Review Article

The Effectiveness of Distraction as Procedural Pain Management Technique in Pediatric Oncology Patients: A Meta-analysis and Systematic Review

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Abstract

Context. Diagnostic tests and treatment regimens for pediatric cancers involve invasive and painful procedures. Effective management of such pain has been shown to be suboptimal in many parts of the world, often because of the cost and limited availability of appropriate medications. Current evidence suggests that distraction (a relatively low-cost technique) is a promising intervention for procedural pain management. There is, however, limited evidence demonstrating its effectiveness in pediatric oncology patients.

Objectives. A systematic review was conducted to ascertain the effectiveness of distraction as a procedural pain management technique in pediatric oncology patients.

Methods. Using a comprehensive search strategy, MEDLINE, PsycINFO, Cochrane Library, AMED, CINAHL, Web of Science, and EMBASE electronic databases were searched for studies comparing distraction techniques to standard care/any intervention. Using the selected studies, a systematic review and meta-analysis of randomized controlled trials was conducted.

Results. Two hundred ninety-nine studies were identified, with seven randomized control trials identified as eligible for inclusion. Pain was assessed using self-report, observer-report, and physiological measures. A meta-analysis of four studies showed distraction as effective in reducing procedural pain, based on self-reported pain. A meta-analysis of three studies, based on pulse rates, demonstrated similar results. For observer-reported pain, limited evidence supported the effectiveness of distraction.

Conclusion. This systematic review demonstrates that distraction is a promising intervention for procedural pain. Future research should assess effectiveness of distraction in varied populations, to explore evidence of cultural influences on pain expression, measurement, and management approaches. J Pain Symptom Manage 2017;54:589–600.

Key Words

Distraction, procedural pain, children, cancer, pediatric oncology

Introduction

Pain is a prevalent symptom among pediatric oncology patients (POPs).[1,2] Pain may be disease-related and/or due to invasive medical procedures such as lumbar punctures, venepuncture, intramuscular injections, port access, finger pricks, bone marrow aspiration, and biopsy. Although cancer-related pain is distressing, POPs report that invasive procedures are the most feared and most prevalent source of pain.[3–6] Unfortunately, numerous invasive procedures will be required for the diagnosis and treatment of the disease. Additional pain and distress may result from the side effects from chemotherapy and other treatments.[2,7,8] Studies have shown that

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persistent and unrelieved procedural pain can be detrimental to the physical, psychological, and social well-being of POPs.[9–12] Moreover, pain relief is closely associated with patient satisfaction and is considered a fundamental human right.[13] Hence, it is imperative that procedural pain is effectively managed to reduce anxiety and promote the well-being of POPs.

Procedural pain is often managed with pharmacologic and nonpharmacologic interventions or both (as integrative medicine); in some settings, no therapy is administered.[14–16] Depending on the procedure, pharmacological interventions such as opioids, non-steroidal anti-inflammatory drugs (NSAIDs), sedatives, local and general anesthesia can be used.[17] Research studies have demonstrated the effectiveness of these drugs.[14,18-20] However, in many developing countries, these drugs are not readily unavailable, mainly due to cost.[15] Therefore, nurses and parents have to restrain a child during a painful procedure.[21] This can cause physical harm to the child. Even in areas where medications are available, it has been shown that pharmacologic interventions do not improve the overall pain experience of children as they still complain of pain and remain distressed.[22,23,17] Thus, research studies and clinical guidelines have recommended the use of nonpharmacologic interventions, which can be cheaper and more accessible.[24–27]

There are different types of nonpharmacologic interventions.[28] A Cochrane review classified them into psychological (e.g., distraction and guided imagery) and nonpsychological (e.g., acupuncture).[29] It claimed that psychological interventions are the most commonly used interventions for procedural pain relief. Nevertheless, in pediatrics, the efficacies of some interventions (e.g., suggestion) remain elusive, whereas others (e.g., distraction and hypnosis) are being established as efficacious interventions.[17,28,29] In pediatric oncology, two systematic reviews concluded that hypnosis might be an effective intervention for procedural pain relief; nevertheless, the quality of the included papers limited the validity of their results.[30,31] Whereas, for distraction, no systematic reviews evaluating its effectiveness for procedural pain relief in POPs was found. Although primary studies have been conducted, their results are inconsistent.[32–34] Moreover, the small sample sizes of these studies limits the generalization of their results. Hence, there is no strong evidence demonstrating the effect of distraction on procedural pain in POPs. Despite the lack of strong evidence, distraction is commonly used in some hospitals around the world.[35,36] In an era of evidenced-based practice, health interventions ought to be grounded on empirical evidence. Therefore, this systematic review aimed to conduct a meta-analysis of these primary studies to generate the pooled treatment effect of distraction on procedural-related pain in children and adolescents with cancer.

Methods

Design

A systematic review was conducted using the guidelines from Cochrane[37] and Joana Briggs Institute.[38] When possible, a meta-analysis was carried out.

Search Strategy

Published articles, dissertations, and grey literature were sought via strategies developed using the appropriate MeSH terms of various databases. Keywords such as "pediatric oncology," "cancer," and "distraction" were used. The search strategies were screened by the two reviewers. A sample of the search strategies is in Appendix. No date, language, or country limitations were applied to searches. Eight databases were searched: Cochrane library (1992–2016), Cumulative Index to Nursing and Allied Health Literature (CINAHL) (1982–2016), Embase (1974–2016), Medline (1946–2016), Allied and complementary Medicine (1985–2016), Web of Science (1900–2016), PsycINFO (1806–2016), and ProQuest Dissertation and Theses (2001–2016). ClinicalTrials.gov and International Clinical Trials Registry Platform Web sites were searched for the possible identification of ongoing trials. The references of relevant literatures and their citation indexes on Google Scholar were probed to identify citations of relevant studies. Key researchers within the field were contacted to identify unpublished studies. This was done to avoid publication bias.

Data Extraction

Data extraction was carried out independently done by two reviewers. The JBI data extraction form for experimental/observational studies were modified and used to extract data from the selected studies. To minimize errors, electronic copies of all studies were obtained, and data were copied and pasted directly into an electronic data extraction form.

General Characteristics. General characteristics, such as author names, dates, study venue, study aim, participant demographics, type of cancer, painful procedure, previous experiences, the interventions used (whether chosen by the child or predetermined), research design, and sampling approach, were recorded for each study.

Pain Assessment/Outcome Measures. In research, there are three ways of measuring pain in children: they are self-report, behavioral, and physiological measures.[39] It is usually recommended that two or more of these measures are used in research, and this is to account for each of their limitations.[40] Therefore, the outcome measures for the systematic review were categorized into self-reports, observer-reported pain,

and physiological measures. The following data were extracted from the included studies: the pain assessment tool used, the assessor (child, a parent, health professional or the researcher), the physiological indicator measured, the point of assessment (before, during, and after the procedure), the means, SDs, and *P*-values.

Dealing With Missing Data. In all cases, where important information on the study and/or data (e.g., means and SDs) was missing from the published articles, the authors were contacted through the e-mail addresses provided on the published articles. However, none of the authors responded to the e-mails. Where possible, the mean was calculated from the median and ranges using a validated and commonly used formula.[41–44]

$$\text{The formula is } x = \frac{a + 2m + b}{4},$$

where x = mean, m = median, a and b, low and high end of the range, respectively.

Nevertheless, when this was impossible, the study was included in the qualitative analysis.

Critical Appraisal

The Cochrane Collaboration's tool for assessing risk of bias was used to critically appraise the individual studies that were included in this review. This tool is two-part tool which is used to assess the quality of a study under six specific domains, namely sequence generation, allocation concealment, blinding of participants, personnel and outcome assessors, incomplete outcome data, selective outcome reporting, and "other sources of bias." The quality of the cumulative evidence was assessed using Grading of Recommendation Assessment, Development and Evaluation (GRADE).

Data Analyses

A meta-analysis was conducted using STATA statistical software 11.2 (StataCorp. LP, College Station, TX). The standard mean difference (SMD), rather than the weighted mean difference, was calculated because the included studies used different scales to measure pain. The pooled effect of distraction, the 95% confidence intervals, and the statistical significance (which was defined as $P < 0.05$) were calculated for the three categories of outcome measures. A random-effects model was used in the meta-analyses to account for the heterogeneity across the studies. In this review, the statistical heterogeneity was calculated using *I*-square (I^2) and chi-square. Chi-square tends to have low power in a meta-analysis when the studies are few or have small sample sizes; hence, the *P*-value was set at 0.10.[37] I^2 is expressed in percentages. In cases, where the heterogeneity was significant; a qualitative analysis was presented instead of the meta-analysis results. Presenting the meta-analysis results for these studies can be misleading. This is because the cause of heterogeneity across the included studies could not be investigated using meta-regression and subgroup analysis. This is because of the small number of studies that was included in this review.[37] In studies where there was more than one control group, the group that did not receive any distraction is considered as the control group.

Selection of Studies

All identified studies were imported into Endnote X6. Duplicates of identified articles were identified and removed. Titles and abstracts of the identified studies were screened, and ineligible studies were removed. Full texts of the selected articles were obtained and examined against the inclusion and exclusion criteria. Studies that failed to report on the medians/means and SDs were excluded from the meta-analysis; instead, they were qualitatively analyzed. Inclusion and exclusion criteria are stated subsequent in sections.

Inclusion Criteria. Any study having the following characteristics was included:

1. Research design: randomized controlled trials (RCT), a quasi-experimental study, or a quasi-randomized study.
2. Intervention: Any type of distraction interventions (e.g., blowing bubbles and toys) administered during any painful procedure.
3. Participants: 0–19 years old with any type of cancer at any stage of the disease.
4. Control group: Participants may not receive any intervention or may receive the standard care for procedural pain relief as determined by the health facility. The standard care must be administered to both the control and intervention groups.

Exclusion Criteria. Any study having the following characteristics was excluded:

1. Research design: case study, retrospective studies, qualitative studies, cohort, and cross-sectional studies.
2. Participants: If any participant does not have a cancer diagnosis or is >19 years.
3. Intervention: Any study investigating distraction in conjunction with other interventions (such as hypnosis) but fails to present the single effect of distraction on procedural pain.

4. Procedures: Noninvasive procedures, painful procedures performed during or after surgical procedures, and surgeries.

Results

Search Results

The search yielded 299 studies. No ongoing trial was identified; 106 duplicates were identified and removed. The titles and/or abstracts of the remaining 193 studies were reviewed. In relation to the inclusion criteria, 153 studies were clearly irrelevant. For instance, a study was comparing the effectiveness of two or more pain medications[45]; others were systematic reviews.[28,29,46] The full texts of the remaining 40 studies were retrieved, and then they were scrutinized against the inclusion and exclusion criteria. Any uncertainty regarding any of the studies was discussed between the two reviewers. There was 100% agreement; 33 of the remaining studies were excluded due to various reasons (see Fig. 1). The remaining seven RCT met the eligibility criteria; hence, they were included in this systematic review. The process of selecting these studies is illustrated in Figure 1 using the PRISMA flow diagram.[47]

Overall, the number of study participants is 312, ranging from age two to 19 years. In four of the included studies, no intervention was given to the control group for pain relief.[33,34,48,49] Whereas, in three studies,[32,50,51] Eutectic Mixture of Local Anesthetics (EMLA) was given to both the control and intervention group as the standard care for procedural pain relief in those health facilities. The painful procedures recorded in these studies are needle procedures, with port access and lumbar puncture being the most common. Only five studies gave a vivid report on the types of cancers. It appears majority had leukaemia, but the stages of their diagnoses were not stated. Only four studies[33,48,50,51] stated the ethnicities

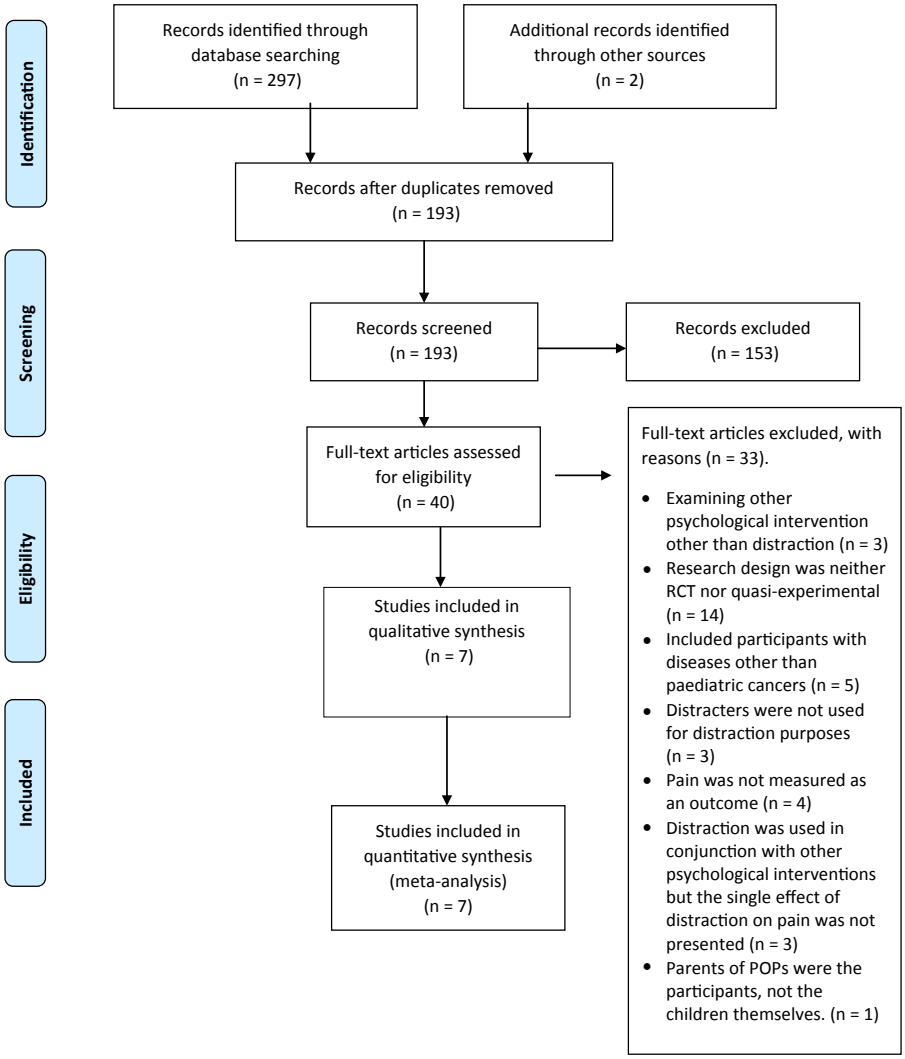

Fig. 1. Flow diagram of the process of selecting included studies.

Table 1
Studies Included in the Systematic Review

Author(s) (Year)	Procedure	Setting	Intervention			Findings		
			Who Chose the Distractor?	Intervention (Number of Participants)	Control (Number of Participants)	Self-reported Pain	Observer-Reported Pain	Physiological Measures
Gershon et al. (2004)	Port access	Outpatient pediatric oncology unit at southwest metropolitan area, United States	Predetermined distractor	EMLA + virtual reality game (22)	Standard care (EMLA) (22)	AP: NS	AP: Nurses' ratings: NS (*P*-value < 0.05). Parents' ratings: NS.	Pulse rate: BP: NS DP: SD (*P*-value = 0.04) AP: NS Respiratory rate BP: NS DP: SD (*P*-value = 0.009) AP: SD (*P*-value = 0.003)
Heden et al. (2009)	Needle procedures	Pediatric Oncology Unit, Uppsala, Sweden.	Predetermined distractor	EMLA + blowing soap bubbles (14)	Standard care (EMLA) (14)		Nurses' and parents' ratings: NS	
Nguyen et al. (2008)	Lumbar puncture. Participants had had at least one lumbar puncture previously.	Oncology Ward at Hanoi, Taiwan	Predetermined distractor; however, children/adolescents were allowed to choose the music they listened to.	Music (20)	Standard care (no analgesia) (20)	DP: SD AP: SD		Pulse rate: BP: NS DP: SD (*P*-value = 0.012) AP: NS
Pourmovahed et al. (2013)	Intrathecal injection. Participants had had no previous intrathecal procedures	Referral hospital at Iran	Predetermined distractor	Standard care + Hey-Hu breathing technique (50)	Standard care (50)	AP: SD (*P*-value = 0.01)		
Sander-wint et al. (2002)	Lumbar puncture	Pediatric teaching hospital in the southwest of United States	Predetermined distractor	EMLA + virtual reality video (17)	Standard care (EMLA cream weight-based conscious sedation using fentanyl and midazolam) (13)	NS (*P* = 0.77)		
Windich-Biermeier et al. (2007)	Port access/ venepunctures. Most had had at least six or more needle procedures in the past. Only 10% had less than five needle procedures	Children's hospital in a major metropolitan city (exact location was not specified)	Children were allowed to choose from a range of options	Standard care + games Interactive books Music table Virtual reality games (22)	Standard care (28)	NS (*P* = 0.68)		

(*Continued*)

Table 1
Continued

Author(s) (Year)	Procedure	Setting	Intervention		Control (Number of Participants)	Findings		
			Who Chose the Distractor?	Intervention (Number of Participants)		Self-reported Pain	Observer-Reported Pain	Physiological Measures
Wolitzky et al. (2005)	Port access. Participants have experienced 0–10 number of port access procedures. Mean: 7.55	Children's hospital in a major metropolitan city (exact location was not specified)	Predetermined distractor	Virtual reality exploratory game (10)	No intervention (10)		Researcher's rating: SD, $P < 0.01$ Nurses' and parents' ratings were not reported	Pulse rates: BP: NS DP: SD (Pvalue < 0.05) AP: NS

NS = nonsignificant; SD = significant difference; DP = during procedure; AP = after procedure; EMLA = Eutectic Mixture of Local Anesthetics.

of their participants; of which, majority were Caucasians. Other information on the included studies are illustrated in Table 1.

Assessment of Risk of Bias

The major sources of bias identified in these studies were blinding of participants, personnel, and outcome assessors. For blinding of participants and personnel, all studies were rated as having a high risk of bias. This is usually expected in studies investigating the impact of distraction because participants are actively involved in using distraction interventions; hence, blinding may be unachievable. Similarly, six of the studies were rated as having a high risk of bias because the outcome assessment was not blinded. This is because the studies aimed to assess the impact of distraction on pain during the procedure and, hence, the outcome assessors needed to be present during the procedures. Moreover, in some of the studies, the participants assessed their own pain. Only one study[34] blinded the personnel and outcome assessors, this was creatively achieved by giving earphones to both the intervention (music) and control groups. The inability to achieve blinding of participants and outcome assessors poses a high risk of performance and detection biases. However, these biases are limited to the two subjectively measured outcomes in these studies, and they are self-reported pain and observer-reported pain. Other unclear sources of bias were random-sequence generation and allocation sequence concealment. For random-sequence generation, three studies[33,48,50] did not report on their method of randomization; hence, they were rated as unclear. For allocation concealment, six studies were rated unclear because they did not provide any information on it. One study[34] was rated as low risk of bias.

Self-reported Pain. Five RCTs[34,48–51] measured the pain levels of the participants using self-report measures. However, four different scales were used across the studies; they are the Visual Analogue Scale (VAS), Numerical Rating Scale, Wong Baker Faces Scale, and the Color Analogue Scale. Three studies used VAS. Of the five studies, only three studies reported the means and SDs of the pain scores. One study[50] reported the median of the pain scores; hence, an estimate of the mean pain scores was calculated from the median, range, and sample size using the formula illustrated under the "Methods" section. One study[51] was excluded from the meta-analysis because the authors failed to report on the means and SDs of the pain scores. However, in relation to the intervention effect, they reported that there were no significant differences between the intervention group and the control group on self-reported pain. The meta-analysis of four RCTs[34,48–50] (summing up a total

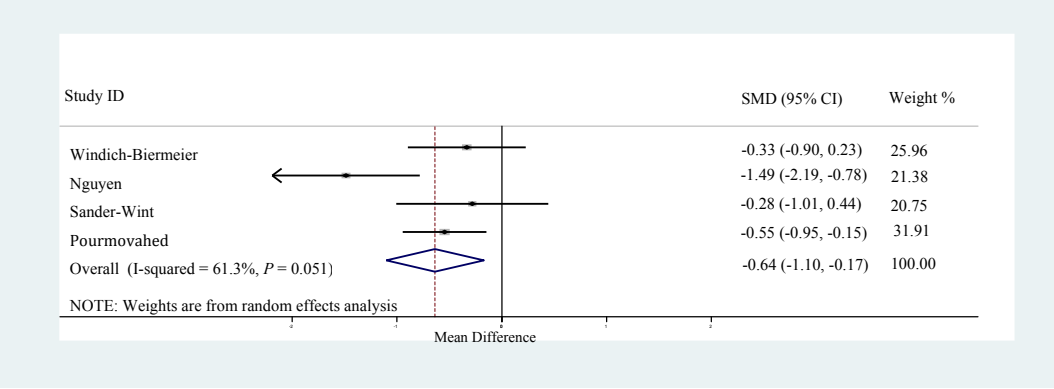

Fig. 2. Forest plot of randomized controlled trials examining distraction for self-reported pain. Study ID is the primary author's last name.

of 220 participants) revealed a significant effect ($z = 4.30$, $P = 0.007$) of distraction on self-reported pain, with an SMD of −0.64 (95% CI [−1.10 to −0.17], $I^2 = 61.3\%$). The forest plot is presented in Figure 2.

Observer-Reported Pain. Three trials[32,33,51] assessed the effect of distraction using behavioral measures rated by an observer. All the three RCTs used VAS; in addition to it, one study[33] used Children's Hospital of Eastern Ontario Pain Scale (CHEOPS). All the ratings were done at the end of the procedure. One study[51] did not report the SDs and means that are necessary for a meta-analysis to be conducted; hence, it was excluded from the meta-analysis. Another study provided the scores for the pain assessment using CHEOPS but failed to report the scores based on VAS. Hence, a meta-analysis was conducted using the scores of CHEOPS and VAS from two studies.[32,33] There was substantial heterogeneity across the studies ($I^2 = 79.1\%$). The cause of heterogeneity could not be investigated because of the small number of studies. However, the heterogeneity may have arisen from the different pain assessment scales used in both studies.[37] Because of the substantial heterogeneity, the meta-analysis was not presented; rather, a qualitative analysis is presented in this article. One study[51] indicated that, according to the nurses' ratings, the effect of distraction on observer-reported pain was significant ($P < 0.05$). Whereas, according to the parents' ratings, there were no significant differences between the intervention and control groups. Two other studies[32,33] demonstrated that the effect of distraction on pain was not significant for both nurses and parents' ratings, whereas the researcher's ratings showed that distraction significantly reduced procedural pain in one study.[33]

Physiological Measures. Only three trials[33,34,51] measured the effect of distraction on procedural pain using the physiological measures. There are numerous physiological measures of pain and distress; nevertheless, all the studies measured pulse rates. Only one study[34] reported on other indicators. Two RCTs[33,51] measured the pulse rates with a pulse oximeter, whereas the other trial[34] took the ratings manually. The pulse rate readings were done by the researchers. A meta-analysis was conducted using the pulse rates, which were taken during the procedures in all the three trials. The meta-analyses that included a total of 104 participants demonstrate that participants who received intervention had a mean pulse significantly lower than those in the control group ($z = 4.24$, $P < 0.001$, SMD = −0.87, 95% CI = −1.28 to −0.47, $I^2 = 0.0\%$). Averagely, the pulse rate reduced by 8.9 bpm. Hence, distraction had a significant effect on the pulse ratings of the participants. The forest plot is presented in Figure 3.

For other physiological measures of pain, one study[34] measured systolic and diastolic blood pressures, respiratory rates, and oxygen saturation (SpO_2). For the blood pressures and SpO_2, there was no significant difference between the intervention and control groups; however, distraction had a significant effect on respiratory rates during and after the procedures.

Discussion

The aim of this review was to ascertain the effectiveness of distraction in reducing pain during painful procedures in POPs. For self-reported pain, the meta-analysis of the four studies depict that distraction had a significant effect on procedural pain ($P = 0.007$). Notwithstanding, these results must be interpreted with caution because of the considerable heterogeneity across the studies ($I^2 = 61.3\%$, $P = 0.051$). In the Cochrane handbook, it was suggested that the reason for heterogeneity should be assessed; nevertheless, because of the small number of

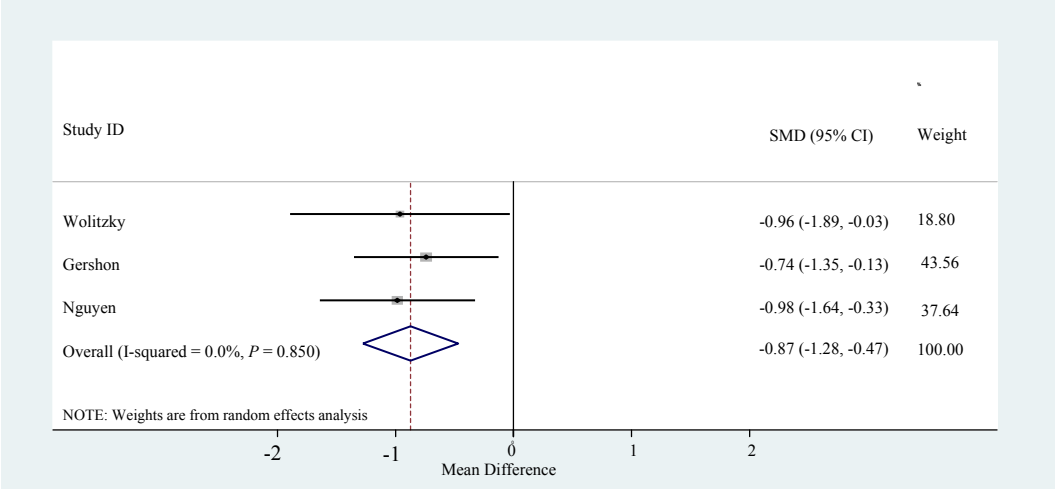

Fig. 3. Forest plot of randomized controlled trials examining distraction for pulse ratings of three studies. Study ID is the primary author's last name.

studies (<10), this was impossible.[37] The heterogeneity may be because of the different pain assessment scales used in the included studies. A random-effect model was used to the meta-analysis, hence taking into consideration the difference in the pain assessment scales. Similarly, a Cochrane review demonstrated the effectiveness of distraction in reducing pain intensity in children in a meta-analysis; nevertheless, the heterogeneity across studies was considerably significant ($I^2 = 88\%$).[29] Based on self-reported pain, other systematic reviews have also revealed that distraction is effective for pediatric procedural pain relief.[28,46,52] Because of the subjective nature of pain, the findings from the self-reported pain are very relevant. They provide the child's perspective on their pain experience and effectiveness of distraction. Also, these findings may indicate that children prefer the use of distractors during painful procedures. This is only an implication; hence, further studies can explore children's satisfaction using distraction techniques, and in comparison, with other nonpharmacologic therapies.

The findings from behavioral measures on the effect of distraction were inconsistent. In a study, it was explained that nurses tend to focus on the needle insertion, hence paying little attention to the observable changes in the child's behavior.[32] Although parents may be more sensitive to subtle changes in the child's behavior, their ratings may be influenced by their subjective feelings about the procedure and, hence, the inconsistency in the results. In congruence to the results of this SR, a systematic review exploring the efficacy of distraction on procedural pain in the general pediatric population revealed that there was weak evidence to support the use of distraction based on behavioral measures, whereas self-report measures provided strong evidence to support its use.[28] In contrast, earlier reviews supported the effectiveness of distraction based on behavioral measures, whereas self-report measures yielded weak evidence.[52,53] In earlier reviews, it was evident that majority of the included studies used behavioral measures.[52,53] This is in contrast to the findings in this SR and other relatively recent reviews, where majority of the included studies used self-report measures.[28,29] This difference in results over time can be attributed to the increased use of self-report measures in recent years.[28] Therefore, it appears that there is decline in the use of behavioral measures and an increase in the use of self-report measures over time. This is probably because behavioral measures are often biased by the observer's individual characteristics (e.g., his/her past experiences with pain and observational skills), hence, leading to misinterpretation of the child's pain.[54]

Pulse rate was the commonest physiological indicator measured in this review; this same finding exists in other reviews on distraction.[28,29] The meta-analysis revealed that distraction had a significant effect on pulse rates ($P < 0.001$). Additionally, no statistical heterogeneity was found among the studies ($I^2 = 0.0\%$). An I^2 of 0% should not be interpreted as homogeneity without appropriate consideration of the clinical and methodologic variability across the studies.[37] Interestingly, it appears these studies are considerably homogenous methodologically and clinically (see Table 1). It is evident that distraction has a significant effect on pulse rates during painful procedures. A review had similar results with a meta-analysis of two studies.[29] Despite this significant finding, a major limitation of physiological indicators is that it is difficult to attribute a change in pulse rates to a particular stimulus. This is because changes in pulse rates can be attributed to

numerous stimuli (such as fever, exertion, pain, and distress).[55] Nevertheless, all the three studies took pulse rates before the procedure; hence, it can be assumed that any change in pulse rates is because of the painful procedure. Interestingly, across all the studies, there was an increase in pulse rates in both the intervention and control group during the procedure. However, distraction caused a smaller increase in the intervention group compared with those in the control group. Hence, based on pulse rates, it seems distraction is effective in reducing procedural pain in POPs.

Factors That Influences the Effectiveness of Distraction

There are factors that have been hypothesized to influence the effectiveness of distraction. For instance, age, whether the distracter is interactive or passive, whether the distractor was under the control of the child, and whether the patient chose that particular distractor.[17,56] Most studies included in this review did not explore the influence of these factors. Only one study evaluated the effect of age and gender on the effectiveness of distraction.[49] It reveals that there was no significant difference between boys and girls in the intervention and control group; nevertheless, it seemed the distraction (Hey-Hu breathing technique) was more effective for children >10 years. A systematic review report that distraction techniques are more effective in children aged six to 11 years old.[28] Also, one study[48] allowed children to self-select their distractors, whereas another study[34] permitted participants to choose the kind of music they wanted to listen to. Apart from these studies, no other study explored the influence of any other factor on distraction. Therefore, the effects of these factors on the effectiveness of distraction could not be assessed in this review. In contrast, an SR containing 26 studies explored the effect of these factors on distraction.[28] Although no difference was found among distractors, it was discovered that interventions without adult participation or passive distraction was marginally more effective than those with adult control or interactive distraction. Nevertheless, it was a subanalysis; hence, it is only suggestive that these factors may have an influence on distraction.[37] Therefore, there is need for more research studies assessing the effects of the aforementioned factors on distraction in POPs.[28,29]

Another factor worth considering is culture. Although it has not been established that culture influences the effectiveness of distraction, there is evidence showing that it influences pain expression and interpretation by caregivers.[57,58] The included studies are representative of only four countries, with majority being Caucasian. Hence, their cultural factors can influence the self-report and observers' ratings of pain. Therefore, it is inconclusive if distraction will be effective in some countries, such as Ghana and Nigeria, where it is believed that a male's ability to endure pain without crying is a sign of strength. Therefore, there is need for more research studies on the effectiveness of distraction on procedural pain in POPs in other countries/cultures, particularly those with cultural misconceptions about pain.[28,29]

Risk of Bias Across the Studies

The quality of the overall evidence was assessed using the GRADE system. Overall, the evidence was judged to be of moderate quality. It was downgraded from the high-quality rating by one level because of the high risk of performance and detection bias present in majority of the studies. In judging the outcomes individually across the studies, the results on pulse rates were rated as being of high quality because the potential biases (i.e., detection and performance) is unlikely to lower confidence in the estimate of the effect. For self-reported pain and observer-reported pain, the evidence is of a moderate quality. This is because of the high risk of performance and detection bias across the studies. These potential biases are likely to lower the confidence in the estimate of effect.

Strengths and Limitations of the Review

This systematic review has a number of strengths that distinguishes it. It appears this is the first systematic review evaluating the effectiveness of distraction in POPs. Other strengths of this review include an extensive search for eligible studies and the use of the meta-analytic approach in analyzing the data. Despite these strengths, this review has its limitations. First, only seven studies including 300 participants was included in this review. Because of the small number of studies, further statistical investigations (such as meta-regression and subgroup analyses) could not be performed. Second, the included studies had small sample sizes ranging from 28 to 100 participants who are representative of only four countries. Hence, caution should be taken when generalizing of these findings to other populations. Additionally, this review did not identify any study evaluating the effectiveness of distraction in POPs less than two years. Hence, it may not be advisable generalize the results of this review to this age group. Third, in relation to the meta-analysis, a number of assumptions were made. Although a validated and widely used formula was used to calculate the mean estimate for one study,[50] the mean estimate may have slight differences from the actual mean. Also, in using the random-effects model to address heterogeneity, the results are estimates of average treatment effects and variability is expected based on the specific intervention. Therefore, in cases where heterogeneity across studies influences

the results, the random-effects model does not take this into account.[37] Furthermore, although the meta-analytic approaches increase the validity of the findings of this review, the results should be used with caution because of the heterogeneity noted in one of the meta-analyses.

Conclusion and Recommendations

Based on the findings of this systematic review, it appears distraction is a promising intervention for the management of procedural pain in POPs, although available evidence is limited. Hence, it is recommended that more studies should be conducted, particularly in areas such as sub-Saharan Africa where it is rarely used. Furthermore, future research should compare the effectiveness of different distractors (e.g., active vs. passive) and also explore the influence of factors such as child's preference and age on the effectiveness of distraction. Also, the effect of distraction on cancer pain should also be evaluated. In this SR, no study evaluating the effectiveness of distraction in children with cancer younger than two years was identified; hence, future research should explore the effect of distraction on this age group. Furthermore, distractors can serve as vehicles for micro-organisms; hence, researchers should explore cost-effective ways of minimizing the risk of transferring infections via distractors. This is important because of the increased risk of infection associated with cancer treatments.[59] Also, researchers should endeavour to improve the qualities of studies through the concealment of allocation and reporting of all important information, such as the method of randomization and the means and SDs of all outcomes measures regardless of their significance. These recommendations will be helpful in improving our knowledge on distraction.

For clinical implications, clinicians and families should be aware of the promising effect of distraction and consider administering it during painful procedures. Notwithstanding, practitioners must carefully consider their local contexts, such as the organizational culture (e.g., institutions where it is normal for children to undergo painful procedures without any pain relief) and staff levels before implementation. For instance, in low-resource settings, where there are very poor nurse-patient ratios, ease of use, and the time-efficiency of administering a distractor during a procedure may hinder implementation.[53]

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Appendix

A Sample of the Search Strategy

Medline

1. (needle* or inject*).mp.
2. (lumbar puncture* or spinal tap*).mp.
3. (bone marrow adj (aspiration or biops*)).mp.
4. (intravenous or intra-venous or ven?puncture* or venous cannulation*).mp.
5. ((catheter adj5 insert*) or remov* or port-a-cath* or portacath*).mp.
6. (local adj (analges* or an?esthe*)).mp.
7. (arterial adj (puncture or line*)).mp.
8. (artery adj5 puncture).mp.
9. finger prick*.mp.
10. (central venous catheter* adj6 insert*).mp.
11. (blood sampl* or inject* or sutur*).mp.
12. (central line adj6 (insert* or remov*)).mp.
13. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12
14. Pain/
15. pain*.mp.
16. exp pain/
17. distress.mp.
18. ((needle* or inject* or procedure* or intervention*) adj5 (pain* or distress* or discomfort or fear* or fright* or anxious or anxiet*)).mp.
19. ((cannul* adj6 pain*) or (needle* adj6 pain*) or (needle* adj6 distress*) or (needle* adj6 discomfort) or (needle* adj6 fear*) or (needle* adj6 fright*) or (needle* adj6 anxious) or (needle* adj6 anxiet*) or (procedure* adj6 pain*) or (intervention* adj6 pain*) or (intervention* adj6 distress*) or (procedure adj6 distress*) or (procedure* adj6 discomfort*) or (procedurerelated adj6 pain)).mp.
20. 14 or 15 or 16 or 17 or 18 or 19
21. ((cognitive* or behaviour* or behavior*) adj5 (intervention* or therap* or distract*)).mp.
22. "Play and Playthings"/
23. Breathing Exercises/
24. virtual reality.mp.
25. exp Laughter/or exp Humor/or cartoon*.mp.
26. exp Distraction/or distract*.mp. [mp = title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
27. blowing bubbles.mp. [mp = title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
28. exp Guided Imagery/or guided imagery.mp.
29. exp Psychotherapy/
30. Cognitive Therapy/or cognitive-behavio?ral intervention*.mp.
31. (((audiovisual or audio visual or visual*) and distract*) or movie* or television* or tv or game* or toy* or virtual reality or tactile stimulat*).mp. [mp = title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
32. ((play or colo?r* or music* or art) and (therap* or distract*)).mp.
33. 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32
34. (leuk?emia* or (childhood adj ALL) or acute lymphocytic leukemia).mp.
35. (AML or lymphom* or hodgkin* or T-cell or B-cell or non-hodgkin*).mp.
36. (sarcom* or Ewing* or osteosarcom* or wilms tumo?r or wilms*).mp.
37. (nephroblastom* or neuroblastom* or rhabdomyosarcom* or hepatoblastom* or medulloblastom* or retinoblastom* or meningiom* or gliom* or hepatoblastom* or hepatoblastom* or nephroblastom* or meningiom* or PNET*).mp. [mp = title, abstract, heading word, table of contents, key concepts, original title, tests & measures]
38. (adolescen* adj5 (cancer* or tumo?r* or malignanc* or neoplasm*)).mp.
39. ((childhood adj cancer*) or (childhood adj tumo?r*) or (childhood adj malignanc*) or (childhood adj neoplasm*)).mp.
40. glioma/or leukemia/or sarcoma/
41. (central nervous system tumo?r* or central nervous system neoplasm* or intracranial neoplasm*).mp.
42. ((brain adj tumo?r*) or (brain adj neoplasm*) or (brain adj cancer*)).mp.
43. ((p?ediatric adj malignanc*) or p?ediatric oncology).mp.
44. 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43
45. 13 and 20 and 33 and 44