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Effectiveness of Mentorship and Simulation-Based Training on Healthcare Workers' Knowledge and Skills on Neonatal Resuscitation: A Rapid Review

Janet Ene-Peter, Alice Nte, Chikaodili S. Ihudiebube, Chinemerem Eleke
Department of Child Health, Africa Centre for Public Health & Toxicological Research, University of Port Harcourt, Nigeria

Correspondence Author: **Dr. Chinemerem Eleke**

Abstract

Background: Mentorship and simulations are used in neonatal resuscitation knowledge and skills training. This study examined current evidence on the effectiveness of mentorship and simulation-based training on healthcare workers' knowledge and skills on neonatal resuscitation. **Methods**: The PubMed, EBSCO essentials and Google Scholar databases were searched for currently published evidence (2013-2023). Studies that examined knowledge and skill outcomes of one day mentorship or simulation-based training were included. The quality of studies was assessed using the Downs and Black checklist and studies that scored ≤14 points (poor) were excluded. **Results**: Six studies (1 Randomized Controlled Trials and 5 Quasi-experiments) involving 576 healthcare workers were included. Simulation-based training resulted in a pooled mean difference of 1.91 for knowledge and 3.45 for skill scores immediately after training. Mentorship resulted in a pooled mean difference of 2.00 for knowledge and 6.03 for skill scores immediately after training. **Conclusions**: The immediate effectiveness of simulation and mentorship were similar for knowledge scores but mentorship produced more effect than simulation for skill scores. The limited number of published studies highlights a need for more controlled trials to establish the comparative effectiveness of mentorship and simulation-based neonatal resuscitation training.

Keywords: Neonatal resuscitation, simulation, mentorship, training, systematic review

Introduction

Neonatal resuscitation is a vital treatment for asphyxia that could arise within the first 28 days of birth (Nyiringango et al., 2021). Compared to other periods in the first five years of a baby's existence, the neonatal phase is the most susceptible to asphyxia

(Wang et al., 2022). About 2.7 million neonatal deaths occur worldwide annually, and about 25% (675,000) are due to neonatal asphyxia (Mendhi et al., 2019). Asphyxia denotes a lack of oxygen in the blood (hypoxia) due to the inability of the neonate to take effective breaths (Okazaki et al., 2023). The resulting hypoxia from asphyxia can cause brain damage and death within one minute of no resuscitation (Frajewicki et al., 2020). Asphyxia most often occurs within the first minute of birth (Riley et al., 2019). The golden minute rule, therefore, recommends the implementation of skilled neonatal resuscitation in the first minute of delivery to improve newborn survival (Ljungblad et al., 2020). Healthcare providers deliver about 50% of newborns and thus need high-level expertise and confidence to perform neonatal resuscitation (Mendhi et al., 2019). As a result, evaluating evidence-based interventions that could effectively enhance the neonatal resuscitation competencies of healthcare providers is necessary.

Strengthening healthcare providers' competencies in timely and adequate neonatal resuscitation is critical to preventing newborn mortality. As initial responders, obstetrics residents and delivery room nurse-midwives conduct low- and moderate-risk births (Chang et al., 2022). In this role, they are responsible for completing early examinations on the newborn, requesting more assistance, and commencing evidence-based neonatal resuscitation techniques. Delays or inadequate newborn resuscitation can result in undesirable birth outcomes such as severe hypoxia, brain damage, and death (Abrha et al., 2019).

Neonatal resuscitation training teaches healthcare providers the measures taken to assist the newborn in breathing during the golden minute of birth. It is a low-cost intervention that could reduce newborn death from birth asphyxia by up to 30% (Briggs et al., 2021). Neonatal Resuscitation Programme (NRP) and Helping Babies Breathe (HBB) are examples of neonatal resuscitation training programmes developed by the American Academy of Pediatrics (Bang et al., 2014). The NRP and HBB are standardized training programmes designed to improve the neonatal resuscitation competencies of healthcare providers. The neonatal resuscitation competencies refer to the knowledge and skills in neonatal airway management (Mendhi et al., 2019; Nyiringango et al., 2021; Sintayehu et al., 2020).

Simulation-based training involves the immersion of a learner in a scenario designed within a physical location that matches the real world. Simulation mimics real-life scenes and is the primary mode of training and competency evaluation before independent skilled birth attendance (Chang et al., 2022). Simulation-based neonatal resuscitation training programmes for front-line healthcare providers frequently require providers to participate in neonatal resuscitation simulations as a team with evaluation based on the overall performance of the Neonatal Resuscitation Protocol or algorithm that focuses primarily on skills such as chest compressions, intubation, and line placement (Matterson et al., 2018). Nevertheless, simulations tend to over-simplify real-life newborn resuscitation team responses (Magee et al., 2018). As a result, the

retention of competencies (knowledge and skills) acquired during simulation training remains a subject matter for research (Sahu & Lata, 2010).
Mentorship is an instructional approach that improves healthcare providers' competence in maternity and newborn care (Ghosh et al., 2020). It refers to the guidance provided by an experienced care provider to a less experienced provider to enhance the transmission of knowledge and skills. Mentorship-based training promotes professional development between the mentor and the mentee by fostering a supportive and dynamic interaction (Data, et al., 2022). Mentoring exposes mentees to real-life situations rather than rely completely on simulation manikins.
Previous studies have documented the effectiveness of neonatal resuscitation training in reducing newborn mortality (Dempsey et al., 2015; Nyiringango et al., 2021). The persisting gap is that successful programs have applied simulation-based training and mentoring approaches in separate study conditions (Briggs et al., 2021; Chalise et al., 2022; Sintayehu et al., 2020). It is however not clear which approach proffers better short term benefits in improving resuscitation skills among trained healthcare providers such as nurses.
The research question for this review was articulated in line with the Population, Intervention, Comparison, and Outcome (PICO) framework. It reads: Among nurses, what is the immediate effectiveness of mentoring and simulation-based training on knowledge and skill score? This review aims to answer the posed question by reviewing current evidence in the literature available within the past 10 years.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed for this review (Moher et al., 2010). The literature search was completed in March 2023. The literature search used specific inclusion and exclusion criteria to evaluate study eligibility, quality, and evidence in outcome data.

Search methods

This review conducted the literature search in the databases of PubMed, EBSCO essentials, and Google Scholar with the search terms "Mentor*," "Simulation," and "Neonatal Resuscitation" (* = truncation). The database search string was as follows: (Mentor*) OR (Simulation) AND ("Neonatal Resuscitation"). A manual search for more studies utilized the references mentioned in original study articles and reviews using the descendant and ancestor techniques. This review limited the search to English language studies published between 2013 and 2023 (10 years) as this review aimed to review current evidence. Two members of the research team (JEP and CE) conducted the search independently and discrepancies were resolved by discussion with AN and CSI.

Eligibility criteria

The titles and abstracts of the obtained studies were screened by two members of the research team (JEP and CE) independently to determine their eligibility according to the following inclusion criteria: (a) studies that examined the effectiveness of simulation-based training on neonatal resuscitation knowledge and skills; (b) studies that investigated mentorship-based training on neonatal resuscitation knowledge and skills; (c) outcome assessment focusing on knowledge and skill. The following exclusion criteria were applied: (a) Non-English language articles; (b) reviews, case reports, case series, qualitative, and mixed studies (c) Non-availability of the full-text version of the study. Duplicate studies were removed. The two members of the research team assessed each retrieved study for a consensus on eligibility before their inclusion for data extraction.

This review extracted study information on the author and year of publication, country, study design, sample size, training approach, and outcome measures (Table 1). Furthermore, the details of the interventions of the included studies were extracted including manikins, training content, and duration of training. JEP and CE independently collected data from each study and compared the results. Discrepancies in the obtained data were resolved by discussions with AN and CSI until a consensus was reached.

Study quality

The risk of bias in the included studies was assessed using the Cochrane Collaboration Risk of Bias tool for controlled trials and the Risk of Bias in Non-randomized Studies of Interventions tool for quasi-experiments. Controlled trials were assessed in terms of random sequence generation, allocation concealment, blinding of participants, blinding of outcome assessment, incomplete outcome data, and selective outcome reporting (Higgins et al., 2011). Quasi-experiments were assessed in terms of confounders, participant selection, intervention type, missing data, and outcome assessment. Two members of the research team (JEP and CE) assessed the quality of studies independently and discrepancies were resolved through discussion and consensus. The quality of studies included for data analysis was objectively measured using the checklist developed by Downs and Black (1998). Studies that scored ≤14 points (poor) were excluded from the study, while studies that scored 14 and above were included.

Data analyses

Data analysis was done by calculating the standardized mean difference in the effects of the interventions (simulation and mentorship).

Results

Study selection

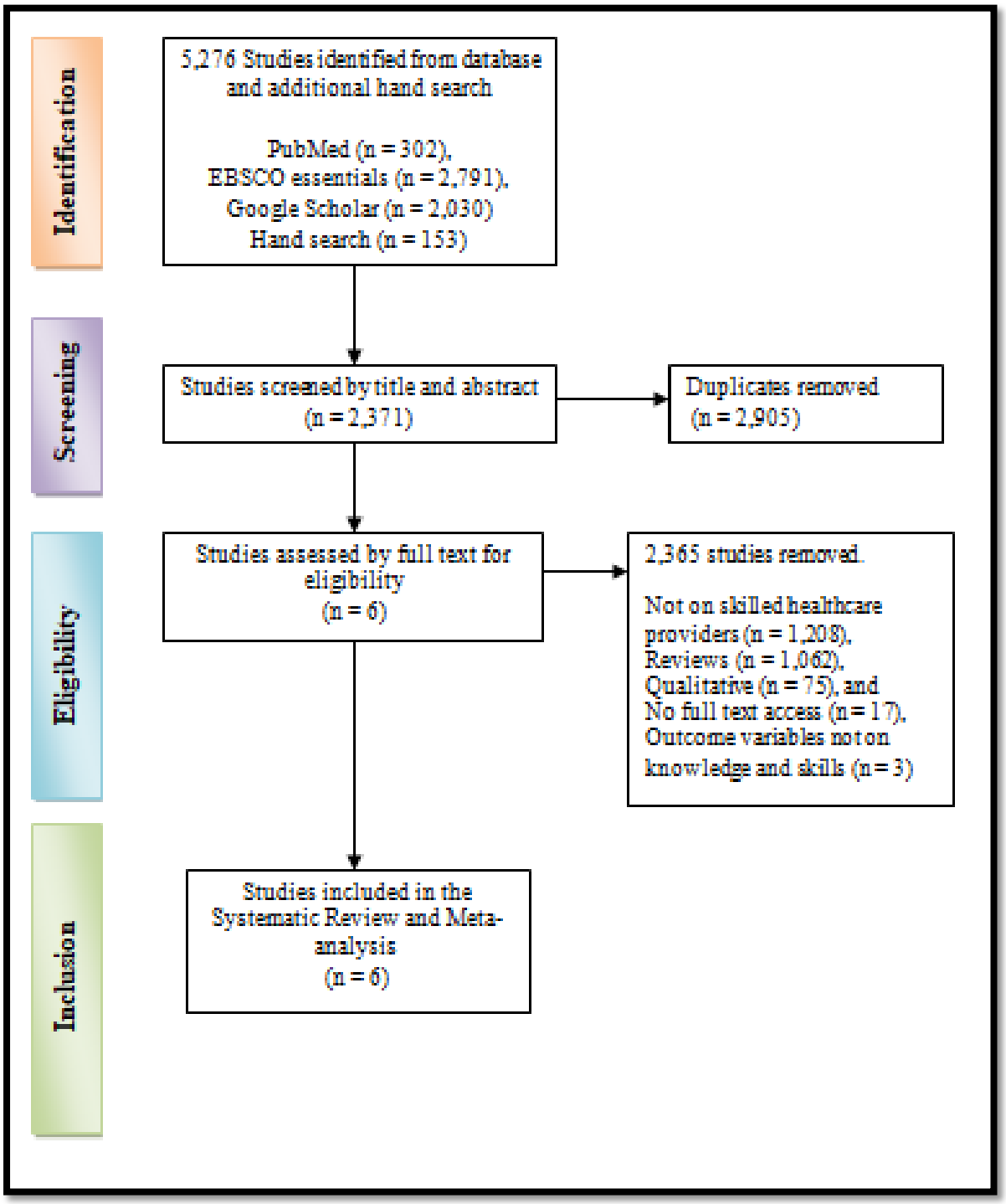

Figure 1: PRISMA flow chart

A Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart depicts the selection procedure as well as the number of retrieved, screened, and included studies (figure 1). PubMed (n = 302), EBSCO essentials (n = 2,791), Google Scholar (n = 2,030), and a manual search from reference lists yielded a total of 5,276 studies. After screening and eliminating duplicate studies (n = 2,905) and studies that met the exclusion criteria (2,365), the 6 remaining studies were determined to be eligible and included in this review (1 Randomized Controlled Trials and 5 Quasi-experiments). Table 1 summarized the included studies by study characteristics.

Study characteristics

Table 1: Study matrix

Author & Year	**Country**	**Study design**	**Sample size**	**Training approach**	**Outcome measures**
Seto et al. (2015)	Honduras	Single group quasi-experiment	70 Health care workers	Helping Babies Breathe (HBB) simulation (1 day duration)	Neonatal Resuscitation Skills **Domains**: neck extension, suction, positive pressure ventilation, positive pressure ventilation rate, assessment of heart rate, and time of completion. **Tool**: Knowledge test and OSCE
Kc et al. (2017)	India	Single group Time series quasi-experiment	137 Health care workers	Mentorship programme on Helping Babies Breathe (HBB, 2 days)	Neonatal Resuscitation Knowledge and Skill **Domains**: Neonatal resuscitation knowledge, suction, ventilation, and drying/stimulation. **Tool**: Knowledge test and OSCE
Gamtessa et al. (2020)	Ethiopia	Single group quasi-experiment	98 Health Workers	Simulation training Helping Babies Breathe (HBB, 2 days duration)	Neonatal Resuscitation Knowledge **Domains**: Neonatal resuscitation knowledge, suction, ventilation, and drying/stimulation. **Tool**: Knowledge test
Briggs et al.	Nigeria	Single group	106 Health	Basic Neonatal Resuscitation	Neonatal Resuscitation Knowledge and Skills

(2021)		quasi-experiment	workers	Simulation training (1 day duration)	**Domains**: neck extension, suction, positive pressure ventilation, positive pressure ventilation rate, assessment of heart rate, and time of completion. **Tool**: Knowledge test and OSCE
Munyaw et al. (2022)	Tanzania	Single group quasi-experiment	107 Health Workers	Neonatal Resuscitation Simulation Training	Neonatal Resuscitation Knowledge and Skill **Domains**: Neonatal resuscitation knowledge, suction, ventilation, and drying/stimulation. **Tool**: Knowledge test and OSCE
Data et al. (2022)	Uganda	Randomized Controlled Trial	58 Health workers	Mentorship for programme for Neonatal management based on Helping Babies Breathe (6 months duration)	Neonatal Resuscitation Knowledge and Skill **Domains**: Neonatal resuscitation knowledge, suction, ventilation, and drying/stimulation. **Tool**: Knowledge test and OSCE

None of the studies included adolescents 15-18 years of age. Table 1 shows that the studies had a combined population of 576 healthcare workers where nurse-midwives were the majority. The studies were conducted in Africa (n =4), Asia (n = 1), and South America (n = 1). Five of the studies applied a single-group pretest-posttest quasi-experimental design and one study was a Randomized Controlled Trial. The knowledge and skill outcomes of neonatal resuscitation interventions utilizing the Simulation approach were examined by four studies and two studies examined the mentorship approach.

Evidence synthesis

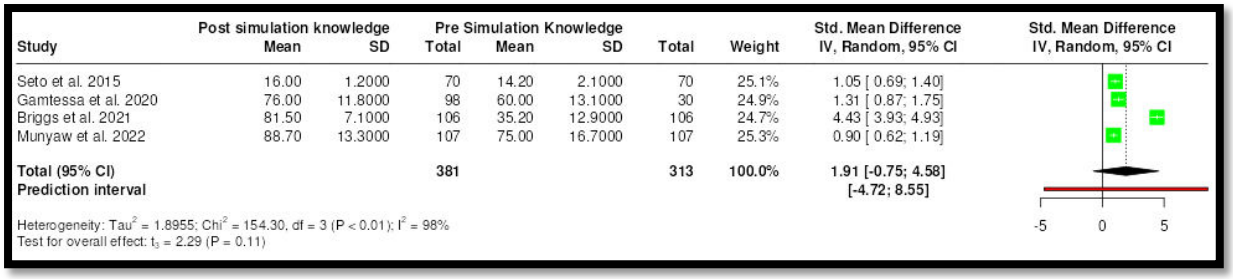

Figure 2: Forest plot on immediate effect of simulation on knowledge scores

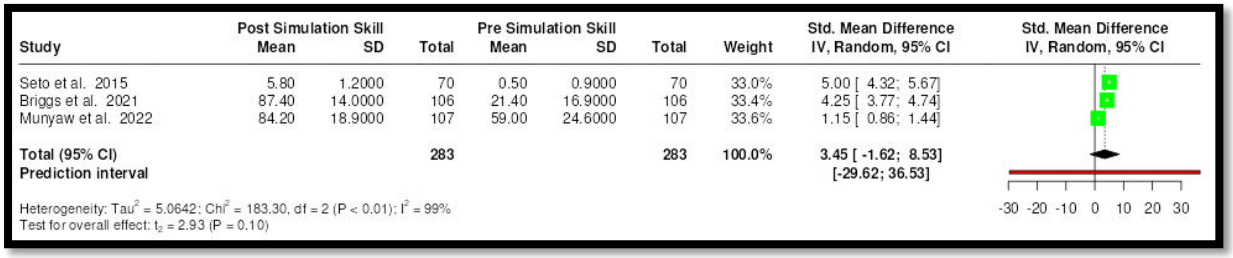

Figure 3: Forest plot on immediate effect of simulation on skill scores

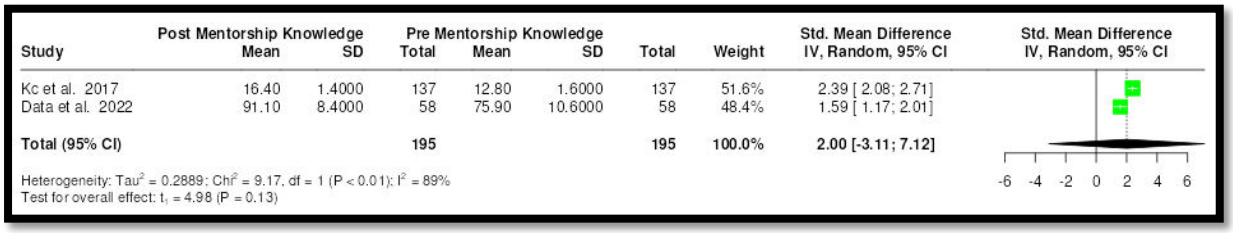

Figure 4: Forest plot on immediate effect of Mentorship on knowledge scores

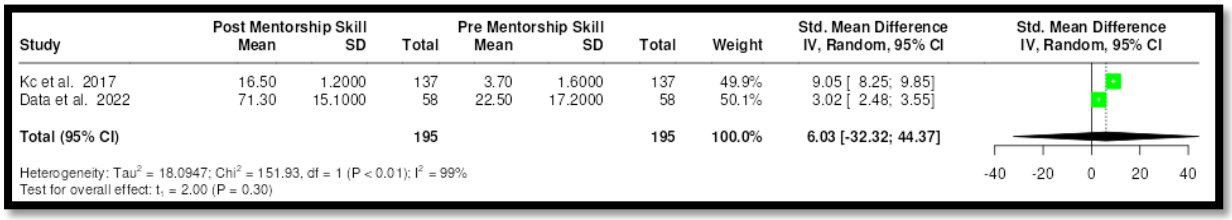

Figure 5: Forest plot on immediate effect of Mentorship on skill scores

Forest plots were used to compute the pooled mean differences in scores resulting from simulation and mentorship (Figures 2-5). Simulation-based training resulted in a pooled mean difference of 1.90 for knowledge and 3.45 for skill scores immediately after training. Mentorship resulted in a pooled mean difference of 2.00 for knowledge and 6.03 for skill scores immediately after training.

Discussion

This study noted that simulation-based neonatal resuscitation training resulted in small improvements in short term knowledge and skill outcomes. This finding corroborates Mileder et al. (2014) that summarized the outcomes of simulation-based neonatal resuscitation training of benefits in knowledge and skills in the short term. This finding also supports Rakshasbhuvankar and Patole (2014) that found that

simulation-based trials demonstrated improvements in neonatal resuscitation knowledge and skills in the short term.

Regarding mentorship, this study found an improvement in knowledge and skill in the short term. Only two studies assessed the short term outcomes of mentorship-based training. The finding was consistent with Data et al. (2022) and Kc et al. (2017) who observed found positive knowledge change after mentorship training.

This is the first rapid review to assess the effectiveness of mentorship and simulation-based training on healthcare providers' neonatal resuscitation knowledge and skills. The strengths of this study include the following: (1) it was a literature search of current evidence published within the past 10 years; (2) it included only peer-reviewed studies published in peer-reviewed journals; and (3) It included studies of fair to good quality based on the Downs and Black (1998) criteria.

A few limitations are obvious concerning this study. Firstly, there were a limited number of studies published within the past 10 years. Secondly, none of the studies statistically compared the effectiveness of the mentorship and simulation-based training programmes on healthcare workers' neonatal resuscitation knowledge and skills. Thirdly, the majority of included studies were conducted in Africa than other parts of the world. The imbalance in countries and distribution of healthcare providers in the different target populations might result in selection bias of the population. Fourthly, the knowledge and skills assessment among the included studies were based on various questionnaire contents and standards which might hamper comparison across studies.

The study's findings have implications for current practice and future research. In terms of short term knowledge outcomes, both mentoring and simulation-based newborn resuscitation training showed small and similar benefits. Unlike mentoring, simulation-based training produced smaller effects on short term skill results.

The complexity and length of the scenarios used in the teaching sessions and the competency and experience of instructors are confounding factors. However, the factors were not controlled across the studies. In future studies, a validated assessment tool for instructors and scenarios would be necessary to standardize the design and implementation of mentorship and simulation-based training.

Conclusion

Mentorship and simulation-based training resulted in small benefits in knowledge outcomes in the short term. Mentorship-based training seemed better suited for skill development than simulation-based training. Nonetheless, the heterogeneity in studies made it impossible to statistically compare the effectiveness of the training approaches. The evidence is however limited by the small number of recently published studies. Therefore, the comparison of effectiveness between mentorship and simulation-based training remains inconclusive. More randomized controlled trials

are needed to establish the effectiveness of mentorship and simulation-based neonatal resuscitation training.

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