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EFFECTS OF HIGH-FIDELITY SIMULATION IN NEONATAL RESUSCITATION ON SELF-EFFICACY AND KNOWLEDGE RETENTION IN MOROCCAN NEONATOLOGY AND PEDIATRICS NURSING STUDENTS: A PILOT STUDY

Sara Alaoui[1]; Kamal Takhdat [1, 2]; Dadda Sakhr [1, 3], Mohamed Eddabbah[1], Amina Alaoui[4], Saloua Lamtali[1]
1-Institut Supérieur des Professions Infirmières et Techniques de santé Marrakech (ISPITS-M), Morocco
-2-Laboratoire de Didactique et de Pédagogie Universitaire, FSSM, UCAM, Morocco.
-3-Faculté des sciences et techniques, Université Moulay Ismail Meknès-Errachidia, Morocco.
-4-Radiology Department, Hassan II[d] Regional Hospital Center, Agadir, Souss Massa, Morocco.

ABSTRACT

Introduction: The adaptation of newborns to extra-uterine life is essential to prevent neonatal morbidity and mortality. Therefore, it requires rapid and structured support. Neonatology and pediatrics nurses are often on the front line, caring for at-risk newborns in the first minutes of life. Neonatology scholarly societies recommend the use of high-fidelity simulation (HFS) into the initial neonatal resuscitation training program. However, there is a scarcity of studies gap regarding the use of HFS among Moroccan neonatology and pediatrics nursing students. **Objective:** Evaluate the effects of the integration of HFS, in the traditional neonatal resuscitation training program, on self-efficacy and knowledge retention. **Methodology:** A quasi-experimental study on a group of 19 students was conducted between May and June 2022 at the high Institute of Nursing and health techniques in Marrakech (ISPITS). All participants benefited from a didactic course and a hands-on in neonatal resuscitation. Afterwards, they took a first test evaluating self-efficacy and knowledge acquisition. Then, they participated in formative HFS in neonatal resuscitation. Finally, after one month, all participants were evaluated by a second test of self-efficacy and knowledge retention. **Results:** This study demonstrated a significant positive effect of HFS on self-efficacy and the l knowledge retention. **Conclusion:** Results support the pedagogical added value of HFS as a complementary learning method in improving self-efficacy and of knowledge retention. Neonatal nursing instructors should consider integrating HFS into the neonatal resuscitation training programs.

Keywords: High-fidelity simulation, knowledge retention, Neonatal resuscitation, Morocco, Self-efficacy.

Corresponding Author:
Sara Alaoui.
Affiliation: Institut Supérieur des Professions Infirmières et Techniques de santé Marrakech (ISPITS-M), Morocco.
E-mail: madameelalaoui@gmail.com

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INTRODUCTION

According to the American Heart Association (AHA), in 2020, 10% of newborns require birth assistance including initial resuscitation (warming up, drying, stimulating, suctioning if necessary), 5% require ventilation (5%), while 1% of newborns require advanced resuscitation maneuvers (intubation, external cardiac massage, adrenaline …etc.) [1]. In Morocco, neonatal mortality was estimated at 11.5 deaths per 1,000 live births [2]. The reduction of neonatal morbidity and mortality has been one of the main objectives in the field of perinatal care since the 1980s [3]. This is mainly linked to the quality of the adaptation of the newborn during his transition to extra-uterine life, which depends on the quality and availability of neonatal resuscitation (NNR) to face the unpredictable events in the postnatal period [4]. NNR is defined as all of the specialized actions and care aimed at restoring and ensuring effective alveolar breathing for the newborn [5]. The basic resuscitation gestures must be initiated very early to be effective and to preserve the neurological prognosis of the newborn. In addition, NNR requires rigor, technicality, dexterity and efficiency, and requires the intervention of a multidisciplinary team including neonatal and pediatric nurses (NPN), midwives, obstetricians and anesthesiologists [1]. The NPNs represent the front-line actors, who start the first NNR actions. The success of the latter depends on both their theoretical and practical knowledge, as well as effective teamwork. Bandura (1997) defines self-efficacy as the belief that one can accomplish required steps to meet an objective. During NNR training, students' self-efficacy in their NNR knowledge, technical skills, and non-technical skills may encourage them to

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transfer their knowledge and confront future NNR situations in real clinical practice.

In Morocco, since 2019, the NPNs profile has been integrated into the training programs of the High institutes of nursing and health techniques (ISPITS). The initial training of NPNs is based on alternating didactic courses, hands-on sessions (low-fidelity simulation) and clinical practice [6]. Unfortunately, students are rarely involved in real clinical NNR activities for different reasons, such as the scarcity and life-threatening nature of NNR situations, the high number of learners, and for ethical reasons underlying the necessity for a trained nurse to take care of such situations. This makes students more observers than actors, which affects their active learning. Therefore, the need to integrate HFS in the initial NNR training programs is essential to counter these difficulties and enhance learning outcomes. As recommended by the AHA, the use of HFS in NNR training should enable students to acquire technical and non-technical skills in NNR [1]. In this context, the present research aimed to assess the effects of the integration of HFS on self-efficacy, knowledge acquisition and retention among Moroccan neonatology and pediatrics students.

METHODS

This is a pilot quasi-experimental study of 19 students. It was carried out between May and June 2022. The study took place at the ISPITS- Marrakech simulation center

Sample

Participants were neonatology and pediatrics nursing students enrolled during the 2021-2022 academic year in the bachelor's degree (the 4th semester) at the ISPITS Marrakech.

Data Collection

Data collection was ensured by a single questionnaire (supplementary file 1), which was distributed and completed by the participants in two stages. The questionnaire consisted of 2 parts. The first part aimed to assess self-efficacy and included two items based on a four Likert scale. The second part aimed to assess acquisition/retention knowledge and contained 35-items. This second part included open-ended, and multiple-choice questions, covering a theoretical part (declarative and procedural knowledge) and a clinical part (conditional knowledge) based on the AHA 2020 recommendations for NNR in the delivery room.

Conduct of the study

The first test after the traditional training in NNR (the sessions of the theoretical course and the practical work) and the second test after the formative sessions of HFS. Before conducting the study, we organized a welcome session to inform and explain the study objectives to the participants. During this session, students voluntarily completed a consent form. First, all participants completed a didactic course of two sessions, three-hour each. This didactic course was based on the latest AHA 2020 NNR guidelines. Then, all participants took hands-on training of NNR technical gestures (positive pressure ventilation and external cardiac massage) on low-fidelity simulators. One week later, participants took the first assessment test of self-efficacy and knowledge acquisition. After that, participants took part in two four-hour formative HFS training sessions with a 15 days interval between the sessions. The HFS scenario was "Management of a newborn in respiratory distress in the delivery room" (supplementary file 2). It was simulated by 3 to 4 participants' teams. One month later, all participants took the second test to assess self-efficacy and knowledge retention (Figure 1)

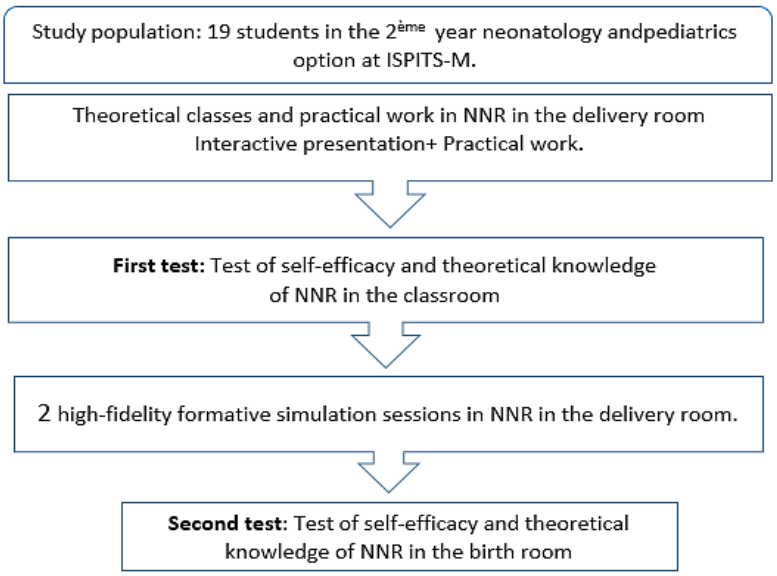

Figure 1: Diagram of the study

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Student Evaluation:

The evaluation of the effect of high-fidelity simulation in NNR was structured according to the first two levels of the Kirkpatrick evaluation model.

The first level evaluates *reactions*: participants' sense of self-efficacy was assessed using Part 1 of the questionnaire. These tools targeted the measurement of confidence in theoretical knowledge, technical and soft skills. A four-point Likert scale was used for this purpose. The effect of HFS on feelings of self-efficacy was assessed by comparing group scores before and after simulation.

The second level explores learning in relation to the *theoretical knowledge*. The acquisition and retention of theoretical knowledge after one month of traditional training was assessed by the 2nd part of the questionnaire. A theoretical knowledge test in 2 identical versions was offered to all participants. One point was awarded for each correct answer, out of a total score of 35 points.

In order to assess the effect of HFS on theoretical knowledge retention, the mean global knowledge retention score and its sub-scores scores were compared between the first and the second tests.

Statistical analysis:

The statistical processing of the data was carried out by the SPSS software version 26 for Windows. The study compared the evolution of scores over time within the group. In order to find out if the difference in the means obtained was significant, Student's test was applied. For all statistical tests, the significance level was set at $p< 0.05$.

Ethical considerations:

An authorization to collect information was granted by the administration of ISPITS Marrakech in the first place. Through a free and informed consent form, the necessary precautions were taken to ensure that the rights and freedom of participation in the study were respected. Confidentiality and anonymity were respected.

RESULTS

Sample

The study population consisted of 19 female students with a median age of 20 years. Ten students had already witnessed a real intervention and had only participated in the preparation of NNR materials during clinical rounds.

Evolution over time of the feeling of self-efficacy

This section compares the ability of NPN students to manage mild difficulty in adapting to ectopic life and actual neonatal resuscitation before and after simulation sessions. (Table I) shows the results of students' sense of self-efficacy towards NNR training and compares their evolution over time.

Before the simulation sessions, 4 NPN students considered themselves largely able to manage a newborn with a slight difficulty adjusting to ectopic life, compared to 18 after the simulation sessions.

None of the NPN students consider themselves fully or largely capable of supporting true neonatal resuscitation with intubation +/- external cardiac massage (ECM) +/- adrenaline injection before the simulation sessions, compared to 18 after the two simulation sessions.

Table I: The evolution of the feeling of self-efficacy over time.

Variable	n=19	t-value	CI (95%)	p-value
Self-efficacy Baseline NNR				
Before simulation		24,70	[2,60 ; 3,08]	.000
Fully capable	0			
Largely able to	4 (21.1%)			
Not very capable	14 (73.7%)			
Not able to	1 (5.3%)			
After simulation		10,87	[1,23 ; 1,82]	.000
Fully capable	10 (52.6%)			
largely capable	8 (42.1%)			
Not very capable	1 (5.3%)			
Not able to	0			
Self-efficacy Advanced NNR				
Before simulation		30,26	[3,09 ; 3,55]	.000
Fully capable	0			
largely capable	0			
Not very capable	13 (68.4%)			
Not able to	6 (31.6%)			
After simulation		26,15	[1,84 ; 2,16]	.000
Fully capable	1 (5.3%)			

largely capable	17 (89.47%)
Not very capable	1 (5.3%)
Not able to	0

CI : Confidence Interval ; NNR : neonatal resuscitation

Evolution of the acquisition and retention of theoretical knowledge over time

This part illustrates the impact of high-fidelity simulation on the retention of theoretical knowledge between the first and second tests. Table II represents the evolution of the overall score and its sub-scores constituting the retention of theoretical knowledge (Table II).

The average overall score increased from 16.42/35 on the first test to 30.95/35 on the second test (after one month).

The questionnaire consisted of a theoretical part and a clinical part. The results obtained by the NPN students were compared for each part

The set of scores constituting the global theoretical knowledge retention score were improved, with a highly significant difference ($p<0.001$) in the scores of the first theoretical part and the second clinical part.

Table II: comparison of the theoretical retention scores obtained by the NPN students at the 1st and 2nd tests

Variable	Means (SD)	value	CI (95%)	value
all score (/35)				.000
est	6,42 (3,58)	.9,99	[14,70 ; 18,15]	
d test	0,95(1,77)	'5,84	[30,09 ; 31,80]	
of the theoretical assessment (/27)				.000
est	3,05(2,77)	:0,47	[11,71 ; 14,39]	
d test	4,26(1,32)	'9,71	[23,62 ; 24,90]	
of the clinical assessment (/8)			,000	
est	3,37(1,34)	.0,94	[2,72 ; 4,02]	
d test	5,68(0,88)	2,91	[6,26 ; 7,11]	

SD : Standard Deviation ; CI : Confidence Interval

DISCUSSION

Simulation finds a fundamental place in the training of NPN students working in the delivery room. Overall, the results of the present study demonstrate a statistically significant positive effect of HFS on self-efficacy and knowledge retention among NPN students. In this study, 10 participants attended, as observers, prior experiences of actual NNR during their clinical and participated in the preparation of resuscitation equipment. This shows that NPN students encounter these critical situations at the clinical practice settings. However, given the context of high-acuity, low-occurrence nature of NNR that requires early intervention, and for ethical reasons, students are more limited to play the role of observers rather than protagonists. Consequently, active learning becomes limited. Therefore, simulation-based learning may offer itself as a promising alternative teaching and learning technique in this field.

Students' Self-efficacy in their abilities and skills is fundamental to the transfer of learning in a clinical setting [7]. This feeling is part of a socio-cognitive approach to learning mechanisms, different from self-esteem and "self-concept". Indeed, self-efficacy does not measure skills, but the perception that a subject has of his ability to mobilize different resources allowing him to perform a given task. An individual's belief in his or her abilities has been shown to be an important element in achieving the desired results [8]. Self-efficacy in one's knowledge (theoretical, technical and relational) of NNR as well as being able to apply it in a clinical practice improved after the formative HFS sessions. In addition, the difference in the evolution of this feeling pre-and post-HFS sessions was largely significant. These results are confirmed by prior studies [4, 9-11].

This study showed that integrating HFS had a significant effect on knowledge retention after one month. The average overall score increased from 16.42/35 in the first test to 30.95/35 in the second test. It also resulted in a statistically significant improvement in theoretical knowledge retention scores ($p <0.001$). These results are supported by several authors such as: Cerra & al. [12], Bultas [13] and Mundell [14]. However, they are contrasted by others [15-16].

Depending on the learning pyramid, memorization is very different depending on the used pedagogical method. On average, we retain 10% of what we learn by reading, and 75% of what is learned by doing [3]. Thus, knowledge retention is promoted and supported by active learning methods based on learners' action, discussion and reflection on action, and targeting higher taxonomic objectives of analysis and synthesis.

The two HFS sessions positively influenced the results of both the theoretical and clinical learning. Hence, clinical simulation makes it possible to consolidate theoretical knowledge of NNR. The evolution of the score of the clinical knowledge part assumes that the participants had a better knowledge of the NNR algorithm. This evolution can be explained by the guided reflective practice, during debriefing, which improves clinical reasoning and allows learning by mistake. Retention and improvement of knowledge play a crucial role in students' clinical reasoning based on solving problem-situations encountered in HFS scenarios. Thus, the learner acquires

and retains his knowledge by overcoming didactic obstacles and changing his previous conceptions [17].

CONCLUSION

This pilot study demonstrates that the integration of HFS into NNR training allows participants to significantly improve their self-efficacy. That may be a motivating and self-determining factor, essential for successful behavior and the transfer of learning to clinical practice. In addition, significant retention and improvement in knowledge after one month were recorded among the participants. The results of this study affirm that the integration of HFS is an attractive complement to traditional teaching and a necessary step in preparing students for critical clinical settings.

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CONFLICT OF INTEREST: Nothing to declare

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