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Testing Effect of the National Basic Newborn Resuscitation Educational Program on Midwives' Knowledge and Skills: Observational Quasi-experimental Study

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ARTICLE INFO	ABSTRACT
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Background: Basic newborn resuscitation is a vital strategy to reduce the incidence of birth asphyxia and the associated outcomes. These outcomes can be improved if the midwives have the knowledge and skills of basic newborn resuscitation. **Purpose**: We assessed the midwives' knowledge and their quality of skills regarding BNR, as well as the effectiveness of an educational program in improving midwives' knowledge and skills during the process of BNR. **Methods**: A pretest-posttest design was conducted. The BNR educational program was adapted from the American Academy of Pediatrics (AAP) Neonatal Resuscitation Program (NRP). It was conducted through three days of workshops, including an overview lecture, interactive video modules, and extensive hands-on teaching of basic resuscitation techniques. Assessments (pre-and post-tests) were performed. Data was analyzed using t-test, one-way ANOVA, relative importance index analysis, and linear regression test. **Results**:100 midwives attended the workshops. Their mean scores were: knowledge score before the program (M=68.38%, SD= 13.4) and after the program (M=78.72%, SD=10.3), t=6.29, p<0.001. The overall mean prioritization before the program was 2.71(out of 3) and after the program 2.9. The mean quality performance of skills (out of 4 points) before and after the educational program, respectively, were (M=2.2, SD=0.8) and (3.64, SD=0.5). According to multi-variant logistic regression, midwives' age (years) and weekly to monthly practice of BNR correlated significantly and positively with higher odds of succeeding with a score >= 84% on the knowledge test of post-educational program having been delivered to all the midwives. **Conclusion:** The study results showed the significant impact of the BNR educational program, followed immediately by the significant improvement in the midwives' knowledge and skills. **Implications for Nursing**: Midwives and neonatal nurses should be encouraged to upgrade their educational level to ensure their skill retention and expose themselves to BNR. Further, it is essential to understand the factors affecting how midwives and neonatal nurses gain and retain skills using a high-level methodology.

Keywords: Basic newborn resuscitation (BNR), Midwives, Knowledge, Skills.

What does this paper add?

1. Nearly one half of newborn deaths could be reduced with appropriate BNR during the first 24 hours after birth.
2. The basic newborn resuscitation program has been developed to fit the Jordanian clinical setting.
3. Asphyxia or respiratory depression is a major etiology of early newborn deaths.
4. Effective management of asphyxia in the first few minutes of life may influence long-term newborn outcomes.

Introduction

Midwives complete physical examinations the first few minutes after a newborn's birth, including adequate respiratory system stimulation and continuous evaluation of the newborn's ventilation, heartbeat, and thermal regulation stability (American Academy of Pediatrics, 2021). This assessment aims to monitor and stabilize the newborn's overall condition. For this study, the term Basic Newborn Resuscitation (BNR) refers to the immediate assessments carried out by midwives to ensure the stability of the newborn's health status. Basic Newborn Resuscitation (BNR) is different from Advance Neonatal Resuscitation (ANR), as the last term necessitates the newborn's intubation to stabilize the newborn's health status and is carried out after the failure of the initial BNR steps (Darmstadt et al., 2005). The literature reported that skilled and trained midwives competent in basic neonatal resuscitation could reduce neonatal mortality by up to 75% worldwide (Salam et al., 2014).

In Jordan, BNR is a significant challenge for registered Jordanian midwives because of the lack of knowledge and skills in performing BNR immediately after birth (Kassab et al., 2017 Khriesat et al., 2017;). Using low-cost, low-tech interventions by competent and skilled midwives can save most newborns' lives due to birth complications (WHO, 2012). The neonatal mortality rate has not decreased since 2012; so efforts are still needed to achieve the 2030 SDG target (Al-Sheyab et al., 2017). Relatively, neonatal mortality in Jordan is 8.81 per 1000 live births compared with different countries such as the United Arab Emirates (3.60 per 1000 live births) and Australia (2.37 per 1000 live births) (Hug et al., 2017; Khader et al., 2020).

Basic newborn resuscitation is a low-cost intervention that is applied immediately after birth.

Moreover, it can preclude neonatal mortality and morbidity due to intrapartum hypoxic events (Wall et al., 2010). The World Health Organization has concluded that basic resuscitation for newborns does not frequently begin at that correct time, or that the actions must be correctly performed (Kattwinkel et al., 2010). Adequate newborn resuscitation needs knowledge, skills, and readiness for health care providers, including midwives (American Academy of Pediatrics, 2021).

World Health Organization (WHO) established guidelines on newborn resuscitation to ensure that each newborn worldwide receives resuscitation effectively. These guidelines focus on equipping health care providers, including midwives, with the knowledge and skills to care for newborns during and after birth immediately (WHO, 2012). Furthermore, there is evidence that basic newborn resuscitation by trained health care providers has reduced the early neonatal mortality rate and improved long-term neuro-development outcome (Janet et al., 2018). A Jordanian study showed that 37% of neonatal deaths were preventable, with 37.3% of neonates receiving optimal care, while the rest received care less than optimal. Also, many neonatal deaths are avoidable by providing optimal intrapartum and immediate postpartum care (Batieha et al., 2013).

The results of this study can lead to the development of skilled and trained health care providers. So, they respond quickly and efficiently to the newborn resuscitation areas and prevent the development of complications. The program provides simple, low technological, and evidence-based interventions to ensure that registered midwives have adequate knowledge and skills regarding basic neonatal resuscitation in the most vulnerable period in a newborn's life.

Basic newborn resuscitation in Jordan has been given little attention and is still ignored by many midwives, which addresses the need for further investigation. This study aims to assess midwives' knowledge and skills regarding BNR. The study also aimed to evaluate the effectiveness and appropriateness of the Basic Newborn Resuscitation Educational Program in improving midwives' knowledge and skills.

Methods
Study Design, Participants and Setting

The study used a pre–post-test design to compare the

knowledge and skills of midwives in performing basic newborn resuscitation. A pre–post-test design was selected to measure any significant differences in the scores on knowledge and skills regarding BNR performance from baseline to end-line measurements. A paired-sample t-test was used to measure the differences between the scores on knowledge and skills between the pre–post-intervention means. A t-test and a one-way ANOVA were also used to test for potential confounders.

The target population for this study was all registered midwives working in the delivery rooms in Jordanian governmental hospitals in the northern region. In contrast, the accessible population was midwives who work at labour units in these hospitals. All midwives working in the labour units during data collection were invited to participate in this study. The data was collected for three months, from 1 August to 1 November 2018. During data collection, purposive sampling was used to select registered midwives available at these units. All employed registered midwives have completed either a 4-year midwifery bachelor program at a university or a 3-year midwifery diploma program at a public community college. Also, they have at least six months of experience in the labour units. Midwives working in maternal units (ante-natal, post-natal) without experience in labour units were excluded.

Study Setting

The study occurred in the labour units of nine governmental hospitals in Jordan's northern region (Irbid, Al-Mafraq, Ajloun, and Jerash). The overall number of governmental hospitals in this region is 14, but labour units are available in nine hospitals, having 291 registered midwives (Ministry of Health Hospitals - Ministry of Health, 2018). The rationale for selecting these hospitals is the participants' availability and the study's feasibility.

The required sample size was calculated using G-power V.3.1 by the following settings: alpha= 0.05, moderate effect size (0.25), and power= 0.80, applying correlation test. The study sample was obtained from all the participating hospitals relative to the midwives' population size, from the nursing managers. One hundred midwives were enrolled in the study.

An Overview of Basic Newborn Resuscitation Education Program Intervention

BNR is a series of workshops adapted from several children's associations, including the American Academy of Paediatrics (2021), conducted over three months between October and December 2018. The workshops included the following components. An overview lecture supported by PowerPoint slides based on a review of the AAP Neonatal Resuscitation Textbook standards, 8th edition, 2017 (Weiner et al., 2021).

The program highlights cardiopulmonary adaptations, basic newborn resuscitation steps, significant equipment, and an overview of the resuscitation algorithm focusing on the initial steps.

(i) A video is displayed to demonstrate the essential skills and the required necessary steps that should be performed for newborns immediately after birth to initiate adequate breathing, mainly using bag and mask ventilation.

(ii) Provided is an active demonstration of the basic resuscitation techniques using a manikin's baby. The demonstration includes cord clamping care, drying the newborn, preventing hypothermia, clearing the airway, providing positive pressure ventilation with a self-inflating bag, and administering chest compression if needed.

(iii) The evaluation section is implemented by administering pre-and post-test questionnaires to assess midwives' knowledge and skills. The pre-test was used one week before the workshops, whereas the post-test was used immediately thereafter.

After grouping the midwives into fifteen teams, the quality of skills was evaluated before and after the workshops directly by observation of the manikin's baby based on different neonatal resuscitation scenarios adopted from the American Academy of Paediatrics, the American Heart Association, the National Heart Foundation of Australia, and the Australian Heart Association.

(iv) Handbook of BNR and pamphlet (soft copy and hard copy) including the main components and steps of the program were distributed to the attendants after each day of the educational program. Experienced NRP trainers conducted the workshops. Independent life support clinical instructor nurses did the observation of the teams.

Before the program's application, a structured self-administered questionnaire was distributed within one week of the start of the educational program to assess the midwives' knowledge and the quality of basic newborn resuscitation skills. Three workshops were conducted in different clinical settings over three days.

Table 1. Midwives' demographic and professional characteristics (N= 100)

	Frequency	Percentage
Age (years), mean(SD)		33.3 (6.6)
30 or below	39	39
31-40	47	47
>40	14	14
Marital status		
Never married	18	18
Ever married	82	82
Education		
4-year bachelor degree of midwifery program	45	45
3-year midwifery diploma education program completed at a public community college	55	55
Experience in ante-natal care		1.8 (3.3)
Experience in labour care		6 (4.9)
Experience in post-natal care		1.7 (3.6)
Experience in midwifery		
Less than 3 years	13	13
3 years – less than 5 years	23	23
5 years – 10 years	27	27
More than 10 years	37	37

At each workshop day, training over 8 hours was implemented; this included extensive hands-on teaching of basic newborn resuscitation techniques. The significant features of the in-service training day focused on the following crucial steps:
Drying the infant;
Preventing hypothermia;
Clearing airway;
Providing positive pressure ventilation with a self-inflating bag;
Administering chest compression as needed;
Several case scenarios were presented, and simulation training was performed.

The Test Script

The study used a structured self-administered questionnaire to measure the knowledge level of midwives regarding basic neonatal resuscitation (Ndzima-Konzeka, 2017). The questionnaire had three sections:
- Section A has biographical data and consists of eight questions, including age, marital status, qualifications, experience, and training, as well as contribution to basic neonatal resuscitation.
- Section B had 22 various multiple-choice and true/false questions. This section assesses the knowledge of midwives regarding BNR. It includes 22 questions from (9-30) from which midwives could choose the correct one, including the most appropriate decisions and actions related to warming, drying, airway clearance, and stimulation immediately after birth. The cut-off score equals 84 (American Academy of Pediatrics, 2021).

Section C had fourteen indicators (skills) of newborn resuscitation for priority, where the midwives were asked to rate them using a Likert-like scale with three levels (1= Not priority, 2= Low priority, and 3= High priority). The same fourteen indicators were measured on the midwives twice, firstly before the educational session, then immediately after completing the educational session.

The skills of midwives regarding basic neonatal

resuscitation were measured by using an instrument established by Khriesat et al. (2017). It included a checklist of basic neonatal resuscitation steps. It involved 14 items. The first eight skills are performed at birth, while the last six are performed between 30 seconds and 5 minutes after birth.

The observer was an independent life support clinical instructor nurse. She rated the resuscitation skills of midwives on a 4-point Likert scale as follows:

1 = not performed.

2 = poorly and inappropriately performed.

3 = appropriately performed, but with minor deviations from the standard sequence.

4 = appropriately performed and met the standard sequence.

The questionnaire was available in English because it is the primary communication language among health care practitioners at hospitals. Currently, the pre-service training and in-service training of midwives are in English.

Conducting the Study

Before the educational program, the midwives were briefed about the workshops and the research format. Furthermore, we informed the midwives that our findings could be presented or published as a research paper later. We asked midwives to fill in the serial number in the designated slots on the questionnaire to enable the matching of pre-and post-tests for statistical analysis.

Statistical Analysis

Chi-squared test of Goodness-Of-Fit ($\chi 2$ GOF test) was used to assess whether the midwives correctly answered the knowledge questions regarding the pre- and post- basic newborn resuscitation educational program. The Relative Importance Index (RII) analysis was used to describe and rank the midwives' skills in basic newborn resuscitation.

A paired-sample test assessed the midwives' mean knowledge gained from the pre-to-post-education program. The same was done for midwives' BNR prioritization and the quality of the team performance of BNR measured scores. T-test and one-way ANOVA were used to assess the mean difference among midwives' knowledge scores at baseline, and multi-level categorization was used to measure any statistically significant differences in the variables. The multi-variate binary logistic regression analysis assessed the combined and individual associations between midwives' demographic, professional, and working characteristics and their odds of passing the Basic Newborn Resuscitation (BNR) knowledge test post the educational session.

Ethical Approval

This study was approved by the Institutional Review Board (IRB 481-2018) committee at JUST and the ethical committee of the Jordanian Ministry of Health (JMH). Autonomy was achieved by notifying the participants of their right to participate voluntarily in the study and obtaining informed consent. Also, justice was applied by respecting the right of the participants to decide freely and not being forced to participate in the study. Also, the participants could withdraw from the study without penalty.

Results

The results of midwives' demographic characteristics, professional characteristics, and previous training and practice of neonatal resuscitation skills are shown in Tables 2 & 4. The midwives' overall knowledge score on BNR before the program was equal to 68.38% (SD= 13.4), with 75% having knowledge scores of 79.1 out of hundred or less. But, the midwives' knowledge was classified into (lowest thru 71= low); (71.001 thru 84= medium); (84.001 thru highest= high). The distribution of midwives' knowledge scores was as follows: 2% had low BNR knowledge, 39% had medium knowledge, and only 9% had high knowledge (see Table 3). The mean knowledge score after the educational session was equal to 78.72% (SD= 10.33) p<0.001, with 75% of the midwives having knowledge scores of 86.2% or less.

The paired-sample t-test showed that there was a statistically significant rise in the midwives' knowledge of basic newborn resuscitation from (M=68.38%, SD= 13.4) before to (M=78.72%, SD=10.3) after the educational program (t=6.29, p<0.001).

Midwives' overall score for performing steps of BNR has been rated with a priority rating equal to 2.71 out of 3 points. Still, after education, their rating score rose to 2.9 out of 3 points. The mean quality of the team performance of practical BNR was rated with adequacy and conformity to the standard mean rating of 2.2 out of 4 points before the educational session. This, however,

raised to a mean quality rating equal to 3.64 out of the maximum four Likert-like points.

There were no statistically significant differences in midwives' knowledge scores before the educational session associated with demographic data. However, midwives with previous training in airway management had significantly lower BNR knowledge on average than those who had never had another training, according to the independent t-test.

Table 2. Descriptive statistics for midwives' overall measured knowledge prioritisation and performance on BNR before and after the BNR program

Stage Intervention	Mean (SD)	25th Percentile	75th Percentile
Before education Midwives' BNR knowledge Score (%)	68.38 (13.4)	58.6	79.1
After education Midwives' BNR knowledge score (%)	78.72 (10.33)	69.8	86.2
Before education Prioritization mean score (1-3) Likert score	2.71 (0.3)	2.5	2.98
After education Prioritisation mean score (1-3) Likert score	2.90 (0.2)	2.8	3
Before education Quality of skills (1-4) Likert score	2.2 (0.8)	1.5	2.64
After education Performance (1-4) Likert score	3.64 (0.5)	3.57	3.93

There was no statistically significant association between midwives' demographic measures (age, marital status, qualification, experience, and previous training) and their likelihood to pass the knowledge test after the educational program.

The multi-variate logistic regression model suggested that the midwives' age correlated significantly and positively with their odds of succeeding in the post-educational session knowledge test with a score >84% (p=0.022). The analysis shows that midwives' educational level and any previous or current type of resuscitation training did not correlate significantly with their odds of passing the BNR post-post-education knowledge test.

Interestingly, there was a significant rise in the midwives' overall quality of BNR team performance from before education (M=2.2, SD=0.8) to after education session (t=5.1, p<0.001). The effect of the educational program on midwives' team performance of the BNR was very substantial (Cohen's d= 1.30) on average, suggesting that the midwives' interacted teamwork on average was significantly better in terms of conformity to standards, completeness, and accuracy after they had attended the educational program.

Discussion

To our knowledge, this is the first research study that addresses the level of midwives' knowledge and skills before and after introducing the basic resuscitation educational program in Jordan.

Interestingly, the strength of the current study lies in the systematic training and assessment of knowledge and skills during one day. Generally, the study revealed that the midwives needed the necessary knowledge and skills in basic newborn resuscitation before the workshop training. The knowledge score percentage was 68.38%, which is far away from the cut-off score of 84%, and the mean quality performance was (M=2.2, SD=0.8).

The baseline knowledge and performance quality scores reflect that midwives' knowledge and skills in BNR could be better. This finding was supported by the study of Kassab et al., which found that Jordanian midwives need better knowledge and skills regarding BNR (Kassab et al., 2017). Also, some barriers were identified, including organizational constraints, educational needs and poor coordination among team members (Kassab et al., 2017). However, no one can ignore that the support system and regular training

should be applied to make midwives more knowledgeable and skillful in basic newborn resuscitation. Remarkably, our workshop training showed a significant rise in the overall midwives' knowledge and quality performance after the training

program (78.72%) (M= 3.64). The current study results are congruent with the literature, which found that knowledge scores and skills on neonatal resuscitation statistically improved after training (Opiyo et al., 2008; Thomas et al., 2017).

Table 3. Midwives' previous training and practice of neonatal resuscitation skills

		Frequency	Percentage
Training on Helping Baby Breath (HBB)	No	73	73
	Yes	27	27
Duration since last training	n=20		49.41 (36.4)
	No	69	69
	Yes	31	96
Duration since last training	n=25		53.82 (36.7)
	No	73	73
	Yes	27	27
Duration since last training	n=19		57.84(39.7)
	No	74	74
	Yes	26	26
Duration since last training	n=17		74.12 (40.5)
Training on Newborn Resuscitation	No	90	90
	Yes	10	10
	Yearly	19	19
	Weekly-Monthly	55	55
	Daily	26	26
When was the last time you participated in neonatal resuscitation?	Within last year	22	22
	Within the last 3-6 months	14	14
	Within the last month	26	26
	Within the last week	38	38

Furthermore, the overall prioritizing of the basic newborn resuscitation skills (before and after the educational program) significantly rose. This suggests that midwives' average ratings of the priorities of the fourteen skills were significantly higher after the educational session. Interestingly, our results suggested that those with previous other training (such as airway management and intubation) had significantly lower BNR knowledge on average than those who had never had training. The elapsed time since those midwives were subjected to previous other training in airway management was 74 months on average. This means the need for ongoing and regular in-service training for midwives in their health facilities.

The literature has shown that ongoing service training is essential and required as frequently as every six months to retain resuscitation skills (Thomas et al., 2017). Another research study suggested that "newborn resuscitation rolling refresher training" conducted every 6 months may not offer another benefit to health care providers (Cepeda Brito et al., 2017).

The American Academy of Pediatrics requires renewing the neonatal certification card every two years. But, AAP suggested that health facilities may require renewal of neonatal resuscitation certification more frequently. This could offer a benefit, such as following any updates to previous steps, which would increase the performance of the resuscitation providers.

Unfortunately, most developing countries, including Jordan, still need regular and updated conduction of newborn resuscitation training.

According to the research of Bennet and Bennet (2004) on knowledge, there is a correlation between midwives' knowledge and the corresponding levels of learning and actions. Midwives might have conceptual knowledge, which is necessary to draw distinctions in applying the required skills (Bennet & Bennet, 2004). Hence, there was a correlation between the updated performance of neonatal resuscitation and gained knowledge.

However, the one-way ANOVA test showed statistically significant differences in the midwives' mean BNR knowledge scores before educational sessions across their measured experience in midwifery levels. Bonferroni adjusted *post hoc* pairwise comparison on the mean BNR knowledge between the midwives' experience levels showed that the midwives experienced with 3-5 years had slightly lower mean knowledge scores (M= 64.32%, SD= 14.2) than their peers with ten or more years of midwifery experience (M= 72.88%, SD=12.5), (p=0.090). This finding agrees with other study findings, which showed that the number of years of experience was associated significantly and positively with knowledge score (Ameh et al., 2016; Ciurzynski et al., 2017).

The current study has several strengths that should be acknowledged. The first strength is that midwives' knowledge and quality of skills were established using the well-established test script that covered the significant domains of basic newborn resuscitation. Secondly, most questions in the test script were related to the practical parts of basic newborn resuscitation. The educational program is achievable with minimal equipment and does not require advanced equipment or preparation, and skills could be applied with simple and low-tech interventions.

Some limitations should be acknowledged in the current study. Firstly, the generalizability of findings could be limited due to the non-random selection of the participants who were taken from one region of Jordan (north). Moreover, we restricted training in simulation training on baby manikins, and we had a short follow-up period.

Conclusions

This study highlighted the importance of knowledge and skills needed by midwives to accomplish their work, as well as practices of preparing delivery rooms in the labour units. It also empowers midwives in the safe practice of the childbirth process and the assessment of the newborns to ensure that newborn babies' adaptation is achieved within the "golden minute." Moreover, the study showed that midwives need to gain knowledge and skills regarding basic newborn resuscitation. The results showed a significant impact of BNR training in improving the midwives' knowledge and skills. However, long-term effects can be established by observational trials in labour units.

The current study showed that the BNR program could improve midwives' performance of basic newborn resuscitation and thus help prevent several newborn complications (hypothermia and inadequate breathing) that could lead to deaths. Similar studies must be conducted to follow up the midwives' training in the clinical areas using the BNR program.

The current study provides valuable information for the review of national policy. Furthermore, the study could guide a plan for future standardized continuing professional education and the development of skill training programs and protocols in Jordan. Reorienting national maternity care to provide continuity of care, upskilling registered midwives to their full scope of practices, and making essential resources available to improve newborn survival rates in Jordan are of vital importance.

Conflict of Interest

No conflict of interest is to be declared by the authors.

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