

How Good is Your Intervention?

Rosemary C. Polomano, PhD, RN, FAAN
Professor of Pain Practice

University of Pennsylvania School of Nursing
Professor of Anesthesiology and Critical Care (Secondary)
University of Pennsylvania Perelman School of Medicine
Claire M. Fagin Hall 418 Curie Blvd
Philadelphia, PA 19104
E-mail: polomanr@nursing.upenn.edu

How Are You Going to Change After this Presentation?

- Hopefully whenever someone tells you that an intervention is evidence-based, you are going to ASK:
 - For WHO? (Population or People)
 - For WHAT 1? (Condition/Illness/Disease/Symptom, Events.....)
 - For WHAT 2? (Outcome)
 - For WHEN? (Timing)
 - For WHERE? (Setting, Circumstance)
 - For HOW? (Nature, Delivery of the Intervention)

What is “Evidence-Based Practice”?



Evidence-Based Practice

“Integration of best research evidence with clinical expertise and client values”

Stressed and Steeped in Tradition



How Do We know How Good an Intervention Is?

- **Strength of the Evidence**
- Effect Size (ES)
- Numbers Needed to Treat (NNT)
- Numbers Needed to Harm (NNH)

Statistically pools results from previous studies into single quantitative analysis

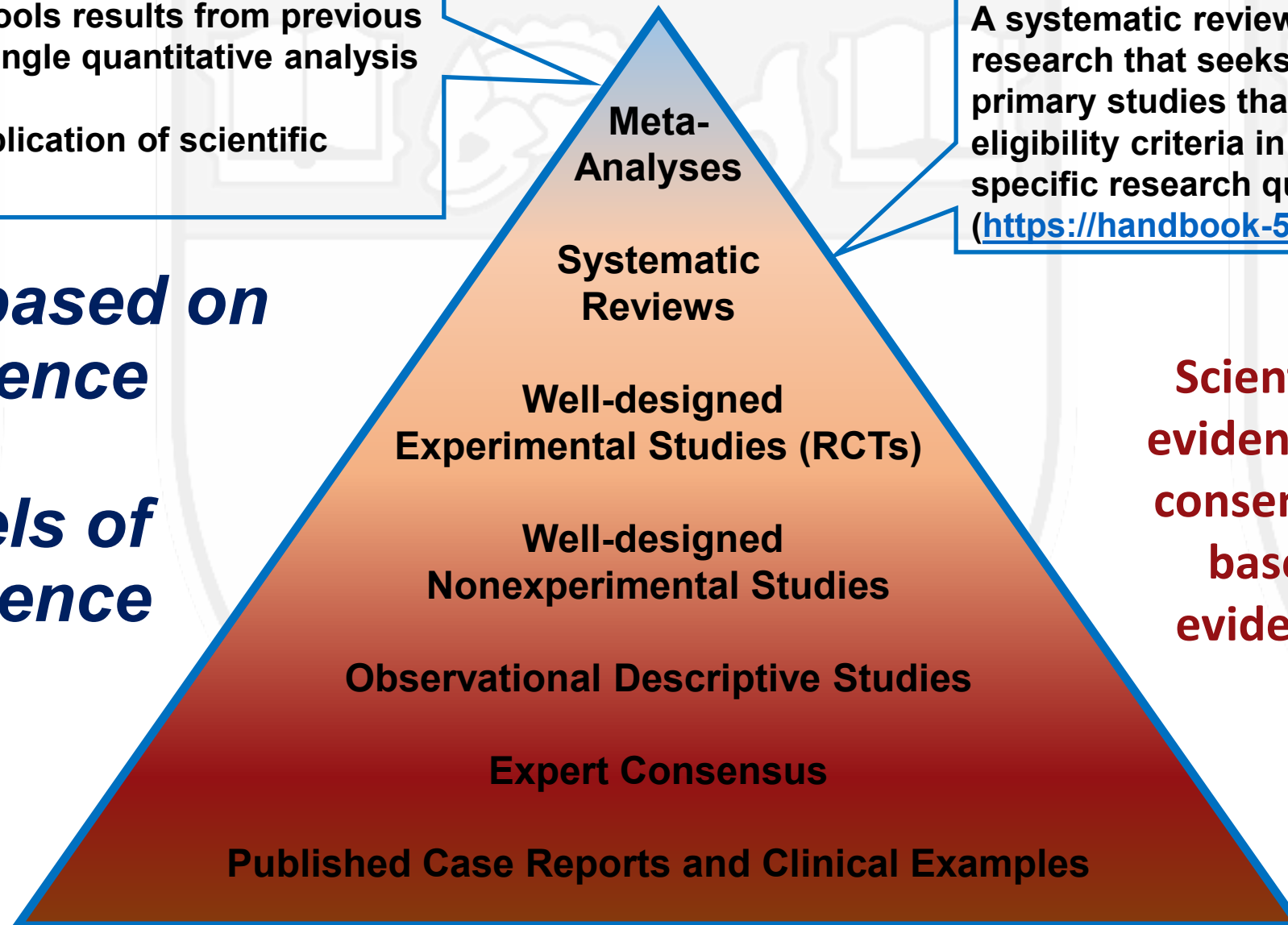
Allows for application of scientific criteria

A systematic review is secondary research that seeks to collate all primary studies that fit prespecified eligibility criteria in order to address a specific research question

(<https://handbook-5-1.cochrane.org/>)

EBP is based on evidence

Levels of Evidence



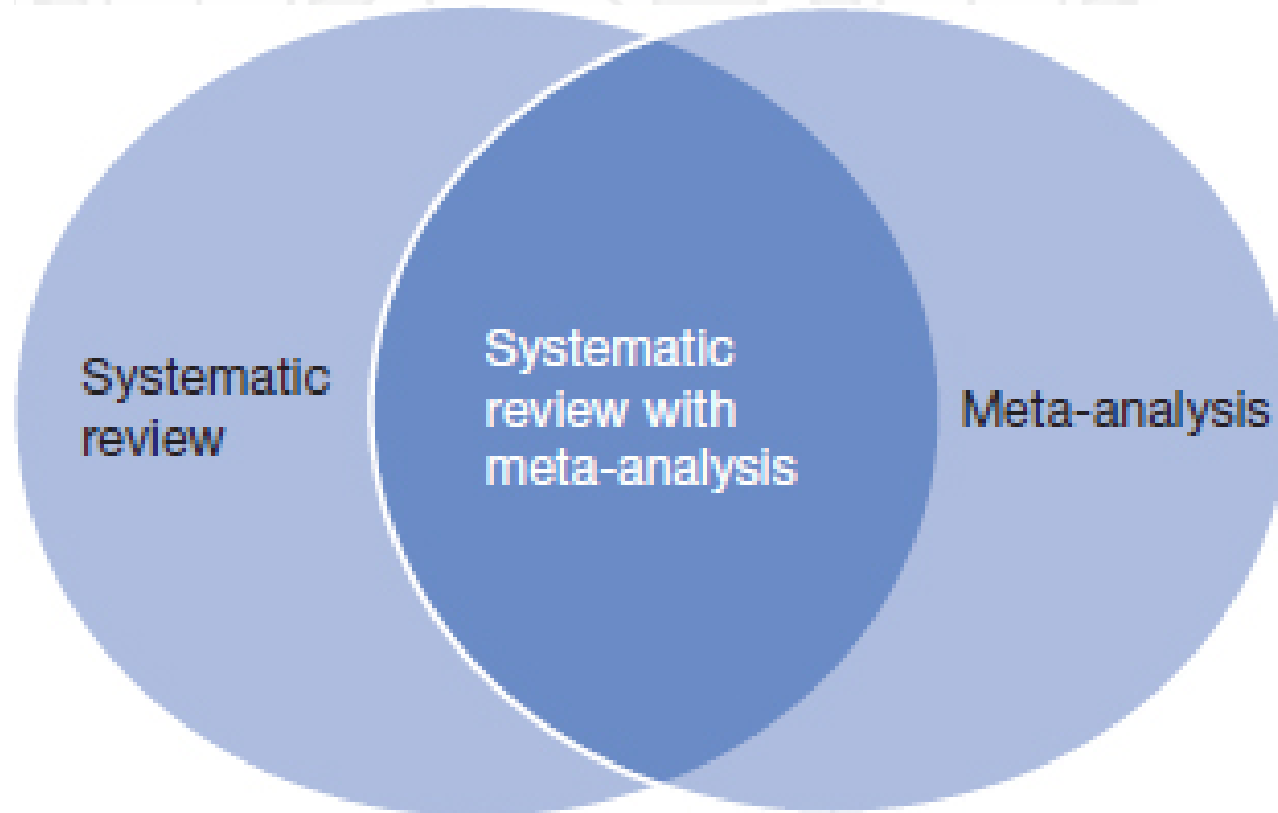
**Scientific
evidence or
consensus-
based
evidence**



The Strongest Level of Synthesis: A Meta-Analysis

- An exhaustive review of the literature
- An integration of results to:
 - Examine research studies and pool data for statistical analyses
 - Formulate statistical conclusions about contradictory research-based information
 - Answer important questions about practice
 - Generalize conclusions

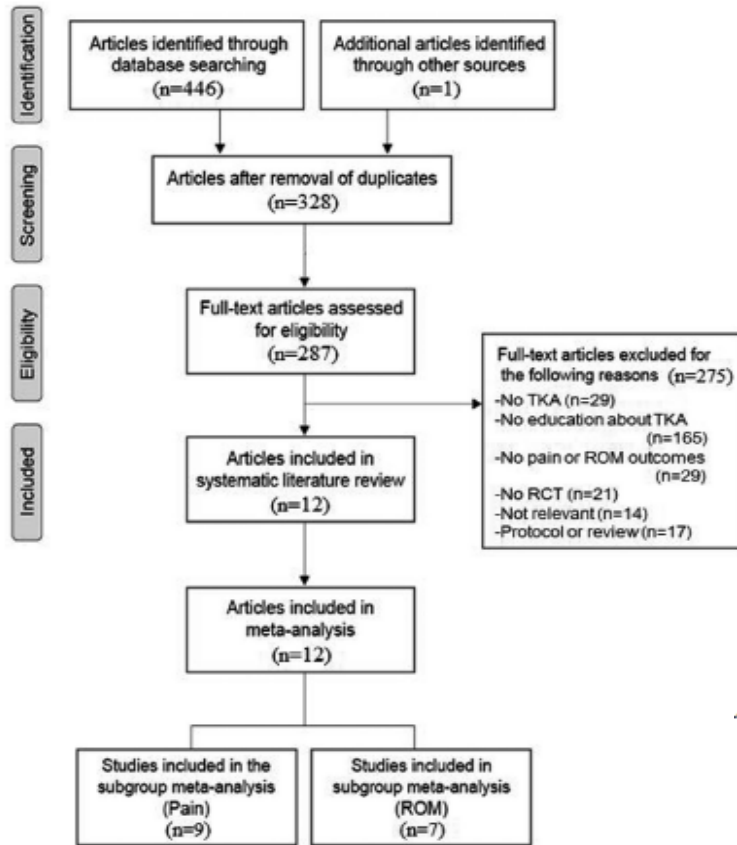
Meta-analyses and Systematic Reviews



JAMA Users guide to the medical literature, 3rd edition. Figure 22-1.

Quality of a Meta-analysis and Systematic Review

- PRISMA Flow Diagram
- Effect size (small, medium large)
- Risk of Bias
- Forest Plot
- Evidence Table



	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)
An (2021)	+	+	?	+	+	+
Beaupre (2004)	+	+	?	+	+	?
Birch (2020)	+	+	+	+	+	+
Campbell (2019)	+	+	+	+	+	+
Crawford (2021)	+	+	+	+	+	+
Madsen (2013)	?	?	?	+	+	+
McDonald (2004)	+	+	?	+	+	+
Riddle (2019)	+	+	+	+	+	+
Sun (2020)	+	+	+	+	+	+
Timmers (2019)	?	?	+	+	+	+
Villafane (2017)	+	+	+	+	+	+
Wilson (2016)	+	+	+	+	+	+

low (+), high (-) and some concerns (?)

Effectiveness of patient education on total knee arthroplasty: A systematic review and meta-analysis

Tae Woo Kim MSN, RN, Staff nurse¹ | Su Hyun Kim PhD, RN, Professor²

¹Kyungpook National University Hospital, Daegu, South Korea

²College of Nursing, Research Institute of Nursing Science, Kyungpook National University, Gukchaebosang-ro 680, Daegu 41944, South Korea

Correspondence

Su Hyun Kim, College of Nursing, Research Institute of Nursing Science, Kyungpook National University, Gukchaebosang-ro 680, Daegu 41944, South Korea.
Email: suhyun_kim@knu.ac.kr

Funding information

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Abstract

Aims and Objectives: This study was designed to examine the contents and methods of patient educational interventions about total knee arthroplasty (TKA) and their effectiveness in reducing postoperative pain and enhancing range of motion (ROM) in the literature.

Background: Patient education has been provided to facilitate recovery after TKA; however, little is known about the contents and methods of the interventions and their effectiveness in reducing postoperative pain and enhancing ROM.

Design: This is a systematic review and meta-analysis of randomised controlled trials (RCTs).

Methods: Published studies from June 1998–June 2021 were identified from electronic databases. Two independent investigators assessed the quality of the studies by using the revised Cochrane risk-of-bias tool. Meta-analyses with random-effects models were conducted to assess the effectiveness of the interventions using the Comprehensive Meta-Analysis Software. The study was performed following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guideline.

Results: Among 12 articles that met the inclusion criteria, three interventions provided education on pain management and mobility/exercises. The most common educational methods were the combinations of oral explanation, written materials, and audiovisual materials, group discussion, while four studies used information technology (IT) devices. The meta-analysis demonstrated that the educational interventions using IT devices were effective in improving pain and ROM, but not the interventions that did not use IT devices.

Conclusion: Structured education for pain management, communication and/or exercise support programs utilising diverse methods have been provided to patients undergoing TKA. Using IT devices could successfully enhance the effectiveness of educational interventions for patients undergoing TKA.

Relevance to clinical practice: Integration of postoperative pain management and mobility/exercises with the use of IT devices should be actively considered in providing patient education in clinical nursing practice.

KEYWORDS

arthroplasty, articular, early ambulation, knee replacement, pain, pain management, postoperative, postoperative period, range of motion

RESEARCH

Chocolate consumption and cardiometabolic disorders: systematic review and meta-analysis

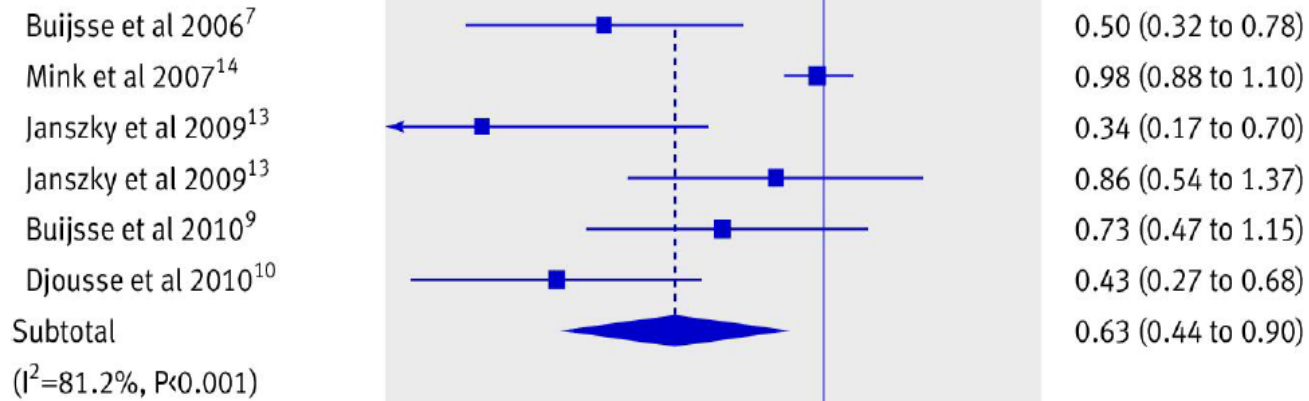


OPEN ACCESS

Adriana Buitrago-Lopez *visiting research assistant*^{1 2 3}, Jean Sanderson *research associate*¹, Laura Johnson *research associate*¹, Samantha Warnakula *PhD student*¹, Angela Wood *university lecturer in biostatistics*¹, Emanuele Di Angelantonio *university lecturer in medical screening*¹, Oscar H Franco *clinical lecturer in public health*¹

Study

Any cardiovascular disease



Heart failure



Stroke

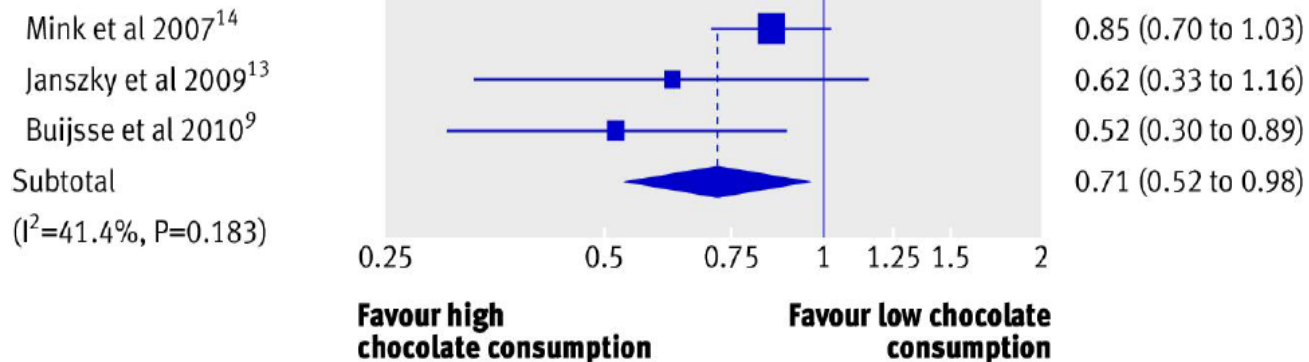


Fig 2 Relative risks for cardiovascular disease, heart failure, and stroke in adults with higher levels of chocolate consumption compared with lower levels





Hourly Rounding to Improve Nursing Responsiveness

A Systematic Review

Matthew D. Mitchell, PhD
Julia G. Lavenberg, PhD, RN

Rebecca L. Trotta, PhD, RN
Craig A. Umscheid, MD

OBJECTIVE: The aims of this study were to synthesize the evidence concerning the effect of hourly rounding programs on patient satisfaction with nursing care and discuss implications for nurse administrators. **BACKGROUND:** Patient satisfaction is a key metric that influences both hospital ratings and reimbursement. Studies have suggested that purposeful nursing rounds can improve patient satisfaction, but the evidence to date has not been systematically examined. **METHODS:** A systematic review of published literature and GRADE analysis of evidence regarding nursing rounds were conducted.

RESULTS: There is little consistency in how results of hourly rounds were measured, precluding quantitative analysis. There is moderate-strength evidence that hourly rounding programs improve patients'

perception of nursing responsiveness. There is also moderate-strength evidence that these programs reduce patient falls and call light use.

CONCLUSIONS: Nurse administrators should consider implementing an hourly rounding program while controlled trials discern the most cost-effective approach.

Hospital stays subject patients and their families to significant stress. In addition to facing bewildering medical conditions that require tests and treatments from physicians, nurses, and other healthcare personnel, patients are placed in dependent roles and become socially and emotionally vulnerable. They are compelled to request assistance with basic needs such as repositioning, eating, and elimination. Unfamiliar

How Do We know How Good an Intervention Is?

- Strength of the Evidence
- **Effect Size (ES)**
- Numbers Needed to Treat (NNT)
- Numbers Needed to Harm (NNH)

Effect Size (ES): It is the size of the treatment/intervention effect

- Tells you how meaningful the relationship between variables or the difference between groups is
- It indicates the practical significance of a research outcome
- A large effect size means that a research finding has practical significance, while a small effect size indicates limited practical applications

Cohen's Effect Sizes for the Magnitude of the **Treatment Effect (d)**

- Small = .2
 - Medium = .5
 - Large = .8
-
- How do you get it? Looking at prior studies is the best bet, and meta-analyses and systematic reviews. Randomized controlled trials (RCTs) also report effect sizes.
 - Estimate it
 - Looking at prior studies
 - Calculate it in the analysis of the study with the study data

Does the ES differ by an intervention? YES

- Aroma Therapy:

- **For WHO?**

- Postoperative patients

- **For WHAT 1?** (Condition/Illness/Disease/Symptom, Events.....)

- Type of surgery

- **For WHAT 2?** (Outcome)

- Frequency or severity

- **For WHERE?** (Setting, Circumstance)

- Post-anesthesia Care Unit
 - General Care Unit

- **For HOW?** (Nature and Delivery of the Intervention)

- Ginger, lavender, and peppermint essential oils
 - Inhalation method

Is Aromatherapy Vs. Music Therapy Evidence-based? (Population, Setting, Condition, Outcome)

- **Aromatherapy for Agitation with Dementia in Older Adults: Not effective!**

- Backhouse, T., et al. (2020). Strategies and interventions to reduce or manage refusals in personal care in dementia: A systematic review. *International Journal of Nursing Studies*, 109, 103640.
- Livingston, G., et al. (2014). Non-pharmacological interventions for agitation in dementia: Systematic review of randomised controlled trials. *The British Journal of Psychiatry: The Journal of Mental Science*, 205(6), 436–442.
- Millán-Calenti, J. C., et al. (2016). Optimal nonpharmacological management of agitation in Alzheimer's disease: Challenges and solutions. *Clinical Interventions in Aging*, 11, 175–184.
- *****Systematic Review: Not superior to placebo**

- **Music Therapy for Agitation in Adults: Is effective!**

- Sisti, A., et al. (2024). Using structured observations to evaluate the effects of a personalized music intervention on agitated behaviors and mood in nursing home residents with dementia: Results from an embedded, pragmatic randomized controlled trial. *The American Journal of Geriatric Psychiatry*, 32(3), 300–311.
- Bleibel, M., et al. (2023). The effect of music therapy on cognitive functions in patients with Alzheimer's disease: A systematic review of randomized controlled trials. *Alzheimer's Research & Therapy*, 15(1), 65.
*****Greater effect was shown when patients are involved in the music making when using active music intervention.**

Evaluating the Efficiency of Breathing Exercises via Telemedicine in Post-Covid-19 Patients: Randomized Controlled Study

Fatih Okan, PhD, RN¹ , Sevil Okan, MD²,
and Fadime Duran Yücesoy, MD²

Clinical Nursing Research
2022, Vol. 31(5) 771–781
© The Author(s) 2022
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/10547738221097241
journals.sagepub.com/home/cnr



Abstract

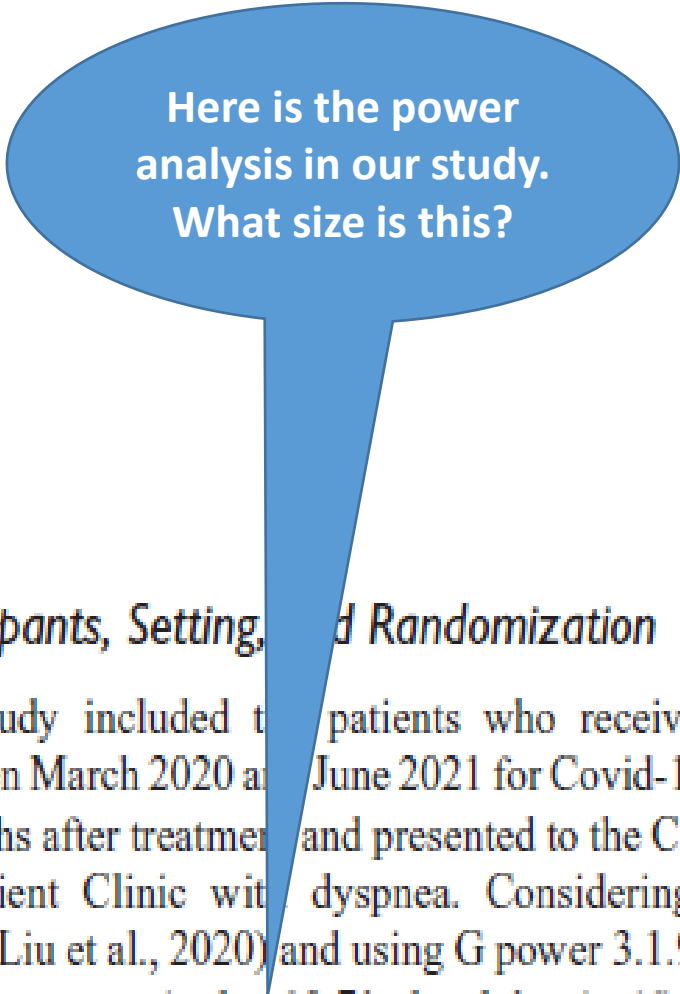
The aim of the study was to evaluate the effectiveness of breathing exercises given by telemedicine in post-Covid-19 dyspneic individuals. Individuals in the intervention group ($n: 26$) were asked to perform breathing exercise three times a day for 5 weeks (one session performed via telemedicine each week). Individuals in the control group ($n: 26$) were given a brochure explaining the exercises. The St George's Respiratory Questionnaire, Pulmonary function tests, and six-minute-walk-tests were administered to all individuals at the beginning and end of the study. The posttest FEV1, FVC, MVV values were significantly higher than the pretest values in the intervention group ($p_2 < .001$) whereas no significant differences were found in the control group. Six-minute-walk-distance increased by 54.27m in the intervention group and 4.69m in the control group. With breathing exercise training applied through telemedicine, improvements were observed in the pulmonary functions, quality of life, and exercise capacities of dyspneic post-Covid-19 individuals.

Keywords

breathing exercise, Covid-19, nursing, telemedicine

Cohen's Effect Sizes for the Magnitude of the Treatment Effect

- The Effect Size (ES) of intervention measures how good the intervention is
 - The bigger the ES, the better the intervention
- ESs are used to determine sample sizes
 - The bigger the ES, fewer participants are needed in a study
 - The smaller the ES, more participants are needed in a study
- **THINK: The better the intervention, the more likely you will be able to see a treatment difference**
- ESs are typically estimated as:
 - Small = .2
 - Medium = .5
 - Large = .8

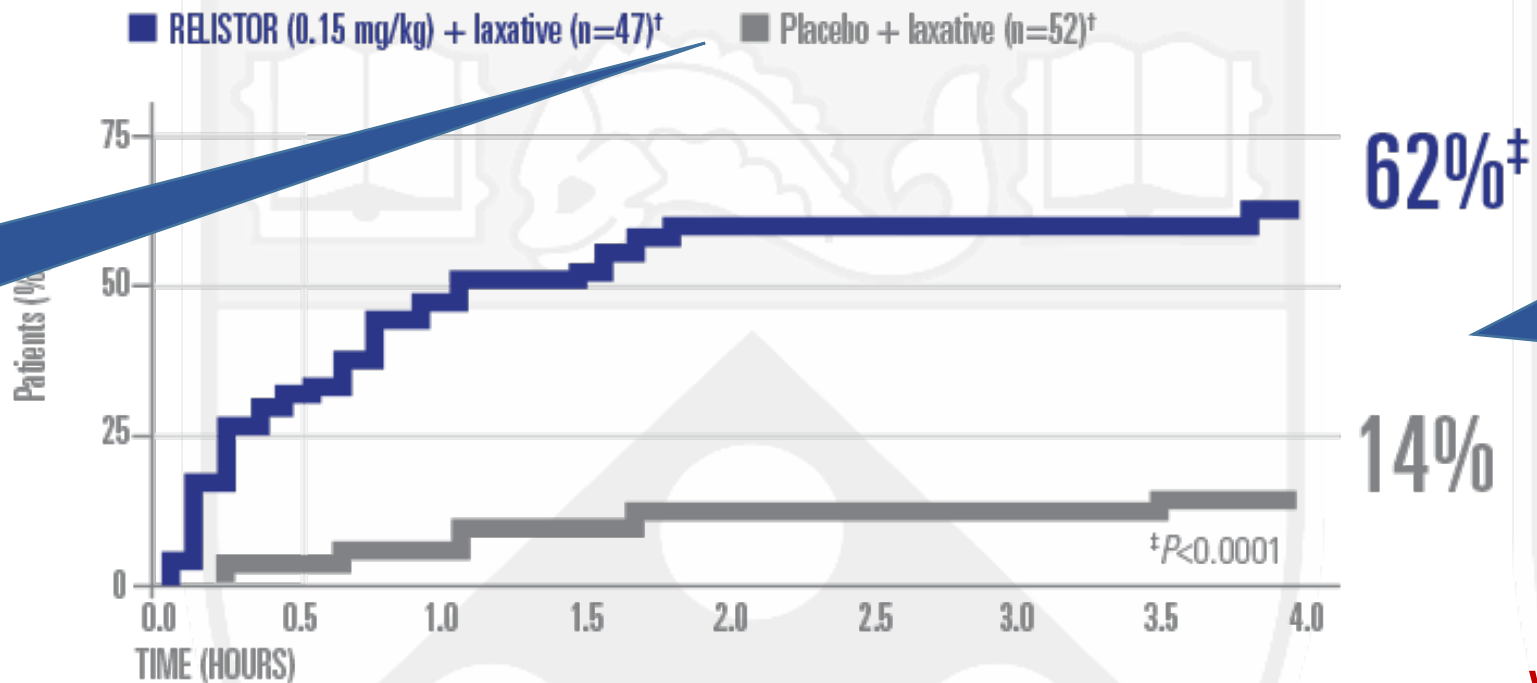


Here is the power analysis in our study.
What size is this?

Participants, Setting, and Randomization

The study included the patients who received treatment between March 2020 and June 2021 for Covid-19, completed 2 months after treatment and presented to the Chest Diseases Outpatient Clinic with dyspnea. Considering a previous study (Liu et al., 2020) and using G power 3.1.9.4. software, the impact magnitude of 0.71, the alpha significance level of .05, and a test power of 0.80, sample size was calculated as 26 individuals in each group.

Example from a Study of a drug for Opioid-induced Constipation (Single-Dose Study): 62% Responded to RELISTOR Within 4 Hours*



Look at small
the sample
sizes for the
groups.

Look at how
big the
difference is
between
groups

~50% of patients who responded under 4 hours reported a BM* within 30 minutes of the first RELISTOR subcutaneous injection

Would you say
this is a small or
large ES?

*A BM that did not require rescue laxative or disimpaction.

[†]Baseline laxatives were used by 96% of patients. Baseline characteristics were well balanced among the treatment groups.



Effect of aromatherapy with rose essential oil on the nausea and vomiting in chemotherapy patients: a randomized controlled trial

Poorva Takasi. MSc^a. Atefeh Ghanbari. PhD^b. Saman Maroufizadeh. PhD^c. Shirin Parvinroo. MD^d.

Nausea and vomiting in patients undergoing chemotherapy

According to the assessment based on VAS before chemotherapy on patients in both control and intervention groups, none of the patients showed symptoms of nausea and vomiting.

As shown in Table 2, in all three time periods of the second cycle, the intervention group exhibited lower levels of nausea and vomiting compared to the control group. A significant interaction between group and time ($F = 6.91$, $\eta_p^2 = 0.100$, $P = 0.001$) was observed. This indicates that the disparity in average nausea and vomiting scores between the control and aromatherapy groups is influenced by the varying levels of time, and conversely, the effect of time on the scores depends on the group assignment. Significant differences were found between the aromatherapy group using rose essential oil and the control group in the first six hours after chemotherapy regarding average nausea and vomiting scores ($t = 10.20$, $d = 2.530$, $P < 0.001$). This trend persisted

Taxotere (80 mg) -	5 (7.8)	3 (9.1)	2 (6.5)
Oxaliplatin (80 mg) -			
Leukovarin (400 mg) -			
Fluorouracil (3000 mg)			

Values are given as a mean (SD) for continuous variables and a number (percentage) for categorical variables.

* P -value was obtained with an independent t -test.

** P -value was obtained with a χ^2 test.

*** P -value was obtained with a Fisher exact test.

in the second six hours ($t = 15.60$, $d = 3.871$, $P < 0.001$) and the third six hours after chemotherapy ($t = 13.56$, $d = 3.404$, $P < 0.001$). Cohen's d -effect size values for these time intervals were considerable, measuring 2.530, 3.871, and 3.404, respectively. Based on the findings, the control group showed a statistically significant difference in average nausea and vomiting scores

Randomized Controlled Study of Self-Managed Music-Guided Exercise Intervention Following Intensive Care

Zhan Liang  ▼ Cindy Munro  ▼ Hilary Yip  ▼ Ming Ji  ▼ Kimberly Sena Moore  ▼ Tanira Ferreira  ▼
Joseph F. Signorile  ▼ Yue Pan 

Background: Patients who are discharged from the intensive care unit (ICU; termed ICU survivors) often experience persistent physical impairment.

Objective: The aim of this study was to explore the effects of a self-managed, music-guided exercise intervention on physical outcomes and adherence rates among ICU survivors.

Methods: A randomized controlled design was used. Following ICU discharge, participants admitted to the ICU for at least 5 days were randomly assigned to a music group ($n = 13$) or an active control group ($n = 13$). Activity counts were measured using an Actiwatch, and the physical health score was measured using the Patient-Reported Outcomes Measurement Information System (PROMIS) global health subscale. Adherence to exercise was documented daily. Independent t -tests were used for data analysis.

Results: Data were analyzed for 26 participants. The mean age was 62.8 ± 13.8 years, 53.8% were male, 65.4% were Veterans, and mean Acute Physiology and Chronic Health Evaluation severity of illness score was 59 ± 23.4 . Global health physical subscale scores were significantly higher in the music group than in the active control group. Although not significantly different, music group participants tended to be more active and had higher physical activity and adherence rates compared to those in the active control group.

Conclusion: A self-managed, music-guided exercise intervention demonstrated positive benefits on physical outcomes. Future clinical trials with a larger sample size should be conducted to examine the effects of this tailored, cost-effective, innovative self-managed exercise intervention among ICU survivors.

Key Words: auditory rhythmic music • exercise • music-based intervention • rehabilitation

Nursing Research, May/June 2023, Vol 72, No 3, 193–199

Pretest and Posttest Comparison on Perception of Physical Health Between the Music and Active Control Groups

Using independent t -tests, the music group showed significant improvement in perception of physical health compared to the active control group (6.5 ± 6.6 vs. -1.62 ± 4.1 , $p = .017$; Cohen's $d = 1.74$; see Table 2). After adding the covariates (APACHE score and age) into the model, the analysis of covariance for perception of physical health yielded similar significant findings ($p = .014$). The multiple imputation analysis yielded a p -value of .1 after considering the variability due to the effect of missing data on the t -test. However, Cohen's $d = 1.74$ is a large effect.

RANDOMIZED CONTROLLED STUDY IN THE USE OF AROMATHERAPY FOR PAIN REDUCTION AND TO REDUCE OPIOID USE IN THE EMERGENCY DEPARTMENT



Authors: Adam N. Brown, BSN, RN, TCRN, Cynthia D. Reed, MSN, RN, CEN, Merle C. Prescott, BSN, RN, MSc, CEN, and Denise Cadle Rhew, PhD, RN, CNS, CEN, Greensboro, NC

Given that we had 3 treatment groups, we wanted to know whether there were any differences in pain scores among the 3 groups. The therapeutic group had a mean post-treatment pain score of 5.81 (SD 2.64) whereas the

show a statistically significant reduction in the pain score. A calculation of the effect size for the therapeutic group compared with the control was 0.3. This means the therapeutic group shows a small effect size.

How Good is an Intervention?

- What do you do when you go to give a medication/intervention, and the patient asks – Is this going to work?

The NEW ENGLAND JOURNAL *of* MEDICINE

ESTABLISHED IN 1812

JUNE 2, 2005

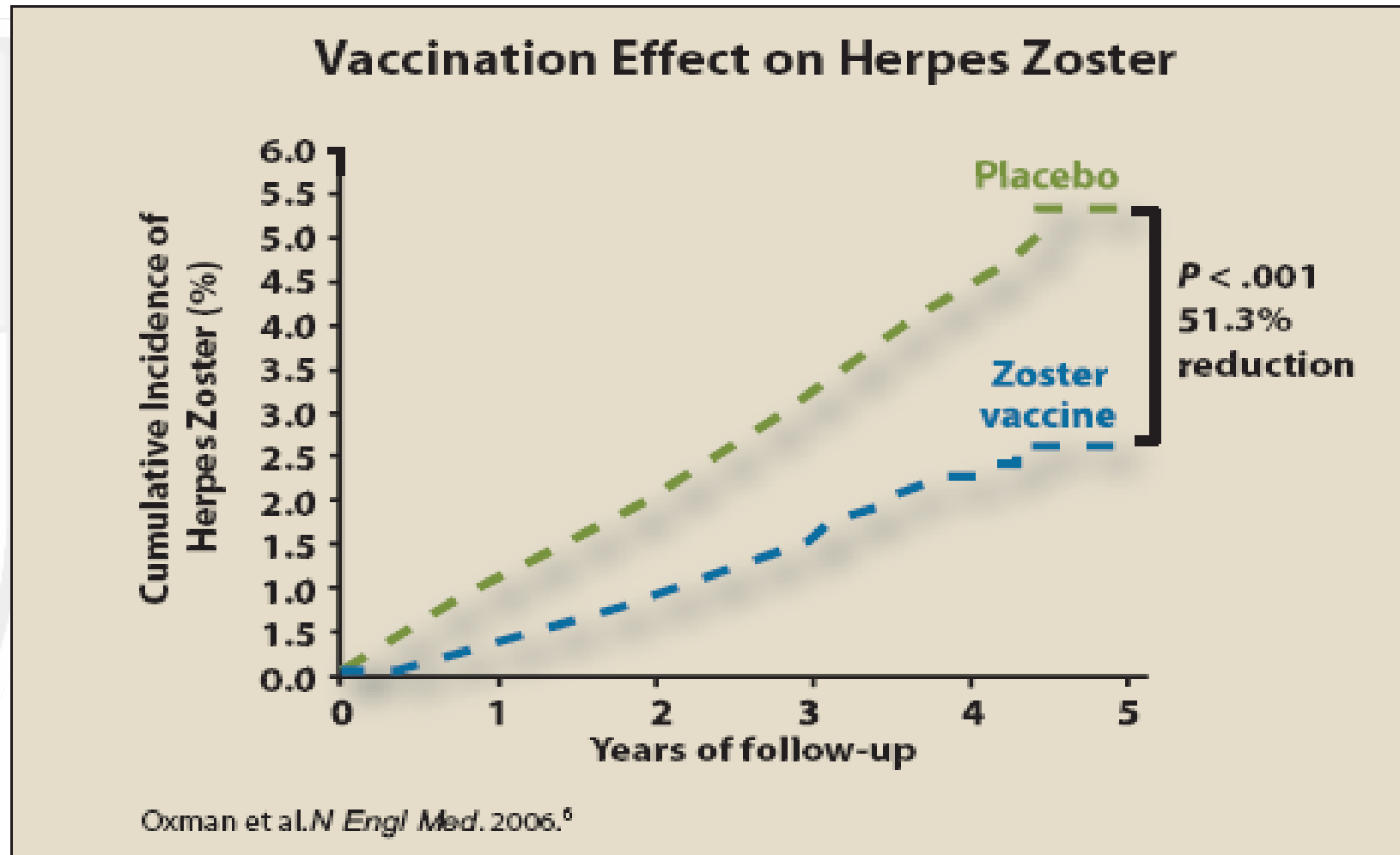
VOL. 352 NO. 22

A Vaccine to Prevent Herpes Zoster and Postherpetic Neuralgia in Older Adults

M.N. Oxman, M.D., M.J. Levin, M.D., G.R. Johnson, M.S., K.E. Schmader, M.D., S.E. Straus, M.D., L.D. Gelb, M.D., R.D. Arbeit, M.D., M.S. Simberkoff, M.D., A.A. Gershon, M.D., L.E. Davis, M.D., A. Weinberg, M.D., K.D. Boardman, R.Ph., H.M. Williams, R.N., M.S.N., J. Hongyuan Zhang, Ph.D., P.N. Peduzzi, Ph.D., C.E. Beisel, Ph.D., V.A. Morrison, M.D., J.C. Guatelli, M.D., P.A. Brooks, M.D., C.A. Kauffman, M.D., C.T. Pachucki, M.D., K.M. Neuzil, M.D., M.P.H., R.F. Betts, M.D., P.F. Wright, M.D., M.R. Griffin, M.D., M.P.H., P. Brunell, M.D., N.E. Soto, M.D., A.R. Marques, M.D., S.K. Keay, M.D., Ph.D., R.P. Goodman, M.D., D.J. Cotton, M.D., M.P.H., J.W. Gnann, Jr., M.D., J. Loutit, M.D., M. Holodniy, M.D., W.A. Keitel, M.D., G.E. Crawford, M.D., S.-S. Yeh, M.D., Ph.D., Z. Lobo, M.D., J.F. Toney, M.D., R.N. Greenberg, M.D., P.M. Keller, Ph.D., R. Harbecke, Ph.D., A.R. Hayward, M.D., Ph.D., M.R. Irwin, M.D., T.C. Kyriakides, Ph.D., C.Y. Chan, M.D., I.S.F. Chan, Ph.D., W.W.B. Wang, Ph.D., P.W. Annunziato, M.D., and J.L. Silber, M.D., for the Shingles Prevention Study Group*

ABSTRACT

Kaplan-Maier Curves for Probability



A. Vaccination effect on incidence of herpes zoster

How Do We know How Good an Intervention Is?

- Strength of the Evidence
- Effect Size (ES)
- **Numbers Needed to Treat (NNT)**
- Numbers Needed to Harm (NNH)

Number Needed to Treat (NNT)

- Estimate of how many people you would need to receive the intervention to obtain a positive or desirable outcome
- Google AI Definition: "Numbers needed to treat" (NNT) refers to the average number of patients that need to be treated with a specific intervention (like a medication) to prevent one additional negative outcome compared to a control group, essentially measuring how effective a treatment is in a clinical trial; a lower NNT indicates a more effective treatment."

Analgesic Properties of Oral Sucrose During Routine Immunizations at 2 and 4 Months of Age

Linda A. Hatfield, PhD, CNNP^a, Maryellen E. Gusic, MD^b, Anne-Marie Dyer, MS^c, Rosemary C. Polomano, PhD, RN, FAAN^d

^aPennsylvania State University School of Nursing, College of Health and Human Development, University Park, Pennsylvania; ^bDivision of General Pediatrics, Pennsylvania State University College of Medicine, and ^cDivision of Biostatistics, Public Health Sciences, Penn State Milton S. Hershey Medical Center, Hershey, Pennsylvania; ^dBiobehavioral Research Center, University of Pennsylvania School of Nursing, University of Pennsylvania, Philadelphia, Pennsylvania

The authors have indicated they have no financial relationships relevant to this article to disclose.

ABSTRACT

OBJECTIVE. The purpose of this work was to evaluate the analgesic properties of oral sucrose during routine immunizations in infants at 2 and 4 months of age.

PATIENTS AND METHODS. A prospective, randomized, placebo-controlled clinical trial was conducted at a pediatric ambulatory care clinic. One-hundred healthy term infants scheduled to receive routine immunizations were recruited, randomly stratified into 2- or 4-month study groups, and further randomly assigned to receive 24% oral sucrose and pacifier or the sterile water control solution. The study preparations were administered 2 minutes before the combined diphtheria-tetanus-acellular pertussis, inactivated polio vaccine, and hepatitis B vaccine. *Haemophilus influenzae* type b vaccine was administered 3 minutes after the combined injection, followed by the pneumococcal conjugate vaccine, 2 minutes after the *H influenzae* type b injection. The University of Wisconsin Children's Hospital Pain Scale measured serial acute pain responses for the treatment and control groups at baseline and 2, 5, 7, and 9 minutes after solution administration. Repeated-measures analysis of variance examined between-group differences and within-subject variability of treatment effect on overall pain scores.

RESULTS. Two- and 4-month-old infants receiving oral sucrose ($n = 38$) displayed reductions in pain scores 2 minutes after solution administration compared with 2- and 4-month-old infants in the placebo group ($n = 45$). Between-group comparisons for the oral sucrose and placebo groups showed lower pain responses at 5, 7, and 9 minutes after solution administration. The oral sucrose and placebo groups demonstrated their highest mean pain score at 7 minutes, with a mean pain score of 3.8 and 4.8, respectively. At 9 minutes, the placebo group had a mean pain score of 2.91 whereas the mean pain score for the oral sucrose group returned to near baseline, reflecting a 78.5% difference in mean pain score (oral sucrose – placebo) relative to the placebo mean.

CONCLUSIONS. Oral sucrose is an effective, easy-to-administer, short-acting analgesic for use during routine immunizations.

www.pediatrics.org/cgi/doi/10.1542/peds.2006-3719

doi:10.1542/peds.2006-3719

This trial has been registered at www.clinicaltrials.gov (Identifier NCT00150189).

Key Words

Immunizations, Infant, pain, sucrose

Abbreviations

RCT—randomized, controlled trial
NNS—nonnutritive sucking
UWCH—University of Wisconsin Children's Hospital
CI—confidence interval
NNT—number needed to treat

Accepted for publication Jul 19, 2007

Address correspondence to Linda A. Hatfield, PhD, CNNP, Pennsylvania State University School of Nursing, College of Health and Human Development, 307B HHD East, University Park, PA 16802. E-mail: lal153@psu.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275). Copyright © 2008 by the American Academy of Pediatrics

Number-needed-to-treat (NNT) analysis provides additional support for the use of oral sucrose before immunization in infants. Within the concept of NNT analysis, values of 4 and 2 are favorable values for determining the effectiveness of this intervention. The NNT with 0.6 mL/kg of 24% sucrose to achieve a behavioral pain score of 0 or 1 at 2 minutes after sucrose administration is 4 ($\text{NNT} = 1/[0.605 - 0.311] = 3.40$). The NNT to observe a behavioral pain score of 0 or 1 at 9 minutes after the administration of sucrose is 2 ($\text{NNT} = 1/[0.842 - 0.333] = 1.96$). Thus, pediatric health care providers would need to treat only a small number of infants to document the efficacy of oral sucrose in reducing pain associated with immunization.

Implications for Practice

Numbers Needed to Treat (NNT)

- 2 Minutes

$$\text{NNT} = 1/(0.61-0.31) = \underline{\underline{3.40}}$$

- 9 Minutes:

$$\text{NNT} = 1/(0.84-0.33) = \underline{\underline{1.96}}$$

The Commonwealth Master of Public Health Program.
<http://www.commonwealthmph.org/forms.html>. February
21, 2005



How Do We know How Good an Intervention Is?

- Strength of the Evidence
- Effect Size (ES)
- Numbers Needed to Treat (NNT)
- **Numbers Needed to Harm (NNH)**

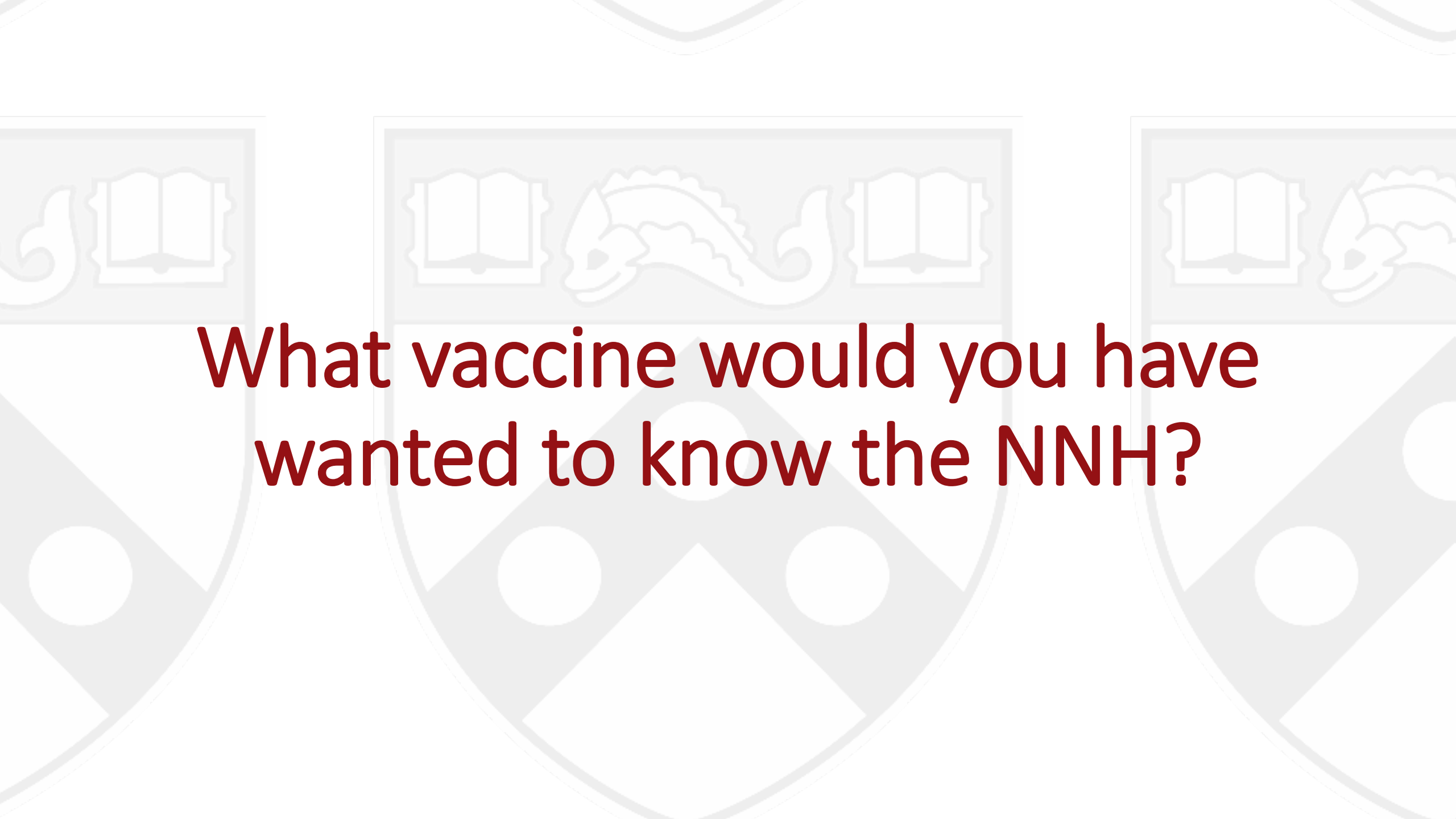
Number Needed to Harm (NNH)

- Number needed to harm (NNH): A calculation that shows how many people need to be given the intervention to cause harm for one person
- **Very important for interventions such as vaccines**

Google NNH for Statins

- The number needed to harm (NNH) for statins varies depending on the adverse event, but is generally between 21 and 204 people
- This means that for every 21 to 204 people treated with statins, one person will experience an adverse event
- Risk/Benefit: Treating 1000 patients with a statin would prevent 37 cardiovascular events, and 5 AEs would be observed

(Silva MA, et al. Statin-related adverse events: a meta-analysis. Clin Ther. 2006;28(1):26-35.)



What vaccine would you have
wanted to know the NNH?

BMJ Open How missing evidence-based medicine indicators can inform COVID-19 vaccine distribution policies: a scoping review and calculation of indicators from data in randomised controlled trials

Andrew Larkin ¹, Howard Waitzkin ^{1,2}, Ella Fassler ¹,
Kesavan Rajasekharan Nayar ^{3,4}

To cite: Larkin A, Waitzkin H, Fassler E, *et al*. How missing evidence-based medicine indicators can inform COVID-19 vaccine distribution policies: a scoping review and calculation of indicators from data in randomised controlled trials. *BMJ Open* 2022;12:e063525. doi:10.1136/bmjopen-2022-063525

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2022-063525>).

AL and HW are joint first authors.

Received 12 April 2022
Accepted 02 November 2022



© Author(s) (or their employer(s)) 2022. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

ABSTRACT

Objective Reports of efficacy, effectiveness and harms of COVID-19 vaccines have not used key indicators from evidence-based medicine (EBM) that can inform policies about vaccine distribution. This study aims to clarify EBM indicators that consider baseline risks when assessing vaccines' benefits versus harms: absolute risk reduction (ARR) and number needed to be vaccinated (NNV), versus absolute risk of the intervention (ARI) and number needed to harm (NNH).

Methods We used a multimethod approach, including a scoping review of the literature; calculation of risk reductions and harms from data concerning five major vaccines; analysis of risk reductions in population subgroups with varying baseline risks; and comparisons with prior vaccines.

Findings The scoping review showed few reports regarding ARR, NNV, ARI and NNH; comparisons of benefits versus harms using these EBM methods; or analyses of varying baseline risks. Calculated ARRs for symptomatic infection and hospitalisation were approximately 1% and 0.1%, respectively, as compared with relative risk reduction of 50%–95% and 58%–100%. NNV to prevent one symptomatic infection and one hospitalisation was in the range of 80–500 and 500–4000. Based on available data, ARI and NNH as measures of harm were difficult to calculate, and the balance between benefits and harms using EBM measures remained uncertain. The effectiveness of COVID-19 vaccines as measured by ARR and NNV was substantially higher in population subgroups with high versus low baseline risks.

Conclusions Priorities for vaccine distribution should target subpopulations with higher baseline risks. Similar analyses using ARR/NNV and ARI/NNH would strengthen evaluations of vaccines' benefits versus harms. An EBM perspective on vaccine distribution that emphasises baseline risks becomes especially important as the world's population continues to face major barriers to vaccine access—sometimes termed 'vaccine apartheid'.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The study uses a scoping review methodology to determine the extent to which publications about COVID-19 vaccines have analysed indicators from evidence-based medicine (EBM)—absolute risk reduction (ARR), number needed to be vaccinated (NNV), absolute risk of the intervention (ARI) and number needed to harm (NNH)—to assess and compare benefits and harms; the study also presents calculations of these rarely discussed EBM indicators based on data from major randomised controlled trials.
- ⇒ The methods of calculating these key EBM indicators facilitate a reproducible technique to compare benefits and harms for assessment of vaccines previously developed and those to be developed in the future.
- ⇒ Because sensitivity analyses permit calculation of ARR and NNV in subpopulations with different baseline risks and with varying assumptions about vaccine effectiveness, the approach can supplement consideration of other contextual risk factors such as age, immunocompromised status and comorbidities in policy decisions about priorities for vaccine distribution.
- ⇒ Measures of harm and comparisons of harms versus benefits by calculation of ARI and NNH were challenging to achieve based on publications or accessible unpublished data, so we were not yet able to resolve the question of benefits versus harms through these EBM indicators.
- ⇒ Partly because we could analyse only published data from the major publications but not the inaccessible raw data, we could not determine if there was a rationale for not reporting ARR and NNV in addition to relative risk reduction, or for not reporting quantitative EBM measures of harm such as NNH.

Table 2 Measures of harm with major vaccines in major randomised controlled trials

	Adverse events	Number needed to harm=1/ARI
Pfizer-BioNTech	'Any adverse effect'	7 (4 to 24)
	'Related adverse effect'	6 (4 to 14)
	'Serious adverse event'	1000 (−47 to 51)
Moderna-NIH	'Solicited adverse events at the injection site'	
	After dose 1	2 (1 to 2)
	After dose 2	1 (1 to 2)
	'Solicited systemic adverse events'	
	After dose 1	8 (−96 to 4)
	After dose 2	2 (2 to 3)
	'Adverse events that were deemed by the trial team to be related to the vaccine or placebo'	27 (−33 to 10)

- In summary, there are many parameters that tell us how good an intervention is
- Because an intervention works in one group, setting, or condition does not mean that it will apply to other populations or situations
- Strength of evidence and ES are the most common ways that we determine how good an intervention is
- Always ask a researcher or statistician to help you interpret how good an intervention might be

