimensional practice common to people of different religions. The lack of a consensus regarding the best way to categorize and assess different types of prayer (concerning, for example, the specific content or topic of the prayer), as well as the time point (for example during the course of a disease) in which data are assessed, and other methodological differences, hampers between-studies comparisons relative to prayer's effects on health-outcomes. These issues also might explain the inconsistent results reported in previous research (Illueca & Doolittle, 2020; Masters & Spielmans, 2007; Pérez et al., 2011). A more consistent pattern of findings might emerge once researchers begin to use similar measures (of both prayer and criterion variables), procedures (e.g., similar assessment time point), and types of prayer.

Ferreira-Valente et al. (2021) propose the following taxonomy to classify prayer with respect to the number of people praying, the content of prayer(s), and the targeted beneficiary of prayer(s): (1) *private* (individual) or *communal* (dyadic or group) prayer (Anderson & Nunnelley, 2016; Baesler, 1999); (2) *active* (i.e., self-motivating style of prayer, such as "God, help me endure the pain"), or *passive* (i.e., asking the object of prayer to solve a given struggle, for instance pain; e.g., "God, take the pain away") *petition*, *thanksgiving*, *adoration*, *confession*, *reception*, *meditation*, or *ritualistic* prayer (Baesler, 1999; Illueca & Doolittle, 2020; Laird et al.,

2004; Meints et al., 2018; Pérez et al., 2011); and (3) *participatory* (person/people doing the praying) or *distant intercessory* (person/people other than the person/people doing the praying) prayer (Levin, 2020). Prior research indicates stronger support for the beneficial effects of *participatory* prayer than for *distant intercessory* prayer (Jegindø et al., 2013; Masters et al., 2006; Tajadini et al., 2016).

Previous preliminary findings also suggest that spiritual/religious practices (e.g., prayer) may reduce distress and pain intensity in individuals experiencing acute pain (Dezutter et al., 2011; Rahman et al., 2020), individuals with chronic pain (Lysne & Wachholtz, 2010; Tajadini et al., 2016), or healthy individuals in experimental settings (Elmholdt et al., 2017; Meints et al., 2018). Illueca and Doolittle (2020) summarized previous findings on the effects of *proactive private participatory* prayer on pain-related outcomes, suggesting that this type of prayer is useful. However, this review was limited to studies published in English from 2000 to 2019 and in journals indexed in one of only four databases. It may have missed studies: (1) published in other languages; (2) published before 2000; (3) published in journals indexed in other relevant databases or present in the gray literature; and/or (4) examining the effects of communal prayer. It also failed to provide a qualitative review of the findings based on a standardized well-established qualitative synthesis method, and to perform a quality assessment of the included studies.

The current systematic review aimed to address these limitations. It summarizes, integrates, and assesses the findings and methodological quality of previous randomized controlled trials (RCTs) examining the effects of *private* and *communal participatory* prayer-based interventions on pain intensity, pain tolerance, and stress in adults experiencing acute/chronic pain, including studies published in English, German, French, Spanish, Italian, or Portuguese, indexed in nine bibliographical databases. Distant intercessory prayer was not included in this review as the recipients of the prayers are not directly involved in the prayer, and because it is difficult to identify the actual prayer recipient for this type of prayer (Masters et al., 2006). Another reason to exclude distant intercessory prayer is the consensus among researchers that, given the findings published to date, examination of the effects of this type of prayer does not justify further research (Masters et al., 2006). We also sought to make recommendations for future research, based on the findings from the review.

Materials and Methods

Review Protocol and Registration

This systematic review with meta-analysis was conducted according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement for systematic reviews and meta-analysis (Liberati et al., 2009). This review protocol was prospectively registered in PROSPERO registry (CRD42020221733) and published (Ferreira-Valente et al., 2021) on December 2, 2020, and on July 5, 2021, respectively.

Eligibility Criteria

Included studies had to be RCTs, published in English, German, French, Spanish, Italian, or Portuguese, and with the following characteristics:

Population: Participants were (1) adults (i.e., 18 years old or older) with (2) pain (regardless of its duration or etiology);
Intervention: Private or communal participatory prayer-based intervention;
Comparator: The control condition could include alternative treatment(s), treatment as usual, or both.
Outcomes: At least one quantitative measure of self-reported pain intensity, pain tolerance, and/or stress.

Although including studies published in one of the six languages described above (i.e., those understood by at least one of the authors on the team) may be restrictive, the research team did not have the resources to include articles published in other languages. Qualitative, cohort, case–control, and cross-sectional studies, and studies examining the effects of complementary and integrative health interventions and spiritual practices different from prayer (e.g., meditation, reiki, yoga), or distant intercessory prayer were excluded from this review.

Information Sources and Search Strategies

The initial literature search was conducted on December 2, 2020 and was updated on April 29, 2022. The search strategy was customized to identify relevant publications in the nine electronic databases (Web of Science Core Collection, MEDLINE, SCIELO Citation Index, PUBMED, Cochrane Central Register of Controlled Clinical Trial, PsycINFO, Scopus, LILACS, and Open-SIGLE). The following search terms were used: (1) Religion OR Prayer AND (2) Pain AND (3) Pain intensity OR Pain tolerance OR Stress. Gray literature was searched in clinical trial registry platforms (e.g., ClinicalTrials.gov; International Standard Randomised Controlled Trial Number, ISRCTN registry). Furthermore, the reference lists of eligible articles and review articles were hand-searched. The detailed search strategy is published elsewhere (Ferreira-Valente et al., 2021).

Study Selection and Data Management

Literature searches results were uploaded into Zotero. Cross-references and duplicates were deleted. References, titles, abstracts, and keywords of all identified studies—after duplicates removal—were uploaded to a Microsoft Excel screening sheet. Two independent reviewers (MJar and IQG) then read the title, abstract, and keywords of all the identified studies to assess their eligibility against inclusion and exclusion criteria. The full texts of potentially eligible manuscripts were independently read by the same reviewers to confirm eligibility. Any discrepancies regarding study eligibility were resolved by consensus. If consensus was not met, a

third reviewer (AFV) was consulted and made the final decision. The decision about study eligibility was recorded on the screening sheet.

Co-Primary Outcomes

Co-primary outcomes include pain intensity, pain tolerance, and/ or stress. Commonly used measures assessing these variables are described below.

Pain Intensity

Valid and reliable commonly used measures of pain intensity include: the Visual Analogue Scale (VAS) and related versions of this scale (e.g., mechanical VAS) (Huskisson, 1983), the 0–10 Numerical Rating Scale (NRS), the Verbal Rating Scale (VRS) (Jensen, 2019), and the Faces Pain Scale-Revised (Hicks et al., 2001).

Pain Tolerance

Pain tolerance is usually operationalized as the length (in seconds) that an individual is willing to experience pain (Feuille & Pargament, 2015; Gonçalves et al., 2017; Samulowitz et al., 2018).

Stress

Valid and reliable commonly used measures of stress are: (1) the Perceived Stress Scale [PSS; (Cohen et al., 1993)]; (2) the stress subscale of the Depression, Anxiety and Stress Scale [DASS; (Lovibond & Lovibond, 1995)] and short versions of this scale. Objective reliable tools to assess stress are: (1) salivary cortisol (Schwabe et al., 2008); (2) heart rate variability (Laborde et al., 2017); and (3) blood pressure (Schwartz et al., 1994).

Data Extraction

Data from eligible studies were extracted to a Microsoft Excel extraction sheet. The following information was independently extracted by two reviewers (MJar and IQG): (1) reference; (2) country of study; (3) type and etiology of pain; (4) sample size; (5) study participants' age (*M*, *SD*); (6) percentage of female participants; (7) site of pain; (8) study participants' religious denomination and self-reported spirituality; (9) study participants' type of religious practice (i.e., religious and practitioner, religious but not practitioner); (10) study participants' attitudes towards the religion (negative vs. positive attitude towards deity); (11) prayer-based intervention's sessions' frequency and length; (l2) type of *participatory* prayer (i.e., *private* or *communal*); (13) content of prayer (petition, thanksgiving, adoration, confession, reception, meditative, or ritualistic); (14) level of engagement and emotional involvement with the prayer-based intervention; (15) type and characteristics of the comparator or control condition; (16) self-reported pain intensity; (17) pain tolerance; and (18)

stress. Data (*M*, SD, *p* values and effect sizes) relative to the co-primary outcomes at the pre- and post-test assessment for all study conditions were extracted. Whenever available, rates by which different groups obtained a 30% and a 50% reduction in pain intensity were extracted. Discrepancies in data extracted were resolved by consensus. A third reviewer (AFV) was consulted if consensus was not met.

Quality Assessment

Study methodological quality (the opposite of risk of bias) assessment was performed by two independent reviewers (MJar and IQG) based on the Consolidated Standards of Reporting Trials (CONSORT) statement and on the Cochrane's assessment of bias tool (Higgins et al., 2021). Discrepancies were settled through consensus. Seventeen items were considered as illustrated in Fig. 1. Each of these items was scored as "Yes" (=1), "No" (=0), or "Unclear" (=?). A total methodological quality score for each included study was computed as a percentage of the number of "1′s", dividing the number of points earned by 17. Study quality scores were categorized as low (<50% "1′s"), medium (50–80% "1′s"), and high (>80% "1′s") (Harrison et al., 2015; Scott et al., 2018). Studies were not excluded based on the quality assessment.

Data Analysis

Qualitative Synthesis

We performed a qualitative synthesis summarizing the methodological characteristics, the strengths and limitations, and the findings of the included studies (Eden

Randomization Process	Random allocation to the conditions
	Allocation sequence adequately concealed
	Similar baseline characteristics of the groups
Deviations from the Intended Interventions	Participants blinded to assigned intervention
	Person delivering the intervention blinded to participants' assigned intervention
	Deviations from the intended intervention did not arose because of the experimental context
	Use of appropriate analysis to estimate the effect of assignment to intervention
Missing Outcome Data	Flow of participants reported
	Outcome measures' data available for (nearly) all participants randomized
	Methods for dealing with missing data described and appropriate
	Missingness in the outcome(s) likely to depend on its tru value
Measurement of the Outcome	Use of valid measures to assess co-primary outcomes
	Evidence supporting the validity and reliability of the co-primary outcome measures was presented
	Measurement or ascertainment of the outcome(s) similar study groups
Selection of the Reported Result	Method to determine study size described and appropriate OR the *n* of each study groups ≥ 30
	Data analyzed in accordance with a pre-specified plan finalized before unblinded outcome data were available for analysis
	Numerical result assessed was not likely to have been selected based on the results from multiple analyses of data

Fig. 1 Study methodological quality assessment

et al., 2011). To summarize the evidence relative to the effects of prayer in changing co-primary outcomes in adults with pain, as compared to a control group, we implemented a narrative summary synthesis method adapted from the proposed by the UK Economic and Social Research Council for systematic reviews (Popay et al., 2006). First, we performed a preliminary synthesis of the findings of the included studies. Then, we explored the relationships in the data. Finally, we assessed the overall robustness of the synthesis. We used the following tools suggested by Popay et al. (2006): (1) textual description of the included studies; (2) clustering/grouping the included studies according to the type of prayer and co-primary outcome considered; (3) tabulation of the included studies characteristics and findings; and (4) subgroup analysis according to the design of the included studies and to the modality of prayer employed.

Meta-Analysis

We planned to conduct meta-analysis for *private* and *communal participatory* prayer interventions separately, if at least two included studies presented data on the same co-primary outcome (Deeks et al., 2022). End-point scores were calculated as standardized mean differences (SMD) with 95% confidence intervals (CI), presented in Cohen's *d*, using the Comprehensive Meta-Analysis Software (Borenstein et al., 2013). Cohen's *d* were deemed small (|.20|), medium (|.50|), large (|.80|), or very large (|1.30|) (Cohen, 1988). Heterogeneity was quantified using the I^2 statistic and was deemed low (< 40%), moderate (30–60%), substantial (50–90%), or considerable (≥ 75%) (Higgins & Green, 2008). Alpha was set at 0.05 for the heterogeneity test.

Assessment of Reporting Bias

In the event that at least 10 studies were included in the meta-analysis, we planned to use funnel plots to assess the existing reporting bias and small-study effects, and to use Egger's regression test method (Lin & Chu, 2018) to quantify publication bias.

Confidence in Cumulative Evidence

The methodological quality, relevance, strengths and limitations of the included studies was assessed. Comparisons between study characteristics, design, and execution were made, and their impact on study outcome was examined. The Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach was employed to assess the strength of the body of evidence (Ryan & Hill, 2016). Independent reviewers (MJar and IQG) performed the strength of the body of evidence assessment. Tables of summary of findings (SoF) tables—one for pain intensity and the other for pain tolerance—were constructed. GRADE starts with a baseline rating of high quality for randomized clinical trials (Ryan & Hill, 2016). Thus, we planned to start rating the evidence as high-quality. If serious, or very serious, concerns regarding the risk of bias, inconsistency, indirectness, imprecision, or publication bias emerged, we planned to downgrade the quality by one level, or two

levels, respectively. Evidence quality was deemed high (i.e., further research is very unlikely to change our confidence in the estimate of effect), moderate (i.e., further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate), low (i.e., further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate) or very low (i.e., we are very uncertain about the estimate) (Ryan & Hill, 2016).

Missing Data

If a study did not report data to allow for the computation of the pre- to post-treatment difference scores in the treatment conditions, the authors of that study were e-mailed with a request to provide the missing information. A second and then a third reminder email was sent, with a two-week interval, if authors did not reply to the requests. If authors did not reply after three requests, or were unable to provide the requested data, studies were excluded from the meta-analysis.

Results

Study Selection

Figure 2 summarizes study selection procedures, and reasons for full-text articles exclusion. Database searches identified 1027 articles. Duplicates deletion resulted in 707 potentially relevant studies whose title, abstract and keywords were screened for eligibility. Full texts of eight potentially eligible articles were read to confirm eligibility; five met the inclusion criteria and were included in this review. Additionally, the reference lists of these five studies, and of review articles, were hand searched. Hand searches resulted in the identification of six additional potentially eligible studies whose title, abstract and keywords were screened. Of these, one was deemed potentially eligible. Its full text was read to confirm eligibility. This study met the inclusion criteria and was included in this review. The pre-submission searches identified 121 additional articles, none of which met the inclusion criteria. A total of six studies were included in the qualitative synthesis, and two were included in the meta-analysis.

Description of the Included Studies

Study Design and Setting

Table 1 summarizes the characteristics of the included studies. The included studies were published between 2014 and 2019. Five studies were conducted in Iran (Beiranvand et al., 2014; Dehkordi et al., 2016; Keivan et al., 2019; Nasiri et al., 2014; Tajadini et al., 2016), while one was conducted in the USA (Meints et al., 2018).

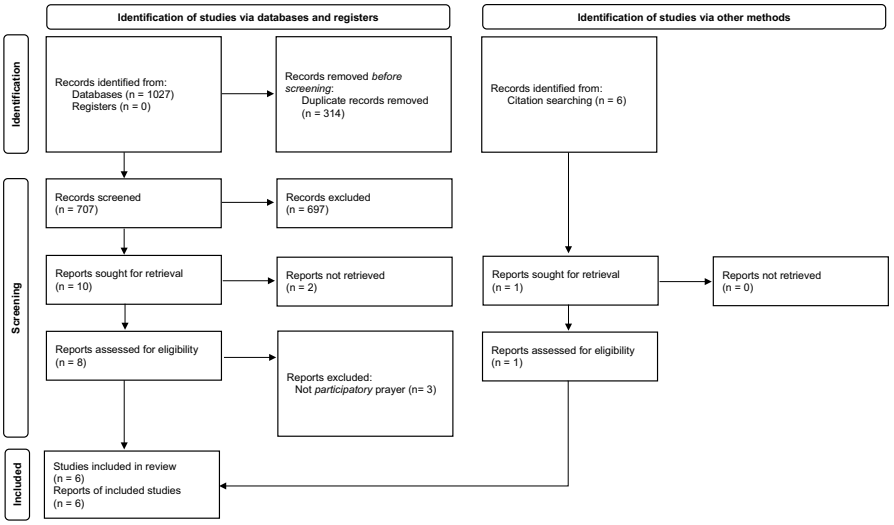

Fig. 2 PRISMA flow diagram

Participants' Characteristics

The six articles included in this review provided data from 712 participants. Study sample sizes ranged from 40 (Nasiri et al., 2014) to 208 (Meints et al., 2018) participants ($M = 118.67$, SD = 50). Four studies included participants with acute pain (Beiranvand et al., 2014; Dehkordi et al., 2016; Keivan et al., 2019; Nasiri et al., 2014), one included participants with chronic pain (Tajadini et al., 2016), and one study included healthy participants undergoing experimentally induced pain (Meints et al., 2018).

In four studies, participants were predominantly women (range from 54 to 100%) (Beiranvand et al., 2014; Dehkordi et al., 2016; Meints et al., 2018; Tajadini et al., 2016). Studies' participants were, mostly, young and middle-aged adults, with mean age at the time of enrolment ranging from 20 to 57 years old. All but one ($n = 5$) study reported participants' religious affiliation as Muslim (Beiranvand et al., 2014; Dehkordi et al., 2016; Keivan et al., 2019; Nasiri et al., 2014; Tajadini et al., 2016), while one study reported multiple religions affiliations (e.g., Christian, Muslim, Agnostic) (Meints et al., 2018). None of the included studies reported the type of religious practice of the participants, or their attitudes towards religion.

Prayer-Based Interventions

All studies' prayer-based interventions were *participatory*, either *private* ($n = 5$) (Beiranvand et al., 2014; Dehkordi et al., 2016; Keivan et al., 2019; Meints et al., 2018; Nasiri et al., 2014) or *communal* ($n = 1$;) (Tajadini et al., 2016). Relative to the content of the prayer, four studies implemented adoration prayer (Beiranvand et al., 2014; Dehkordi et al., 2016; Keivan et al., 2019; Nasiri et al., 2014), while one study

Table 1 Characteristics of the included studies

Author (year)	Country	Design	Type of pain	Population	*N* (*n* per group)	*N* (%) female participants	Age (*M* ± SD)	Prayer-based intervention	Control condition	Primary outcome (measure)
Beiranvand et al. (2014)	Iran	DB-RCT	AP	Adults with mild pain undergoing caesarean surgery under spinal anaesthesia	160 (80 vs. 80)	160 (100%)	EG: 27 ± 4; CG: 28 ± 4	1 session during surgery, 20 min duration; listen to adoration prayer with headphones; adoration prayer; private prayer + spinal anesthesia	No prayer and phone off + spinal anesthesia	Pain intensity (VAS)
Dehkordi et al. (2016)	Iran	RCT	AP	Adults with post- gastrointestinal system elective surgery pain	108 (54 vs. 54)	58 (54%)	32.5 ± 3	1 session, unclear duration; adoration prayer; private prayer + analgesic medication	Analgesic medication	Pain intensity (VAS)
Keivan et al. (2019)	Iran	RCT	AP	Adults with burns (≥ 20% body coverage) 24-72 h after the burning	64 (32 vs. 32)	27 (42%)	EG: 33.94 ± 13.76; CG: 34.12 ± 9	3 sessions, unclear duration (before, during, and after dressing change); adoration prayer; private prayer + spiritual care from a nurse, a clergy and the patient's companion + unspecified routine control care of pain	3 sessions, 45–60 min; emphatic listening by a research colleague + unspecified routine control care of pain	Pain intensity (VAS)

Table 1 (continued)

Author (year)	Country	Design	Type of pain	Population	*N* (*n* per group)	*N* (%) female participants	Age (*M* ± SD)	Prayer-based intervention	Control condition	Primary outcome (measure)
Meints et al. (2018)	USA	RCT	EIP	Healthy adults	208 (73 vs. 75 vs. 60)	166 (80%)	Black participants: 20.4 ± 4.7; White participants: 19.9 ± 3.6	Group A: 1 session, unclear duration; petition prayer [repeat the sentence "God, help me endure the pain" during CPT (A)]; private prayer; Group B: 1 session, unclear duration; petition prayer [repeat the sentence "God, take the pain away" during CPT (B)] Private prayer	1 session, unclear duration; no prayer [repeat the sentence "The sky is blue" during CPT (C)]	Pain tolerance (in seconds)
Nasiri et al. (2014)	Iran	RCT	AP	Adults that underwent coronary artery bypass graft surgery in open heart	80 (40 vs. 40);	23 (29%)	EG: 56.6 ± 7.73; CG: 57.22 ± 8.48	3 sessions, 10–15 min duration; adoration prayer; private prayer + standard medical postoperative care protocol + analgesic medication	Standard medical postoperative care protocol + analgesic medication	Pain intensity (VAS)

Table 1 (continued)

Author (year)	Country	Design	Type of pain	Population	*N* (*n* per group)	*N* (%) female participants	Age (*M* ± SD)	Prayer-based intervention	Control condition	Primary outcome (measure)
Tajadini et al. (2016)	Iran	DB-RCT	CP	Adults with migraine headache with and without aura	92 (46 vs. 46);	82 (89%)	33.7 ± 10.3	8 sessions, 45 min of weekly prayer; unknown content of prayer; communal prayer + 40 mg of propranolol twice a day	40 mg of propranolol twice a day	Pain intensity (VAS)

RCT randomized clinical trial, *DB-RCT* double-blinded randomized clinical trial, *AP* acute pain, *EIP* experimentally induced pain (cold pressor test), *CP* chronic pain, *EG* experimental group, *CG* control group, *VAS* visual analogue scale

implemented petition prayer (Meints et al., 2018). One study did not report the content of the prayer implemented (Tajadini et al., 2016). No studies reported the level of engagement and emotional involvement of the participants with the prayer-based intervention.

Half ($n=3$) of the studies implemented a single-session prayer-based intervention (Beiranvand et al., 2014; Dehkordi et al., 2016; Meints et al., 2018). The length of the prayer session was known for only one study, which was 20 min (Beiranvand et al., 2014). Half ($n=3$) of the studies tested multiple-sessions prayer-based interventions. In one of the studies, three sessions with 10–15 min long (Nasiri et al., 2014) were implemented. In another, the prayer-based intervention consisted of eight 45 min sessions (Tajadini et al., 2016). The last study implemented 3 sessions with unknown length (Keivan et al., 2019). In all but one study (Meints et al., 2018), the prayer-based interventions were delivered in conjunction with other medical care similar to the one provided to the control group, including spinal anesthesia (Beiranvand et al., 2014), analgesic medication (Dehkordi et al., 2016; Tajadini et al., 2016), standard medical postoperative care (Nasiri et al., 2014), or unspecified routine control care (Keivan et al., 2019).

Measures of Primary Outcomes Used

All but one ($n=5$) study (Beiranvand et al., 2014; Dehkordi et al., 2016; Keivan et al., 2019; Nasiri et al., 2014; Tajadini et al., 2016) considered pain intensity as the primary outcome. All used the VAS, ranging from "No pain" to "Worst possible pain" (Huskisson, 1983), as a measure of pain intensity. The remaining study (Meints et al., 2018) considered pain tolerance as the primary outcome, defined as the number of seconds elapsed from the beginning of the exposure to painful stimulation to the time of withdrawal from the cold pressor test, with a maximum of 180 s. None of the included studies assessed stress.

Methodological Quality of the Included Studies

All studies were rated as having moderate methodological quality, with quality scores ranging from 59 to 65% (cf. Table 2). Some concerns related to attrition bias were found for five studies, due to reporting of missing outcome data. In fact, none of the studies reported neither if missing data were observed nor the methods used to deal with missing data. Only one study (Dehkordi et al., 2016) reported the participants' flow. Thus, whether or not missingness in the outcome(s) was likely to depend on its true value is unclear for all six studies. Some concerns pertaining to performance bias arose across all studies, due to deviations from the intended interventions or to not presenting evidence supporting the validity of the outcome measures. Only one study characterizes it as being single-blinded, but fails to report what procedures were undertaken to guarantee participants or experimenters remain blinded to participants' allocation (Dehkordi et al., 2016). Half ($n=3$) of the studies did not mention if, and how, participants' blinding with respect to treatment allocation was attempted (Keivan et al., 2019; Meints et al., 2018; Nasiri et al., 2014).

Table 2 Methodological quality assessment of the included studies ($n=6$)

Author (year)	Randomization process			Deviations from intended interventions				Missing outcome data	
	1. Random allocation to the conditions	2. Allocation sequence adequately concealed	3. Similar baseline characteristics of the groups	4. Participants blinded to assigned intervention	5. Person delivering the intervention blinded to participants' assigned intervention	6. Deviations from the intended intervention did not arose because of the experimental context	7. Use of appropriate analysis to estimate the effect of assignment to intervention	8. Flow of participants reported	9. Outcome measures' data available for (nearly) all participants randomized
Beiranvand et al. (2014)	1	?	1	1	1	1	0	0	1
Dehkordi et al. (2016)	1	?	1	?	?	1	1	1	1
Keivan et al. (2019)	1	?	1	?	?	1	1	0	1
Meints et al. (2018)	1	?	1	?	0	1	1	0	1
Nasiri et al. (2014)	1	1	1	?	0	1	1	0	1
Tajadini et al. (2016)	1	?	1	1	1	1	1	0	1

Table 2 (continued)

Author (year)	Missing outcome data		Measurement of the outcome			Selection of the reported result			Total score (%)
	10. Methods for dealing with missing data described and appropriate	11. Missingness in the outcome(s) likely to depend on its true value	12. Use of valid measures to assess co-primary outcomes	13. Evidence supporting the validity and reliability of the co-primary outcome measures was presented	14. Measurement or ascertainment of the outcome(s) similar in all study groups	15. Method to determine study size described and appropriate OR the *n* of each study groups ≥ 30	16. Data analyzed in accordance with a pre-specified plan finalized before unblinded outcome data were available for analysis	17. Numerical result assessed was not likely to have been selected based on the results from multiple analyses of data	
Beiranvand et al. (2014)	0	?	1	0	1	1	?	1	59
Dehkordi et al. (2016)	0	?	1	0	1	1	?	1	59
Keivan et al. (2019)	0	?	1	1	1	1	?	1	59
Meints et al. (2018)	0	?	1	1	1	1	?	1	59
Nasiri et al. (2014)	0	?	1	1	1	1	?	1	65
Tajadini et al. (2016)	0	?	1	0	1	1	?	1	59

1 = "Yes", 0 = "No", ? = "Unclear"

Blinding of experimenters to participants allocation was reported, and likely to be successful, in two studies (Beiranvand et al., 2014; Tajadini et al., 2016). Half ($n=3$) of the studies (Keivan et al., 2019; Meints et al., 2018; Nasiri et al., 2014) presented evidence of outcome measures validity. The few concerns that emerged relative to participant selection and reporting bias were associated with the concealment of allocation sequence. For all but one study (Nasiri et al., 2014), it was either unclear if allocation sequence was adequately concealed, if data were analyzed in accordance with a pre-specified plan defined a priori, or both.

Deviation from the Original Study Protocol

We had originally planned to also include studies that reported stress measured through a quantitative measure (Ferreira-Valente et al., 2021). However, none of the studies reported such outcome, and the effects of prayer on stress could not be evaluated in this review. Second, the included studies did not provide the rates by which different groups obtained a 30% and a 50% reduction in pain intensity. These results also could not be summarized in this review. Third, Comprehensive Meta-Analysis Software (Borenstein et al., 2013) was used, instead of Campbell Collaboration online calculator (Lipsey & Wilson, 2001), to perform meta-analysis and transform data extracted into Cohen's *d* effect size, as the former, but not the latter, enables to create the forest plot for the meta-analysis. Fourth, we had originally planned to perform assessment of the reporting bias if more than 10 studies were included in the meta-analysis. Since meta-analysis comprehended only two studies, this analysis was omitted. Finally, Illueca and Doolittle (2020) proposed that prayer can also be classified, in terms of its implementation mode or modality, as being *proactive* (i.e., the person/people doing the praying verbalize/s the prayer) or *receptive* (i.e., the person/people doing the praying listen/s to the prayer). As suggested by these authors, we analyzed the modality of prayer, which was not a part of our original plan.

Qualitative Synthesis of the Included Studies Findings

Table 3 displays the within- and between-group comparison results for the included studies. A summary of these findings is presented below, separately for studies focusing *private* prayer, and for studies focusing *communal* prayer.

Private Participatory Prayer

All but one ($n=5$) study assessed the effects of *private participatory* prayer, four of which focused on pain intensity as the primary outcome (Beiranvand et al., 2014; Dehkordi et al., 2016; Keivan et al., 2019; Nasiri et al., 2014), while one considered pain tolerance (Meints et al., 2018).

Pain intensity: Between-group comparisons All studies focusing *private* prayer's effects on pain intensity performed between-group comparisons (Beiranvand et al., 2014; Dehkordi et al., 2016; Keivan et al., 2019; Nasiri et al., 2014; Tajadini et al., 2016). Taken the findings of these studies together, results from 16 between-group

Table 3 Within- and between-group comparisons of primary outcomes of the included studies

Author (year)	Primary outcome (measure)	Assessment(s)	Statistical analysis of interest	$M \pm SD$ (EG)	$M \pm SD$ (CG)	Within-group (EG) comparisons	Between-group comparisons (EG *vs.* CG)
Beiranvand et al. (2014)	Pain intensity (VAS)	T0: baseline T1: during pray meditation T2: 30 min after T3: 60 min after T4: 3 h after T5: 6 h after pray meditation	Independent samples *t* Paired samples *t* [a]	T0: 2.7 ± ? T1: 1.8 ± ? T2: 1.6 ± ? T3: 1.2 ± ? T4: 1.5 ± .3 T5: 1.3 ± .8	T0: 2.3 ± ? T1: 2.6 ± ? T2: 1.7 ± ? T3: 1.4 ± ? T4: 3 ± 1.3 T5: 3 ± 1.1	?	T1: EG = CG (*ns*, *d* = ?) T2: EG = CG (*ns*, *d* = ?) T3: EG = CG (*ns*, *d* = ?) T4: EG < CG ($p = .03$, $d = 0.65$[b]) T5: EG < CG ($p = .03$, $d = 1.77$[b])
Dehkordi et al. (2016)	Pain intensity (VAS)	T1: 3 h after surgery T2: 12 h after surgery T3: 24 h after surgery	Chi-square test	T1: ? T2: ? T3: ?	T1: ? T2: ? T3: ?	?	T1: EG < GC ($p < .001$, $d = 26.17$) T2: EG < GC ($p < .001$, $d = 12.28$) T3: EG < GC ($p = .003$, $d = 9.8$)
Keivan et al. (2019)	Pain intensity (VAS)	T0: baseline T1: after session 1 T2: after session 2 T3: after session 3	Independent samples *t*	T0: 8.5 ± 1.64 T1: 6.94 ± 2.29 T2: 6.03 ± 2.12 T3: 4.44 ± 2.33	T0: 7.74 ± 2.18 T1: 8.25 ± 2.13 T2: 8.44 ± 1.74 T3: 8.34 ± 2.09	T0 > T1 ($p < .001$[a], $d = 0.76$[b]) T0 > T2 ($p < .001$[a], $d = 1.28$[b]) T0 > T3 ($p < .001$[a], $d = 1.96$[b])	T1: EG < GC ($p = .02$, $d = .59$[b]) T2: EG < GC ($p < .001$, $d = 1.24$[b]) T3: EG < GC ($p < .001$, $d = 1.76$[b])

Table 3 (continued)

Author (year)	Primary outcome (measure)	Assessment(s)	Statistical analysis of interest	$M \pm SD$ (EG)	$M \pm SD$ (CG)	Within-group (EG) comparisons	Between-group comparisons (EG *vs.* CG)
Meints et al. (2018)	Pain tolerance (seconds)	T1: during CPT	ANCOVA	T1(A): 38.9 ± 9.4[c] T1(B): 30.9 ± 9.53[c]	T1(C): 29.51 ± 8.52[c]	?	T1: EG(A) > CG(C) ($p = .03$, $d = 1.05$[b]) T1: EG(B) = CG(C) (*ns*, $d = 0.15$[b]) T1: EG(A) = EG(B) (*ns*, $d = 0.85$[b])
Nasiri et al. (2014)	Pain intensity (VAS)	T0: baseline T1: after session 1 T2: before session 2 T3: after session 2 T4: before session 3 T5: after session 3	Independent samples *t*, Paired samples *t*	T0: 5.32 ± 2.28 T1: 3.19 ± 1.91 T2: 4.46 ± 2.66 T3: 2.24 ± 1.95 T4: 3.59 ± 1.87 T5: 1.99 ± 1.38	T0: 5.48 ± 1.17 T1: 5.17 ± 2.67 T2: 4.38 ± 2.51 T3: 4.12 ± 3.24 T4: 3.84 ± 2.61 T5: 3.67 ± 2.25	T0 > T1 ($p < .001$[a], $d = 1.01$[b]) T0 > T3 ($p < .001$[a], $d = 1.44$[b]) T0 > T5 ($p < .001$[a], $d = 1.67$[b])	T1: EG < CG ($p < .001$, $d = 0.85$[b]) T2: EG = CG ($p = .53$, $d = 0.03$[b]) T3: EG < CG ($p < .001$, $d = 0.70$[b]) T4: EG = CG ($p = .53$, $d = 0.11$[b]) T5: EG < CG ($p < .01$, $d = 0.90$[b])
Tajadini et al. (2016)	Pain intensity (VAS)	T0: baseline T1: 3 months follow-up	Independent samples *t* Paired samples *t*	T0: 6.5 ± 1.9 T1: 4.2 ± 2.3	T0: 5.7 ± 1.6 T1: 5.4 ± 1.1	T0 > T1 ($p < .001$[a], $d = 1.08$[b])	T1: EG > CG ($p < .001$, $d = 0.67$[b])

CG control group, *CPT* cold pressor test, *EG* experimental group, *VAS* visual analogue scale, *?* unknown, *NS* non-significant

[a]Beiranvand et al. (2014) reported to have performed paired sample *t* tests to perform between-group comparisons, but the findings from these analyses were not reported in their paper, nor did the authors provide us with those findings upon request

[b]Computed by the review's authors

[c]SD computed by the review's authors from the SE reported in the included study

comparisons are reported. However, the moments of assessment for each of these studies differed. Overall, 11 out of 16 (69%) between-group comparisons for this cluster of studies were statistically significant (eight large and three medium SMDs). Individuals in the *private* prayer condition reported, on average, lower pain intensity than those in the control condition. This is especially true for the studies implementing *private proactive* prayer as compared to those implementing *private receptive* prayer. The effect sizes for most (63%) between-group comparisons performed in studies implementing a *proactive* modality of prayer were large, while only 38% of the effect sizes were large for those focusing *receptive* prayer (cf. Table 4). This trend does not appear to be dependent on other study characteristics, including sample size, duration and length of intervention, or prayer content.

Pain intensity: Within-group comparisons Only two out of four studies analyzing the effects of *private* prayer on pain intensity either performed within-group comparisons or provided sufficient information allowing for the computation of *p*-values and effects sizes for such comparisons (Keivan et al., 2019; Nasiri et al., 2014), resulting in six within-group comparisons. All within-group comparisons for the *private* prayer condition were statistically significant (five large and one medium SMDs). The findings do not appear to depend on any study characteristics, including sample size, duration and length of intervention, or prayer content and modality. However, the only medium effect that emerged (as opposed to large effects for other comparisons) was in a study examining *private receptive* prayer (Keivan et al., 2019).

Pain tolerance: Between-group comparisons Only one study examined the between-group effects of a prayer-based intervention (Group A: active petition prayer, repeating the sentence "God, help me endure the pain" during CPT; Group B: passive petition prayer, repeating the sentence "God, take the pain away" during CPT) on pain tolerance relative to a control (Group C: repeating the sentence "The sky is blue" during CPT) condition (Meints et al., 2018). A total of three pairwise between-group comparisons were reported, resulting in only one statistically significant effect (large SMD), with individuals in the active petition prayer condition (Group A) reporting higher pain tolerance than individuals in the control condition. The effect size of the pairwise comparison between the active petition prayer condition and the passive petition prayer condition (Group A vs. Group B) was also large. However it did not reached statistical significance.

Communal Participatory Prayer

Only one study (Tajadini et al., 2016) examined the effects of *communal prayer*. The primary outcome of this study was pain intensity. Both within and between-group comparisons were performed.

Pain intensity: Between-group comparisons A single between-group comparison was computed comparing pain intensity, on average, of the participants in the experimental and in the control conditions three months after the intervention. A statistically significant effect (medium SMD) was observed, with individuals in the experimental condition reporting lower pain intensity.

Table 4 Summary of the Results (Effect Size) of Private Participatory Prayer on Pain Intensity by Study Characteristics ($n=4$)

Intervention characteristics	Group comparisons					Pre- and post-intervention comparisons				
	# of comparisons	Large Effect	Medium Effect	Small Effect	Unknown	# of comparisons	Large Effect	Medium Effect	Small Effect	Unknown
Sample size										
< 100	8	4 (50%)	2 (25%)	2 (25%)[a]		6	5 (83%)	1 (17%)		
> 100	8	4 (50%)	1 (12.5%)		3 (38%)[a, b]					
Prayer modality										
Receptive prayer	8	3 (38%)	2 (25%)		3 (38%)[a, b]	3	2 (67%)	1 (33%)		
Proactive prayer	8	5 (63%)	1 (12.5%)	2 (25%)[a]		3	3 (100%)			
Duration of intervention										
1 session	8	4 (50%)	1 (13%)		3 (38%)[a, b]					
3 sessions	8	4 (50%)	2 (25%)	2 (25%)[a]		6	5 (83%)	1 (17%)		

Included studies in the current table did not differ regarding content of prayer or methodological quality, so these parameters were not included in comparisons due to redundancy

[a]Effect sizes associated with a non-significant p value ($p < .05$)

[b]Effect sizes not computed due to insufficient data

Pain intensity: Within-group comparisons A single within-group comparison, within the experimental group, was available, comparing the average pain intensity observed at the pre-test with the average pain intensity observed three months after the intervention. A statistically significant effect (large SMD) was observed, with pain intensity at the three-months follow-up being significantly lower.

Meta-Analysis

A total of two studies (Keivan et al., 2019; Nasiri et al., 2014) performing within-group comparisons and implementing *private* prayer reported sufficient information to allow for inclusion in a meta-analysis (cf. Table 5 and Fig. 3). *Private* prayer-based interventions resulted in a significant reduction of pain intensity from the pre- to the post-test, with low heterogeneity (Keivan et al., 2019; Nasiri et al., 2014): 72 participants, SMD = − 2.63 [− 3.11, − 2.14], $I^2 = 0\%$.

Confidence in Cumulative Evidence

The methodological quality of the included studies and comparisons between study characteristics, design, and execution were reported above (cf. "Methodological Quality of the Included Studies" and "Qualitative Synthesis of Interventions' Effect" sections). Confidence in the cumulative evidence was moderate. Therefore, further research would be useful to improve confidence in the estimate of the effects observed and could potentially change those estimates. The risk of bias was considered moderate due to unclear allocation concealment, blinding of participants, and blinding of researchers in three of the studies (Dehkordi et al., 2016; Keivan et al., 2019; Nasiri et al., 2014). Certainty of the evidence regarding the effect of prayer-based interventions on pain tolerance was also considered moderate due to the risk of bias (e.g., unclear allocation concealment and blinding of researchers) and imprecision (i.e., for continuous outcomes, information is likely to be insufficient if sample size is lower than 400).

Discussion

This systematic review with meta-analysis aimed to estimate the extent to which *private* and *communal participatory* prayer-based interventions affect pain-related outcomes (i.e., pain intensity, pain tolerance, and stress) in adults experiencing acute and chronic pain. Only RCTs were included. The findings suggest that *participatory* prayer-based interventions, as an adjunct to treatment as usual, are effective, and more effective than treatment as usual alone (or combined with another comparator), in reducing pain intensity. The size of the effect of *participatory* prayer-based interventions seems to be independent from the duration and length of prayer-based interventions, and other study characteristics, as well as from the type (*private* or *communal*) and content (petition or adoration) of prayer. Furthermore, when compared with *receptive* prayer, *proactive* prayer seems to be more effective in reducing

Table 5 Meta-analysis: summary of findings for the main comparison

Experimental group: Within-group (pre- and post-test) comparisons						
Population: Adults (18 years old or more) with acute, chronic, or experimental induced pain Intervention: Prayer-based intervention Comparison: Pre- and post-test						
Outcomes	Illustrative comparative risks* (95% CI)					
	Assumed risk Pre- prayer-based intervention	Corresponding risk Post- prayer-based intervention	Relative effect (95% CI)	No of participants (studies)[a]	Quality of the evidence (GRADE)	Comments
Pain intensity Average score of VAS (0–10) Follow up: 3 days	Average pain intensity at the pre-test ranged from 5.32 to 8.50 (out of 10)	Average pain intensity at the post-test was 2.63 (from 3.11 to 2.14 lower)	–	72 (2)	+++O Moderate	
Pain tolerance—not measured	–	–	–	–	–	Studies included in the meta-analysis did not measure pain tolerance
GRADE Working Group grades of evidence *High quality* Further research is very unlikely to change our confidence in the estimate of effect *Moderate quality* Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate *Low quality* Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate Very low quality: We are very uncertain about the estimate						
The studies were at serious risk for risk of bias, due to unclear allocation concealment, blinding of participants, and blinding of researchers						
[a]The studies included in meta-analysis were Keivan and colleagues (2019) and Nasiri and colleagues (2014)						

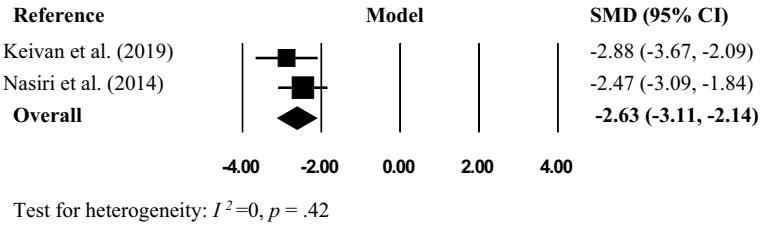

Fig. 3 Forest plots displaying the standardized mean differences (SMDs) between prayer-based interventions and alternative non-prayer-based comparators in the post-treatment time point for the studies included in the analyses. SMDs were derived for pain intensity

pain intensity. Only one randomized controlled trial examined the effects of *participatory* prayer-based interventions on pain tolerance. The findings from this study indicated that active petition prayer may be more useful for this purpose as compared to passive petition prayer and to a control condition. To date, no randomized controlled trials have examined the effects of *participatory* prayer-based interventions on stress.

Our conclusions regarding the utility of *participatory* prayer-based interventions (especially if *proactive*) as an adjunctive approach to pain treatment as usual, for reducing pain intensity and increasing pain tolerance, are consistent with those from Illueca and Doolittle (2020). They are also consistent with prior research suggesting the usefulness of spirituality/religiosity, and of spiritual and religious practices for people experiencing pain (Büssing et al., 2009; Dezutter et al., 2011; Ferreira-Valente et al., 2020, 2022). Nonetheless, the limited number of RCTs examining the effectiveness of *participatory* prayer-based interventions in improving pain-related outcomes as an adjunctive approach to pain management as usual limits any definitive conclusions. Moreover, most studies assessed the effects of adoration prayer on pain intensity; no study examined the extent to which the effects of prayer may be mediated and moderated by potential mechanisms (e.g., participants' type of religious practice; participants' attitudes toward the religion; level of engagement and emotional involvement with the prayer-based intervention). Thus, the extent to which these findings generalize for different prayer content, and for different pain-related outcomes, is yet to be determined. Furthermore, all six studies included in this review were conducted with individuals who self-identified as being religious, and five were conducted with Muslim individuals (Beiranvand et al., 2014; Dehkordi et al., 2016; Keivan et al., 2019; Nasiri et al., 2014; Tajadini et al., 2016). The extent to which these findings generalize across religious denominations remains unclear. In addition, the observed benefits of prayer on pain might be due, at least in part, to social or religious desirability, cultural/contextual specificities of the settings in which the included studies were conducted, or selection bias. It is possible, for example, that only the most religion- and prayer-enthusiastic individuals agreed to participate in these studies. If so, at least some of these participants might have had either high outcome expectations (i.e., a placebo effect might have occurred), or have been reluctant to report an absence or low beneficial effects of prayer (Jors et al., 2015).

Some previous evidence supports the need for future research to address these topics. For example, potential effects of a *participatory* prayer-based interventions on pain-related outcomes may vary as a function of religious denomination, level of self-reported spirituality, different attitudes towards religion, outcome expectations, and social desirability (Hultman et al., 2014; Jors et al., 2015; Siddall et al., 2015). To the extent that these factors moderate the impact of prayer on pain, prayer-based interventions might need to be tailored for each individual or group of individuals to maximize their benefits. Additional studies from different countries, with larger samples of individuals from different religious denominations is needed. Such research should test the effects of *private* or *communal*, *proactive* or *receptive*, *participatory* prayer with different content on different pain-related outcomes. Research is also needed to evaluate the potential mechanisms of such prayer-based intervention that could explain why and how prayer impacts pain experience. Potential mechanisms include outcome expectations, level of religiosity, and social (religious) desirability.

This review highlighted large heterogeneities in study designs, and the failure to report essential data on the methods and results of each randomized controlled trial, resulting in limited—only medium—methodological quality ratings of the included studies, and moderate confidence in the cumulative evidence. Nonetheless, the medium methodological quality and moderate confidence in the cumulative evidence provides some assurance of the reliability of the reported findings and of the tentative conclusions drawn above, at least for Muslim individuals. The adoption of common methodological frameworks, the implementation of comparable study designs, and following the CONSORT recommendations (Higgins et al., 2021) for the implementation and report of parallel-group RCTs in future research would be beneficial. To facilitate inter-study comparisons and methodological quality assessment, and to improve methodological quality of the studies itself, we suggest that future studies should pay attention and report the: (1) sociodemographic (and clinical) characteristics of the participants (e.g., gender, age, pain duration, pain etiology, country of origin, religious denomination); (2) characteristics of the prayer-based intervention (e.g., type, prayer implementation mode, prayer content, number and length of sessions) as well as the characteristics of the comparator (if applicable) and of the control condition; (3) number of participants allocated to each study condition; (4) randomization and concealment of allocation related procedures; (5) blinding procedures; (6) participants' flow; (7) procedures adopted to determine the study sample size; (8) procedures adopted for dealing with missing data; (9) a priori defined statistical analysis plan; (10) descriptive statistics for all study outcomes (including means, standard deviations); (11) statistical test statistics (including degrees of freedom, p values, statistical power, and effect-sizes with corresponding 95% confidence interval); and (12) rates of 30% and 50% reduction/increase in pain-related outcomes.

Strengths and Limitations of the Current Systematic Review

To our knowledge, this is the first systematic review with meta-analysis focusing the effects of both *private* and *communal participatory* prayer-based interventions on

pain intensity, pain tolerance and stress, including studies published in languages other than English, and performing a qualitative review of the findings based on a standardized and well-established method for qualitative synthesis of the findings and a quality assessment of the included studies. The authors implemented a high-quality systematic review method, as recommended by the Cochrane Collaboration and the PRISMA guidelines, searching nine databases (including one gray literature database), and studies published in six different languages. Other strengths of the current review are the identification of literature and methodological gaps that should be addressed in future research.

This review has a number of limitations that should be taken into account. The first limitation of this and other systematic reviews on this topic concerns the limited number and heterogeneity of eligible studies, all with limited—only medium—methodological quality. Most studies investigated *private* prayer, did not allow for pre- and post-test comparisons, and focused on examining the effects of adoration prayer (four studies *vs*. one study focusing active and passive petition prayer) on pain intensity within Muslim individuals living in Iran. As a result, it was not possible to perform sub-group analysis considering the content of the prayer. The limited number of included studies also limited our ability to perform sub-group analysis considering the duration and etiology of pain. Such an analysis would have been useful given that these clinical characteristics could potentially influence the effects of prayer on pain. For example, one of the studies included participants with migraine with and without aura (Tajadini et al., 2016). Although episodes of migraine are often recurrent, each episode itself is self-limited in time, and a decrease of pain intensity observed in the study might be explained, at least for some of the participants, by a spontaneous remission of the migraine episode. As a result, the generalizability of our findings and conclusions to different types and contents of prayer, as well as to clinical settings, especially to chronic pain, is limited. Findings from fully powered RCTs with high methodological quality and assessing the effects of prayer-based interventions, of different type and content, on different pain-related outcomes in individuals of different countries and with different religious denominations, with different types of pain, and using the same set of measures and similar procedures, would be important to enable the determination of reliable conclusions. Secondly, no study evaluated the long-term follow-up effects of *participatory* prayer-based interventions. Future studies, with longitudinal design, and considering six-months follow-up assessment should be considered. Third, as discussed above, there remains the possibility of a selection bias in the studies, as it is possible that only the most religion-enthusiastic participants might have agreed to participate in the included studies. Although we had planned to extract from the included studies information regarding study participants' type of religious practice and attitudes towards religion, none of the included studies provided information regarding either of these issues. As a result, we were not able to determine—and control for—the possible effects of selection bias related to degree of religiosity. Future research controlling for these variables is needed. Finally, only two eligible studies performing within-group comparisons and implementing private participatory prayer reported sufficient information to allow for inclusion in a meta-analysis. Although, according to the Cochrane recommendations (Deeks et al., 2022), a meta-analysis may be

performed even with as few as two studies, the extremely low number of studies included in the meta-analysis indicates that the conclusions should be viewed with extreme caution. This supports the importance of conducting additional and well-powered RCTs evaluating the effects of *participatory* prayer-based interventions on pain-related outcomes.

Conclusions

Despite these limitations, our findings suggest that *participatory* prayer-based interventions, used as adjunctive to pain treatment as usual, are more effective than pain treatment as usual alone in reducing pain intensity, at least in Iranian Muslim individuals undergoing surgery or painful procedures and engaging in *proactive* adoration/petition prayer. The evidence concerning the beneficial effects of *participatory* prayer-based interventions on pain tolerance is more limited. No previous RCTs examined the effects of these interventions on stress. Further research examining this research question in individuals from different countries, with different religious denominations and painful conditions, and comparing the effects of types (and content) of prayer, is warranted.

Author Contributions AFV is the principal investigator, obtained funding, conceived the study idea, and together with MJ, MPJ and MD developed the design of the study. IQG, FP, RC, and JPR contributed to the review of the review design. AFV performed the literature searches. MJ and IQG screened the identified studies to determine eligibility and performed data extraction and methodological quality assessment. AFV acted as third senior reviewer to settle disagreements regarding eligibility, data extraction and methodological quality assessment. MJ and AFV performed the analysis and wrote the first draft of the manuscript. MPJ, MD, IQG, JPR, RC, and FP critically reviewed the manuscript. All authors approved the final version.

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Declarations

Conflict of interest AFV has received a Grant from Fundação para a Ciência e Tecnologia, IP (FCT) (grant number SFRH/BPD/121452/2016), and is supported by a FCT Scientific Employment Stimulus contract under the 2021 Institutional Call to Scientific Employment Stimulus - 2nd Edition (reference CEECINST/00070/2021; internal reference, Edict/Public notification number Edital/0030/2022). The remaining authors have no relevant financial or non-financial interests to declare associated with this manuscript.

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Authors and Affiliations

Margarida Jarego[1] · Alexandra Ferreira-Valente[1,2,3] · Inês Queiroz-Garcia[1] · Melissa A. Day[2,4] · José Pais-Ribeiro[1,5] · Rui M. Costa[1] · Filipa Pimenta[1] · Mark P. Jensen[2]

[1] William James Center for Research, Ispa – University Institute, Rua Jardim do Tabaco, No. 34, 1149-041 Lisbon, Portugal

[2] Department of Rehabilitation Medicine, University of Washington, 325 Ninth Avenue, Box 359612, Seattle, WA 98104, USA

[3] Faculty of Education and Psychology, Research Centre for Human Development, Universidade Católica Portuguesa, Rua de Diogo Botelho, 1327, 4169-005 Porto, Portugal

[4] Faculty of Health and Behavioral Sciences, School of Psychology, University of Queensland, St. Lucia Campus, Sta Lucia, QLD 4072, Australia

[5] Faculty of Psychology and Education Sciences, University of Porto, R. Alfredo Allen, 4200-135 Porto, Portugal