

2020-01-30

**Master's Dissertation of  
St. Luke's International University  
Graduate School (2019)**

A Feasibility Study on Basic Resuscitation Program for Health Providers in  
Indonesia: A Controlled Before-After Study

「インドネシアにおける新生児心肺蘇生法研修プログラムの開発および  
実行可能性検証のための比較介入研究」

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## 1. Background

According to the WHO report in 2016, 46% of the under 5 mortality rate occurs in the neonatal period (less than 28 days after birth) (WHO & Mathers, 2016). Most neonatal deaths occur in low- and middle-income countries, particularly in the sub-Saharan African and Central and South Asian countries.

Indonesia is in Southeast Asia and it has many islands in the East and West within a 5,110 km radius. However, as the country has more than 10,000 islands, medical regional disparities are large, making the current quality of medical care unequal. The regional map is shown in Figure 1.

The Gross Domestic Product (GDP) of Indonesia in 2018 was \$10,422,000 million, and it has recently grown by about 5.2% (World Bank, 2019). Indonesia was ranked 16th in the GDP ranking in 2018. However, its GDP capita was in the 118<sup>th</sup> position, indicating a low level of affluence compared with the other listed countries on the ranking (World Bank, 2019).

Notably, Indonesia has made a remarkable success in the Millennium Development Goals Target 4. The under 5 mortality rate improved from 80.6 (per 1000 live births) in 1991 to 27.3 (per 1000 live births) in 2015. However, this number is still a huge challenge to reduce in Indonesia. Progress has been very slow, particularly among ASEAN countries (Victora et al., 2016). The neonatal mortality rate represents the highest proportion in the under 5 mortality rates, and this was 14 (per 1000 live births) in 2016 in Indonesia (U. WHO & Mathers, 2016). Approximately 60,000 children under 5 years of age die annually in Indonesia, and about 48% of them are newborn deaths (Rosales et al., 2017; UNICEF, 2015).

Neonatal deaths occur most frequently within 24 hours after birth (75%). In 80% of the cases, the causes are preterm birth, infections, or birth asphyxia (Hug, Sharrow, & You, 2017). As reported in the *Lancet* in 2016, 36% of newborn deaths in Indonesia were described as preterm birth, 22% as birth asphyxia, and 13% as caused by infection (Liu et al, 2016). Therefore, educational programs for newborn resuscitation for healthcare providers at the time of delivery are crucially important in low- and middle-income countries including Indonesia.

Accordingly, it is important to develop an appropriate system for an educational program of simulation training on neonatal resuscitation to save new lives during the time of delivery at the in-service level in Indonesia. Moreover, it is indispensable to clarify the effects of resuscitative care on the knowledge, skills and self-confidence of nurses and midwives at health community centers (i.e., Puskesmas) where most births occur in North Sulawesi.

## **2. Literature Review**

### **2-1. Sustainable Development Goals and skilled birth attendance in Indonesia**

In North Sulawesi, the under 5 mortality rate was 43 (per 1000 live births) and the neonatal mortality rate was 24 (per 1000 live births) in 2008 (Indonesian Government Statistics, 2008). Hence, there is an urgent need to disseminate neonatal resuscitation care.

In the Sustainable Development Goals 3.2, the United Nations proposed that “By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under 5 mortality to at least as low as 25 per 1,000 live births” (Way, 2015).

WHO and UNICEF launched the "Every Newborn Action Plan" (WHO, 2014), which is a joint action platform for the reduction of preventable newborn deaths and stillbirths. The plan encourages the provision of high-quality care by the same health providers with midwifery skills (WHO, 2014). WHO defines a skilled birth attendant as someone “trained to proficiency in the skills needed to manage normal (uncomplicated) pregnancies, childbirth and the immediate postnatal period, and in the identification, management and referral of complications in women and newborns” (Hug et al., 2017). In Indonesia, the coverage of skilled birth attendants at birth increased to 87.3% in 2012 (UNICEF, 2015) from 40.7% in 1992 (Indonesian Government Statistics, 2008). However, as the country has more than 10,000 islands, medical regional disparities remain large, and the quality of perinatal care is currently unequal.

The International Liaison Committee on Resuscitation consensus 2005 emphasized that a resuscitation-skilled person should attend at every delivery. Many studies have shown that training in neonatal resuscitation improves perinatal outcomes (Carlo et al., 2010; Jukkala & Henly, 2007; Lee et al., 2011; Msemo et al., 2013)

In Indonesia, there are only 0.2 doctors for every 1,000 people compared with 1.4 nurses and midwives (UNICEF, 2015). The coverage of skilled birth attendance at birth is 84.2% in North Sulawesi (UNICEF, 2015), and midwives and nurses are expected to decrease the high neonatal mortality rate in this area. Skilled birth attendants who can administer appropriate medical treatment to newborns, including maternal and fetal care, are encouraged to eradicate preventable newborn deaths.

In 2014, the Indonesian government enforced the National Social Insurance (JKN) system, aiming to adapt the JKN system to all citizens by 2019. The expense of childbirth is covered by the insurance system free of charge, and the government settled the system to encouraged the placement of midwives on a village-based basis to improve the quality of pregnancy and delivery since 1989 (Achadi et al., 2007). The Indonesian government and Japan International Cooperative Agency collaborated to disseminate utilizing the maternal

and child handbook which is effective in increasing knowledge from pregnancy to childcare (Osaki & Aiga, 2019). The institutional delivery rate in Indonesia is 80.1% in urban areas and 46.5% in rural areas (UNICEF, 2015). These data indicate that neonatal resuscitation education for medical personnel in facilities is very effective.

According to the Indonesian Ministry of Public Health, the number of healthcare providers in North Sulawesi, particularly nurses and midwives, was larger than the number of physicians (6201 nurses and 1804 midwives vs 714 physicians) in 2018 (Recapitulation of Health Human Resources, 2018). As midwives have been assigned in villages, nurses and midwives are mainly involved in delivery care in public health centers referred to as “Puskesmas” which handles delivery in the area. There are many opportunities to improve asphyxia by applying neonatal resuscitation.

It is important for many nurses and midwives to become skilled in treating asphyxia for newborns and to educate as many health providers as possible to improve the prognosis of newborns in the community.

## **2-2. Purpose for conducting simulation training on neonatal resuscitation for nurses and midwives**

Simulation education is one of the educational methods that has attracted attention in recent years. In fact, there are many studies that report its effectiveness in neonatal resuscitation (Halamek et al., 2000; Sawyer et al., 2011; G. M. Weiner et al., 2011). Simulation-based learning is based on adult learning. It is important for learners to be aware of successes, problems, and issues from their experiences and to obtain feedback (Fanning & Gaba, 2007). This type of training effectively raises technical skills on decision making, social communication skills, and non-technical skills such as leadership for the effective use of human resources (Dunn, Niday, Watters, McGrath, & Alcock, 1992).

To resuscitate newborns from neonatal asphyxia without delay, it is important to improve resuscitation decision-making and techniques by performing repetitive simulation training in an appropriate simulated environment. Abe stated that simulation education involves “the individual or team engaging in a learner experience medical treatment on a simulated environment, and based on that experience, learners improve their ability to understand what specialized knowledge, skills, and attitudes are clinically important in practice to provide the best medical treatment by utilizing related materials, focusing on discussions between learners, and referring to feedback from the instructor” (Abe, 2013). Learners are able to practice repeatedly without harm to the patient, and as for adult learning, it is very effective to train independent and voluntary posture and attitude development on clinical care. At the same time, it removes the anxiety of nurses and midwives who take care of newborns

immediately after delivery and this leads to increased confidence in terms of resuscitation decision-making ability and skills. Simulation education provides ideas to nurses and midwives emphasizing the importance of supporting each other during births and learning how to use effective leadership and communication as a team to save lives. In addition, greater confidence and motivation are cultivated to work as a team member to save the life of babies, which leads to vitality in practice.

Notably, there are more nurses and midwives than physicians in Indonesia. Nurses and midwives represent the largest proportion (76%) of the total health workforce of Indonesia (Indonesia Ministry of Health, 2017). The World Bank reported that there were 0.4 physicians per 1,000 people, and 2.1 nurses and midwives per 1,000 people in Indonesia in 2017 (World Bank, 2017). Although nurses and midwives play very important medical roles in Indonesia, they lack knowledge of basic newborn care when handling normal childbirths and managing emergencies (Hennessy, Hicks, Hilan, & Kawonal, 2006; Sethi, Tholandi, Amelia, Pedrana, & Ahmed, 2019). Some studies highlighted their inadequate training and preparations for their roles (Hennessy, Hicks, Hilan, et al., 2006; Hennessy, Hicks, & Koesno, 2006; Shields & Hartati, 2003).

If neonatal resuscitation is properly carried out by healthcare professionals, neonatal asphyxia can be significantly reduced. This can improve neonatal prognosis and ultimately reduce healthcare costs in the region. For Indonesia with a low per capita GDP, it is very important for nurses and midwives to have competency in reducing the rate of neonatal asphyxia. In addition, the value of neonatal resuscitation is very high if it can be taught and passed on through proper education.

### **2-3. Simulation-based training intervention in Indonesia**

Education on neonatal resuscitation has been reported to improve knowledge, as well as resuscitation ability and confidence in resuscitation (Jukkala & Henly, 2007). Numerous studies have shown that neonatal resuscitation is particularly effective in rural areas where medical equipment resources are scarce. Carlo and colleagues reported that neonatal resuscitation care training reduced the 7-day mortality rate from 11.5 (1000 live births) to 6.8 (1000 live births) in Zambia (Carlo et al., 2010). Similarly, the 47% neonatal deaths within the first 24 hours of life and the 24% stillbirths decreased after neonatal resuscitation care training as revealed in a two-year survey from eight hospitals in Tanzania (Msemu et al., 2013).

The most important part of neonatal resuscitation is lung ventilation of the newborn (Gary M Weiner, Zaichkin, Pediatrics, & Association, 2019). Opiyo and co-workers stated that basic neonatal resuscitation is possible with minimal equipment and without intensive care facilities



in 95% of cases where it is required (Opiyo et al., 2008). Many studies have indicated that training in neonatal resuscitation skills, even the basic steps alone, is cost-effective, simple, and can have a large impact on neonatal mortality and morbidity from birth asphyxia (Bream, Gennaro, Kafulafula, Mbweza, & Hehir, 2005; Carlo et al., 2010; Msemo et al., 2013). These lines of evidence indicate that neonatal resuscitation can be implemented in areas where medical equipment resources are lacking, particularly in low-income settings. Unfortunately, effective simulation-based training has not yet been conducted in Indonesia.

### **3. Methods**

#### **3-1. Study design**

A controlled before-after study in two arms was used in the present study to ascertain the difference in improvement of knowledge and skills for neonatal resuscitation that conforms to the culture of Indonesia, a country which has a high neonatal mortality rate. The educational program on simulation training was conducted to enhance the ability of the participants to provide delivery care with team medical care. The outcome measures were used to compare the differences during the transitions in the pre-, post-, and three-month interventions. The evaluation of the program by the participants was examined in terms of feasibility and acceptability. The timeline of this study is shown in Figure 3.

#### **3-2. Setting**

This study was conducted in Manado, North Sulawesi, Indonesia from September 4, 2018 to March 13, 2019.

#### **3-3. Participants**

A total of 68 participants (35, intervention; 33 control) were recruited for the present study. We included midwives and nurses who worked in Puskesmas in North Sulawesi, Indonesia. Only midwives and nurses whose work was associated with resuscitative care of neonates were included. I implemented the neonatal resuscitation program for midwives and nurses in the Puskesmas of eight regions and cities in North Sulawesi. These midwives and nurses were classified as the intervention group. The midwives and nurses working in the remaining Puskesmas in Tomohon city were classified as the comparison group. The regional map are shown in Figure 1 and 2. The participant flow diagram is shown in Figure 5.

#### **3-4. Outcome measures**

##### **3-4-1. Primary outcome**

##### **a) Knowledge and skills related to neonatal resuscitative care**

The demographic characteristics of the participants including their age, job qualification, clinical experience, experience of resuscitative treatments and care on the newborn, collaborative support of colleagues, and experience of a resuscitative training program were obtained from the pre-questionnaire survey.

The contents with regard to the participants' knowledge and skills were based on information from the Neonatal Cardiopulmonary Resuscitation (NCPR) and Neonatal Resuscitation Program textbook (Gary M Weiner et al., 2019). The participants contributed 23 True or False questions in the questionnaire regarding their core competencies such as

basic skills, knowledge, and decision-making ability on neonatal resuscitation at three points (pre-, post-, and three-month intervention) (Appendix 1). The differences in the scores between the pre- and post-interventions, the pre- and three-month interventions, and the post- and three-month interventions were examined in the intervention group, as well as those between the pre- and three-month interventions in the control group.

#### **b) Self-confidence on neonatal resuscitative care**

Self-confidence on neonatal resuscitative care was assessed using the questionnaire in relation to 16 basic treatments and care on the Likert scale from “very unconfident” to “very confident” at three intervention points (pre-, post-, and three-month interventions) (Appendix 2). The differences in the scores between the pre- and post-interventions, pre- and three-month interventions, and post- and three-month interventions were examined in the intervention group, as well as those in the pre- and three-month interventions in the control group.

### **3-4-2. Secondary outcome**

#### **a) Evaluation of the program**

For evaluation of the program, the participants were asked five questions about the program content and facilitation using the following categories on the Likert scale from “strongly disagree” to “strongly agree”. There were four open questions related to the course evaluation and requests from the participants. In addition, the participants in the intervention group were asked if the program was useful in clinical practice (Appendix 3).

#### **b) Acceptability**

For the evaluation of acceptability of the program, acceptable performance in terms of a transition towards a change in knowledge was evaluated. Additionally, the participants were asked five questions about the program content and facilitation using the Likert scale from “strongly disagree” to “strongly agree”. There were four open questions to obtain qualitative data which were related to course evaluation, satisfaction, and requests from the participants. In addition, the participants in the intervention group were asked if the program was useful in clinical practice (Appendix 4).

#### **c) Feasibility**

The feasibility of the educational program was evaluated according to the following aspects: acceptable recruitment, number of participations in the program, number of completed questionnaires returned, adherence to assessment of the patients using the

program, and retention of competency in neonatal resuscitation. Additionally, the participants were asked five questions about the program content and facilitation using the Likert scale from “strongly disagree” to “strongly agree”. There were four open qualitative questions related to course evaluation and requests from the participants. In addition, the participants in the intervention group were asked if the program was useful in clinical practice. Their scores for knowledge, skills, and self-confidence represent their retention of neonatal resuscitation ability indicative of the feasibility of the program.

### **3-5. Recruitment**

The participants were recruited from August 2018 in cooperation with Dr. Windy from the headquarters of Puskesmas in North Sulawesi province by sending invitations of written requests by mail. Convenience sampling was used to select participants from Puskesmas in eight regions and cities of North Sulawesi for the intervention group, and in three out of seven regions of Tomohon city for the control group.

### **3-6. Data collection**

All questionnaires were translated into Indonesian in cooperation with the faculty of the University of Sam Ratulangi in Indonesia. Two of the research collaborators checked the accuracy of the Indonesian translation. Dr. Windy M. V. Wariki of the University of Sam Ratulangi in Indonesia and Ishak Halim Octawijaya of Tsukuba University in Japan double-checked the Indonesian language.

#### **3-6-1. Procedure for intervention**

Written informed consent was obtained from all the participants in the intervention group before the study. Pre-questionnaires were given to the participants before the implementation of the training program (Pre: Appendix 5). The participants' demographic variables were obtained including their age, job qualification, clinical experience, experience of resuscitative treatments and care of newborn, collaborative support of colleagues, and experience of a resuscitative training program. In addition, the participants were asked about their self-confidence on resuscitative skills in which the midwives and nurses rated items on a quality scale of 1 to 5, and answered True-False questions about resuscitation knowledge and decision-making ability.

Implementation of the training program of neonatal cardiopulmonary resuscitation was based on the NCPR simulation training. The program included task training, algorithm training, and situation-based training which utilized a blended approach including lecture and hands-on case-based simulation.

After completion of the resuscitation training program, we distributed the same questionnaires with components similar to those of the pre-questionnaires to evaluate the transition of resuscitation skills and knowledge, decision-making ability, and self-confidence on resuscitation. Additionally, the midwives and nurses were asked questions to evaluate the facilities, processes, and evaluation throughout the program (Post: Appendix 6).

Three months after the completion of the resuscitation training program, the same self-reported questionnaire was distributed to the participants. The questionnaire had the same components: self-confidence on resuscitative skills which asked midwives and nurses to rate items on a quality scale of 1 to 5, and True-False questions about resuscitation knowledge and decision-making ability. In addition, the participants were asked if the program was useful in clinical practice (three-month: Appendix 7).

### **3-6-2. Procedure for control**

Written informed consent was obtained from all the participants in the control group before the study. The same Pre-questionnaires were given to the control participants. The participants' demographic variables were obtained including their age, job qualification, clinical experience, the experience of resuscitative treatments and care of newborn, collaborative support of colleagues, and experience of a resuscitative training program. In addition, the participants were asked about their self-confidence on resuscitative skills in which the midwives and nurses rated items on a quality scale of 1 to 5, and answered True-False questions about resuscitation knowledge and decision-making ability (Pre: Appendix 5).

Three months after the Pre-questionnaires were given, the same self-reported questionnaire was distributed to the control participants. The questionnaire had the same components to evaluate the transition: self-confidence on resuscitative skills which asked the midwives and nurses to rate items on a quality scale of 1 to 5, and True-False questions about resuscitation knowledge and decision-making ability (three-month: Appendix 7).

Even for the participants in the control group who have not experienced an intervention resuscitation training program, we implemented the same program as in the intervention group in August 2019, a year after the intervention to provide resuscitation techniques to all the participants.

## **3-7. Educational program of simulation training on neonatal resuscitation**

### **3-7-1. Objectives of this program**

- A) To develop an appropriate educational program of simulation training on neonatal resuscitation in Indonesia

- B) To evaluate the effects of resuscitative care on knowledge, skills and self-confidence related to the neonatal resuscitative care of nurses and midwives at health center in North Sulawesi

### **3-7-2. Contents of the training program**

The following educational program was intended for nurses and midwives at Puskesmas in North Sulawesi. The basic simulation-based neonatal resuscitation training program was implemented for about three hours. The contents of the training program are shown in Figure 4. The training program was organized by the NCPR committee, and its contents were approved for use by Masanori Tamura, the Chair of the committee.

Giving the knowledge of newborn physiology at birth in the first learning activity, and participants learn basic skills of neonatal resuscitation by hands-on practice in the second activity. In the third activity, participants learn to integrate the knowledge, skills and decision-making ability using algorithm in a scenario session.

### **3-7-3. Training facilitators**

The researcher acted as the facilitator of the program. She was trained and certified in the NCPR instructor course by the NCPR committee. The NCPR training program has been facilitated for over 20 times in 8 years. A training assistant in the person of Ms. Hitomi Suzuki helped to facilitate the program. Ms. Suzuki is a midwife and a masteral student at St. Luke's International University in Japan. She is certified in the NCPR provider course by the NCPR committee. Ishak Halim Octawijaya of Tsukuba University in Japan interpreted the program.

## **3-8. Measurement tool**

### **3-8-1. Primary outcomes**

#### **a) A questionnaire for measuring knowledge and skills for neonatal resuscitation**

The pre-, post-, and three-month questionnaires (Appendices 5, 6, and 7) were created to measure competency of knowledge and skills for neonatal resuscitation based on the contents of an educational program. It was composed of 23 items (Appendix 1).

The participants were asked about each item on a scale of "True" and "False". The number of correct answers comprised the score. A wrong answer or no answer was regarded as having no score. If the participants answered all the questions properly, a perfect score had 23 points.

#### **b) A questionnaire on self-confidence for neonatal resuscitation**

The pre-, post-, and three-month questionnaires (Appendix 5, 6, and 7) were created to evaluate self-confidence for neonatal resuscitation as basic treatment based on the contents of an educational program. The questionnaire was composed of 18 items (Appendix 2).

The participants were asked about each item on a Likert scale with 18 basic treatments and care using the following scales: 1= strongly unconfident, 2= unconfident, 3= neutral, 4= confident, 5= strongly confident". The total scores of the 18 items were calculated. The higher the score, the more positive the attitude on self-confidence of care related to neonatal resuscitative treatments.

### **3-8-2. Secondary outcome**

#### **a) A questionnaire to evaluate the educational program for neonatal resuscitation**

A post-questionnaire (Appendix 6) was created to evaluate the educational program of simulation training on neonatal resuscitation in Indonesia. The aim was to implement an appropriate educational program for nurses and midwives in terms of acceptability and feasibility of the program, demand for the program, and practicality of the program.

#### **b) Acceptability and feasibility**

The pre-, post-, and three-month questionnaires included questions to assess the transition of competencies in knowledge and skills, ascertain adherence of participants to the program, and evaluate retention of competency in neonatal resuscitation.

The questions on acceptability and feasibility were evaluated based on the contents of an educational program (Appendix 3). The questions to evaluate acceptability and feasibility were composed of five items on the post-questionnaire: "Q1: "The content of the program matched my expectations."; "Q2: It was easy to understand."; "Q3: The program content will be useful for my future clinical activities."; "Q4: Guidance of the facilitator was appropriate."; "Q5: Are you confident about your resuscitation now?". Each item was scored using a 5-point Likert scale as follows: 1= strongly disagree, 2= disagree, 3= neither agree nor disagree, 4= agree, 5= strongly agree".

Furthermore, the participants were asked to provide comments related to the evaluation such as "Q5: What was good about the program?"; "Q6: What was bad about the program?"; "Q7: Do you have any suggestions for improving the program?"; "Q8: Do you have any further questions or any request about the program?".

Additionally, the scores of knowledge, skills, and self-confidence represent the retention of neonatal resuscitation competence, which are indicative of the feasibility of the program.

Furthermore, there were questions to evaluate the acceptability and feasibility of the

program consisting of six items on the three-month questionnaire: “Q1: “I used the content of the resuscitation program.”; “Q2: I had the opportunity to practice the resuscitation.”; “Q3: It became easy to evaluate the status of a neonate.”; “Q4: I have been able to do collaborative team work.”; “Q5: Do you think the contents of the resuscitation program will be useful in the clinical setting in the future?”; “Q6: Do you think the resuscitation program should be routinely held in your facility?” (Appendix 4).

### **3-9. Data analysis**

Data were entered into IBM SPSS Statistics (version 26 for Windows, Chicago, IL, USA) to analyze quantitative data.

#### **3-9-1. Primary outcomes**

##### **a) Nurses and midwives’ knowledge and skills for neonatal resuscitation**

Statistical analysis was conducted using the Mann–Whitney U test for continuous values, and Pearson’s chi-square test for binary variables in the demographic characteristics between the intervention and control groups.

The Student t-test was used to analyze the difference in the average scores of the response to the 23 True-False questions regarding core competencies such as basic skills, knowledge, and decision-making ability on neonatal resuscitation at the three intervention points (pre-, post-, and three-month interventions) and at two intervention points (pre- and three-month interventions) in the control group. The results were analyzed using the paired t-test to assess changes in the total average scores.

The interactions of group and time were evaluated for any correlation. Single and multiple regression analyses were used to explain if there were correlations between the variables such as age, job qualification, clinical experience, experience of a resuscitative training program, and True-False questions about their core competency.

##### **b) Nurses and midwives’ self-confidence for neonatal resuscitation**

Self-confidence on resuscitation was measured using a Likert scale with 18 items on basic treatments and care. The average score was calculated at three intervention points (pre-, post-, and three-month interventions). The Wilcoxon signed-rank test was used to analyze the difference in the average scores between the pre- and post-interventions.

The interactions of group and time were evaluated to analyze any correlation. Single and multiple regression analyses were used to explain if there were correlations between the variables such as age, job qualification, clinical experience, experience of a resuscitative training program, and confidence.



### **3-9-2. Secondary outcome**

#### **a) Evaluation of the educational program for neonatal resuscitation**

The educational program was evaluated using a five-item Likert scale after the intervention and at three-month after the intervention. The descriptions in the comments were analyzed independently and narratively to evaluate the program.

#### **b) Acceptability and feasibility**

For the evaluation of the acceptability of the program, acceptable performance in the transition change in knowledge was evaluated. Additionally, the acceptability and feasibility of the program were measured quantitatively using a Likert scale with five items, particularly for three items: “Q1: “The content of the program matched my expectations.”; “Q2: It was easy to understand.”; “Q3: The program content will be useful for my future clinical activities.” The average score was calculated for each item in the intervention group. It was indicated that the higher the score, the more positive the evaluation was about the program. The qualitative descriptions in the comments were analyzed independently and narratively to evaluate the program.

Furthermore, questions were developed to evaluate the acceptability and feasibility of the program consisting of six items on the three-month questionnaire. The average score was calculated for each item in the intervention group. A higher score indicated the demand for and practicality of the program.

### **3-10. Ethical consideration**

The researcher provided all the participants oral and written explanations about the intervention. Written informed consent was obtained from all of the participants in control group before the study. The researcher explained that participation in this research was completely voluntary. The participants can refuse to join the program or answer the questionnaire at any point of the study. The researcher also mentioned that at any point when the participants decide to refuse, withdraw, or cancel their consent, they would not be at a disadvantage (Appendix 9). This research was approved by the Ethics Committee of both St. Luke's International University (Approval number: 17-A105) and the University of Sam Ratulangi (Approval number: 4638/UN12/LL/2018).

## 4. Results

### 4-1. Characteristics of the participants

A total of 68 participants (35, intervention; 33 control) participated in this study. Two abstained during the study period and did not take part in answering the post-questionnaire in the intervention group. Therefore, the total number of participants whose data were analyzed in the intervention group was 33, and that in the control group was 33. The baseline demographic characteristics of the participants are shown in Table 1.

The mean age of the participants in the intervention group was 37.94 years (range: 22-60, SD = 8.93). Their mean years of clinical experience was 15.52 years (range: 0.3-29, SD = 8.39). On the other hand, the mean age of the participants in the control group was 37.36 years (range: 26-54, SD = 7.39). Their mean years of clinical experience was 15.60 years (range: 3-34, SD = 8.02). There were no significant differences in the age and clinical experience of the participants in both groups.

However, there were significant differences in the years of clinical experience of the nurses between the two groups. The mean years of clinical experience of the nurses in the intervention group was 5.0 years (range: 1-11, SD = 3.89), whereas the mean years of clinical experience of the nurses in the control group was 13.96 years (range: 2-34, SD = 8.01). The mean years of clinical experience of the midwives in the intervention group was 16.24 years (range: 0.3-29, SD = 7.85), whereas the mean years of clinical experience of the midwives in the control group was 16.67 years (range: 3-24, SD = 6.78). There were no significant differences in the years of clinical experience of the nurses and midwives between the two groups.

The intervention group consisted of five nurses (14.3%) and 30 midwives (85.7%). The control group consisted of 22 nurses (66.7%), eight midwives (24.2 %), two public health nurse (6.1%), and one not described. There was a significant difference in the occupation of the participants in the two groups.

There was significant difference in the educational level of the participants between the two groups. Almost 83% of the nurses and midwives in the intervention group were educated at the D3 (Diploma in 3-year nursing education) or D4 (Diploma in 4-year nursing education) level. On the other hand, more than half of the nurses and midwives (53.3%) in the control group were educated at S1 (Bachelor's program in nursing) level.

More than half of the nurses and midwives in both groups work at the obstetrics department, pediatrics department, or both. The control group included internal medicine nurses (about 40%) because the nursing staff rotate in Puskesmas.

"Free-Flow Oxygen", "Heart rate check with Stethoscope", "Drying & Prevention of heat loss of newborns", and "Mouth suctioning with a catheter" were frequently experienced by

the participants in both groups. Thirty percent of the participants experienced “Chest Compressions”, which means that they often encounter asphyxiation of neonates. Although more than half of the participants answered that they had experienced resuscitative treatments, “Positive-Pressure bag-mask Ventilation”, “Endotracheal Intubation”, “Continuous Positive Airway Pressure (CPAP)” and “drug administration” were less experienced by the participants. “Preterm Birth” was also not experienced often.

Many participants answered that they received support and feedback from the senior midwives and doctors about resuscitation.

More than 80% of the participants in the intervention group had experienced participating in a resuscitative training program. In contrast, half of the participants in the control group had not experienced participating in a resuscitative training program. There were no participants who experienced attending resuscitative training programs such as Basic Newborn Resuscitation (WHO), Neonatal Resuscitation Program (American Academy of Pediatrics), Helping Baby Breathe (American Academy of Pediatrics) or Neonatal Cardio-pulmonary Resuscitation (The Japan Society of Perinatal and Neonatal Medicine).

## **4-2. Primary outcome**

### **4-2-1. Nurses and midwives’ knowledge and skills for neonatal resuscitation**

The distribution of scores on competency of knowledge and skills for neonatal resuscitation of the nurses and midwives is shown in Table 2. The average scores of the knowledge and skills of the nurses and midwives were 11.9 points (SD = 1.9, n = 35) in the intervention group and 10.1 points (SD = 3.6, n = 33) in control group before the program. There was no significant difference in the average scores between the two groups.

Three months after the program, the average scores were 12.8 points (SD = 2.1, n = 12) in intervention group and 11.4 points (SD = 2.5, n = 32) in the control group. There was no significant difference in the average scores between the two groups.

The paired t-test was used to measure the transition of knowledge and skills for neonatal resuscitation as shown in Table 3 and Figure 6. There was a significant difference in the average scores between pre- and post-interventions in the intervention group (SD = 2.6,  $P < 0.05$ ). The average score in the post-intervention was significantly higher than that in the pre-intervention. Although the score in the post-intervention was higher than that in the pre-intervention, the score in the three-month intervention decreased. There was no significant difference in the scores between the pre-intervention and the three-month intervention, and between the post-intervention and the three-month intervention. On the other hand, in the control group, there was a significant difference in the average scores between the pre-intervention and the three-month intervention (SD = 3.7,  $P < 0.05$ ).

Single and multiple regression analyses were carried out to clarify if there were correlations between the variables such as age, job qualification, clinical experience, experience of a resuscitative training program, and the score of self-confidence for neonatal resuscitation in the pre- and post-interventions. The results are shown in Tables 6 and 7.

There was a significant difference between “Occupation (midwife)”. In other words, midwives significantly have a higher competency of knowledge and skills on neonatal resuscitation before the program (Regression coefficient: -0.346, 95% CI (-3.498 to -0.025)). Additionally, a higher level of self-confidence on neonatal resuscitation treatments before the program tended to result in a higher score of competencies of knowledge and skills on neonatal resuscitation after the program (Regression coefficient: 0.359, 95% CI (-0.004 to 2.419)).

#### **4-2-2. Nurses and midwives’ self-confidence for neonatal resuscitation**

The average score was calculated in the intervention group. The Wilcoxon signed-rank test indicated a significant difference in self-confidence of neonatal resuscitative treatment. The average ranks were as follows: pre 3.18; post 3.77; three months 3.88. The distribution of average scores on self-confidence of neonatal resuscitative treatment is shown in Table 4. The paired t-test was used to measure the transition of knowledge and skill for neonatal resuscitation as shown in Table 5 and Figure 7.

Single and multiple regression analyses were carried out to explain if there were correlations between the variables such as age, job qualification, clinical experience, experience of resuscitative training program, and their confidence in the pre- and post-interventions. The results are shown in Tables 8 and 9.

There was a significant difference between self-confidence of neonatal resuscitative treatment and “Experience of Resuscitative Training Program”. Nurses and midwives who had a chance to attend a neonatal resuscitation training program have a significantly higher self-confidence of resuscitative treatment (Regression coefficient: -0.494, 95% CI (-1.197 to -0.320)). Additionally, a higher self-confidence of neonatal resuscitation treatment after the program tended to have a significantly higher score of competencies of knowledge and skills on neonatal resuscitation after the program (Regression coefficient: 0.359, 95% CI (-0.004 to 2.419)).

#### **4-3. Secondary outcome**

##### **4-3-1. Evaluation of the educational program for neonatal resuscitation**

The educational program for neonatal resuscitation was evaluated using a 5-item Likert scale after the intervention and after three months. The evaluation scores for the neonatal

resuscitation program are shown in Tables 10 and 11.

Almost 90% of the participants answered “agree” or “strongly agree” for “Q3-1-1: “The content of the program matched my expectations”. More than 90% of the participants answered “agree” or “strongly agree” for “Q3-1-2: It was easy to understand”. All the participants answered “agree” or “strongly agree” for “Q3-1-3: The program content will be useful for my future clinical activities”. Nearly 100% of the participants answered “agree” or “strongly agree” for “Q3-1-4: Guidance of the facilitator was appropriate”. More than 90% of the participants answered “agree” or “strongly agree” for “Q3-1-5: Are you confident about your resuscitation now?”.

The descriptions on the comments were analyzed independently and narratively. The answers are shown in Table 12. The answers in the same category are tabulated together.

Many participants evaluated the program as increasing their knowledge (51.4%), enhancing their active learning towards an effective practice (14.3%) and promoting their review of resuscitation. On the other hand, the participants wanted more communication with the instructor (5.7%) and more training equipment (5.7%). Unfortunately, there were participants who no longer worked at the clinical site to be able to use resuscitation care (5.7%). More than one-third of the participants suggested that they should have this kind of program more regularly (36.4%). Some participants wanted to have a longer time for the program to learn resuscitation (9.1%).

The participants wrote requests mostly about the program as follows: “holding the program regularly” and “longer time for the program”. In addition, some participants wrote the following: “we want you to ask the prefecture and city health bureaus to hold the program often” and “we need to do this program in areas with high neonatal mortality”. The participants stated the importance of this kind of program for their practice.

#### **4-3-2. Acceptability**

The distribution of average scores on competency of knowledge and skills for neonatal resuscitation of nurses significantly increased from 11.9 to 13.6 (pre to post,  $P < 0.01$ ), and decreased by 0.8 points (5.8%) at the three-month intervention. There were significant differences in the scores between the pre to post and the pre- to three-month (pre to post,  $P < 0.01$ , Pre to three-month,  $P < 0.05$ ). The program encouraged the participants to accept neonatal resuscitation.

As stated earlier, the majority of the participating nurses and midwives answered “strongly agree” or “agree” to the following questions in the post questionnaire : “Q3-1-1: “The content of the program matched my expectations”, “Q3-1-2: It was easy to understand”, and “Q3-1-3: The program content will be useful for my future clinical activities”. The actual percentages

of the participants' replies for "strongly agree" or "agree" were 87.9% (29), 93.9% (31), and 100% (33) (Table 10).

The facilitator ratings in terms of comfort level, competency, and helpfulness were also high for the following question: "Q3-1-4: Guidance of the facilitator was appropriate". The actual percentage of the participants who replied "strongly agree" or "agree" was 97.0% (32) (Table 10).

The distribution of the average scores on self-confidence of neonatal resuscitative treatment increased from 3.18 to 3.77 (pre to post,  $P < 0.01$ ). On the one hand, the participants responded positively to the question "Q3-1-5: Are you confident about your resuscitation now?". The actual percentage answering "strongly agree" or "agree" was 94.0% (31) (Table 10).

Additionally, the qualitative descriptions in the comments were analyzed independently and narratively to evaluate the program. The qualitative data are presented in more detail separately. The participants reported a feeling a sense of empowerment from the program. The participants reported that the neonatal resuscitation program helped them to increase their knowledge which could be used in practice immediately. In addition, many of them suggested that the program should be held more regularly, and some wrote that the prefecture and city health bureaus should be involved. A midwife suggested that this program should be held in areas with high mortality in Indonesia.

Despite the positive opinions, some participants suggested that the program should improve the materials used (e.g., simulation manikins), the lecture speed, communication with the facilitator, and time management.

#### **4-3-3. Feasibility**

Adherence to the intervention was high as most of the candidates who were enrolled in the study completed the educational program (94.3%;  $n = 33/35$ ). Despite the good program attendance, the number of participants decreased at three months (34.3%;  $n = 12/35$ ). On the other hand, most of the candidates in the control group enrolled in the study completed the program until the end (96.9%;  $n = 32/35$ ). Two participants in the intervention group withdrew for personal reasons during the training program. Eleven participants in intervention group were considered as having dropped out at three months because they were not responsive to contact made by the staff. On the other hand, only one participant was considered as having dropped out from the control group between pre to three-month because she was not responsive to contact made by the staff.

The average scores of both knowledge and skills competency and self-confidence for neonatal resuscitation of nurses increased after the program. There were significant

differences in the scores between the pre and post in both outcomes (11.9 and 13.6,  $P < 0.01$ ; 3.18 to 3.77,  $P < 0.01$ ) (Tables 2 and 4). Despite the increase in competency and confidence, the scores decreased at three months (12.8, 3.38). However, both scores did not decrease below the first score in the pre-questionnaire. Finally, retention of the program was considerable.

The participants' evaluation of the perceived helpfulness of the various treatment components was also remarkably positive (Table 10). All the participants of the program answered that they had used the content of the educational program ( $n = 12$ ). The actual opportunity for resuscitating neonates was also reported (66%,  $n = 6$ ).

The participants reported feeling a sense of empowerment with regard to decision making for resuscitation from the program. All the nurses and midwives reported that the contents of the program provided benefits for assessing the status of neonates ( $n = 12$ ). Although one-third of the participants did not have a chance to practice resuscitation, all the participants reported that the contents learned in the resuscitation program will be useful in their clinical practice in the future ( $n = 12$ ). Additionally, the nurses and midwives realized the importance of collaborative team work to resuscitate neonates ( $n = 12$ ).

Nevertheless, many of the participants suggested in the post-questionnaire that the program should be held more regularly, and all of the participants answered similarly in three-month questionnaire ( $n = 12$ ).

## 5. Discussion

To the best of our knowledge, this is the first study that provides a comprehensive understanding of the competency and self-confidence of nurses and midwives after participating in a neonatal resuscitation program at Puskesmas in North Sulawesi, Indonesia. A simulation-based neonatal resuscitation program has not yet been conducted in North Sulawesi, Indonesia, and such a program has not been provided in both pre-service and in-service. The average score of the knowledge and skills of the participants in the intervention group was 11.9 points (SD = 1.9,  $n = 35$ ) with a 51.7% accuracy, and was 10.1 points (SD = 3.6,  $n = 33$ ) with a 43.9% accuracy in the control group before the program. Only half of the participants could answer the questions correctly. The findings of this study indicate that the participants have deficiencies in knowledge and skills. In other words, the nurses and midwives do not have much opportunities to learn evidence-based theoretical curricula at the pre-service and in-service levels.

The score of the knowledge and skills in the intervention group was 11.9 points (SD = 1.9,  $n = 35$ ) at baseline, and it gradually increased to 13.6 points (SD = 1.9,  $n = 33$ ) in the post-test, indicating a gain of 12.5%. The score gradually decreased after three months (12.8 points, SD = 2.1,  $n = 12$ ), which was a 5.9% reduction. The three-month test scores which dropped remained higher than the pre-test scores. Similar studies have also reported a decrease in knowledge and skills over time (Carlo et al., 2010). In particular, practical skills were shown to decline faster than theoretical knowledge (Skidmore & Urquhart, 2001). There is a wide range of reports about knowledge retention (Oermann, Kardong-Edgren, & Odom-Maryon, 2011; Skidmore & Urquhart, 2001). However, the Neonatal Resuscitation 2015 International Consensus on Cardiovascular Care Science with Treatment suggests that training should be repeated and considered more frequently instead of holding it only once a year to maintain knowledge and skills (Wyllie et al., 2015).

Self-confidence was also described to follow a similar transition. The results showed that the score of self-confidence in the intervention group was 3.18 (SD = 0.55,  $n = 35$ ) at baseline, and it gradually increased to 3.77 (SD = 0.43,  $n = 33$ ) in the post-questionnaire. However, it gradually decreased after three months (3.38, SD = 0.79,  $n = 12$ ).

In contrast, this study showed an increase in the score in the control group. The average score of knowledge and skills in the control group was 10.1 points (SD = 3.6,  $n = 33$ ) before the program, and this increased to 11.4 points (SD = 2.5,  $n = 32$ ) after three months with a significant difference. The same can be said for self-confidence. The average score of self-confidence in the control group was 2.92 (SD = 0.89,  $n = 33$ ) before the program, and it increased to 3.48 (SD = 0.59,  $n = 32$ ) after three months with a significant difference. Although the control group did not have an educational program intervention, appreciable



improvements were observed.

This natural improvement is assumed to occur because there were more S1 nurses in the control group. They knew how to review or deepen their learning about neonatal resuscitation from the contents of the pre-questionnaire. Their higher education helped them to have the ability to search for clinical questions.

The nurses and midwives who participated in this study were from Puskesmas in North Sulawesi, Indonesia. This area has a higher GDP growth rate (6.01%) than other areas in Indonesia (Average 5.17%) (Indonesian Government Statistics, 2018). The Human Development Index (HDI), which is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and have a decent standard of living, is also slightly higher in North Sulawesi (HDI = 72.2) than in other areas of Indonesia (HDI = 71.4). In particular, both rates were higher in Tomohon city where the control group was obtained (i.e., GDP growth rate = 8.85; HDI = 75.8) (Indonesian Government Statistics, 2018). The nurses and midwives in this area have the potential to maintain the effectiveness of the simulation-based training both economically and educationally.

The results of this study showed that knowledge, skills, and self-confidence can be improved by simulation-based education. The average score of the post-test was significantly higher than that of the pre-test in the intervention group. In particular, the midwives showed more improvements in their score. A major factor underlying this result was that midwives more frequently experience immediate newborn care than nurses in Puskesmas. On the other hand, nurses and midwives with a higher education also had a higher score, which is associated with the educational program.

Indonesia classifies nurses as vocational nurses and professional nurses. Nurses who complete a basic education consisting of a three-year diploma program are considered as vocational nurses (D3). There is also a four-year diploma program and nurses who complete this program become certified diploma nurses (D4). These D3 or D4 vocational nurses make up the majority of nurses in Indonesia (77.6%) (Indonesia Ministry of Health, 2017). This situation has been recognized as a major contributing factor to the low levels of health and the high mortality of mothers and newborn (Shields & Hartati, 2003).

In 2014, the House of Representatives passed a new Nurses Act to improve the professional quality of nurses and the quality of nursing care. The Act explores and encourages the implementation of higher education in nursing as a professional course such as the institution of a Bachelor of Nursing degree involving clinical placement rotation (S1), as well as developing nurse specialists with a master's degree involving clinical residency in a designated specialty focus area (S2) (Suba & Scruth, 2015). The percentages of nurses

based on educational classification are shown in Table 1. The majority of the nurses and midwives are classified as D3 and D4 nurses. Conversely, the majority of the nurses had a Bachelor of Nursing degree S1 in the control group. These features had a significant effect on the results.

Some studies have clarified the use of ongoing refresher training support to retain skills and knowledge (McClure et al., 2007; Mildenberger, Ellis, & Lee, 2017; Skidmore & Urquhart, 2001). Mildenberger suggested that retention of knowledge and skills can be improved by holding regular, ongoing refresher training in neonatal resuscitation (Mildenberger et al., 2017). According to their study, midwives have a higher level of competency and have more chances of maintaining their knowledge and skills in-service.

Additionally, the present results found that a higher level of self-confidence on neonatal resuscitation treatments before the program leads to a significantly higher score of competencies in terms of knowledge and skills of neonatal resuscitation after the program. This suggests a correlation between self-confidence and knowledge. Previous studies have reported that classroom-based simulation heightened self-confidence and improved knowledge (Carson & Harder, 2016; Malmstrom, Nohlert, Ewald, & Widarsson, 2017). Although several studies have shown a positive correlation between knowledge and clinical performance (Kramer et al., 2002; Remmen et al., 2001), other studies have revealed little or no association between self-reported confidence and simulation performance (Fox, Ingham Clark, Scotland, & Dacre, 2000; Mavis, 2001).

The present results also showed a significant correlation between self-confidence and the experience of the resuscitation program. Simulation-based training provides positive effects such as satisfaction, self-confidence, self-efficacy, critical thinking, team development, ability to communicate with team members, and ability to take responsibility in practice (Reyhan, Mete, & Celik, 2018; Wright et al., 2018). Hands-on practice in pre-service and continuous learning at the in-service level regarding neonatal resuscitation are needed to maintain knowledge, skills, and self-confidence.

Investigation into the acceptability and feasibility of the intervention was a secondary focus of the present study. The participants showed improvement in their competency to resuscitate neonates, and their evaluation rating of the intervention was high. The participants reported that the intervention was beneficial to their practice. The participants' positive responses lend support to the acceptability and feasibility of the program.

On the other hand, retention of competencies in terms of knowledge and skills of neonatal resuscitation needs to be given consideration because the scores declined moderately with time. Retention of knowledge and skills declines because of the lack of follow-up training (Mildenberger et al., 2017). As this basic neonatal resuscitation program is feasible with

minimal equipment needed, and because it does not necessitate intensive care facilities in 95% of cases (Opiyo et al., 2008), the facilitation of ongoing refresher training is distinctly possible for improving knowledge and skills of neonatal resuscitation.

Adherence to the intervention was excellent, but the responses to the three-month questionnaire were inferior. Realistically, conducting appropriate intervention in low- and middle-income countries such as Indonesia will require a fair amount of time and human resources to increase feasibility.

## 6. Limitations

This study has several limitations. *First*, there was a relatively small number of participants involved. Especially, many participants in the intervention group dropped out of the study at three months which may have caused attrition bias. At that time, there was difficulty in collecting the three-month questionnaire. It is necessary to create an opportunity to intentionally gather the participants such as when conducting a follow-up training in three months. The researcher should monitor the reliable collection of questionnaires from the participants in the field. Additionally, a larger sample size is needed to definitively clarify the reliability of this program. In particular, Indonesia has regional disparities with many islands in the East and West within a 5,110 km radius. These characteristics necessitate a focused assessment.

*Second*, a number of studies have stated that a self-assessment questionnaire does not correlate with skills or actual ability (Patel, Posencheg, & Ades, 2012). The questionnaire in the present study was a self-rating measurement tool, and self-ability assessment may not always reflect the true acquisition of knowledge or clinical skills.

*Thirdly*, there was a baseline difference in the two groups. This may cause a selection bias that is a systematic difference between the characteristics of the participants in this study and the whole target population of nurses and midwives in Puskesmas. To confirm this problem, the eligibility of participants in the inclusion criteria should be considered. At the same time, randomized control trials should be considered.

This study was a before-after intervention involving those who had attended a neonatal resuscitation training program and those who had not attended a neonatal resuscitation training program. There was a natural improvement in the control group. To accurately evaluate the educational effects of the simulation training, the participants in the control group may use study materials such as handouts or leaflets to achieve equal comparison.

Further trials are needed to address the limitations of this study and to confirm the benefits of the resuscitation training program.

## **7. Conclusion**

The knowledge and skills of nurses and midwives were initially increased by the neonatal resuscitation program, but their levels decreased over a three-month period. This occurred similarly for self-confidence. An important issue that needs to be considered is the lack of hands-on practice. Despite the regional disparities in Indonesia, North Sulawesi has the potential to manage its equipment and human resources to support and promote neonatal care. Nurses and midwives in North Sulawesi act as evidence-based practitioners and can potentially become leaders not only for the community but also for the whole country to save more lives. Further studies are required to develop simulation-based trainings suitable to the Indonesian setting, as well as strategies to reduce the high neonatal mortality rates in rural regions.