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Evidence for the effects of Viewing Visual Artworks on Stress Outcomes: A Scoping Review

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Abstract

Objective: To review the existing evidence on the effects of viewing visual artworks on stress outcomes and outline any gaps in the research.

Design: A scoping review was conducted based on the Joanna Briggs Institute methodology for scoping reviews and using the preferred reporting items for systematic reviews and meta-analyses extension for scoping reviews. Two independent reviewers performed the screening and data extraction.

Data Sources: Medline, Embase, APA PsycINFO, Cochrane CENTRAL, Scopus, Google Scholar, Google, ProQuest Theses and Dissertations Database, APA PsycExtra and Opengrey.eu were searched in May 2020.

Eligibility Criteria: Studies were included if they investigated the effects of viewing at least one visual artwork on at least one stress outcome measure. Studies involving active engagement with art, review papers or qualitative studies were excluded. There were no limits in terms of year of publication, contexts or population types; however, only English studies were considered.

Data Extraction and Synthesis: Information extracted from manuscripts included: study methodologies, population and setting characteristics, details of the artwork interventions, key findings and details related to methodological quality.

Results: 14 primary studies were identified, with heterogeneous study designs, methodologies and artwork interventions. The results of these studies demonstrated consistent reductions in self-reported stress after viewing artworks, but mixed effects on physiological stress measures. The methodological quality of the studies was poor, with many important methodological details missing.

Conclusions: There is promising evidence for effects of viewing artwork on reducing stress. Moderating factors may include setting, individual characteristics, artwork content, and viewing instructions. More robust research, using more standardised methods and randomised controlled trials, are needed before full conclusions can be made.

Registration Details: A protocol for this review is registered with the Open Science Framework (osf.io/gq5d8).

Strengths and Limitations of this Study

- A comprehensive scoping review was conducted using a broad and inclusive search strategy and a large variety of databases were searched.
- The reviewers independently followed a structured and pre-published protocol for searching, screening and extracting data which followed the Joanna Briggs Institute methodology for scoping reviews and PRISMA-ScR guidelines.
- Only English studies were included, possibly resulting in articles of other languages being missed.
- Slight deviations in the original protocol were performed in order to make the data screening more feasible.

Introduction

A number of studies suggest that participation in the arts is beneficial for health. This has resulted in a proliferation of different arts programmes. Many healthcare and workplace settings offer art programmes to reduce stress and improve wellbeing for staff, patients and customers[1]. However, there is little evidence that these programmes have the desired effects and there is a need for a high-quality evidence base for art-based interventions[2, 3].

Engagement with arts can be divided into active and passive participation. Active participation involves making, creating or teaching arts; whereas passive participation involves behaviours such as observing, viewing, listening and watching art[4, 5]. Passive viewing of artworks is an easy, low-cost and non-invasive intervention; however, research is lacking compared to the substantial evidence base for the active participation in artwork making and art therapy. This scoping review focussed on the effects of passively viewing visual artworks and therefore excluded research pertaining to the active participation in arts.

There is some evidence that viewing artworks is beneficial; however, this evidence is not of uniformly high quality, is rarely critical, and is sparse, with many important theoretical and evidential gaps. As well as this, most of the evidence comes from anecdotes, descriptions and personal experiences, rather than empirical research[6, 7]. Although many settings have been used within this research, including healthcare, art museums and laboratories, there is a paucity of evidence to demonstrate whether these settings affect outcomes differently. Demographics may be important moderators as ethnicity, gender and age may influence preferences for certain types of artworks. However, rigorous research has yet to be conducted examining the influence of settings and populations.

Due to these limitations, it is important to review the existing evidence and identify any research gaps that need to be addressed. As the evidence base is small and heterogeneous, a systematic review cannot be accurately completed, so instead a scoping review was conducted. The results can be used to direct future research to fill these gaps before a full systematic review can be completed.

There is no universally accepted definition of artworks as this construct has been inconsistent and debated. For the purpose of this review, artwork was defined as two-dimensional artistic works made primarily for their aesthetics, rather than any functional purpose. This definition was created from working definitions of visual and fine arts used in previous research[8, 9]. Based on this definition, this review included studies on paintings, drawings and prints and excluded studies on sculpture, films, interior design or architecture. Photographs were only included if they depicted artworks. Digital artworks were included.

Viewing artworks is a form of visual environmental enrichment and is theorised to be stress-reducing through positive distraction[6, 10]. To explore this theory, the review focused on the effects of viewing visual artworks on stress outcomes. Both psychological and physiological stress outcomes were included.

Objective and Research Questions

The aim of this scoping review was to systematically examine the extent of existing research available on the effects of viewing visual artworks on stress outcome measures and identify knowledge gaps to aid future research. The following research question was formulated: what research has been conducted on the effects of viewing visual artworks on stress outcomes in any populations and settings?

Several secondary questions were developed:

- What populations and settings were studied?
- What stress outcomes were measured?
- What type and content of artworks were viewed?
- What was the duration of the artwork viewing and how many artworks were viewed?
- Were the interventions effective in changing the outcomes?
- What is the methodological quality of the existing studies?

A preliminary search for previous reviews on this topic was conducted on Google Scholar, JBI Evidence Synthesis and the Cochrane Database of Systematic Reviews prior to creating the protocol.

Methods

Protocol

A scoping review protocol was developed based on the Joanna Briggs Institute methodology for scoping reviews[11] and using the preferred reporting items for systematic reviews and meta-analyses extension for scoping reviews (PRISMA-ScR). The objectives, eligibility criteria and methods were specified in advance and documented in the protocol registered at osf.io/gq5d8.

Eligibility criteria

Studies had to meet the following inclusion criteria; be a primary study where participants passively viewed at least one visual artwork as an intervention, including viewing paintings, drawings, prints, digital artwork, or photographs of artworks, and measured at least one stress outcome measure (physiological or psychological indices). Measures of anxiety or mood were not considered as direct measures of stress and therefore fell out of the scope of this review. Unpublished research, including working papers, theses/dissertations and conference proceedings were included.

Studies were excluded if participants had active engagement in the arts (e.g. studies on art therapy or the production/creation of art), the study investigated the effects of interior design, architecture, sculpture, films or photography not depicting artworks, and review papers, including systematic reviews, scoping reviews and meta-analyses.

Due to the small and heterogeneous nature of this research area, there were no restrictions in terms of populations, contexts, dates of publication or study designs. However, during the screening phase, it was decided to exclude qualitative studies as these studies did not have clear stress outcomes, which was a key inclusion criterion. Only English studies were considered.

Search Strategy

To identify potentially relevant studies, the following electronic databases were systematically searched; Medline, Embase, APA PsycINFO, Cochrane CENTRAL, Scopus and Google Scholar (first 30 pages), with the help of a subject librarian. The search string combined a set of artwork and stress terms within each set with “OR” and between the two sets with “AND.” The search was first conducted using an extended list of search terms from the registered protocol; however, this search strategy resulted in a large number of irrelevant articles. Therefore, in the final search, some of the more ambiguous search terms were removed to refine the search further. For example, the term 'drawing' was removed as this could refer both to artistic drawings and ‘drawing’ blood. The final search strategies for two example databases are presented in Table 1.

The grey literature was searched using the same search terms to identify any unpublished studies. Grey literature databases searched included; Google (limited to the first 20 pages), ProQuest theses and dissertations database, APA PsycExtra and Opengrey.eu.

A search was then conducted by hand of the reference lists of relevant identified articles. Lastly, the 'cited by' feature of Google Scholar was used to see if any of the relevant studies had been cited by undetected articles. All extracted references from these searches were imported to RefWorks and all duplicates removed. The final search was executed on 27 May 2020. The number of studies identified by the search strategy is shown in Figure 1.

Screening and Study Selection

Screening of the studies identified by the search strategy was conducted by two independent reviewers using a two-staged approach using the programme Covidence. Due to the high volume and large amount of unrelated studies identified, one author initially screened the titles and removed any irrelevant studies, before the first stage. In the first stage of screening, two reviewers independently screened the abstracts for the eligibility criteria. If a study's eligibility was judged to be uncertain, the article was included in the second stage. In the second stage, two reviewers screened the full texts of the studies to determine final inclusion or exclusion based on the eligibility criteria. The two stages were conducted by the reviewers independently, with the results of each stage discussed. Any disagreements related to eligibility of an article were discussed and agreement was reached. The number of included and excluded studies at each stage of the screening procedure is shown in Figure 1, with reasons for exclusion.

Data Extraction and Analysis

Data was extracted from each included study into a charting form by the two reviewers independently. This charting form was developed in accordance with the review questions. It included; publication details (i.e. title, year, authors), methodology (i.e. aims, design, population characteristics, setting, outcomes), artwork details (i.e. type and content of artwork, duration of artwork viewing, number of artworks), key findings related to scoping review questions, and items to assess methodological quality (i.e. registration details, comparator groups, randomisation, blinding, power analyses).

The charting form was iteratively refined during the extraction process to ensure all useful information was extracted. The charting form was first independently pilot tested by the two reviewers on a random sample of four studies. The reviewers discussed this process and amended the charting form by adding a column about the artwork viewing directives given to the participants. Data extraction was then completed for the remaining studies independently by the two reviewers and any inconsistencies were discussed. This extracted data is reported in tabular and descriptive text format to answer the review questions.

Patient and Public Involvement

Patients and the public were not involved in any phase of this review.

Results

As shown in Figure 1, the search strategy resulted in 3882 texts, which were screened for eligibility. After the initial title and abstract screening, the full text was retrieved for 53 articles and examined against the eligibility criteria. During this process, three theses were found to have matching published journal articles and therefore were excluded as duplicates. The remaining excluded

articles did not meet the eligibility criteria. This screening narrowed the studies down to 14 articles for inclusion.

The design and key findings related to the stress outcomes of each study are briefly detailed in Table 2, with specific details regarding the secondary review questions provided in Table 3. All 14 articles were primary studies published as journal articles. Apart from the duplicate theses mentioned above, no grey literature met the eligibility criteria for inclusion. The studies' publication dates ranged from 1972 to 2020. Eight studies came from Europe, four from the United States of America and one each from Australia and New Zealand.

Summary of Study Methodologies

Designs. The 14 studies had very different designs and methodologies (see Table 3). Only nine studies used a between groups design. Another four used a within groups design, where measures were compared pre- to post-viewing the artworks, with no comparator groups. The final study used a cross-sectional design, measuring stress-reduction at one time-point.

Of the nine between groups designs, six used a no artwork control group as a comparator, and one used scrambled versions of the artworks. Although the remaining two studies had comparator groups, the viewing directives given to the groups[12] and the art experience of the participants in each group[13] were different, rather than the artwork viewed.

Settings. Six studies were conducted in an art gallery or museum, three in a laboratory, four in hospital rooms or hospital public spaces, and one in senior citizens' apartments. These settings represent a mix of both naturalistic settings with high ecological validity and laboratory settings with high experimental control.

Populations. The majority of studies investigated healthy participants in the form of students (n=3), office workers (n=1) or the general public (n=4). Other research used patient populations known to have high stress levels. Four studies investigated hospitalised patients, with two being paediatric samples. Lastly, D'Cunha et al[14] investigated people living with dementia and Wikström et al[15], elderly women.

There is little research on whether population type affects stress reactions. Very few studies compared demographic factors, with the following exceptions. De Jong[13] found that having different art experience affected outcomes. Three studies found significant differences between the stress-reducing effects of viewing artwork between males and females[8, 16, 17]. Lastly, one study compared results across different health conditions, but found similar results between groups[18].

Outcomes. Nine studies explored only physiological stress measures, three explored only psychological stress measures and the remaining two explored both. The psychological stress measures included; the Cox Mackay Stress Arousal checklist[19], a stress adjective checklist[20], Likert scales, and a distress thermometer[21]. The physiological measures were mainly cardiovascular, including blood pressure, heart rate and skin conductance, which were measured in eight studies. Salivary biomarkers were measured in three studies including cortisol, alpha-amylase and interlukin-6. Respiration was measured in two studies.

Summary of the Artwork Interventions

Types of artworks. 10 studies used physical artworks. Most were original paintings, however one study used posters depicting artworks[17] and another used a window mural[22]. Another three studies used digital reproductions of artworks. Two used slideshows of digital images[13, 23],

whereas the third used the Open Window, which digitally projected artworks[7]. The last study directly compared physical artworks with their digital reproductions[24]. This study did not find any differences between the types of artwork, indicating that digital reproductions may be just as stress-reducing as physical artworks.

Content of artworks. The content ranged from representational nature images, to complex abstract artworks. Four studies provided an assortment of artwork content in one exhibition and therefore it could not be determined whether content was influential. Two studies investigated the effects of abstract artwork but did not compare these to another artwork type. Another study[13] compared the physiological effects of artworks rated to be 'ugly' or 'beautiful.' Although the exact content of the artwork was not described, this study did find that participants had higher skin conductance and respiration rates while viewing the 'beautiful' paintings, compared to the 'ugly' paintings, demonstrating that the aesthetic content of the artwork may influence their effects.

Another four studies investigated the effects of viewing nature artworks. Two studies found that self-reported stress was lower when viewing nature artworks compared to abstract artworks[8, 17]. One study found that different aspects of nature might have stronger effects; a forest mural resulted in larger blood pressure decreases than an aquatic mural[22]. Nature content may also affect biological indicators of stress responses; cortisol levels decreased faster after a stressor in people viewing scrambled versions of nature artworks, compared to the original nature artworks[23].

The remaining two studies did not report on the content of the artwork and therefore, cannot be categorised.

Duration of artwork viewing. Nine studies reported the duration participants spent looking at the artwork (see Table 3). This ranged from two minutes to over 48 hours. No study investigated whether changing the duration of exposure to artworks affected stress outcomes.

Quantity of artworks. Most of the studies did not specify the exact number of artworks viewed. Of those studies that did specify a number, it ranged from one artwork to over 5300 in one exhibition. Half of the studies had participants view a collection of artworks as an exhibition or art programme. Only two studies showed each participant one artwork and both were in paediatric hospital rooms[8, 22]. The other experimental studies ranged from viewing four to 26 artworks in one sitting, with the exact numbers provided in Table 3.

Viewing directives. Five studies explicitly mentioned the viewing directives given to participants. Two experimental studies told participants to attentively look at and explore each artwork[13, 24], whereas another study asked visitors to explore the art gallery in any way they pleased[16]. The remaining two studies asked participants to discuss and describe each artwork to the group and/or art director during art programmes[14, 15].

Summary of Key Findings

All but one of the studies that measured self-reported stress found a significant decrease after viewing artwork[8, 16-18], with the final study showing no significant changes[7]. A consistent decrease in systolic blood pressure was also found across the four studies measuring blood pressure[8, 15, 22, 25]. Skin conductance and skin conductance variability both increased while viewing artworks[12, 13, 26]. The results for heart rate were mostly consistent. Two of the three studies that measured heart rate found that viewing artworks decreased heart rate[22, 26]. The other study found that viewing beautiful paintings increased heart rate for students trained in fine arts and decreased heart rate for other participants[13].

The cortisol and respiration results were less consistent. An art gallery visit decreased salivary cortisol levels[16]; however, a 6 week art intervention for people living with dementia increased waking cortisol levels[14]. Lastly, after a stressor, salivary cortisol decreased faster in those viewing scrambled images, compared to those viewing landscapes[23]. Viewing beautiful paintings lead to an increase in respiration rates in a healthy sample[13]. Whereas nature artworks in a hospital room decreased respiration rates in children[8]. These studies all had different samples, settings and artworks which may have accounted for these mixed findings. Lastly both alpha-amylase[23] and interleukin- 6[14] were each only measured in one study and showed no significant changes.

Summary of Methodological Quality

Many of the studies lacked sufficient methodological details to conduct a full quality analysis and the quality problems have been briefly detailed below. None of the studies were pre-registered. Sample sizes ranged from 27 to 826 participants; however, only two studies conducted a power analysis to determine their sample size. Therefore, it is difficult to determine if all studies were adequately powered.

Only nine studies had comparator groups, with only seven related to the artwork intervention. For most studies, it was difficult to blind the participants, because in most cases participants were explicitly asked to view artworks. However, two studies did successfully blind the study as both the researchers/nurses collecting the measures and the participants were not explicitly made aware of the presence (or absence) of the artworks[17, 22]. All nine between-groups studies reported randomisation of participants to groups. However, the method of randomisation was not stated in many studies. Only four studies[7, 8, 12, 15] were randomised controlled trials, which are the gold-standard of research.

Discussion

This scoping review aimed to examine the existing research on the effects of viewing visual artworks on stress outcomes and identify gaps in the research. The 14 included studies demonstrate research in this area is growing, with 10 studies being published in the last 10 years. However, there is still a paucity of studies, and the evidence that does exist has heterogeneous methodologies, creating difficulty in comparing results.

Overall, the evidence supports the claim that viewing artworks can reduce stress, in particular self-reported stress and systolic blood pressure. These preliminary quantitative results support qualitative research showing that viewing artworks provides positive distraction from a hospital environment and lowers self-reported stress[7, 10, 27]. However, mixed findings combined with a lack of homologous methodologies means that this claim cannot be concluded without more rigorous research. Future research needs to ensure better methodological quality including: adequate comparator groups, power analyses to ensure sufficient sample sizes, clearly defined randomisation procedures and pre-registration.

The differences between the studies suggest important moderating factors, one of which is setting. The museum context may add to the effects of viewing artwork, as museum related factors may lead to greater appreciation of artwork[28]. In addition, viewing artwork in a museum usually involves walking, which has its own stress-reducing effects[29]. Laboratory studies remove some of these contextual factors and may provide more specific evidence for the effects of viewing artworks, but they have lower ecological validity. The hospital room is an important setting as patients are often confined to their room for long time-periods and rooms are often deprived of environmental enrichment. Artwork could act as visual stimulation to positively distract patients from their stress,

pain and medical conditions. Artwork could also have stress-reducing benefits in other settings such as waiting rooms and workplaces, which are often related to high stress. More research in these settings should be conducted.

Other possible moderating factors include individual characteristics, although little research has investigated these. Gender differences were found in two of the included studies, with a trend towards females experiencing greater stress-reduction in response to nature artworks[8, 17]. One small survey found that African Americans and Caucasians have similar preferences for nature artworks[30]; however, no study has investigated whether culture affects the stress-reducing effects of artworks. Given the diversity in cultures, demographics and individual preferences for artwork, it may be over simplistic to suggest that all individuals experience artwork the same way[31].

The findings indicate that the content and aesthetic qualities of artwork are also important considerations. Although mixed, the studies generally indicated that nature, especially greenery, may be the most stress-reducing. This is consistent with research demonstrating that nature artwork is most preferred by adults[32] and children[8]. It is theorised that nature artwork has the greatest stress-reducing effects as evolutionarily humans are predisposed to experience restoration as a response to nature scenes[33]. On the other hand, abstract artworks can be seen as challenging, ambiguous and unclear for viewers, leading to increased stress[28, 34]. Other artwork content could be provocative and emotionally inappropriate for certain situations, eliciting anger and dislike. For example, a study by Ho and colleagues[31] found that certain provocative artworks elicited feelings of loneliness and hopelessness in viewers, suggesting artwork must be chosen carefully.

The mixed findings suggest that under some conditions, viewing artwork may be physiologically relaxing, whereas under other conditions viewing artwork may be physiologically stimulating. The direction of these effects may not only depend upon the content of the artwork, but also the context and viewers' stress levels. Regardless of the direction of effects on physiology, lower self-reported stress may result.

Although this review focussed on the stress-reducing effects of viewing artwork, it may also be important to investigate the stimulating aspects of artwork. For certain populations, such as people living with dementia, visual stimulation and enrichment through artworks could improve other aspects of health, such as cognitive function[14]. As discussed above, visual stimulation and enrichment may also be important to provide positive distraction from negative experiences. Three studies showed an increase in physiological stress[13, 14, 23]. This increased stimulation may be related to the content of the artworks ('beautiful' vs 'ugly' paintings[13], or landscapes vs scrambled images[23]) or the types of populations involved (people living with dementia[14] and art students[13]).

Choice may be another important variable. This is especially pertinent in settings where people have little control. Art Carts have been used in hospitals to allow patients to choose which artworks to view during their stay to give them a sense of control over their environment[27]. Two studies in this review[7, 15] gave participants a choice of artwork, however research is yet to investigate whether the element of choice affects stress outcomes.

Directives given to viewers may influence the way participants view artworks and therefore moderate the artworks' stress-reducing effects. Wikström[35] previously discussed the importance of creating an art-dialogue when viewing and discussing artworks in order to improve engagement, understanding and empowerment. Other research[31] demonstrated that the descriptions given to viewers about artwork could be influential, and therefore this may be an important element for

studies to include. However, few studies reported the directives given. It is important for future research to report what directives were provided and investigate whether this is influential.

Finally, it is difficult to determine the dose-response relationship of artwork viewing. There was little consistency in the number of artworks shown to each participant, and no study investigated whether the quantity of artworks or viewing durations mattered. Therefore, future research could investigate the best artwork viewing duration and number of works.

Limitations

This review is limited by only including English articles. Articles in other languages could have been missed. The review deviated slightly from the original protocol. Due to the large number of irrelevant articles identified using the original search strategy, the search terms were narrowed and the original title screening was only conducted by one reviewer. These deviations were required to make the search and screening more feasible. This review did not include anxiety or mood measures or studies using qualitative methodology. These were considered outside the scope of the review as they are not direct stress outcome measures.

Conclusions

This scoping review summarised research on the effects of viewing visual artworks on stress outcomes. 14 studies met the eligibility criteria, with consistent reductions in self-reported stress, but mixed effects on physiology. Most of the research was low quality, with many methodological details missing, and there was high heterogeneity in research methodologies. Setting, individual characteristics, artwork content, and viewing instructions may be important moderating factors. More robust research, using standardised methods and randomised controlled trials, is needed before strong conclusions can be made about the effects of viewing visual art on stress outcomes.

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Figure 1. PRISMA-ScR flow diagram of the study selection process

Table 1

Example search strategy syntax for databases

Database	Search Strategy Syntax
Scopus	(TITLE-ABS-KEY (artwork OR "art work" OR "visual art" OR "art museum" OR painting OR mural OR "works of art" OR "viewing art" OR "viewing artwork" OR "artwork viewing" OR "art gallery" OR "art galleries") AND TITLE-ABS-KEY (stress OR "blood pressure" OR anxiety OR "heart rate" OR mood OR norepinephrine OR epinephrine OR "stress hormones" OR stressor OR glucocorticoids OR cortisol OR alpha-amylase OR "stress reduction")) AND (LIMIT TO (LANGUAGE , "English"))
ProQuest Dissertations and Thesis	ab(artwork OR “art work” OR “visual art” OR “art museum” OR painting OR mural OR “works of art” OR museum OR “viewing art” OR “artistic work” OR “viewing artwork” OR “artwork viewing” OR “art gallery” OR “art galleries”) AND ab(stress OR “blood pressure” OR anxiety OR respiration OR “heart rate” OR mood OR norepinephrine OR epinephrine OR “stress hormones” OR “mental health” OR stressor OR glucocorticoids OR cortisol OR alpha-amylase OR “immune marker” OR “stress reduction”)

Table 2

Summaries of the studies' designs and key stress outcome findings

Study	Study Design and Key Findings
Clow & Fredhoi (2006)[16]	Studied self-reported stress and arousal, and salivary cortisol levels in a group of London city workers during a lunchtime visit to an art gallery. Measurements were taken before and after the 35-40-minute gallery visit to explore pre-post intervention changes. Self-reported stress and salivary cortisol levels both decreased over the intervention. There were no differences in arousal levels.
D'Cunha et al (2019)[14]	Evaluated the psychophysiological effects of attending the National Art Gallery of Australia Art and Dementia programme. People living with dementia attended the group-based, six-week programme which involved viewing and discussing artworks, led by an art director. Measures of salivary cortisol and interleukin-6 were taken at baseline, at the end of the programme and 12 weeks later. Waking salivary cortisol levels increased from baseline to post-intervention, but decreased at follow-up. No changes in evening cortisol or interleukin-6 were observed. The ratio of waking to evening cortisol increased from baseline to post-intervention indicating a more dynamic diurnal cortisol rhythm.
de Jong (1972)[13]	Three groups of participants (advanced art history students, advanced fine art students and laboratory workers as controls) viewed projections of 12 paintings considered to be 'beautiful' and 12 paintings considered to be 'ugly' in a random order while their heart rate, respiration rate and skin conductance was measured continuously. The fine arts and art history students showed a greater change in skin conductance than the laboratory workers. Respiration and skin conductance were higher during the 'beautiful' paintings than the 'ugly' paintings in all groups. The fine arts students had faster heart rate during the 'beautiful' paintings compared to the 'ugly' paintings, however, for the other two groups, this result was reversed.
Eisen et al (2008)[8]	The third phase this study investigated which type of art was most effective in reducing stress in paediatric patients. On arrival to the hospital, patients were randomly allocated to one of three rooms; a room with a nature artwork, a room with an abstract artwork or a room with no artwork. Self-reported stress, blood pressure and respiratory rate were taken at baseline and after two hours of exposure to the artworks. Overall, there were no significant differences between the groups on stress, blood pressure or respiration. However, sub-analyses showed that significantly more males than females in the 8-10 age group were positively affected by the nature artwork, as demonstrated by decreased self-reported stress, blood pressure and respiratory rates.
Karnik et al (2014)[18]	Installed a diverse collection of artworks in the public spaces and clinic rooms of a hospital. Patients were retrospectively contacted with a survey which included evaluating whether the art installations changed their self-reported stress levels. 61% of the patients that reported seeing the artworks stated that the artworks somewhat or significantly reduced their stress levels.
Krauss et al (2019)[12]	Participants viewed six Flemish expressionism artworks in an art museum, while heart rate and skin conductance were continuously measured. Participants were randomly assigned to either receive descriptive information about the artworks (described the artwork in a declarative way) or elaborative information about the artworks (described the context and deeper meaning behind the artworks). There were no significant differences in heart rate, heart rate variability or skin conductance between the two groups. However, in both groups heart rate was lower, and skin conductance and heart rate variability higher when viewing the artworks, compared to baseline.

Kweon et al (2008)[17]	Conducted an experiment investigating the effects of artwork posters on stress and anger levels in an office setting. Students were asked to complete a series of stress and anger provoking computer tasks in one of four different mock office conditions; an office with nature posters, abstract posters, both nature and abstract posters or no posters. Levels of self-reported stress were measured across the experiment. Males had the highest stress levels in the office with no posters, and the lowest stress levels in the office with mixed art posters. On the other hand, females had the highest stress in the office with all abstract posters and the lowest levels in the office with all nature posters. However, these results were only significant for males and not females.
Law et al (2020)[23]	Conducted a pilot study to investigate whether nature artworks could improve recovery from a laboratory stressor. Participants were randomised to either view a 30-minute digital slideshow of landscape artworks or digitally scrambled versions of these artworks after being exposed to a laboratory stressor. Saliva samples were taken at baseline, after the stressor, during the art viewing and after the art viewing to measure cortisol and alpha-amylase. Salivary cortisol levels decreased more rapidly while viewing the scrambled images compared to the landscape artworks. There were no changes in alpha-amylase across the experiment or between groups.
Mastandrea et al (2019)[25]	Students visited an art museum and were randomly assigned to visit one of three art exhibitions for five minutes; a figurative art exhibition, a modern art exhibition or a museum office as a control condition. Blood pressure and heart rate were measured before and after the visit. Systolic blood pressure decreased in all groups; however, this decrease was only significant in the figurative art group. Heart rate also decreased in all three groups, however, there was no significant differences between groups.
McCabe et al (2013)[7]	Evaluated the effects of the Open Window art intervention on stem-cell transplantation patients. The Open Window is a virtual window which is installed in a hospital room, where the patients can switch through nine art channels with different artworks. Patients were randomised to either a room with the Open Window or not. Self-reported distress was measured at admission, the day before transplant, seven days after transplant, prior to discharge, and 60 days, 100 days and six months post-transplant. Results demonstrated no significant differences in levels of distress between the two groups at any of the time-points.
Pearson et al (2019)[22]	Examined the impact of nature-themed window murals on physiological measures in paediatric patients. Paediatric patients were assigned to hospital rooms with either a fish-themed window mural, a tree-themed window mural or no window mural. Patients' blood pressure and heart rate were taken retrospectively from the patients' medical records. Those patients with the window murals had significant improvements in heart rate and systolic blood pressure, with the tree-themed mural having the greatest effect.
Siri et al (2018)[24]	Examined the effects of viewing original physical artworks and their digital reproductions within a museum context. Cardiovascular variables were measured via ECG continuously in healthy volunteers while viewing two real abstract paintings and their digital reproductions. Results showed that there was a significant difference in heart rate between viewing the two real paintings, but no difference was found between the digital reproductions, or between the real and digital reproductions. No differences in heart rate variability were found.
Tschacher et al (2012)[26]	Monitored the physiology of visitors to an art museum using an electronic sensor glove which recorded physiological data and locomotion activity while they viewed the artworks. Afterwards, they were asked to rate the aesthetic qualities of some of the artworks. Heart rate variability increased while viewing artworks that were deemed beautiful, high quality and surprising/humorous.

	Skin conductance variability increased, and heart rate decreased while viewing more dominant artworks (artworks experienced as dominant and stimulating by the viewers).
Wikström et al (1993)[15]	Investigated whether visual stimulation could improve the health of elderly women living alone. The women were randomised to either an intervention or control group. The intervention group were shown a selection of pictures, including artworks, and asked to discuss them, whereas the control group discussed current events. Blood pressure was measured at baseline, immediately after the intervention and four months later. The intervention group had significantly lower systolic blood pressure than the control group after the intervention and at follow-up

Table 3

Overview of studies included in the review

Study	Study Design	Comparator Group	Setting	Population (N)	Stress Outcome Measures	Type and Content of Artwork	Quantity of Artworks Viewed by Each Participant	Duration of Artwork Viewing
Clow & Fredhoi (2006)[16]	Pre- and post-test, within groups quasi-experimental study	None	Art gallery	Office workers N=28 (25 included in the analysis)	Self-reported stress Self-reported arousal Salivary cortisol	Physical artworks in a gallery- exact content not specified	Not specified- gallery exhibition	35-40 minutes in the gallery
D'Cunha et al (2019)[14]	Pre- and post-test, within groups quasi-experimental study	None	Art gallery	People living with dementia N=28 (22 included in the analysis)	Salivary cortisol interleukin-6	Physical artworks in a gallery- exact content not specified	3-4 artworks each session, over 5-6 sessions	5-6x 90-minute sessions. Each artwork was viewed for 20 minutes
de Jong (1972)[13]	Between groups experimental study	Laboratory workers (non-art students)	Laboratory	Advanced art history students, advanced fine arts students and laboratory workers N= 27	Heart rate Skin conductance Respiration rate	Digital projections of 12 paintings considered 'beautiful' and 12 paintings considered 'ugly'	24	Each painting was viewed for 10 seconds
Eisen et al (2008)[8]	Pre- and post-test, randomised controlled trial	Room with no artwork	Hospital- patients' room	Paediatric patients (aged 5-17) N=78	Self-reported stress Heart rate Blood pressure Respiratory rate	One group had a representational nature artwork hung on the wall, whereas the other group had an abstract artwork hung on the wall	1	2 hours
Karnik et al (2014)[18]	Cross-sectional survey	None	Hospital- public spaces and clinic rooms	Hospital patients N= 826	Self-reported change in stress	Physical collection of abstract and representational imagery (including nature imagery). Includes an assortment of artistic media; and a variety of subject matter	Collection of over 5300 artworks	N/A
Krauss et al (2019)[12]	Randomised controlled trial	Group received only descriptive information about	Art museum	General public aged between 18 and 35 N= 75	Heart rate Heart rate variability	Physical abstract paintings of Flemish expressionism	6	Not specified

		the artwork (compared to elaborative information)			Skin conductance			
Kweon et al (2008)[17]	Between groups experimental study	No artwork posters group	Laboratory (replicated office setting)	Psychology students N=210	Self-reported stress	Nature posters and abstract posters	4	Not specified
Law et al (2020)[23]	Between groups experimental pilot study	Scrambled artwork images	Laboratory	General public N=30	Salivary cortisol Salivary alpha-amylase	Digital slideshow of either landscape paintings or digitally scrambled versions of these paintings	26	30 minutes
Mastandrea et al (2019)[25]	Between groups experimental study	Museum office	Art museum	Undergraduate students N=77	Blood pressure Heart rate	Physical artworks in a gallery- including figurative artworks (e.g. landscapes and portraits) and modern artworks (e.g. abstract, impressionist and informal paintings)	Not specified- gallery exhibition	5 minutes
McCabe et al (2013)[7]	Randomised prospective clinical trial	Room without the 'Open Window'	Hospital-patients' room	Stem cell transplantation patients N= 199 (164 included in the analysis)	Self-reported distress	Virtual window, with artwork projections. Artwork collections ranged from visually complex abstract images to images of nature.	Not specified- 9 art 'channels,' each with a collection of artworks	For the duration of their hospital stay- times not specified
Pearson et al (2019)[22]	Pre- and post-test, between groups quasi-experimental study	Room without a window mural	Hospital-patients' room	Paediatric patients aged 2-18) N=90	Heart rate Systolic blood pressure	Window mural- either aquatic or forest themed	1	Minimum of 48 hours
Siri et al (2018)[24]	Within groups experimental study	None	Art museum	General public N=60	Heart rate Heart rate variability	2 real abstract contemporary paintings and their digitally produced replicates	4	144 seconds per artwork
Tschacher et al (2012)[26]	Within groups quasi-experimental study	None	Art museum	Museum visitors N=517 (373 included in the analysis)	Skin conductance Heart rate Heart rate variability	Physical modern and contemporary art exhibition	76	No specific timeframe given to participants. On average, they spent 28 minutes at the gallery.

Wikström et al (1993)[15]	Pre- and post-test randomised controlled trial	Group that were not shown artworks	Senior citizen apartment	Women aged over 70 N=40	Systolic blood pressure	Physical pictures- ranging from artworks of nature, flowers and people, abstract patterns, white figures on black backgrounds and photographs.	Not specified how many each participant viewed	Not specified

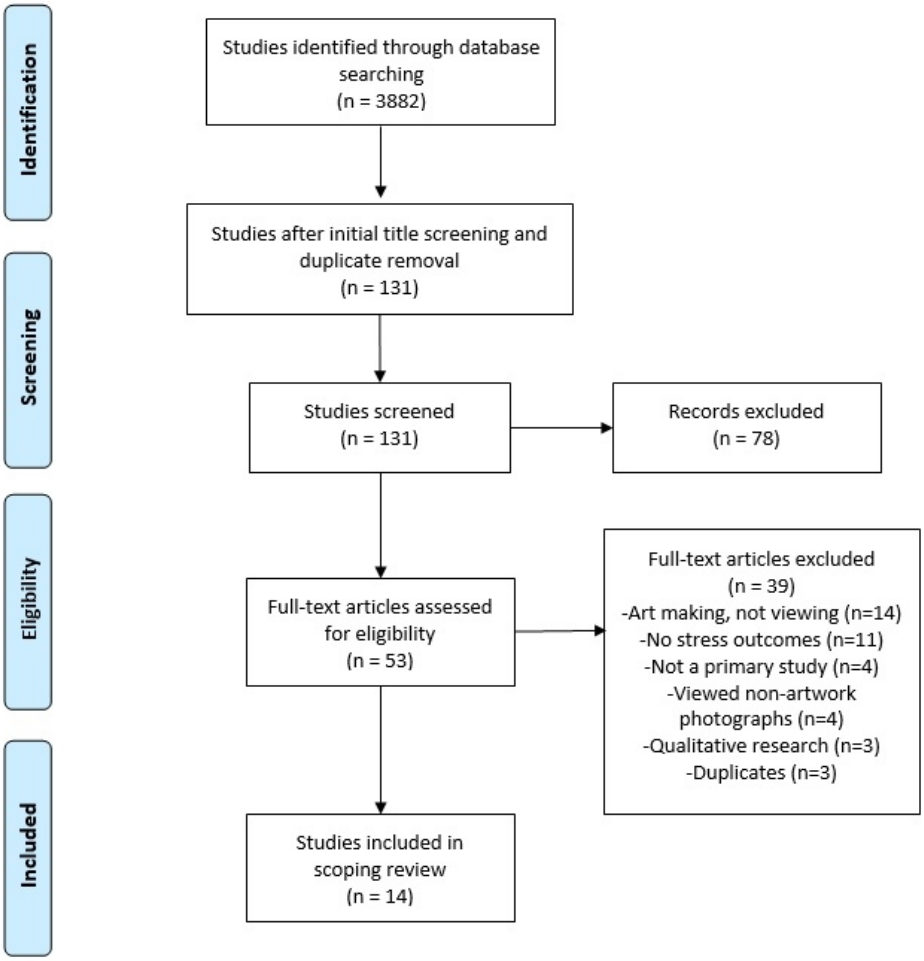

Figure 1. PRISMA-ScR flow diagram of the study selection process

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Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	
Limitations	20	Discuss the limitations of the scoping review process.	
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Ann Intern Med. ;169:467–473. doi: 10.7326/M18-0850

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Keywords:	COMPLEMENTARY MEDICINE, MENTAL HEALTH, PSYCHIATRY, SOCIAL MEDICINE

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Evidence for the effects of Viewing Visual Artworks on Stress Outcomes: A Scoping Review

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Abstract

Objective: To review the existing evidence on the effects of viewing visual artworks on stress outcomes and outline any gaps in the research.

Design: A scoping review was conducted based on the Joanna Briggs Institute methodology for scoping reviews and using the preferred reporting items for systematic reviews and meta-analyses extension for scoping reviews. Two independent reviewers performed the screening and data extraction.

Data Sources: Medline, Embase, APA PsycINFO, Cochrane CENTRAL, Scopus, Google Scholar, Google, ProQuest Theses and Dissertations Database, APA PsycExtra and Opengrey.eu were searched in May 2020.

Eligibility Criteria: Studies were included if they investigated the effects of viewing at least one visual artwork on at least one stress outcome measure. Studies involving active engagement with art, review papers or qualitative studies were excluded. There were no limits in terms of year of publication, contexts or population types; however, only studies published in the English language were considered.

Data Extraction and Synthesis: Information extracted from manuscripts included: study methodologies, population and setting characteristics, details of the artwork interventions, key findings and details related to methodological quality.

Results: 14 primary studies were identified, with heterogeneous study designs, methodologies and artwork interventions. The results of these studies demonstrated consistent reductions in self-reported stress after viewing artworks, but mixed effects on physiological stress measures. The methodological quality of the studies was poor, with many important methodological details missing.

Conclusions: There is promising evidence for effects of viewing artwork on reducing stress. Moderating factors may include setting, individual characteristics, artwork content, and viewing instructions. More robust research, using more standardised methods and randomised controlled trials, are needed before full conclusions can be made.

Registration Details: A protocol for this review is registered with the Open Science Framework (osf.io/gq5d8).

Strengths and Limitations of this Study

- A comprehensive scoping review was conducted using a broad and inclusive search strategy and a large variety of databases were searched.
- The reviewers independently followed a structured and pre-published protocol for searching, screening and extracting data which followed the Joanna Briggs Institute methodology for scoping reviews and PRISMA-ScR guidelines.
- Only studies published in the English language were included, possibly resulting in articles of other languages being missed.
- Slight deviations in the original protocol were performed in order to make the data screening more feasible.

INTRODUCTION

A number of studies and reviews have suggested that participation in the arts is beneficial for health[1-4]. Because of this, many healthcare and workplace settings offer art programmes, including art therapy, music and visual art displays, to reduce stress and improve wellbeing for staff, patients and customers[5]. However, there is little evidence that these programmes have the desired effects and there is a need for a high-quality evidence base for art-based interventions[1, 4].

Engagement with arts can be divided into active and passive participation. Active participation involves making, creating or teaching arts[2, 6]. This includes art therapy (where an art therapist directs the creation of artworks to achieve a particular goal and foster improved mental health and wellbeing), as well as other arts-based interventions that are not goal-driven and do not require a trained professional[7]. In contrast passive participation involves behaviours such as observing, viewing, listening and watching art[2, 6]. Passive viewing of artworks has the advantages of being an easy, low-cost and non-invasive intervention. This scoping review focussed on the effects of passively viewing visual artworks and therefore excluded research pertaining to the active participation in arts.

There is some evidence that viewing artworks as an intervention is beneficial; however, this evidence is not of uniformly high quality, is rarely critical, and is sparse, with many important theoretical and evidential gaps. As well as this, most of the evidence comes from anecdotes, descriptions and personal experiences, rather than empirical research[8, 9]. Although many settings have been used within this research, including healthcare, art museums and laboratories, there is a paucity of evidence to demonstrate whether these settings affect outcomes differently. Demographics may be important moderators as ethnicity, gender and age may influence preferences for certain types of artworks. However, rigorous research has yet to be conducted examining the influence of settings and populations.

Due to these limitations, it is important to review the existing evidence and identify any research gaps that need to be addressed. As the evidence base is small and heterogeneous, a systematic review could not be accurately completed and would be too restrictive, so instead a scoping review was conducted. The results can be used to direct future research to fill these gaps before a full systematic review can be completed.

There is no universally accepted definition of artworks as this construct has been inconsistent and debated. For the purpose of this review, artwork was defined as two-dimensional artistic works made primarily for their aesthetics, rather than any functional purpose. This definition was created from working definitions of visual and fine arts used in previous research[10, 11]. Based on this definition, this review included studies on paintings, drawings and prints and excluded studies on sculpture, films, interior design or architecture. Photographs were only included if they depicted artworks, as it was deemed too difficult to determine the difference between “artistic” photography and “non-artistic” photography based on the definition of artworks provided for this review. Digital artworks were included.

Viewing artworks is a form of visual environmental enrichment and is theorised to be stress-reducing through positive distraction[8, 12]. To explore this theory, the review focused on the effects of viewing visual artworks on stress outcomes. Both psychological and physiological stress outcomes were included.

Objective and Research Questions

The aim of this scoping review was to systematically examine the extent of existing research available on the effects of viewing visual artworks on stress outcome measures and identify knowledge gaps to aid future research. The following research question was formulated: what research has been conducted on the effects of viewing visual artworks on stress outcomes in any populations and settings?

Several secondary questions were developed:

- What populations and settings were studied?
- What stress outcomes were measured?
- What type and content of artworks were viewed?
- What was the duration of the artwork viewing and how many artworks were viewed?
- Were the interventions effective in changing the outcomes?
- What is the methodological quality of the existing studies?

METHODS

A preliminary search for previous reviews on this topic was conducted on Google Scholar, JBI Evidence Synthesis and the Cochrane Database of Systematic Reviews prior to creating the protocol.

Protocol

A scoping review protocol was developed based on the Joanna Briggs Institute (JBI) methodology for scoping reviews[13] and using the preferred reporting items for systematic reviews and meta-analyses extension for scoping reviews (PRISMA-ScR). The objectives, eligibility criteria and methods were specified in advance and documented in the protocol registered at osf.io/gq5d8.

Eligibility Criteria

Studies had to meet the following inclusion criteria; be a primary study where participants passively viewed at least one visual artwork as an intervention, including viewing paintings, drawings, prints, digital artwork, or photographs of artworks, and measured at least one stress outcome measure (physiological or psychological indices). Measures of anxiety or mood were not considered as direct measures of stress and therefore fell out of the scope of this review. Unpublished research, including working papers, theses/dissertations and conference proceedings were included if they were identified by the search.

Studies were excluded if participants had active engagement in the arts (e.g. studies on art therapy or the production/creation of art), the study investigated the effects of interior design, architecture, sculpture, films or photography not depicting artworks, and review papers, including systematic reviews, scoping reviews and meta-analyses.

As per the scoping review objectives, there were no restrictions in terms of populations, contexts, dates of publication or study designs. However, during the screening phase, it was decided to exclude qualitative studies as these studies did not have clear stress outcomes, which was a key inclusion criterion. Only studies published in the English language were considered.

Search Strategy

To identify potentially relevant studies, the following electronic databases were systematically searched; Medline, Embase, APA PsycINFO, Cochrane CENTRAL, Scopus and Google Scholar (first 30 pages), with the help of a subject librarian. The search string combined a set of artwork and stress terms within each set with “OR” and between the two sets with “AND.” The search was first

conducted using an extended list of search terms from the registered protocol; however, this search strategy resulted in a large number of irrelevant articles. Therefore, in the final search, some of the more ambiguous search terms were removed to refine the search further. For example, the term 'drawing' was removed as this could refer both to artistic drawings and 'drawing' blood. The final search strategies for two example databases are presented in Table 1.

The grey literature was searched using the same search terms to identify any unpublished studies. Grey literature databases searched included; Google (limited to the first 20 pages), ProQuest theses and dissertations database, APA PsycExtra and Opengrey.eu.

A search was then conducted by hand of the reference lists of relevant identified articles. Lastly, the 'cited by' feature of Google Scholar was used to see if any of the relevant studies had been cited by undetected articles. All extracted references from these searches were imported to RefWorks and all duplicates removed. The final search was executed on 27 May 2020. The number of studies identified by the search strategy is shown in Figure 1.

Screening and Study Selection

Screening of the studies identified by the search strategy was conducted by two independent reviewers using a two-staged approach using the programme Covidence (www.covidence.org). Due to the high volume and large number of unrelated studies identified, one author initially screened the titles and removed any irrelevant studies, before the first stage. In the first stage of screening, two reviewers independently screened the abstracts for the eligibility criteria. If a study's eligibility was judged to be uncertain, the article was included in the second stage. In the second stage, two reviewers screened the full texts of the studies to determine final inclusion or exclusion based on the eligibility criteria. The two stages were conducted by the reviewers independently, with the results of each stage discussed. Any disagreements related to eligibility of an article were discussed and agreement was reached. The two reviewers had overall 86% agreement. The number of included and excluded studies at each stage of the screening procedure is shown in Figure 1, with reasons for exclusion.

Data Extraction and Analysis

Data was extracted from each included study into a charting form by the two reviewers independently. This charting form was developed in accordance with the review questions. It included; publication details (i.e. title, year, authors), methodology (i.e. aims, design, population characteristics, setting, outcomes), artwork details (i.e. type and content of artwork, duration of artwork viewing, number of artworks), key findings related to scoping review questions, and items to assess methodological quality (i.e. registration details, comparator groups, randomisation, blinding, power analyses). The JBI methodology for scoping reviews[13] recommends that formal methodological quality analyses should not be conducted in a scoping review. Instead, a descriptive summary of methodological quality items is provided as a simple indicator of quality.

The charting form was iteratively refined during the extraction process to ensure all useful information was extracted. The charting form was first independently pilot tested by the two reviewers on a random sample of four studies. The reviewers discussed this process and amended the charting form by adding a column about the artwork viewing directives given to the participants. Data extraction was then completed for the remaining studies independently by the two reviewers and any inconsistencies were discussed. This extracted data is reported in tabular and descriptive text format to answer the review questions.

Patient and Public Involvement

Patients and the public were not involved in any phase of this review.

RESULTS

As shown in Figure 1, the search strategy resulted in 3882 texts, which were screened for eligibility. After the initial title and abstract screening, the full text was retrieved for 53 articles and examined against the eligibility criteria. During this process, three theses were found to have matching published journal articles and therefore were excluded as duplicates. The remaining excluded articles did not meet the eligibility criteria. This screening narrowed the studies down to 14 articles for inclusion.

The design and key findings related to the stress outcomes of each study are briefly detailed in Table 2, with specific details regarding the secondary review questions provided in Table 3. All 14 articles were primary studies published as journal articles. Apart from the duplicate theses mentioned above, no grey literature met the eligibility criteria for inclusion. The studies' publication dates ranged from 1972 to 2020. Eight studies came from Europe[9, 14-20], four from the United States of America[10, 21-23] and one each from Australia[24] and New Zealand[25].

Summary of Study Methodologies

Designs. The 14 studies had very different designs and methodologies (see Table 3). Only nine studies used a between groups design[9, 10, 14, 16, 17, 20, 22, 23, 25]. Another four used a within groups design, where measures were compared pre- to post-viewing the artworks, with no comparator groups[15, 18, 19, 24]. The final study used a cross-sectional design, measuring stress-reduction at one time-point[21].

Of the nine between groups designs, six used a no artwork control group as a comparator[9, 10, 17, 20, 22, 23], and one used scrambled versions of the artworks[25]. Although the remaining two studies had comparator groups, the viewing directives given to the groups[16] and the art experience of the participants in each group[14] were different, rather than the artwork viewed. Four of these between groups studies were considered randomised controlled trials (RCTs)[9, 10, 16, 20].

Settings. Six studies were conducted in an art gallery or museum[15, 16-19, 24], three in a laboratory[14, 22, 25], four in hospital rooms or hospital public spaces[9, 10, 21, 23], and one in senior citizens' apartments[20]. These settings represent a mix of both naturalistic settings with high ecological validity and laboratory settings with high experimental control.

Populations. The majority of studies investigated healthy participants in the form of students[14, 17, 22], office workers[15] or the general public[16, 18, 19, 25]. Other research used patient populations known to have high stress levels. Four studies investigated hospitalised patients[9, 21], with two being paediatric samples[10, 23]. Lastly, D'Cunha et al[24] investigated people living with dementia and Wikström et al[20], elderly women.

There is little research on whether population type affects stress reactions. Very few studies compared demographic factors, with the following exceptions. De Jong[14] found that having different art experience affected outcomes. Three studies found significant differences between the stress-reducing effects of viewing artwork between males and females[10, 15, 22]. Lastly, one study compared results across different health conditions, but found similar results between groups[21].

Outcomes. Nine studies explored only physiological stress measures[14, 16, 19, 20, 23-25], three explored only psychological stress measures[9, 21, 22] and the remaining two explored both[10, 15]. The psychological stress measures included; the Cox Mackay Stress Arousal checklist[26], a stress adjective checklist[27], Likert scales, and a distress thermometer[28]. The physiological measures were mainly cardiovascular, including blood pressure, heart rate and skin conductance, which were measured in eight studies. Salivary biomarkers were measured in three studies[15, 24, 25] including cortisol, alpha-amylase and interlukin-6. Respiration was measured in two studies[10, 14].

Summary of the Artwork Interventions

Types of artworks. 10 studies used physical artworks. Most were original paintings, however one study used posters depicting artworks[22] and another used a window mural[23]. Another three studies used digital reproductions of artworks. Two used slideshows of digital images[14, 25], whereas the third used the Open Window, which digitally projected artworks[9]. The last study directly compared physical artworks with their digital reproductions[18]. This study did not find any differences between the types of artwork, indicating that digital reproductions may be just as stress-reducing as physical artworks.

Content of artworks. The content ranged from representational nature images, to complex abstract artworks. Five studies provided an assortment of artwork content in one exhibition[15, 17, 21, 24] and therefore it could not be determined whether content was influential. Two studies investigated the effects of abstract artwork but did not compare these to another artwork type[16, 18]. Another study[14] compared the physiological effects of artworks rated to be 'ugly' or 'beautiful.' Although the exact content of the artwork was not described, this study did find that participants had higher skin conductance and respiration rates while viewing the 'beautiful' paintings, compared to the 'ugly' paintings, demonstrating that the aesthetic content of the artwork may influence their effects.

Another four studies investigated the effects of viewing nature artworks. Two studies found that self-reported stress was lower when viewing nature artworks compared to abstract artworks[10, 22]. One study found that different aspects of nature might have stronger effects; a forest mural resulted in larger blood pressure decreases than an aquatic mural[23]. Nature content may also affect biological indicators of stress responses; cortisol levels decreased faster after a stressor in people viewing scrambled versions of nature artworks, compared to the original nature artworks[25].

The remaining two studies[9, 20] did not report on the content of the artwork and therefore, cannot be categorised.

Duration of artwork viewing. Nine studies reported the duration participants spent looking at the artwork (see Table 3). This ranged from two minutes to over 48 hours. No study investigated whether changing the duration of exposure to artworks affected stress outcomes.

Quantity of artworks. Most of the studies did not specify the exact number of artworks viewed. Of those studies that did specify a number, it ranged from one artwork to over 5300 in one exhibition. Half of the studies had participants view a collection of artworks as an exhibition or art programme. Only two studies showed each participant one artwork and both were in paediatric hospital rooms[10, 23]. The other experimental studies ranged from viewing four to 26 artworks in one sitting, with the exact numbers provided in Table 3.

Viewing directives. Five studies explicitly mentioned the viewing directives given to participants. The researchers from two experimental studies told participants to attentively look at and explore each

artwork[14, 18], whereas the researcher in another study asked visitors to explore the art gallery in any way they pleased[15]. The remaining two studies asked participants to discuss and describe each artwork to the group during art programmes[20, 24]. One of these studies[24] had a trained art educator facilitating the discussions, whereas the other[20] had a lead researcher, with no specified training.

Summary of Key Findings

All but one of the studies that measured self-reported stress found a significant decrease after viewing artwork[10, 15, 21, 22], with the final study showing no significant changes[9]. A consistent decrease in systolic blood pressure was also found across the four studies measuring blood pressure[10, 17, 20, 23]. Skin conductance and skin conductance variability both increased while viewing artworks[14, 16, 19]. The results for heart rate were mostly consistent. Two of the three studies that measured heart rate found that viewing artworks decreased heart rate[19, 23]. The other study found that viewing beautiful paintings increased heart rate for students trained in fine arts and decreased heart rate for other participants[14].

The cortisol and respiration results were less consistent. An art gallery visit decreased salivary cortisol levels[15]; however, a six week art intervention for people living with dementia increased waking cortisol levels[24]. Lastly, after a stressor, salivary cortisol decreased faster in those viewing scrambled images, compared to those viewing landscapes[25]. Viewing beautiful paintings lead to an increase in respiration rates in a healthy sample[14]. Whereas nature artworks in a hospital room decreased respiration rates in children[10]. These studies all had different samples, settings and artworks which may have accounted for these mixed findings. Lastly both alpha-amylase[25] and interleukin- 6[24] were each only measured in one study and showed no significant changes.

Summary of Methodological Quality

A full quality analysis is not recommended for a scoping review and many of the studies lacked sufficient methodological details. Therefore, a simple descriptive summary of key quality issues was performed as an indicator of possible quality issues. None of the studies were pre-registered. Sample sizes ranged from 27 to 826 participants; however, only two studies conducted a power analysis to determine their sample size. Krauss et al's[16] power analysis gave a required sample size of at least 68, and a final sample of 75 was recruited. The power analysis in McCabe et al[9] gave 200 participants and a sample of 199 were recruited; however, only 164 were included in the analyses. The other 12 studies did not provide a power analysis. Law et al[25] was a pilot study, and was not expected to conduct a power analysis to determine sample size. Therefore, it is difficult to determine if all studies were adequately powered.

Only nine studies had comparator groups, with only seven related to the artwork intervention. For most studies, it was difficult to blind the participants, because in most cases participants were explicitly asked to view particular artworks, and therefore both the researcher and participants were aware of which artworks they were viewing. However, two studies did successfully blind the study as both the researchers/nurses collecting the stress measures and the participants themselves were not explicitly made aware of the presence (or absence) of the artworks[23, 25]. All nine between-groups studies reported randomisation of participants to groups. However, the method of randomisation was not stated in many studies. Only four studies[9, 10, 16, 20] were RCTs, which are the gold-standard of research.

DISCUSSION

This scoping review aimed to examine the existing research on the effects of viewing visual artworks on stress outcomes and identify gaps in the research. The 14 included studies demonstrate research in this area is growing, with 10 studies being published in the last 10 years. However, there is still a paucity of high-quality research, and the evidence that does exist has heterogeneous methodologies and interventions, creating difficulty in comparing and directly summarising the results. Despite this, the scoping review was able to gather sufficient evidence to address the research questions outlined in the introduction and identify gaps for future research, as detailed below.

Overall, the evidence supports the claim that viewing artworks can reduce stress, in particular self-reported stress and systolic blood pressure. These preliminary quantitative results support qualitative research showing that viewing artworks provides positive distraction from a hospital environment and lowers self-reported stress[9, 12, 29]. The findings indicated that digital artworks can have similar stress-reducing effects to physical artworks, thus increasing the avenues available for viewers. Artwork interventions can therefore be transposed onto computers, TVs, phones and tablets, as a portable, cheap and easy intervention for stress-reduction.

Together the results suggest that the provision of artworks could be an effective stress-reduction intervention. However, mixed findings combined with a lack of homologous methodologies means that this claim about effective stress-reduction cannot be concluded without more rigorous research. Future research needs to ensure better methodological quality including: adequate comparator groups, power analyses to ensure sufficient sample sizes, clearly defined randomisation procedures and pre-registration. If we examine the results from just the four RCTs, the evidence is even less conclusive. More detail on these studies and their findings are provided in Table 2; however, only one of the four RCTs showed significant effects for their main hypotheses. Wikström et al[20] found a significant decrease in systolic blood pressure after an art intervention. In contrast, McCabe et al[9] found no significant effects on distress measures, and Eisen et al[10] only found significant effects when subgroup analyses of age were conducted. Lastly, Krauss et al[16] did find significant decreases in physiological stress when viewing artworks compared to baseline; however, they found no significant differences between the viewing directives provided, which was their main hypothesis. Therefore, more RCTs still need to be conducted on this topic for clearer conclusions to be made.

The differences between the studies suggest important moderating factors, one of which is setting. The museum context may add to the effects of viewing artwork, as museum related factors may lead to greater appreciation of artwork[30]. In addition, viewing artwork in a museum usually involves walking, which has its own stress-reducing effects[31]. Laboratory studies remove some of these contextual factors and may provide more specific evidence for the effects of viewing artworks, but they have lower ecological validity. The hospital room is an important setting as patients are often confined to their room for long time-periods and rooms are often deprived of environmental enrichment. Artwork could act as visual stimulation to positively distract patients from their stress, pain and medical conditions, and therefore it is suggested that artwork is placed in hospital rooms and waiting rooms. Artwork could also have stress-reducing benefits in other settings such as waiting rooms and workplaces, which are often related to high stress. More research in these settings should be conducted.

Other possible moderating factors include individual characteristics, although little research has investigated these. Gender differences were found in two of the included studies, with a trend towards females experiencing greater stress-reduction in response to nature artworks[10, 22]. One small survey found that African Americans and Caucasians have similar preferences for nature artworks[32]; however, no study has investigated whether culture affects the stress-reducing effects

of artworks. Given the diversity in cultures, demographics and individual preferences for artwork, it may be over simplistic to suggest that all individuals experience artwork the same way[33].

The findings indicate that the content and aesthetic qualities of artwork are also important considerations. Although mixed, the studies generally indicated that nature, especially greenery, may be the most stress-reducing. This is consistent with research demonstrating that nature artwork is most preferred by adults[34] and children[10]. There are two main theories as to why viewing nature is beneficial for humans. The evolutionary theory proposes that because humans evolved in a natural environment, nature is processed more efficiently and we are predisposed to experience restoration[35]. On the other hand, the attention restoration theory posits that nature can counteract the mental fatigue caused by stress and therefore reduce cognitive strain[36]. Thus, these two theories point to nature artwork as having the greatest stress reducing effects, as demonstrated in this review. In contrast, abstract artworks can be seen as challenging, ambiguous and unclear for viewers, leading to increased stress[30, 37]. This is supported by the emotional congruence theory which posits that stressed people are likely to project their negative experiences and emotions onto ambiguous environmental surroundings, including artworks[5]. Other artwork content could be provocative and emotionally inappropriate for certain situations, eliciting anger and dislike. For example, a study by Ho and colleagues[33] found that certain provocative artworks elicited feelings of loneliness and hopelessness in viewers, suggesting artwork must be chosen carefully, with particular emphasis on the provision of nature artworks.

The mixed findings suggest that under some conditions, viewing artwork may be physiologically relaxing, whereas under other conditions viewing artwork may be physiologically stimulating. The direction of these effects may not only depend upon the content of the artwork, but also the context and viewers' stress levels. Regardless of the direction of effects on physiology, lower self-reported stress may result.

Although this review focussed on the stress-reducing effects of viewing artwork, it may also be important to investigate the stimulating aspects of artwork. For certain populations, such as people living with dementia, visual stimulation and enrichment through artworks could improve other aspects of health, such as cognitive function[24]. As discussed above, visual stimulation and enrichment may also be important to provide positive distraction from negative experiences. Three studies showed an increase in physiological stress[14, 24, 25]. This increased stimulation may be related to the content of the artworks ('beautiful' vs 'ugly' paintings[14], or landscapes vs scrambled images[25]) or the types of populations involved (people living with dementia[24] and art students[14]). Therefore, the provision of stimulating artworks may be appropriate for certain situations, including for people living with dementia.

Choice may be another important variable. This is especially pertinent in settings where people have little control. Art Carts have been used in hospitals to allow patients to choose which artworks to view during their stay to give them a sense of control over their environment[29]. Two studies in this review[9, 20] gave participants a choice of artwork, however research is yet to investigate whether the element of choice affects stress outcomes.

Directives given to viewers may influence the way participants view artworks and therefore moderate the artworks' stress-reducing effects. Wikström[38] previously discussed the importance of creating an art-dialogue when viewing and discussing artworks in order to improve engagement, understanding and empowerment. Other research[33] demonstrated that the descriptions given to viewers about artwork could be influential, and therefore this may be an important element for

studies to include. However, few studies reported the directives given. It is important for future research to report what directives were provided and investigate whether this is influential.

Finally, it is difficult to determine the dose-response relationship of artwork viewing. There was little consistency in the number of artworks shown to each participant, and no study investigated whether the quantity of artworks or viewing durations mattered. Therefore, future research could investigate the best artwork viewing duration and number of works.

Limitations

This review is limited by only including articles published in the English language. Articles in other languages could have been missed. The review deviated slightly from the original protocol. Due to the large number of irrelevant articles identified using the original search strategy, the search terms were narrowed and the original title screening was only conducted by one reviewer. These deviations were required to make the search and screening more feasible. This review did not include anxiety or mood measures or studies using qualitative methodology, as these outcomes were considered outside the scope of the review.

Conclusions

This scoping review summarised research on the effects of viewing visual artworks on stress outcomes. 14 studies met the eligibility criteria, with consistent reductions in self-reported stress, but mixed effects on physiology. This research suggests that the provision of artworks could be an effective stress-reduction intervention. However, most of the research was low quality, with many methodological details missing, and there was high heterogeneity in research methodologies. Setting, individual characteristics, artwork content, and viewing instructions may be important moderating factors. More robust research, using standardised methods and RCTs, is needed before strong conclusions can be made about the effects of viewing visual art on stress outcomes.

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Figure 1. PRISMA-ScR flow diagram of the study selection process

Table 1

Example search strategy syntax for databases

Database	Search Strategy Syntax
Scopus	(TITLE-ABS-KEY (artwork OR "art work" OR "visual art" OR "art museum" OR painting OR mural OR "works of art" OR "viewing art" OR "viewing artwork" OR "artwork viewing" OR "art gallery" OR "art galleries") AND TITLE-ABS-KEY (stress OR "blood pressure" OR anxiety OR "heart rate" OR mood OR norepinephrine OR epinephrine OR "stress hormones" OR stressor OR glucocorticoids OR cortisol OR alpha-amylase OR "stress reduction")) AND (LIMIT TO (LANGUAGE , "English"))
ProQuest Dissertations and Thesis	ab(artwork OR “art work” OR “visual art” OR “art museum” OR painting OR mural OR “works of art” OR museum OR “viewing art” OR “artistic work” OR “viewing artwork” OR “artwork viewing” OR “art gallery” OR “art galleries”) AND ab(stress OR “blood pressure” OR anxiety OR respiration OR “heart rate” OR mood OR norepinephrine OR epinephrine OR “stress hormones” OR “mental health” OR stressor OR glucocorticoids OR cortisol OR alpha-amylase OR “immune marker” OR “stress reduction”)

Table 2

Summaries of the studies' designs and key stress outcome findings

Study	Study Design and Methods	Key Findings
Clow & Fredhoi (2006)[15]	Studied self-reported stress and arousal, and salivary cortisol levels in a group of London city workers during a lunchtime visit to an art gallery. Measurements were taken before and after the 35-40-minute gallery visit to explore pre-post intervention changes.	Self-reported stress and salivary cortisol levels both decreased over the intervention. There were no differences in arousal levels.
D'Cunha et al (2019)[24]	Evaluated the psychophysiological effects of attending the National Art Gallery of Australia Art and Dementia programme. People living with dementia attended the group-based, six-week programme which involved viewing and discussing artworks, led by an art director. Measures of salivary cortisol and interleukin-6 were taken at baseline, at the end of the programme and 12 weeks later.	Waking salivary cortisol levels increased from baseline to post-intervention, but decreased at follow-up. No changes in evening cortisol or interleukin-6 were observed. The ratio of waking to evening cortisol increased from baseline to post-intervention indicating a more dynamic diurnal cortisol rhythm.
de Jong (1972)[14]	Three groups of participants (advanced art history students, advanced fine art students and laboratory workers as controls) viewed projections of 12 paintings considered to be 'beautiful' and 12 paintings considered to be 'ugly' in a random order while their heart rate, respiration rate and skin conductance was measured continuously.	The fine arts and art history students showed a greater change in skin conductance than the laboratory workers. Respiration and skin conductance were higher during the 'beautiful' paintings than the 'ugly' paintings in all groups. The fine arts students had faster heart rate during the 'beautiful' paintings compared to the 'ugly' paintings, however, for the other two groups, this result was reversed.
Eisen et al (2008)[10]	The third phase this study investigated which type of art was most effective in reducing stress in paediatric patients. On arrival to the hospital, patients were randomly allocated to one of three rooms; a room with a nature artwork, a room with an abstract artwork or a room with no artwork. Self-reported stress, blood pressure and respiratory rate were taken at baseline and after two hours of exposure to the artworks.	Overall, there were no significant differences between the groups on stress, blood pressure or respiration. However, sub-analyses showed that significantly more males than females in the 8-10 age group were positively affected by the nature artwork, as demonstrated by decreased self-reported stress, blood pressure and respiratory rates.
Karnik et al (2014)[21]	Installed a diverse collection of artworks in the public spaces and clinic rooms of a hospital. Patients were retrospectively contacted with a survey which included evaluating whether the art installations changed their self-reported stress levels.	61% of the patients that reported seeing the artworks stated that the artworks somewhat or significantly reduced their stress levels.

Krauss et al (2019)[16]	Participants viewed six Flemish expressionism artworks in an art museum, while heart rate and skin conductance were continuously measured. Participants were randomly assigned to either receive descriptive information about the artworks (described the artwork in a declarative way) or elaborative information about the artworks (described the context and deeper meaning behind the artworks).	There were no significant differences in heart rate, heart rate variability or skin conductance between the two groups. However, in both groups heart rate was lower, and skin conductance and heart rate variability higher when viewing the artworks, compared to baseline.
Kweon et al (2008)[22]	Conducted an experiment investigating the effects of artwork posters on stress and anger levels in an office setting. Students were asked to complete a series of stress and anger provoking computer tasks in one of four different mock office conditions; an office with nature posters, abstract posters, both nature and abstract posters or no posters. Levels of self-reported stress were measured across the experiment.	Males had the highest stress levels in the office with no posters, and the lowest stress levels in the office with mixed art posters. On the other hand, females had the highest stress in the office with all abstract posters and the lowest levels in the office with all nature posters. However, these results were only significant for males and not females.
Law et al (2020)[25]	Conducted a pilot study to investigate whether nature artworks could improve recovery from a laboratory stressor. Participants were randomised to either view a 30-minute digital slideshow of landscape artworks or digitally scrambled versions of these artworks after being exposed to a laboratory stressor. Saliva samples were taken at baseline, after the stressor, during the art viewing and after the art viewing to measure cortisol and alpha-amylase.	Salivary cortisol levels decreased more rapidly while viewing the scrambled images compared to the landscape artworks. There were no changes in alpha-amylase across the experiment or between groups.
Mastandrea et al (2019)[17]	Students visited an art museum and were randomly assigned to visit one of three art exhibitions for five minutes; a figurative art exhibition, a modern art exhibition or a museum office as a control condition. Blood pressure and heart rate were measured before and after the visit.	Systolic blood pressure decreased in all groups; however, this decrease was only significant in the figurative art group. Heart rate also decreased in all three groups, however, there was no significant differences between groups.
McCabe et al (2013)[9]	Evaluated the effects of the Open Window art intervention on stem-cell transplantation patients. The Open Window is a virtual window which is installed in a hospital room, where the patients can switch through nine art channels with different artworks. Patients were randomised to either a room with the Open Window or not. Self-reported distress was measured at admission, the day before transplant, seven days after transplant, prior to discharge, and 60 days, 100 days and six months post-transplant.	Results demonstrated no significant differences in levels of distress between the two groups at any of the time-points.
Pearson et al (2019)[23]	Examined the impact of nature-themed window murals on physiological measures in paediatric patients. Paediatric patients were assigned to hospital rooms with either a fish-themed window mural, a tree-themed	Those patients with the window murals had significant improvements in heart rate and systolic blood pressure, with the tree-themed mural having the greatest effect.

	window mural or no window mural. Patients' blood pressure and heart rate were taken retrospectively from the patients' medical records.	
Siri et al (2018)[18]	Examined the effects of viewing original physical artworks and their digital reproductions within a museum context. Cardiovascular variables were measured via ECG continuously in healthy volunteers while viewing two real abstract paintings and their digital reproductions.	Results showed that there was a significant difference in heart rate between viewing the two real paintings, but no difference was found between the digital reproductions, or between the real and digital reproductions. No differences in heart rate variability were found.
Tschacher et al (2012)[19]	Monitored the physiology of visitors to an art museum using an electronic sensor glove which recorded physiological data and locomotion activity while they viewed the artworks. Afterwards, they were asked to rate the aesthetic qualities of some of the artworks.	Heart rate variability increased while viewing artworks that were deemed beautiful, high quality and surprising/humorous. Skin conductance variability increased, and heart rate decreased while viewing more dominant artworks (artworks experienced as dominant and stimulating by the viewers).
Wikström et al (1993)[20]	Investigated whether visual stimulation could improve the health of elderly women living alone. The women were randomised to either an intervention or control group. The intervention group were shown a selection of pictures, including artworks, and asked to discuss them, whereas the control group discussed current events. Blood pressure was measured at baseline, immediately after the intervention and four months later.	The intervention group had significantly lower systolic blood pressure than the control group after the intervention and at follow-up

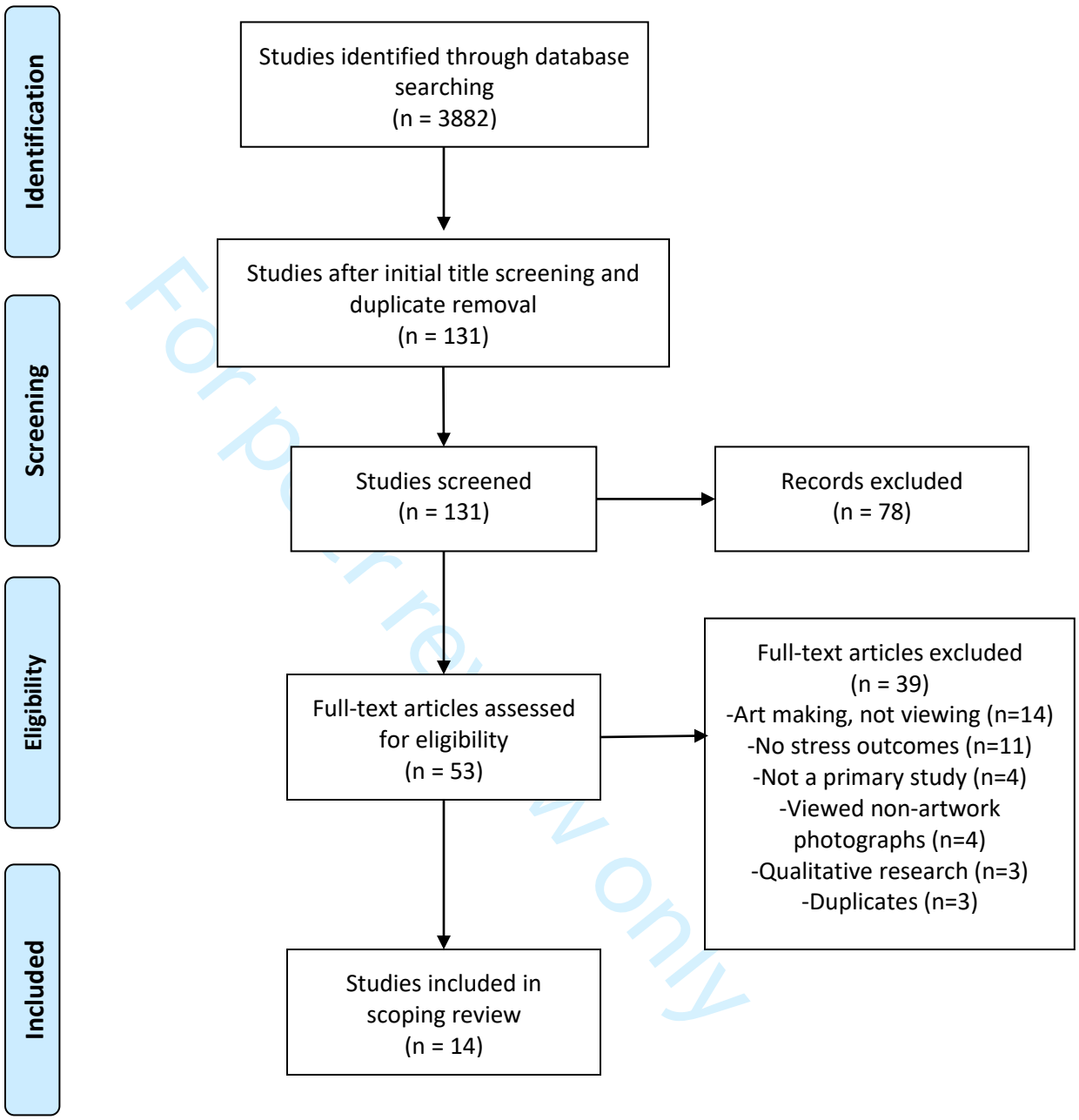
Table 3

Overview of studies included in the review

Study	Country	Study Design	Comparator Group	Setting	Population (N)	Stress Outcome Measures	Type and Content of Artwork	Quantity of Artworks Viewed by Each Participant	Duration of Artwork Viewing
Clow & Fredhoi (2006)[15]	United Kingdom	Pre- and post-test, within groups quasi-experimental study	None	Art gallery	Office workers N=28 (25 included in the analysis)	Self-reported stress Self-reported arousal Salivary cortisol	Physical artworks in a gallery- exact content not specified	Not specified- gallery exhibition	35-40 minutes in the gallery
D'Cunha et al (2019)[24]	Australia	Pre- and post-test, within groups quasi-experimental study	None	Art gallery	People living with dementia N=28 (22 included in the analysis)	Salivary cortisol interleukin-6	Physical artworks in a gallery- exact content not specified	3-4 artworks each session, over 5-6 sessions	5-6x 90-minute sessions. Each artwork was viewed for 20 minutes
de Jong (1972)[14]	Netherlands	Between groups experimental study	Laboratory workers (non-art students)	Laboratory	Advanced art history students, advanced fine arts students and laboratory workers N= 27	Heart rate Skin conductance Respiration rate	Digital projections of 12 paintings considered 'beautiful' and 12 paintings considered 'ugly'	24	Each painting was viewed for 10 seconds
Eisen et al (2008)[10]	USA	Pre- and post-test, randomised controlled trial	Room with no artwork	Hospital-patients' room	Paediatric patients (aged 5-17) N=78	Self-reported stress Heart rate Blood pressure Respiratory rate	One group had a representational nature artwork hung on the wall, whereas the other group had an abstract artwork hung on the wall	1	2 hours
Karnik et al (2014)[21]	USA	Cross-sectional survey	None	Hospital-public spaces and clinic rooms	Hospital patients N= 826	Self-reported change in stress	Physical collection of abstract and representational imagery (including nature imagery). Includes an assortment of artistic media; and a variety of subject matter	Collection of over 5300 artworks	N/A
Krauss et al (2019)[16]	Switzerland	Randomised controlled trial	Group received only descriptive	Art museum	General public aged between 18 and 35 N= 75	Heart rate Heart rate variability	Physical abstract paintings of Flemish expressionism	6	Not specified

			information about the artwork (compared to elaborative information)			Skin conductance			
Kweon et al (2008)[22]	USA	Between groups experimental study	No artwork posters group	Laboratory (replicated office setting)	Psychology students N=210	Self-reported stress	Nature posters and abstract posters	4	Not specified
Law et al (2020)[25]	New Zealand	Between groups experimental pilot study	Scrambled artwork images	Laboratory	General public N=30	Salivary cortisol Salivary alpha-amylase	Digital slideshow of either landscape paintings or digitally scrambled versions of these paintings	26	30 minutes
Mastandrea et al (2019)[17]	Italy	Between groups experimental study	Museum office	Art museum	Undergraduate students N=77	Blood pressure Heart rate	Physical artworks in a gallery- including figurative artworks (e.g. landscapes and portraits) and modern artworks (e.g. abstract, impressionist and informal paintings)	Not specified- gallery exhibition	5 minutes
McCabe et al (2013)[9]	Ireland	Randomised prospective clinical trial	Room without the 'Open Window'	Hospital-patients' room	Stem cell transplantation patients N= 199 (164 included in the analysis)	Self-reported distress	Virtual window, with artwork projections. Artwork collections ranged from visually complex abstract images to images of nature.	Not specified- 9 art 'channels,' each with a collection of artworks	For the duration of their hospital stay- times not specified
Pearson et al (2019)[23]	USA	Pre- and post-test, between groups quasi-experimental study	Room without a window mural	Hospital-patients' room	Paediatric patients aged 2-18) N=90	Heart rate Systolic blood pressure	Window mural- either aquatic or forest themed	1	Minimum of 48 hours
Siri et al (2018)[18]	Italy	Within groups experimental study	None	Art museum	General public N=60	Heart rate Heart rate variability	2 real abstract contemporary paintings and their digitally produced replicates	4	144 seconds per artwork
Tschacher et al (2012)[19]	Switzerland	Within groups quasi-experimental study	None	Art museum	Museum visitors N=517 (373 included in the analysis)	Skin conductance Heart rate Heart rate variability	Physical modern and contemporary art exhibition	76	No specific timeframe given to participants. On average, they spent

									28 minutes at the gallery.
Wikström et al (1993)[20]	Sweden	Pre- and post-test randomised controlled trial	Group that were not shown artworks	Senior citizen apartment	Women aged over 70 N=40	Systolic blood pressure	Physical pictures- ranging from artworks of nature, flowers and people, abstract patterns, white figures on black backgrounds and photographs.	Not specified how many each participant viewed	Not specified



Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	
Limitations	20	Discuss the limitations of the scoping review process.	
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Ann Intern Med. ;169:467–473. doi: 10.7326/M18-0850

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Evidence for the effects of Viewing Visual Artworks on Stress Outcomes: A Scoping Review

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Evidence for the effects of Viewing Visual Artworks on Stress Outcomes: A Scoping Review

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Abstract

Objective: To review the existing evidence on the effects of viewing visual artworks on stress outcomes and outline any gaps in the research.

Design: A scoping review was conducted based on the Joanna Briggs Institute methodology for scoping reviews and using the preferred reporting items for systematic reviews and meta-analyses extension for scoping reviews. Two independent reviewers performed the screening and data extraction.

Data Sources: Medline, Embase, APA PsycINFO, Cochrane CENTRAL, Scopus, Google Scholar, Google, ProQuest Theses and Dissertations Database, APA PsycExtra and Opengrey.eu were searched in May 2020.

Eligibility Criteria: Studies were included if they investigated the effects of viewing at least one visual artwork on at least one stress outcome measure. Studies involving active engagement with art, review papers or qualitative studies were excluded. There were no limits in terms of year of publication, contexts or population types; however, only studies published in the English language were considered.

Data Extraction and Synthesis: Information extracted from manuscripts included: study methodologies, population and setting characteristics, details of the artwork interventions, key findings and details related to methodological quality.

Results: 14 primary studies were identified, with heterogeneous study designs, methodologies and artwork interventions. The results of these studies demonstrated consistent reductions in self-reported stress after viewing artworks, but mixed effects on physiological stress measures. The methodological quality of the studies was poor, with many important methodological details missing.

Conclusions: There is promising evidence for effects of viewing artwork on reducing stress. Moderating factors may include setting, individual characteristics, artwork content, and viewing instructions. More robust research, using more standardised methods and randomised controlled trials, is needed.

Registration Details: A protocol for this review is registered with the Open Science Framework (osf.io/gq5d8).

Strengths and Limitations of this Study

- A comprehensive scoping review was conducted using a broad and inclusive search strategy and a large variety of databases were searched.
- The reviewers independently followed a structured and pre-published protocol for searching, screening and extracting data which followed the Joanna Briggs Institute methodology for scoping reviews and PRISMA-ScR guidelines.
- Only studies published in the English language were included, possibly resulting in articles of other languages being missed.
- Slight deviations in the original protocol were performed in order to make the data screening more feasible.

INTRODUCTION

A number of studies and reviews have suggested that participation in the arts is beneficial for health[1-4]. Because of this, many healthcare and workplace settings offer art programmes, including art therapy, music and visual art displays, to reduce stress and improve wellbeing for staff, patients and customers[5]. However, there is little evidence that these programmes have the desired effects and there is a need for a high-quality evidence base for art-based interventions[1, 4].

Engagement with arts can be divided into active and passive participation. Active participation involves making, creating or teaching arts[2, 6]. This includes art therapy (where an art therapist directs the creation of artworks to achieve a particular goal and foster improved mental health and wellbeing), as well as other arts-based interventions that are not goal-driven and do not require a trained professional[7]. In contrast passive participation involves behaviours such as observing, viewing, listening and watching art[2, 6]. Passive viewing of artworks has the advantages of being an easy, low-cost and non-invasive intervention. This scoping review focussed on the effects of passively viewing visual artworks and therefore excluded research pertaining to the active participation in arts.

There is some evidence that viewing artworks as an intervention is beneficial; however, this evidence is not of uniformly high quality, is rarely critical, and is sparse, with many important theoretical and evidential gaps. As well as this, most of the evidence comes from anecdotes, descriptions and personal experiences, rather than empirical research[8, 9]. Although many settings have been used within this research, including healthcare, art museums and laboratories, there is a paucity of evidence to demonstrate whether these settings affect outcomes differently. Demographics may be important moderators as ethnicity, gender and age may influence preferences for certain types of artworks. However, rigorous research has yet to be conducted examining the influence of settings and populations.

Due to these limitations, it is important to review the existing evidence and identify any research gaps that need to be addressed. As the evidence base is small and heterogeneous, a systematic review could not be accurately completed and would be too restrictive, so instead a scoping review was conducted. The results can be used to direct future research to fill these gaps before a full systematic review can be completed.

There is no universally accepted definition of artworks as this construct has been inconsistent and debated. For the purpose of this review, artwork was defined as two-dimensional artistic works made primarily for their aesthetics, rather than any functional purpose. This definition was created from working definitions of visual and fine arts used in previous research[10, 11]. Based on this definition, this review included studies on paintings, drawings and prints and excluded studies on sculpture, films, interior design or architecture. Photographs were only included if they depicted artworks, as it was deemed too difficult to determine the difference between “artistic” photography and “non-artistic” photography based on the definition of artworks provided for this review. Digital artworks were included.

Viewing artworks is a form of visual environmental enrichment and is theorised to be stress-reducing through positive distraction[8, 12]. To explore this theory, the review focused on the effects of viewing visual artworks on stress outcomes. Both psychological and physiological stress outcomes were included.

Objective and Research Questions

The aim of this scoping review was to systematically examine the extent of existing research available on the effects of viewing visual artworks on stress outcome measures and identify knowledge gaps to aid future research. The following research question was formulated: what research has been conducted on the effects of viewing visual artworks on stress outcomes in any populations and settings?

Several secondary questions were developed:

- What populations and settings were studied?
- What stress outcomes were measured?
- What type and content of artworks were viewed?
- What was the duration of the artwork viewing and how many artworks were viewed?
- Were the interventions effective in changing the outcomes?
- What is the methodological quality of the existing studies?

METHODS

A preliminary search for previous reviews on this topic was conducted on Google Scholar, JBI Evidence Synthesis and the Cochrane Database of Systematic Reviews prior to creating the protocol.

Protocol

A scoping review protocol was developed based on the Joanna Briggs Institute (JBI) methodology for scoping reviews[13] and using the preferred reporting items for systematic reviews and meta-analyses extension for scoping reviews (PRISMA-ScR). The objectives, eligibility criteria and methods were specified in advance and documented in the protocol registered at osf.io/gq5d8.

Eligibility Criteria

Studies had to meet the following inclusion criteria; be a primary study where participants passively viewed at least one visual artwork as an intervention, including viewing paintings, drawings, prints, digital artwork, or photographs of artworks, and measured at least one stress outcome measure (physiological or psychological indices). Measures of anxiety or mood were not considered as direct measures of stress and therefore fell out of the scope of this review. Unpublished research, including working papers, theses/dissertations and conference proceedings were included if they were identified by the search.

Studies were excluded if participants had active engagement in the arts (e.g. studies on art therapy or the production/creation of art), the study investigated the effects of interior design, architecture, sculpture, films or photography not depicting artworks, and review papers, including systematic reviews, scoping reviews and meta-analyses.

As per the scoping review objectives, there were no restrictions in terms of populations, contexts, dates of publication or study designs. However, during the screening phase, it was decided to exclude qualitative studies as these studies did not have clear stress outcomes, which was a key inclusion criterion. Only studies published in the English language were considered.

Search Strategy

To identify potentially relevant studies, the following electronic databases were systematically searched; Medline, Embase, APA PsycINFO, Cochrane CENTRAL, Scopus and Google Scholar (first 30 pages), with the help of a subject librarian. The search string combined a set of artwork and stress terms within each set with “OR” and between the two sets with “AND.” The search was first

conducted using an extended list of search terms from the registered protocol; however, this search strategy resulted in a large number of irrelevant articles. Therefore, in the final search, some of the more ambiguous search terms were removed to refine the search further. For example, the term 'drawing' was removed as this could refer both to artistic drawings and 'drawing' blood. The final search strategies for two example databases are presented in Table 1.

The grey literature was searched using the same search terms to identify any unpublished studies. Grey literature databases searched included; Google (limited to the first 20 pages), ProQuest theses and dissertations database, APA PsycExtra and Opengrey.eu.

A search was then conducted by hand of the reference lists of relevant identified articles. Lastly, the 'cited by' feature of Google Scholar was used to see if any of the relevant studies had been cited by undetected articles. All extracted references from these searches were imported to RefWorks and all duplicates removed. The final search was executed on 27 May 2020. The number of studies identified by the search strategy is shown in Figure 1.

Screening and Study Selection

Screening of the studies identified by the search strategy was conducted by two independent reviewers using a two-staged approach using the programme Covidence (www.covidence.org). Due to the high volume and large number of unrelated studies identified, one author initially screened the titles and removed any irrelevant studies, before the first stage. In the first stage of screening, two reviewers independently screened the abstracts for the eligibility criteria. If a study's eligibility was judged to be uncertain, the article was included in the second stage. In the second stage, two reviewers screened the full texts of the studies to determine final inclusion or exclusion based on the eligibility criteria. The two stages were conducted by the reviewers independently, with the results of each stage discussed. Any disagreements related to eligibility of an article were discussed and agreement was reached. The two reviewers had overall 86% agreement. The number of included and excluded studies at each stage of the screening procedure is shown in Figure 1, with reasons for exclusion.

Data Extraction and Analysis

Data was extracted from each included study into a charting form by the two reviewers independently. This charting form was developed in accordance with the review questions. It included; publication details (i.e. title, year, authors), methodology (i.e. aims, design, population characteristics, setting, outcomes), artwork details (i.e. type and content of artwork, duration of artwork viewing, number of artworks), key findings related to scoping review questions, and items to assess methodological quality (i.e. registration details, comparator groups, randomisation, blinding, power analyses). The JBI methodology for scoping reviews[13] recommends that formal methodological quality analyses should not be conducted in a scoping review. Instead, a descriptive summary of methodological quality items is provided as a simple indicator of quality.

The charting form was iteratively refined during the extraction process to ensure all useful information was extracted. The charting form was first independently pilot tested by the two reviewers on a random sample of four studies. The reviewers discussed this process and amended the charting form by adding a column about the artwork viewing directives given to the participants. Data extraction was then completed for the remaining studies independently by the two reviewers and any inconsistencies were discussed. This extracted data is reported in tabular and descriptive text format to answer the review questions.

Patient and Public Involvement

Patients and the public were not involved in any phase of this review.

RESULTS

As shown in Figure 1, the search strategy resulted in 3882 texts, which were screened for eligibility. After the initial title and abstract screening, the full text was retrieved for 53 articles and examined against the eligibility criteria. During this process, three theses were found to have matching published journal articles and therefore were excluded as duplicates. The remaining excluded articles did not meet the eligibility criteria. This screening narrowed the studies down to 14 articles for inclusion.

The design and key findings related to the stress outcomes of each study are briefly detailed in Table 2, with specific details regarding the secondary review questions provided in Table 3. All 14 articles were primary studies published as journal articles. Apart from the duplicate theses mentioned above, no grey literature met the eligibility criteria for inclusion. The studies' publication dates ranged from 1972 to 2020. Eight studies came from Europe[9, 14-20], four from the United States of America[10, 21-23] and one each from Australia[24] and New Zealand[25].

Summary of Study Methodologies

Designs. The 14 studies had very different designs and methodologies (see Table 3). Only nine studies used a between groups design[9, 10, 14, 16, 17, 20, 22, 23, 25]. Another four used a within groups design, where measures were compared pre- to post-viewing the artworks, with no comparator groups[15, 18, 19, 24]. The final study used a cross-sectional design, measuring stress-reduction at one time-point[21].

Of the nine between groups designs, six used a no artwork control group as a comparator[9, 10, 17, 20, 22, 23], and one used scrambled versions of the artworks[25]. Krauss et al.[16] gave different viewing directives to each group and de Jong[14] had groups with different art experience levels. Four of these between groups studies were considered randomised controlled trials (RCTs)[9, 10, 16, 20].

Settings. Six studies were conducted in an art gallery or museum[15, 16-19, 24], three in a laboratory[14, 22, 25], four in hospital rooms or hospital public spaces[9, 10, 21, 23], and one in senior citizens' apartments[20]. These settings represent a mix of both naturalistic settings with high ecological validity and laboratory settings with high experimental control.

Populations. The majority of studies investigated healthy participants in the form of students[14, 17, 22], office workers[15] or the general public[16, 18, 19, 25]. Other research used patient populations known to have high stress levels. Four studies investigated hospitalised patients[9, 21], with two being paediatric samples[10, 23]. Lastly, D'Cunha et al[24] investigated people living with dementia and Wikström et al[20], elderly women.

There is little research on whether population type affects stress reactions. Very few studies compared demographic factors, with the following exceptions. De Jong[14] found that having different art experience affected outcomes. Three studies found significant differences between the stress-reducing effects of viewing artwork between males and females[10, 15, 22]. Lastly, one study compared results across different health conditions, but found similar results between groups[21].

Outcomes. Nine studies explored only physiological stress measures[14, 16, 19, 20, 23-25], three explored only psychological stress measures[9, 21, 22] and the remaining two explored both[10, 15].

The psychological stress measures included; the Cox Mackay Stress Arousal checklist[26], a stress adjective checklist[27], Likert scales, and a distress thermometer[28]. The physiological measures were mainly cardiovascular, including blood pressure, heart rate and skin conductance, which were measured in eight studies. Salivary biomarkers were measured in three studies[15, 24, 25] including cortisol, alpha-amylase and interlukin-6. Respiration was measured in two studies[10, 14].

Summary of the Artwork Interventions

Types of artworks. 10 studies used physical artworks. Most were original paintings, however one study used posters depicting artworks[22] and another used a window mural[23]. Another three studies used digital reproductions of artworks. Two used slideshows of digital images[14, 25], whereas the third used the Open Window, which digitally projected artworks[9]. The last study directly compared physical artworks with their digital reproductions[18]. This study did not find any differences between the types of artwork, indicating that digital reproductions may be just as stress-reducing as physical artworks.

Content of artworks. The content ranged from representational nature images, to complex abstract artworks. Five studies provided an assortment of artwork content in one exhibition[15, 17, 21, 24] and therefore it could not be determined whether content was influential. Two studies investigated the effects of abstract artwork but did not compare these to another artwork type[16, 18]. Another study[14] compared the physiological effects of artworks rated to be 'ugly' or 'beautiful.' Although the exact content of the artwork was not described, this study did find that participants had higher skin conductance and respiration rates while viewing the 'beautiful' paintings, compared to the 'ugly' paintings, demonstrating that the aesthetic content of the artwork may influence their effects.

Another four studies investigated the effects of viewing nature artworks. Two studies found that self-reported stress was lower when viewing nature artworks compared to abstract artworks[10, 22]. One study found that different aspects of nature might have stronger effects; a forest mural resulted in larger blood pressure decreases than an aquatic mural[23]. Nature content may also affect biological indicators of stress responses; cortisol levels decreased faster after a stressor in people viewing scrambled versions of nature artworks, compared to the original nature artworks[25].

The remaining two studies[9, 20] did not report on the content of the artwork and therefore, cannot be categorised.

Duration of artwork viewing. Nine studies reported the duration participants spent looking at the artwork (see Table 3). This ranged from two minutes to over 48 hours. No study investigated whether changing the duration of exposure to artworks affected stress outcomes.

Quantity of artworks. Most of the studies did not specify the exact number of artworks viewed. Of those studies that did specify a number, it ranged from one artwork to over 5300 in one exhibition. Half of the studies had participants view a collection of artworks as an exhibition or art programme. Only two studies showed each participant one artwork and both were in paediatric hospital rooms[10, 23]. The other experimental studies ranged from viewing four to 26 artworks in one sitting, with the exact numbers provided in Table 3.

Viewing directives. Five studies explicitly mentioned the viewing directives given to participants. The researchers from two experimental studies told participants to attentively look at and explore each artwork[14, 18], whereas the researcher in another study asked visitors to explore the art gallery in any way they pleased[15]. The remaining two studies asked participants to discuss and describe each

artwork to the group during art programmes[20, 24]. One of these studies[24] had a trained art educator facilitating the discussions, whereas the other[20] had a lead researcher, with no specified training.

Summary of Key Findings

All but one of the studies that measured self-reported stress found a significant decrease after viewing artwork[10, 15, 21, 22], with the final study showing no significant changes[9]. A consistent decrease in systolic blood pressure was also found across the four studies measuring blood pressure[10, 17, 20, 23]. Skin conductance and skin conductance variability both increased while viewing artworks[14, 16, 19]. The results for heart rate were mostly consistent. Two of the three studies that measured heart rate found that viewing artworks decreased heart rate[19, 23]. The other study found that viewing beautiful paintings increased heart rate for students trained in fine arts and decreased heart rate for other participants[14].

The cortisol and respiration results were less consistent. An art gallery visit decreased salivary cortisol levels[15]; however, a six week art intervention for people living with dementia increased waking cortisol levels[24]. Lastly, after a stressor, salivary cortisol decreased faster in those viewing scrambled images, compared to those viewing landscapes[25]. Viewing beautiful paintings lead to an increase in respiration rates in a healthy sample[14]. Whereas nature artworks in a hospital room decreased respiration rates in children[10]. These studies all had different samples, settings and artworks which may have accounted for these mixed findings. Lastly both alpha-amylase[25] and interleukin- 6[24] were each only measured in one study and showed no significant changes.

Summary of Methodological Quality

A full quality analysis is not recommended for a scoping review and many of the studies lacked sufficient methodological details. Therefore, a simple descriptive summary of key quality issues was performed as an indicator of possible quality issues. None of the studies were pre-registered. Sample sizes ranged from 27 to 826 participants; however, only two studies conducted a power analysis to determine their sample size. Krauss et al's[16] power analysis gave a required sample size of at least 68, and a final sample of 75 was recruited. The power analysis in McCabe et al[9] gave 200 participants and a sample of 199 were recruited; however, only 164 were included in the analyses. The other 12 studies did not provide a power analysis. Law et al[25] was a pilot study, and was not expected to conduct a power analysis to determine sample size. Therefore, it is difficult to determine if all studies were adequately powered.

Only nine studies had comparator groups, with only seven related to the artwork intervention. For most studies, it was difficult to blind the participants, because in most cases participants were explicitly asked to view particular artworks, and therefore both the researcher and participants were aware of which artworks they were viewing. However, two studies did successfully blind the study as both the researchers/nurses collecting the stress measures and the participants themselves were not explicitly made aware of the presence (or absence) of the artworks[23, 25]. All nine between-groups studies reported randomisation of participants to groups. However, the method of randomisation was not stated in many studies. Only four studies[9, 10, 16, 20] were RCTs.

DISCUSSION

This scoping review aimed to examine the existing research on the effects of viewing visual artworks on stress outcomes and identify gaps in the research. The 14 included studies demonstrate research in this area is growing, with 10 studies being published in the last 10 years. However, there is still a

paucity of high-quality research, and the evidence that does exist has heterogeneous methodologies and interventions, creating difficulty in comparing and directly summarising the results. Despite this, the scoping review was able to gather sufficient evidence to address the research questions outlined in the introduction and identify gaps for future research, as detailed below.

Overall, the evidence supports the claim that viewing artworks can reduce stress, in particular self-reported stress and systolic blood pressure. These preliminary quantitative results support qualitative research showing that viewing artworks provides positive distraction from a hospital environment and lowers self-reported stress[9, 12, 29]. The findings indicated that digital artworks can have similar stress-reducing effects to physical artworks, thus increasing the avenues available for viewers. Artwork interventions can therefore be transposed onto computers, TVs, phones and tablets, as a portable, cheap and easy intervention for stress-reduction.

Together the results suggest that the provision of artworks could be an effective stress-reduction intervention. However, mixed findings combined with a lack of homologous methodologies means that this claim about effective stress-reduction cannot be concluded without more rigorous research. Future research needs to ensure better methodological quality including: adequate comparator groups, power analyses to ensure sufficient sample sizes, clearly defined randomisation procedures and pre-registration. If we examine the results from just the four RCTs, the evidence is even less conclusive. More detail on these studies and their findings are provided in Table 2; however, only one of the four RCTs showed significant effects for their main hypotheses. Wikström et al[20] found a significant decrease in systolic blood pressure after an art intervention. In contrast, McCabe et al[9] found no significant effects on distress measures, and Eisen et al[10] only found significant effects when subgroup analyses of age were conducted. Lastly, Krauss et al[16] did find significant decreases in physiological stress when viewing artworks compared to baseline; however, they found no significant differences between the viewing directives provided, which was their main hypothesis. Therefore, more RCTs still need to be conducted on this topic for clearer conclusions to be made.

The differences between the studies suggest important moderating factors, one of which is setting. The museum context may add to the effects of viewing artwork, as museum related factors may lead to greater appreciation of artwork[30]. In addition, viewing artwork in a museum usually involves walking, which has its own stress-reducing effects[31]. Laboratory studies remove some of these contextual factors and may provide more specific evidence for the effects of viewing artworks, but they have lower ecological validity. The hospital room is an important setting as patients are often confined to their room for long time-periods and rooms are often deprived of environmental enrichment. Artwork could act as visual stimulation to positively distract patients from their stress, pain and medical conditions, and therefore it is suggested that artwork is placed in hospital rooms and waiting rooms. Artwork could also have stress-reducing benefits in other settings such as waiting rooms and workplaces, which are often related to high stress. More research in these settings should be conducted.

Other possible moderating factors include individual characteristics, although little research has investigated these. Gender differences were found in two of the included studies, with a trend towards females experiencing greater stress-reduction in response to nature artworks[10, 22]. One small survey found that African Americans and Caucasians have similar preferences for nature artworks[32]; however, no study has investigated whether culture affects the stress-reducing effects of artworks. Given the diversity in cultures, demographics and individual preferences for artwork, it may be over simplistic to suggest that all individuals experience artwork the same way[33].

The findings indicate that the content and aesthetic qualities of artwork are also important considerations. Although mixed, the studies generally indicated that nature, especially greenery, may be the most stress-reducing. This is consistent with research demonstrating that nature artwork is most preferred by adults[34] and children[10]. There are two main theories as to why viewing nature is beneficial for humans. The evolutionary theory proposes that because humans evolved in a natural environment, nature is processed more efficiently and we are predisposed to experience restoration[35]. On the other hand, the attention restoration theory posits that nature can counteract the mental fatigue caused by stress and therefore reduce cognitive strain[36]. Thus, these two theories point to nature artwork as having the greatest stress reducing effects, as demonstrated in this review. In contrast, abstract artworks can be seen as challenging, ambiguous and unclear for viewers, leading to increased stress[30, 37]. This is supported by the emotional congruence theory which posits that stressed people are likely to project their negative experiences and emotions onto ambiguous environmental surroundings, including artworks[5]. Other artwork content could be provocative and emotionally inappropriate for certain situations, eliciting anger and dislike. For example, a study by Ho and colleagues[33] found that certain provocative artworks elicited feelings of loneliness and hopelessness in viewers, suggesting artwork must be chosen carefully, with particular emphasis on the provision of nature artworks.

The mixed findings suggest that under some conditions, viewing artwork may be physiologically relaxing, whereas under other conditions viewing artwork may be physiologically stimulating. The direction of these effects may not only depend upon the content of the artwork, but also the context and viewers' stress levels. Regardless of the direction of effects on physiology, lower self-reported stress may result.

Although this review focussed on the stress-reducing effects of viewing artwork, it may also be important to investigate the stimulating aspects of artwork. For certain populations, such as people living with dementia, visual stimulation and enrichment through artworks could improve other aspects of health, such as cognitive function[24]. As discussed above, visual stimulation and enrichment may also be important to provide positive distraction from negative experiences. Three studies showed an increase in physiological stress[14, 24, 25]. This increased stimulation may be related to the content of the artworks ('beautiful' vs 'ugly' paintings[14], or landscapes vs scrambled images[25]) or the types of populations involved (people living with dementia[24] and art students[14]). Therefore, the provision of stimulating artworks may be appropriate for certain situations, including for people living with dementia.

Choice may be another important variable. This is especially pertinent in settings where people have little control. Art Carts have been used in hospitals to allow patients to choose which artworks to view during their stay to give them a sense of control over their environment[29]. Two studies in this review[9, 20] gave participants a choice of artwork, however research is yet to investigate whether the element of choice affects stress outcomes.

Directives given to viewers may influence the way participants view artworks and therefore moderate the artworks' stress-reducing effects. Wikström[38] previously discussed the importance of creating an art-dialogue when viewing and discussing artworks in order to improve engagement, understanding and empowerment. Other research[33] demonstrated that the descriptions given to viewers about artwork could be influential, and therefore this may be an important element for studies to include. However, few studies reported the directives given. It is important for future research to report what directives were provided and investigate whether this is influential.

Finally, it is difficult to determine the dose-response relationship of artwork viewing. There was little consistency in the number of artworks shown to each participant, and no study investigated whether the quantity of artworks or viewing durations mattered. Therefore, future research could investigate the best artwork viewing duration and number of works.

Limitations

This review is limited by only including articles published in the English language. Articles in other languages could have been missed. The review deviated slightly from the original protocol. Due to the large number of irrelevant articles identified using the original search strategy, the search terms were narrowed and the original title screening was only conducted by one reviewer. These deviations were required to make the search and screening more feasible. This review did not include anxiety or mood measures or studies using qualitative methodology, as these outcomes were considered outside the scope of the review.

Conclusions

This scoping review summarised research on the effects of viewing visual artworks on stress outcomes. 14 studies met the eligibility criteria, with consistent reductions in self-reported stress, but mixed effects on physiology. This research suggests that the provision of artworks could be an effective stress-reduction intervention. However, most of the research was low quality, with many methodological details missing, and there was high heterogeneity in research methodologies. Setting, individual characteristics, artwork content, and viewing instructions may be important moderating factors. Before a systematic review is conducted, more robust research is recommended that uses standardised methods and RCTs to investigate the effects of viewing visual art on stress outcomes.

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Figure 1. PRISMA-ScR flow diagram of the study selection process

Table 1

Example search strategy syntax for databases

Database	Search Strategy Syntax
Scopus	(TITLE-ABS-KEY (artwork OR "art work" OR "visual art" OR "art museum" OR painting OR mural OR "works of art" OR "viewing art" OR "viewing artwork" OR "artwork viewing" OR "art gallery" OR "art galleries") AND TITLE-ABS-KEY (stress OR "blood pressure" OR anxiety OR "heart rate" OR mood OR norepinephrine OR epinephrine OR "stress hormones" OR stressor OR glucocorticoids OR cortisol OR alpha-amylase OR "stress reduction")) AND (LIMIT TO (LANGUAGE , "English"))
ProQuest Dissertations and Thesis	ab(artwork OR “art work” OR “visual art” OR “art museum” OR painting OR mural OR “works of art” OR museum OR “viewing art” OR “artistic work” OR “viewing artwork” OR “artwork viewing” OR “art gallery” OR “art galleries”) AND ab(stress OR “blood pressure” OR anxiety OR respiration OR “heart rate” OR mood OR norepinephrine OR epinephrine OR “stress hormones” OR “mental health” OR stressor OR glucocorticoids OR cortisol OR alpha-amylase OR “immune marker” OR “stress reduction”)

Table 2

Summaries of the studies' designs and key stress outcome findings

Study	Study Design and Methods	Key Findings
Clow & Fredhoi (2006)[15]	Studied self-reported stress and arousal, and salivary cortisol levels in a group of London city workers during a lunchtime visit to an art gallery. Measurements were taken before and after the 35-40-minute gallery visit to explore pre-post intervention changes.	Self-reported stress and salivary cortisol levels both decreased over the intervention. There were no differences in arousal levels.
D'Cunha et al (2019)[24]	Evaluated the psychophysiological effects of attending the National Art Gallery of Australia Art and Dementia programme. People living with dementia attended the group-based, six-week programme which involved viewing and discussing artworks, led by an art director. Measures of salivary cortisol and interleukin-6 were taken at baseline, at the end of the programme and 12 weeks later.	Waking salivary cortisol levels increased from baseline to post-intervention, but decreased at follow-up. No changes in evening cortisol or interleukin-6 were observed. The ratio of waking to evening cortisol increased from baseline to post-intervention indicating a more dynamic diurnal cortisol rhythm.
de Jong (1972)[14]	Three groups of participants (advanced art history students, advanced fine art students and laboratory workers as controls) viewed projections of 12 paintings considered to be 'beautiful' and 12 paintings considered to be 'ugly' in a random order while their heart rate, respiration rate and skin conductance was measured continuously.	The fine arts and art history students showed a greater change in skin conductance than the laboratory workers. Respiration and skin conductance were higher during the 'beautiful' paintings than the 'ugly' paintings in all groups. The fine arts students had faster heart rate during the 'beautiful' paintings compared to the 'ugly' paintings, however, for the other two groups, this result was reversed.
Eisen et al (2008)[10]	The third phase this study investigated which type of art was most effective in reducing stress in paediatric patients. On arrival to the hospital, patients were randomly allocated to one of three rooms; a room with a nature artwork, a room with an abstract artwork or a room with no artwork. Self-reported stress, blood pressure and respiratory rate were taken at baseline and after two hours of exposure to the artworks.	Overall, there were no significant differences between the groups on stress, blood pressure or respiration. However, sub-analyses showed that significantly more males than females in the 8-10 age group were positively affected by the nature artwork, as demonstrated by decreased self-reported stress, blood pressure and respiratory rates.
Karnik et al (2014)[21]	Installed a diverse collection of artworks in the public spaces and clinic rooms of a hospital. Patients were retrospectively contacted with a survey which included evaluating whether the art installations changed their self-reported stress levels.	61% of the patients that reported seeing the artworks stated that the artworks somewhat or significantly reduced their stress levels.

Krauss et al (2019)[16]	Participants viewed six Flemish expressionism artworks in an art museum, while heart rate and skin conductance were continuously measured. Participants were randomly assigned to either receive descriptive information about the artworks (described the artwork in a declarative way) or elaborative information about the artworks (described the context and deeper meaning behind the artworks).	There were no significant differences in heart rate, heart rate variability or skin conductance between the two groups. However, in both groups heart rate was lower, and skin conductance and heart rate variability higher when viewing the artworks, compared to baseline.
Kweon et al (2008)[22]	Conducted an experiment investigating the effects of artwork posters on stress and anger levels in an office setting. Students were asked to complete a series of stress and anger provoking computer tasks in one of four different mock office conditions; an office with nature posters, abstract posters, both nature and abstract posters or no posters. Levels of self-reported stress were measured across the experiment.	Males had the highest stress levels in the office with no posters, and the lowest stress levels in the office with mixed art posters. On the other hand, females had the highest stress in the office with all abstract posters and the lowest levels in the office with all nature posters. However, these results were only significant for males and not females.
Law et al (2020)[25]	Conducted a pilot study to investigate whether nature artworks could improve recovery from a laboratory stressor. Participants were randomised to either view a 30-minute digital slideshow of landscape artworks or digitally scrambled versions of these artworks after being exposed to a laboratory stressor. Saliva samples were taken at baseline, after the stressor, during the art viewing and after the art viewing to measure cortisol and alpha-amylase.	Salivary cortisol levels decreased more rapidly while viewing the scrambled images compared to the landscape artworks. There were no changes in alpha-amylase across the experiment or between groups.
Mastandrea et al (2019)[17]	Students visited an art museum and were randomly assigned to visit one of three art exhibitions for five minutes; a figurative art exhibition, a modern art exhibition or a museum office as a control condition. Blood pressure and heart rate were measured before and after the visit.	Systolic blood pressure decreased in all groups; however, this decrease was only significant in the figurative art group. Heart rate also decreased in all three groups, however, there was no significant differences between groups.
McCabe et al (2013)[9]	Evaluated the effects of the Open Window art intervention on stem-cell transplantation patients. The Open Window is a virtual window which is installed in a hospital room, where the patients can switch through nine art channels with different artworks. Patients were randomised to either a room with the Open Window or not. Self-reported distress was measured at admission, the day before transplant, seven days after transplant, prior to discharge, and 60 days, 100 days and six months post-transplant.	Results demonstrated no significant differences in levels of distress between the two groups at any of the time-points.
Pearson et al (2019)[23]	Examined the impact of nature-themed window murals on physiological measures in paediatric patients. Paediatric patients were assigned to hospital rooms with either a fish-themed window mural, a tree-themed	Those patients with the window murals had significant improvements in heart rate and systolic blood pressure, with the tree-themed mural having the greatest effect.

	window mural or no window mural. Patients' blood pressure and heart rate were taken retrospectively from the patients' medical records.	
Siri et al (2018)[18]	Examined the effects of viewing original physical artworks and their digital reproductions within a museum context. Cardiovascular variables were measured via ECG continuously in healthy volunteers while viewing two real abstract paintings and their digital reproductions.	Results showed that there was a significant difference in heart rate between viewing the two real paintings, but no difference was found between the digital reproductions, or between the real and digital reproductions. No differences in heart rate variability were found.
Tschacher et al (2012)[19]	Monitored the physiology of visitors to an art museum using an electronic sensor glove which recorded physiological data and locomotion activity while they viewed the artworks. Afterwards, they were asked to rate the aesthetic qualities of some of the artworks.	Heart rate variability increased while viewing artworks that were deemed beautiful, high quality and surprising/humorous. Skin conductance variability increased, and heart rate decreased while viewing more dominant artworks (artworks experienced as dominant and stimulating by the viewers).
Wikström et al (1993)[20]	Investigated whether visual stimulation could improve the health of elderly women living alone. The women were randomised to either an intervention or control group. The intervention group were shown a selection of pictures, including artworks, and asked to discuss them, whereas the control group discussed current events. Blood pressure was measured at baseline, immediately after the intervention and four months later.	The intervention group had significantly lower systolic blood pressure than the control group after the intervention and at follow-up

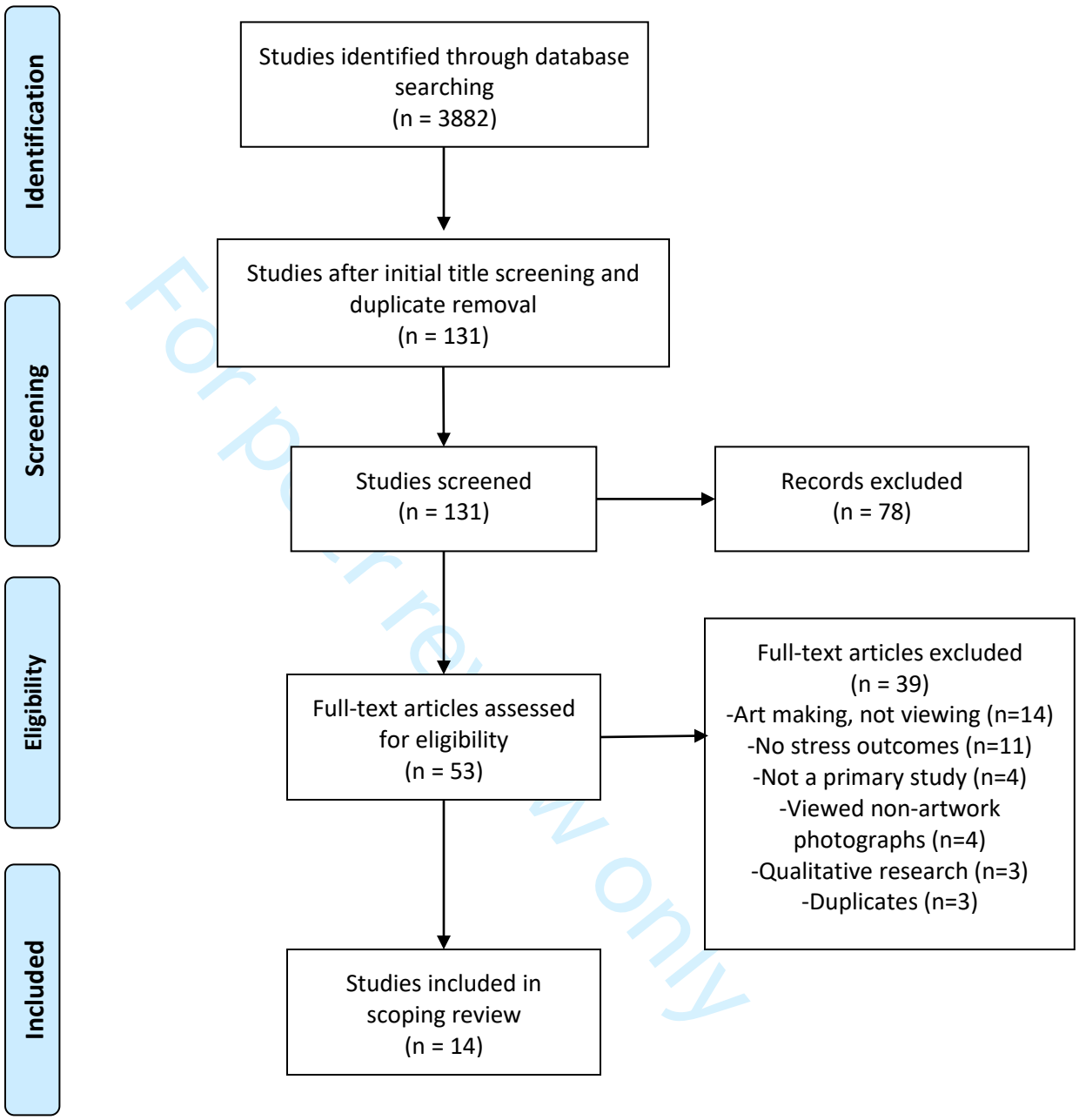
Table 3

Overview of studies included in the review

Study	Country	Study Design	Comparator Group	Setting	Population (N)	Stress Outcome Measures	Type and Content of Artwork	Quantity of Artworks Viewed by Each Participant	Duration of Artwork Viewing
Clow & Fredhoi (2006)[15]	United Kingdom	Pre- and post-test, within groups quasi-experimental study	None	Art gallery	Office workers N=28 (25 included in the analysis)	Self-reported stress Self-reported arousal Salivary cortisol	Physical artworks in a gallery- exact content not specified	Not specified- gallery exhibition	35-40 minutes in the gallery
D'Cunha et al (2019)[24]	Australia	Pre- and post-test, within groups quasi-experimental study	None	Art gallery	People living with dementia N=28 (22 included in the analysis)	Salivary cortisol interleukin-6	Physical artworks in a gallery- exact content not specified	3-4 artworks each session, over 5-6 sessions	5-6x 90-minute sessions. Each artwork was viewed for 20 minutes
de Jong (1972)[14]	Netherlands	Between groups experimental study	Laboratory workers (non-art students)	Laboratory	Advanced art history students, advanced fine arts students and laboratory workers N= 27	Heart rate Skin conductance Respiration rate	Digital projections of 12 paintings considered 'beautiful' and 12 paintings considered 'ugly'	24	Each painting was viewed for 10 seconds
Eisen et al (2008)[10]	USA	Pre- and post-test, randomised controlled trial	Room with no artwork	Hospital-patients' room	Paediatric patients (aged 5-17) N=78	Self-reported stress Heart rate Blood pressure Respiratory rate	One group had a representational nature artwork hung on the wall, whereas the other group had an abstract artwork hung on the wall	1	2 hours
Karnik et al (2014)[21]	USA	Cross-sectional survey	None	Hospital-public spaces and clinic rooms	Hospital patients N= 826	Self-reported change in stress	Physical collection of abstract and representational imagery (including nature imagery). Includes an assortment of artistic media; and a variety of subject matter	Collection of over 5300 artworks	N/A
Krauss et al (2019)[16]	Switzerland	Randomised controlled trial	Group received only descriptive	Art museum	General public aged between 18 and 35 N= 75	Heart rate Heart rate variability	Physical abstract paintings of Flemish expressionism	6	Not specified

			information about the artwork (compared to elaborative information)			Skin conductance			
Kweon et al (2008)[22]	USA	Between groups experimental study	No artwork posters group	Laboratory (replicated office setting)	Psychology students N=210	Self-reported stress	Nature posters and abstract posters	4	Not specified
Law et al (2020)[25]	New Zealand	Between groups experimental pilot study	Scrambled artwork images	Laboratory	General public N=30	Salivary cortisol Salivary alpha-amylase	Digital slideshow of either landscape paintings or digitally scrambled versions of these paintings	26	30 minutes
Mastandrea et al (2019)[17]	Italy	Between groups experimental study	Museum office	Art museum	Undergraduate students N=77	Blood pressure Heart rate	Physical artworks in a gallery- including figurative artworks (e.g. landscapes and portraits) and modern artworks (e.g. abstract, impressionist and informal paintings)	Not specified- gallery exhibition	5 minutes
McCabe et al (2013)[9]	Ireland	Randomised prospective clinical trial	Room without the 'Open Window'	Hospital-patients' room	Stem cell transplantation patients N= 199 (164 included in the analysis)	Self-reported distress	Virtual window, with artwork projections. Artwork collections ranged from visually complex abstract images to images of nature.	Not specified- 9 art 'channels,' each with a collection of artworks	For the duration of their hospital stay- times not specified
Pearson et al (2019)[23]	USA	Pre- and post-test, between groups quasi-experimental study	Room without a window mural	Hospital-patients' room	Paediatric patients aged 2-18) N=90	Heart rate Systolic blood pressure	Window mural- either aquatic or forest themed	1	Minimum of 48 hours
Siri et al (2018)[18]	Italy	Within groups experimental study	None	Art museum	General public N=60	Heart rate Heart rate variability	2 real abstract contemporary paintings and their digitally produced replicates	4	144 seconds per artwork
Tschacher et al (2012)[19]	Switzerland	Within groups quasi-experimental study	None	Art museum	Museum visitors N=517 (373 included in the analysis)	Skin conductance Heart rate Heart rate variability	Physical modern and contemporary art exhibition	76	No specific timeframe given to participants. On average, they spent

									28 minutes at the gallery.
Wikström et al (1993)[20]	Sweden	Pre- and post-test randomised controlled trial	Group that were not shown artworks	Senior citizen apartment	Women aged over 70 N=40	Systolic blood pressure	Physical pictures- ranging from artworks of nature, flowers and people, abstract patterns, white figures on black backgrounds and photographs.	Not specified how many each participant viewed	Not specified



Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	
Limitations	20	Discuss the limitations of the scoping review process.	
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Ann Intern Med. ;169:467–473. doi: 10.7326/M18-0850

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Evidence for the effects of Viewing Visual Artworks on Stress Outcomes: A Scoping Review

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Abstract

Objective: To review the existing evidence on the effects of viewing visual artworks on stress outcomes and outline any gaps in the research.

Design: A scoping review was conducted based on the Joanna Briggs Institute methodology for scoping reviews and using the preferred reporting items for systematic reviews and meta-analyses extension for scoping reviews. Two independent reviewers performed the screening and data extraction.

Data Sources: Medline, Embase, APA PsycINFO, Cochrane CENTRAL, Scopus, Google Scholar, Google, ProQuest Theses and Dissertations Database, APA PsycExtra and Opengrey.eu were searched in May 2020.

Eligibility Criteria: Studies were included if they investigated the effects of viewing at least one visual artwork on at least one stress outcome measure. Studies involving active engagement with art, review papers or qualitative studies were excluded. There were no limits in terms of year of publication, contexts or population types; however, only studies published in the English language were considered.

Data Extraction and Synthesis: Information extracted from manuscripts included: study methodologies, population and setting characteristics, details of the artwork interventions and key findings.

Results: 14 primary studies were identified, with heterogeneous study designs, methodologies and artwork interventions. Many studies lacked important methodological details and only four studies were randomised controlled trials. 13 of the 14 studies on self-reported stress reported reductions after viewing artworks, and all of the four studies that examined systolic blood pressure reported reductions. Fewer studies examined heart rate, heart rate variability, cortisol, respiration or other physiological outcomes.

Conclusions: There is promising evidence for effects of viewing artwork on reducing stress. Moderating factors may include setting, individual characteristics, artwork content, and viewing instructions. More robust research, using more standardised methods and randomised controlled trial designs, is needed.

Registration Details: A protocol for this review is registered with the Open Science Framework (osf.io/gq5d8).

Strengths and Limitations of this Study

- A comprehensive scoping review was conducted using a broad and inclusive search strategy and a large variety of databases were searched.
- The reviewers independently followed a structured and pre-published protocol for searching, screening and extracting data which followed the Joanna Briggs Institute methodology for scoping reviews and PRISMA-ScR guidelines.
- Only studies published in the English language were included, possibly resulting in articles of other languages being missed.
- Slight deviations in the original protocol were performed in order to make the data screening more feasible.

INTRODUCTION

A number of studies and reviews have suggested that participation in the arts is beneficial for health[1-4]. Because of this, many healthcare and workplace settings offer art programmes, including art therapy, music and visual art displays, to reduce stress and improve wellbeing for staff, patients and customers[5]. However, there is little evidence that these programmes have the desired effects and there is a need for a high-quality evidence base for art-based interventions[1, 4].

Engagement with arts can be divided into active and passive participation. Active participation involves making, creating or teaching arts[2, 6]. This includes art therapy (where an art therapist directs the creation of artworks to achieve a particular goal and foster improved mental health and wellbeing), as well as other arts-based interventions that are not goal-driven and do not require a trained professional[7]. In contrast passive participation involves behaviours such as observing, viewing, listening and watching art[2, 6]. Passive viewing of artworks has the advantages of being an easy, low-cost and non-invasive intervention. This scoping review focussed on the effects of passively viewing visual artworks and therefore excluded research pertaining to the active participation in arts.

There is some evidence that viewing artworks as an intervention is beneficial; however, this evidence is not of uniformly high quality, is rarely critical, and is sparse, with many important theoretical and evidential gaps. As well as this, most of the evidence comes from anecdotes, descriptions and personal experiences, rather than empirical research[8, 9]. Although many settings have been used within this research, including healthcare, art museums and laboratories, there is a paucity of evidence to demonstrate whether these settings affect outcomes differently. Demographics may be important moderators as ethnicity, gender and age may influence preferences for certain types of artworks. However, rigorous research has yet to be conducted examining the influence of settings and populations.

Due to these limitations, it is important to review the existing evidence and identify any research gaps that need to be addressed. As the evidence base is small and heterogeneous, a systematic review could not be accurately completed and would be too restrictive, so instead a scoping review was conducted. The results can be used to direct future research to fill these gaps before a full systematic review can be completed.

There is no universally accepted definition of artworks as this construct has been inconsistent and debated. For the purpose of this review, artwork was defined as two-dimensional artistic works made primarily for their aesthetics, rather than any functional purpose. This definition was created from working definitions of visual and fine arts used in previous research[10, 11]. Based on this definition, this review included studies on paintings, drawings and prints and excluded studies on sculpture, films, interior design or architecture. Photographs were only included if they depicted artworks, as it was deemed too difficult to determine the difference between “artistic” photography and “non-artistic” photography based on the definition of artworks provided for this review. Digital artworks were included.

Viewing artworks is a form of visual environmental enrichment and is theorised to be stress-reducing through positive distraction[8, 12]. To explore this theory, the review focused on the effects of viewing visual artworks on stress outcomes. Both psychological and physiological stress outcomes were included.

Objective and Research Questions

The aim of this scoping review was to systematically identify the current evidence available on the effects of viewing visual artworks on stress outcome measures and identify research and knowledge gaps to aid future research. The following research question was formulated: what research has been conducted on the effects of viewing visual artworks on stress outcomes in any populations and settings?

Several secondary questions were developed to map the available evidence:

What populations and settings were studied?
What study methodologies were used?
What stress outcomes were measured?
What type and content of artworks were viewed?
What was the duration of the artwork viewing and how many artworks were viewed?
Did the studies show changes in the stress outcomes?

METHODS

A preliminary search for previous reviews on this topic was conducted on Google Scholar, JBI Evidence Synthesis and the Cochrane Database of Systematic Reviews prior to creating the protocol.

Protocol

A scoping review protocol was developed based on the Joanna Briggs Institute (JBI) methodology for scoping reviews[13] and using the preferred reporting items for systematic reviews and meta-analyses extension for scoping reviews (PRISMA-ScR). The objectives, eligibility criteria and methods were specified in advance and documented in the protocol registered at osf.io/gq5d8.

Eligibility Criteria

Studies had to meet the following inclusion criteria; be a primary study where participants passively viewed at least one visual artwork as an intervention, including viewing paintings, drawings, prints, digital artwork, or photographs of artworks, and measured at least one stress outcome measure (physiological or psychological indices). Measures of anxiety or mood were not considered as direct measures of stress and therefore fell out of the scope of this review. Unpublished research, including working papers, theses/dissertations and conference proceedings were included if they were identified by the search.

Studies were excluded if participants had active engagement in the arts (e.g. studies on art therapy or the production/creation of art), the study investigated the effects of interior design, architecture, sculpture, films or photography not depicting artworks, and review papers, including systematic reviews, scoping reviews and meta-analyses.

As per the scoping review objectives, there were no restrictions in terms of populations, contexts, dates of publication or study designs. However, during the screening phase, it was decided to exclude qualitative studies as these studies did not have clear stress outcomes, which was a key inclusion criterion. Only studies published in the English language were considered.

Search Strategy

To identify potentially relevant studies, the following electronic databases were systematically searched; Medline, Embase, APA PsycINFO, Cochrane CENTRAL, Scopus and Google Scholar (first 30 pages), with the help of a subject librarian. The search string combined a set of artwork and stress terms within each set with “OR” and between the two sets with “AND.” The search was first

conducted using an extended list of search terms from the registered protocol; however, this search strategy resulted in a large number of irrelevant articles. Therefore, in the final search, some of the more ambiguous search terms were removed to refine the search further. For example, the term 'drawing' was removed as this could refer both to artistic drawings and 'drawing' blood. The final search strategies for two example databases are presented in Table 1.

The grey literature was searched using the same search terms to identify any unpublished studies. Grey literature databases searched included; Google (limited to the first 20 pages), ProQuest theses and dissertations database, APA PsycExtra and Opengrey.eu.

A search was then conducted by hand of the reference lists of relevant identified articles. Lastly, the 'cited by' feature of Google Scholar was used to see if any of the relevant studies had been cited by undetected articles. All extracted references from these searches were imported to RefWorks and all duplicates removed. The final search was executed on 27 May 2020. The number of studies identified by the search strategy is shown in Figure 1.

Screening and Study Selection

Screening of the studies identified by the search strategy was conducted by two independent reviewers using a two-staged approach using the programme Covidence (www.covidence.org). Due to the high volume and large number of unrelated studies identified, one author initially screened the titles and removed any irrelevant studies, before the first stage. In the first stage of screening, two reviewers independently screened the abstracts for the eligibility criteria. If a study's eligibility was judged to be uncertain, the article was included in the second stage. In the second stage, two reviewers screened the full texts of the studies to determine final inclusion or exclusion based on the eligibility criteria. The two stages were conducted by the reviewers independently, with the results of each stage discussed. Any disagreements related to eligibility of an article were discussed and agreement was reached. The two reviewers had overall 86% agreement. The number of included and excluded studies at each stage of the screening procedure is shown in Figure 1, with reasons for exclusion.

Data Extraction and Analysis

Data was extracted from each included study into a charting form by the two reviewers independently. This charting form was developed in accordance with the review questions. It included; publication details (i.e. title, year, authors), methodology (i.e. aims, design, population characteristics, setting, outcomes, study registration, power analyses, comparator groups, randomisation and blinding), artwork details (i.e. type and content of artwork, duration of artwork viewing, number of artworks), and key findings related to scoping review questions.

The charting form was iteratively refined during the extraction process to ensure all useful information was extracted. The charting form was first independently pilot tested by the two reviewers on a random sample of four studies. The reviewers discussed this process and amended the charting form by adding a column about the artwork viewing directives given to the participants. Data extraction was then completed for the remaining studies independently by the two reviewers and any inconsistencies were discussed. This extracted data is reported in tabular and descriptive text format to answer the review questions.

Patient and Public Involvement

Patients and the public were not involved in any phase of this review.

RESULTS

As shown in Figure 1, the search strategy resulted in 3882 texts, which were screened for eligibility. After the initial title and abstract screening, the full text was retrieved for 53 articles and examined against the eligibility criteria. During this process, three theses were found to have matching published journal articles and therefore were excluded as duplicates. The remaining excluded articles did not meet the eligibility criteria. This screening narrowed the studies down to 14 articles for inclusion.

The design and key findings related to the stress outcomes of each study are briefly detailed in Table 2, with specific details regarding the secondary review questions provided in Table 3. All 14 articles were primary studies published as journal articles. Apart from the duplicate theses mentioned above, no grey literature met the eligibility criteria for inclusion. The studies' publication dates ranged from 1972 to 2020. Eight studies came from Europe[9, 14-20], four from the United States of America[10, 21-23] and one each from Australia[24] and New Zealand[25].

Summary of Study Methodologies

Designs. The 14 studies had very different designs and methodologies (see Table 3). Only nine studies used a between groups design[9, 10, 14, 16, 17, 20, 22, 23, 25]. Another four used a within groups design, where measures were compared pre- to post-viewing the artworks, with no comparator groups[15, 18, 19, 24]. The final study used a cross-sectional design, measuring stress-reduction at one time-point[21].

Of the nine between groups designs, six used a no artwork control group as a comparator[9, 10, 17, 20, 22, 23], and one used scrambled versions of the artworks[25]. Krauss et al.[16] gave different viewing directives to each group and de Jong[14] had groups with different art experience levels. Four of these between groups studies were considered randomised controlled trials (RCTs)[9, 10, 16, 20].

Settings. Six studies were conducted in an art gallery or museum[15, 16-19, 24], three in a laboratory[14, 22, 25], four in hospital rooms or hospital public spaces[9, 10, 21, 23], and one in senior citizens' apartments[20]. These settings represent a mix of both naturalistic settings with high ecological validity and laboratory settings with high experimental control.

Populations. The majority of studies investigated healthy participants in the form of students[14, 17, 22], office workers[15] or the general public[16, 18, 19, 25]. Other research used patient populations known to have high stress levels. Four studies investigated hospitalised patients[9, 21], with two being paediatric samples[10, 23]. Lastly, D'Cunha et al[24] investigated people living with dementia and Wikström et al[20], elderly women.

There is little research on whether population type affects stress reactions. Very few studies compared demographic factors, with the following exceptions. De Jong[14] found that having different art experience affected outcomes. Three studies found significant differences between the stress-reducing effects of viewing artwork between males and females[10, 15, 22]. Lastly, one study compared results across different health conditions, but found similar results between groups[21].

Outcomes. Nine studies explored only physiological stress measures[14, 16, 19, 20, 23-25], three explored only psychological stress measures[9, 21, 22] and the remaining two explored both[10, 15]. The psychological stress measures included; the Cox Mackay Stress Arousal checklist[26], a stress adjective checklist[27], Likert scales, and a distress thermometer[28]. The physiological measures were mainly cardiovascular, including blood pressure, heart rate and skin conductance, which were

measured in eight studies. Salivary biomarkers were measured in three studies[15, 24, 25] including cortisol, alpha-amylase and interlukin-6. Respiration was measured in two studies[10, 14].

Registration details. None of the studies were pre-registered.

Power. Sample sizes ranged from 27 to 826 participants; however, only two studies conducted a power analysis to determine their sample size. Krauss et al's[16] power analysis gave a required sample size of at least 68, and a final sample of 75 was recruited. The power analysis in McCabe et al[9] gave 200 participants and a sample of 199 were recruited; however, only 164 were included in the analyses. The other 12 studies did not provide a power analysis. Law et al[25] was a pilot study, and was not expected to conduct a power analysis to determine sample size. Therefore, it is difficult to determine if all studies were adequately powered.

Randomisation. All nine between-groups studies reported randomisation of participants to groups. However, the method of randomisation was not stated in many studies. Only four studies[9, 10, 16, 20] were RCTs.

Blinding. For most studies, it was difficult to blind the participants, because in most cases participants were explicitly asked to view particular artworks, and therefore both the researcher and participants were aware of which artworks they were viewing. However, two studies did successfully blind the study as both the researchers/nurses collecting the stress measures and the participants themselves were not explicitly made aware of the presence (or absence) of the artworks[23, 25].

Summary of the Artwork Interventions

Types of artworks. 10 studies used physical artworks. Most were original paintings, however one study used posters depicting artworks[22] and another used a window mural[23]. Another three studies used digital reproductions of artworks. Two used slideshows of digital images[14, 25], whereas the third used the Open Window, which digitally projected artworks[9]. The last study directly compared physical artworks with their digital reproductions[18]. This study did not find any differences between the types of artwork, indicating that digital reproductions may be just as stress-reducing as physical artworks.

Content of artworks. The content ranged from representational nature images, to complex abstract artworks. Five studies provided an assortment of artwork content in one exhibition[15, 17, 21, 24] and therefore it could not be determined whether content was influential. Two studies investigated the effects of abstract artwork but did not compare these to another artwork type[16, 18]. Another study[14] compared the physiological effects of artworks rated to be 'ugly' or 'beautiful.' Although the exact content of the artwork was not described, this study did find that participants had higher skin conductance and respiration rates while viewing the 'beautiful' paintings, compared to the 'ugly' paintings, demonstrating that the aesthetic content of the artwork may influence their effects.

Another four studies investigated the effects of viewing nature artworks. Two studies found that self-reported stress was lower when viewing nature artworks compared to abstract artworks[10, 22]. One study found that different aspects of nature might have stronger effects; a forest mural resulted in larger blood pressure decreases than an aquatic mural[23]. Nature content may also affect biological indicators of stress responses; cortisol levels decreased faster after a stressor in people viewing scrambled versions of nature artworks, compared to the original nature artworks[25].

The remaining two studies[9, 20] did not report on the content of the artwork and therefore, cannot be categorised.

Duration of artwork viewing. Nine studies reported the duration participants spent looking at the artwork (see Table 3). This ranged from two minutes to over 48 hours. No study investigated whether changing the duration of exposure to artworks affected stress outcomes.

Quantity of artworks. Most of the studies did not specify the exact number of artworks viewed. Of those studies that did specify a number, it ranged from one artwork to over 5300 in one exhibition. Half of the studies had participants view a collection of artworks as an exhibition or art programme. Only two studies showed each participant one artwork and both were in paediatric hospital rooms[10, 23]. The other experimental studies ranged from viewing four to 26 artworks in one sitting, with the exact numbers provided in Table 3.

Viewing directives. Five studies explicitly mentioned the viewing directives given to participants. The researchers from two experimental studies told participants to attentively look at and explore each artwork[14, 18], whereas the researcher in another study asked visitors to explore the art gallery in any way they pleased[15]. The remaining two studies asked participants to discuss and describe each artwork to the group during art programmes[20, 24]. One of these studies[24] had a trained art educator facilitating the discussions, whereas the other[20] had a lead researcher, with no specified training.

Summary of Key Findings

All but one of the studies that measured self-reported stress found a significant decrease after viewing artwork[10, 15, 21, 22], with the final study showing no significant changes[9]. A consistent decrease in systolic blood pressure was also found across the four studies measuring blood pressure[10, 17, 20, 23]. Skin conductance and skin conductance variability both increased while viewing artworks[14, 16, 19]. The results for heart rate were mostly consistent. Two of the three studies that measured heart rate found that viewing artworks decreased heart rate[19, 23]. The other study found that viewing beautiful paintings increased heart rate for students trained in fine arts and decreased heart rate for other participants[14].

The cortisol and respiration results were less consistent. An art gallery visit decreased salivary cortisol levels[15]; however, a six week art intervention for people living with dementia increased waking cortisol levels[24]. Lastly, after a stressor, salivary cortisol decreased faster in those viewing scrambled images, compared to those viewing landscapes[25]. Viewing beautiful paintings lead to an increase in respiration rates in a healthy sample[14]. Whereas nature artworks in a hospital room decreased respiration rates in children[10]. These studies all had different samples, settings and artworks which may have accounted for these mixed findings. Lastly both alpha-amylase[25] and interleukin- 6[24] were each only measured in one study and showed no significant changes.

DISCUSSION

This scoping review aimed to identify the available evidence on the effects of viewing visual artworks on stress outcomes and identify gaps in the research. The 14 included studies demonstrate that research in this area is growing, with 10 studies being published in the last 10 years. There are a number of limitations to research in this area, including a paucity of RCTs, and heterogeneous methodologies and interventions. This scoping review was able to comprehensively identify the relevant research and descriptively present some evidence to address the research questions outlined in the introduction and identify gaps for future research, as detailed below.

Overall, the preliminary findings from the included studies support the claim that viewing artworks can reduce stress, in particular self-reported stress and systolic blood pressure. These preliminary

quantitative results support qualitative research showing that viewing artworks provides positive distraction from a hospital environment and lowers self-reported stress[9, 12, 29]. The findings indicated that digital artworks can have similar stress-reducing effects to physical artworks, thus increasing the avenues available for viewers. Artwork interventions can therefore be transposed onto computers, TVs, phones and tablets, as a portable, cheap and easy intervention for stress-reduction.

Together the preliminary evidence suggest that the provision of artworks could reduce stress. However, mixed findings combined with a lack of homologous methodologies mean that more rigorous research is needed. Future research needs to employ stronger methods including: adequate comparator groups, power analyses to ensure sufficient sample sizes, clearly defined randomisation procedures and pre-registration. If we examine the results from just the four RCTs, the evidence is even less conclusive. More detail on these studies and their findings are provided in Table 2; however, only one of the four RCTs showed significant effects for their main hypotheses. Wikström et al[20] found a significant decrease in systolic blood pressure after an art intervention. In contrast, McCabe et al[9] found no significant effects on distress measures, and Eisen et al[10] only found significant effects when subgroup analyses of age were conducted. Lastly, Krauss et al[16] did find significant decreases in physiological stress when viewing artworks compared to baseline; however, they found no significant differences between the viewing directives provided, which was their main hypothesis. Therefore, more RCTs still need to be conducted on this topic for clearer conclusions to be made.

The differences between the studies suggest important moderating factors, one of which is setting. The museum context may add to the effects of viewing artwork, as museum related factors may lead to greater appreciation of artwork[30]. In addition, viewing artwork in a museum usually involves walking, which has its own stress-reducing effects[31]. Laboratory studies remove some of these contextual factors and may provide more specific evidence for the effects of viewing artworks, but they have lower ecological validity. The hospital room is an important setting as patients are often confined to their room for long time-periods and rooms are often deprived of environmental enrichment. Artwork could act as visual stimulation to positively distract patients from their stress, pain and medical conditions, and therefore it is suggested that artwork is placed in hospital rooms and waiting rooms. Artwork could also have stress-reducing benefits in other settings such as waiting rooms and workplaces, which are often related to high stress. More research in these settings should be conducted.

Other possible moderating factors include individual characteristics, although little research has investigated these. Gender differences were found in two of the included studies, with a trend towards females experiencing greater stress-reduction in response to nature artworks[10, 22]. One small survey found that African Americans and Caucasians have similar preferences for nature artworks[32]; however, no study has investigated whether culture affects the stress-reducing effects of artworks. Given the diversity in cultures, demographics and individual preferences for artwork, it may be over simplistic to suggest that all individuals experience artwork the same way[33].

The findings indicate that the content and aesthetic qualities of artwork are also important considerations. Although mixed, the studies generally indicated that nature, especially greenery, may be the most stress-reducing. This is consistent with research demonstrating that nature artwork is most preferred by adults[34] and children[10]. There are two main theories as to why viewing nature is beneficial for humans. The evolutionary theory proposes that because humans evolved in a natural environment, nature is processed more efficiently and we are predisposed to experience restoration[35]. On the other hand, the attention restoration theory posits that nature can

counteract the mental fatigue caused by stress and therefore reduce cognitive strain[36]. Thus, these two theories point to nature artwork as having the greatest stress reducing effects, as demonstrated in this review. In contrast, abstract artworks can be seen as challenging, ambiguous and unclear for viewers, leading to increased stress[30, 37]. This is supported by the emotional congruence theory which posits that stressed people are likely to project their negative experiences and emotions onto ambiguous environmental surroundings, including artworks[5]. Other artwork content could be provocative and emotionally inappropriate for certain situations, eliciting anger and dislike. For example, a study by Ho and colleagues[33] found that certain provocative artworks elicited feelings of loneliness and hopelessness in viewers, suggesting artwork must be chosen carefully, with particular emphasis on the provision of nature artworks.

The mixed findings suggest that under some conditions, viewing artwork may be physiologically relaxing, whereas under other conditions viewing artwork may be physiologically stimulating. The direction of these effects may not only depend upon the content of the artwork, but also the context and viewers' stress levels. Regardless of the direction of effects on physiology, lower self-reported stress may result.

Although this review focussed on the stress-reducing effects of viewing artwork, it may also be important to investigate the stimulating aspects of artwork. For certain populations, such as people living with dementia, visual stimulation and enrichment through artworks could improve other aspects of health, such as cognitive function[24]. As discussed above, visual stimulation and enrichment may also be important to provide positive distraction from negative experiences. Three studies showed an increase in physiological stress[14, 24, 25]. This increased stimulation may be related to the content of the artworks ('beautiful' vs 'ugly' paintings[14], or landscapes vs scrambled images[25]) or the types of populations involved (people living with dementia[24] and art students[14]). Therefore, the provision of stimulating artworks may be appropriate for certain situations, including for people living with dementia.

Choice may be another important variable. This is especially pertinent in settings where people have little control. Art Carts have been used in hospitals to allow patients to choose which artworks to view during their stay to give them a sense of control over their environment[29]. Two studies in this review[9, 20] gave participants a choice of artwork, however research is yet to investigate whether the element of choice affects stress outcomes.

Directives given to viewers may influence the way participants view artworks and therefore moderate the artworks' stress-reducing effects. Wikström[38] previously discussed the importance of creating an art-dialogue when viewing and discussing artworks in order to improve engagement, understanding and empowerment. Other research[33] demonstrated that the descriptions given to viewers about artwork could be influential, and therefore this may be an important element for studies to include. However, few studies reported the directives given. It is important for future research to report what directives were provided and investigate whether this is influential.

Finally, it is difficult to determine the dose-response relationship of artwork viewing. There was little consistency in the number of artworks shown to each participant, and no study investigated whether the quantity of artworks or viewing durations mattered. Therefore, future research could investigate the best artwork viewing duration and number of works.

Limitations

This review is limited by only including articles published in the English language. Articles in other languages could have been missed. The review deviated slightly from the original protocol. Due to

the large number of irrelevant articles identified using the original search strategy, the search terms were narrowed and the original title screening was only conducted by one reviewer. These deviations were required to make the search and screening more feasible. This review did not include anxiety or mood measures or studies using qualitative methodology, as these outcomes were considered outside the scope of the review.

Conclusions

This scoping review summarised the relevant research that investigated viewing visual artworks on stress outcomes. 14 studies met the eligibility criteria, with extracted results showing consistent reductions in self-reported stress and systolic blood pressure, but mixed effects on other physiological outcomes. However, there were only four RCTs, and there was high heterogeneity in research methodologies. Setting, individual characteristics, artwork content, and viewing instructions may be important moderating factors. More robust research is recommended that uses standardised interventions, validated assessment methods, and RCT designs, to investigate the effects of viewing visual art on stress outcomes.

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Figure 1. PRISMA-ScR flow diagram of the study selection process

Table 1

Example search strategy syntax for databases

Database	Search Strategy Syntax
Scopus	(TITLE-ABS-KEY (artwork OR "art work" OR "visual art" OR "art museum" OR painting OR mural OR "works of art" OR "viewing art" OR "viewing artwork" OR "artwork viewing" OR "art gallery" OR "art galleries") AND TITLE-ABS-KEY (stress OR "blood pressure" OR anxiety OR "heart rate" OR mood OR norepinephrine OR epinephrine OR "stress hormones" OR stressor OR glucocorticoids OR cortisol OR alpha-amylase OR "stress reduction")) AND (LIMIT TO (LANGUAGE , "English"))
ProQuest Dissertations and Thesis	ab(artwork OR “art work” OR “visual art” OR “art museum” OR painting OR mural OR “works of art” OR museum OR “viewing art” OR “artistic work” OR “viewing artwork” OR “artwork viewing” OR “art gallery” OR “art galleries”) AND ab(stress OR “blood pressure” OR anxiety OR respiration OR “heart rate” OR mood OR norepinephrine OR epinephrine OR “stress hormones” OR “mental health” OR stressor OR glucocorticoids OR cortisol OR alpha-amylase OR “immune marker” OR “stress reduction”)

Table 2

Summaries of the studies' designs and key stress outcome findings

Study	Study Design and Methods	Key Findings
Clow & Fredhoi (2006)[15]	Studied self-reported stress and arousal, and salivary cortisol levels in a group of London city workers during a lunchtime visit to an art gallery. Measurements were taken before and after the 35-40-minute gallery visit to explore pre-post intervention changes.	Self-reported stress and salivary cortisol levels both decreased over the intervention. There were no differences in arousal levels.
D'Cunha et al (2019)[24]	Evaluated the psychophysiological effects of attending the National Art Gallery of Australia Art and Dementia programme. People living with dementia attended the group-based, six-week programme which involved viewing and discussing artworks, led by an art director. Measures of salivary cortisol and interleukin-6 were taken at baseline, at the end of the programme and 12 weeks later.	Waking salivary cortisol levels increased from baseline to post-intervention, but decreased at follow-up. No changes in evening cortisol or interleukin-6 were observed. The ratio of waking to evening cortisol increased from baseline to post-intervention indicating a more dynamic diurnal cortisol rhythm.
de Jong (1972)[14]	Three groups of participants (advanced art history students, advanced fine art students and laboratory workers as controls) viewed projections of 12 paintings considered to be 'beautiful' and 12 paintings considered to be 'ugly' in a random order while their heart rate, respiration rate and skin conductance was measured continuously.	The fine arts and art history students showed a greater change in skin conductance than the laboratory workers. Respiration and skin conductance were higher during the 'beautiful' paintings than the 'ugly' paintings in all groups. The fine arts students had faster heart rate during the 'beautiful' paintings compared to the 'ugly' paintings, however, for the other two groups, this result was reversed.
Eisen et al (2008)[10]	The third phase this study investigated which type of art was most effective in reducing stress in paediatric patients. On arrival to the hospital, patients were randomly allocated to one of three rooms; a room with a nature artwork, a room with an abstract artwork or a room with no artwork. Self-reported stress, blood pressure and respiratory rate were taken at baseline and after two hours of exposure to the artworks.	Overall, there were no significant differences between the groups on stress, blood pressure or respiration. However, sub-analyses showed that significantly more males than females in the 8-10 age group were positively affected by the nature artwork, as demonstrated by decreased self-reported stress, blood pressure and respiratory rates.
Karnik et al (2014)[21]	Installed a diverse collection of artworks in the public spaces and clinic rooms of a hospital. Patients were retrospectively contacted with a survey which included evaluating whether the art installations changed their self-reported stress levels.	61% of the patients that reported seeing the artworks stated that the artworks somewhat or significantly reduced their stress levels.

Krauss et al (2019)[16]	Participants viewed six Flemish expressionism artworks in an art museum, while heart rate and skin conductance were continuously measured. Participants were randomly assigned to either receive descriptive information about the artworks (described the artwork in a declarative way) or elaborative information about the artworks (described the context and deeper meaning behind the artworks).	There were no significant differences in heart rate, heart rate variability or skin conductance between the two groups. However, in both groups heart rate was lower, and skin conductance and heart rate variability higher when viewing the artworks, compared to baseline.
Kweon et al (2008)[22]	Conducted an experiment investigating the effects of artwork posters on stress and anger levels in an office setting. Students were asked to complete a series of stress and anger provoking computer tasks in one of four different mock office conditions; an office with nature posters, abstract posters, both nature and abstract posters or no posters. Levels of self-reported stress were measured across the experiment.	Males had the highest stress levels in the office with no posters, and the lowest stress levels in the office with mixed art posters. On the other hand, females had the highest stress in the office with all abstract posters and the lowest levels in the office with all nature posters. However, these results were only significant for males and not females.
Law et al (2020)[25]	Conducted a pilot study to investigate whether nature artworks could improve recovery from a laboratory stressor. Participants were randomised to either view a 30-minute digital slideshow of landscape artworks or digitally scrambled versions of these artworks after being exposed to a laboratory stressor. Saliva samples were taken at baseline, after the stressor, during the art viewing and after the art viewing to measure cortisol and alpha-amylase.	Salivary cortisol levels decreased more rapidly while viewing the scrambled images compared to the landscape artworks. There were no changes in alpha-amylase across the experiment or between groups.
Mastandrea et al (2019)[17]	Students visited an art museum and were randomly assigned to visit one of three art exhibitions for five minutes; a figurative art exhibition, a modern art exhibition or a museum office as a control condition. Blood pressure and heart rate were measured before and after the visit.	Systolic blood pressure decreased in all groups; however, this decrease was only significant in the figurative art group. Heart rate also decreased in all three groups, however, there was no significant differences between groups.
McCabe et al (2013)[9]	Evaluated the effects of the Open Window art intervention on stem-cell transplantation patients. The Open Window is a virtual window which is installed in a hospital room, where the patients can switch through nine art channels with different artworks. Patients were randomised to either a room with the Open Window or not. Self-reported distress was measured at admission, the day before transplant, seven days after transplant, prior to discharge, and 60 days, 100 days and six months post-transplant.	Results demonstrated no significant differences in levels of distress between the two groups at any of the time-points.
Pearson et al (2019)[23]	Examined the impact of nature-themed window murals on physiological measures in paediatric patients. Paediatric patients were assigned to hospital rooms with either a fish-themed window mural, a tree-themed	Those patients with the window murals had significant improvements in heart rate and systolic blood pressure, with the tree-themed mural having the greatest effect.

	window mural or no window mural. Patients' blood pressure and heart rate were taken retrospectively from the patients' medical records.	
Siri et al (2018)[18]	Examined the effects of viewing original physical artworks and their digital reproductions within a museum context. Cardiovascular variables were measured via ECG continuously in healthy volunteers while viewing two real abstract paintings and their digital reproductions.	Results showed that there was a significant difference in heart rate between viewing the two real paintings, but no difference was found between the digital reproductions, or between the real and digital reproductions. No differences in heart rate variability were found.
Tschacher et al (2012)[19]	Monitored the physiology of visitors to an art museum using an electronic sensor glove which recorded physiological data and locomotion activity while they viewed the artworks. Afterwards, they were asked to rate the aesthetic qualities of some of the artworks.	Heart rate variability increased while viewing artworks that were deemed beautiful, high quality and surprising/humorous. Skin conductance variability increased, and heart rate decreased while viewing more dominant artworks (artworks experienced as dominant and stimulating by the viewers).
Wikström et al (1993)[20]	Investigated whether visual stimulation could improve the health of elderly women living alone. The women were randomised to either an intervention or control group. The intervention group were shown a selection of pictures, including artworks, and asked to discuss them, whereas the control group discussed current events. Blood pressure was measured at baseline, immediately after the intervention and four months later.	The intervention group had significantly lower systolic blood pressure than the control group after the intervention and at follow-up

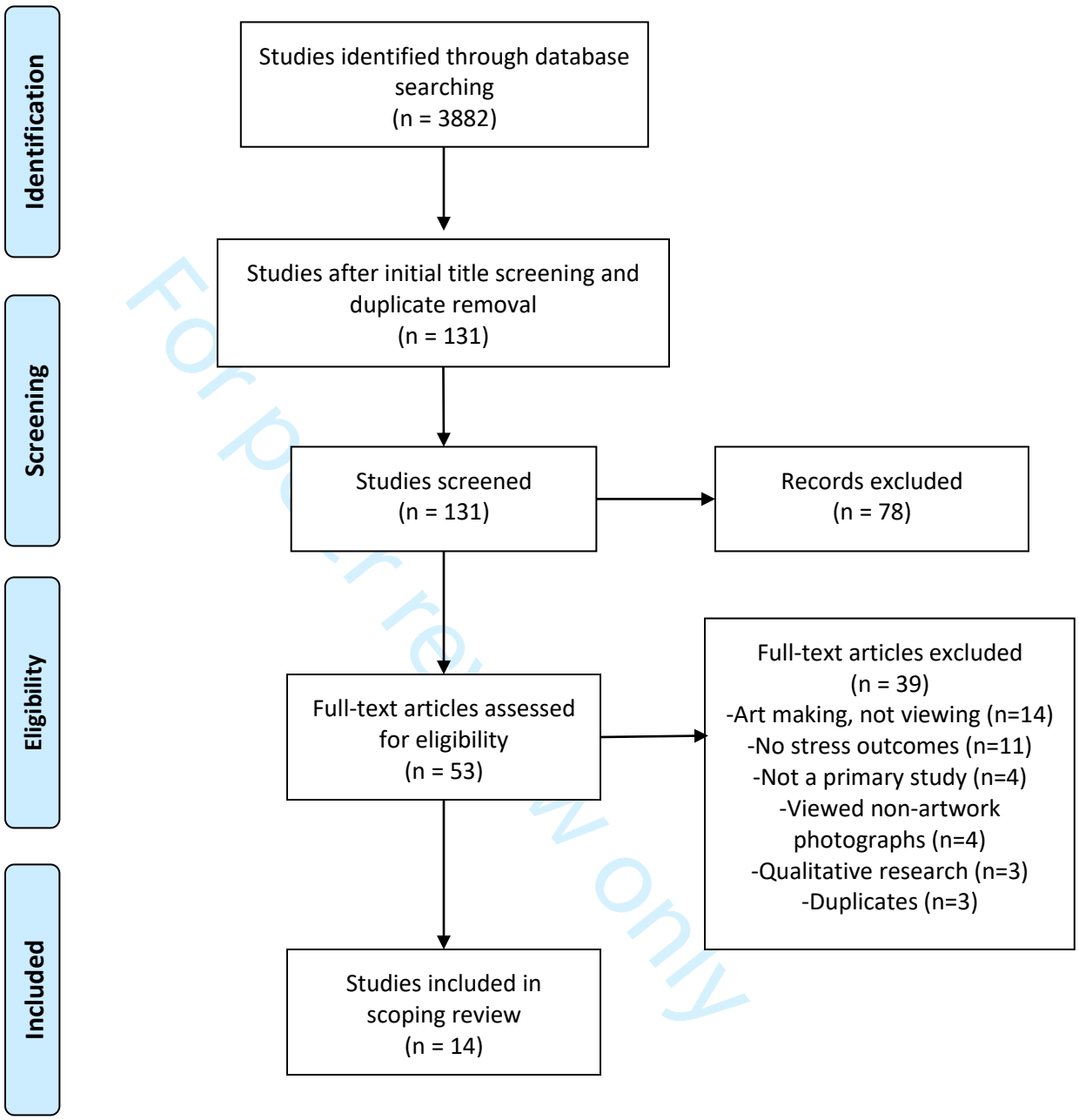
Table 3

Overview of studies included in the review

Study	Country	Study Design	Comparator Group	Setting	Population (N)	Stress Outcome Measures	Type and Content of Artwork	Quantity of Artworks Viewed by Each Participant	Duration of Artwork Viewing
Clow & Fredhoi (2006)[15]	United Kingdom	Pre- and post-test, within groups quasi-experimental study	None	Art gallery	Office workers N=28 (25 included in the analysis) Power analysis not performed	Self-reported stress Self-reported arousal Salivary cortisol	Physical artworks in a gallery- exact content not specified	Not specified- gallery exhibition	35-40 minutes in the gallery
D'Cunha et al (2019)[24]	Australia	Pre- and post-test, within groups quasi-experimental study	None	Art gallery	People living with dementia N=28 (22 included in the analysis) Power analysis not performed	Salivary cortisol interleukin-6	Physical artworks in a gallery- exact content not specified	3-4 artworks each session, over 5-6 sessions	5-6x 90-minute sessions. Each artwork was viewed for 20 minutes
de Jong (1972)[14]	Netherlands	Between groups experimental study	Laboratory workers (non-art students) Not randomised Not blinded	Laboratory	Advanced art history students, advanced fine arts students and laboratory workers N= 27 Power analysis not performed	Heart rate Skin conductance Respiration rate	Digital projections of 12 paintings considered 'beautiful' and 12 paintings considered 'ugly'	24	Each painting was viewed for 10 seconds
Eisen et al (2008)[10]	USA	Pre- and post-test, randomised controlled trial	Room with no artwork Randomised Not blinded	Hospital-patients' room	Paediatric patients (aged 5-17) N=78 Power analysis not performed	Self-reported stress Heart rate Blood pressure Respiratory rate	One group had a representational nature artwork hung on the wall, whereas the other group had an abstract artwork hung on the wall	1	2 hours
Karnik et al (2014)[21]	USA	Cross-sectional survey	None	Hospital-public spaces and clinic rooms	Hospital patients N= 826 Power analysis not performed	Self-reported change in stress	Physical collection of abstract and representational imagery (including nature imagery). Includes an assortment of artistic media; and a variety of subject matter	Collection of over 5300 artworks	N/A

Krauss et al (2019)[16]	Switzerland	Randomised controlled trial	Group received only descriptive information about the artwork (compared to elaborative information) Randomised Not blinded	Art museum	General public aged between 18 and 35 N= 75 Power analysis performed	Heart rate Heart rate variability Skin conductance	Physical abstract paintings of Flemish expressionism	6	Not specified
Kweon et al (2008)[22]	USA	Between groups experimental study	No artwork posters group Randomised Not blinded	Laboratory (replicated office setting)	Psychology students N=210 Power analysis not performed	Self-reported stress	Nature posters and abstract posters	4	Not specified
Law et al (2020)[25]	New Zealand	Between groups experimental pilot study	Scrambled artwork images Randomised Blinded	Laboratory	General public N=30 Power analysis not performed	Salivary cortisol Salivary alpha-amylase	Digital slideshow of either landscape paintings or digitally scrambled versions of these paintings	26	30 minutes
Mastandrea et al (2019)[17]	Italy	Between groups experimental study	Museum office Randomised Not blinded	Art museum	Undergraduate students N=77 Power analysis not performed	Blood pressure Heart rate	Physical artworks in a gallery- including figurative artworks (e.g. landscapes and portraits) and modern artworks (e.g. abstract, impressionist and informal paintings)	Not specified- gallery exhibition	5 minutes
McCabe et al (2013)[9]	Ireland	Randomised prospective clinical trial	Room without the 'Open Window' Randomised Not blinded	Hospital-patients' room	Stem cell transplantation patients N= 199 (164 included in the analysis) Power analysis performed	Self-reported distress	Virtual window, with artwork projections. Artwork collections ranged from visually complex abstract images to images of nature.	Not specified- 9 art 'channels,' each with a collection of artworks	For the duration of their hospital stay- times not specified
Pearson et al (2019)[23]	USA	Pre- and post-test, between groups quasi-experimental study	Room without a window mural Randomised Blinded	Hospital-patients' room	Paediatric patients aged 2-18) N=90 Power analysis not performed	Heart rate Systolic blood pressure	Window mural- either aquatic or forest themed	1	Minimum of 48 hours
Siri et al (2018)[18]	Italy	Within groups experimental study	None	Art museum	General public N=60	Heart rate	2 real abstract contemporary paintings	4	144 seconds per artwork

					Power analysis not performed	Heart rate variability	and their digitally produced replicates		
Tschacher et al (2012)[19]	Switzerland	Within groups quasi-experimental study	None	Art museum	Museum visitors N=517 (373 included in the analysis) Power analysis not performed	Skin conductance Heart rate Heart rate variability	Physical modern and contemporary art exhibition	76	No specific timeframe given to participants. On average, they spent 28 minutes at the gallery.
Wikström et al (1993)[20]	Sweden	Pre- and post-test randomised controlled trial	Group that were not shown artworks Randomised Not blinded	Senior citizen apartment	Women aged over 70 N=40 Power analysis not performed	Systolic blood pressure	Physical pictures- ranging from artworks of nature, flowers and people, abstract patterns, white figures on black backgrounds and photographs.	Not specified how many each participant viewed	Not specified



Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	
Limitations	20	Discuss the limitations of the scoping review process.	
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

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