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# Effect of Training Intervention on Enhancing Knowledge and Practice of Primary Health Care Nurses regarding Newborn Hearing Screening

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**Abstract: Background:** Hearing loss is a worldwide public health issue that requires more attention from health care personal. So primary health care nurses have the main role in early detection of newborn hearing loss. **Purpose:** This study was conducted to assess effect of training intervention on enhancing knowledge and practice of primary health care nurses regarding newborn hearing screening. **Design:** A quasi-experimental research approach was used (pre and post-test). **Setting:** This research was carried out at five primary health care units affiliated to Ministry of health at kom Hamada center in El Behera Governorate. **Sample:** This study was conducted on 116 primary health care nurses. **Instruments:** a- Self-administered structured questionnaire included personal characteristics, nurses' knowledge about newborn hearing loss and hearing screening test b- Observational checklist for nurses, practices related to hearing screening for newborns was used. **Results:** The main findings revealed that nurses who had good knowledge increased from 23.3% on pre-test to 86.2 % on posttest. While in the retention test, 87.1% of them had good knowledge. Also, the findings revealed that on post and retention test showed a highly significant improvement in hearing screening practice than in pre-test. In addition, there were a highly statistical significant improvement in both knowledge and practice among studied nurses. **Conclusion:** It was concluded that there training intervention was effective in improving nurses' knowledge and practice regarding newborn hearing screening on posttest and retention tests than pretest. **Recommendations:** Continuous training and teaching sessions to enhance knowledge and practice of nurses on hearing screening test should be applied in all primary health care units.

***Keywords:*** *Newborn Hearing Screening, Nurses Knowledge, Nurses Practice, Primary Health Care Nurses.*

## Introduction

Hearing is one of the vital five senses because it helps in the understanding and gives alert of any danger in the surrounding environment (Anna, 2017). Hearing loss or hearing impairment refers to complete or partial decrease in the ability of the ear to hear or recognize sounds (Ha et al., 2022). Congenital hearing loss is present at delivery which occurs when the ability of the ear to change the vibratory mechanical energy of sound into the electrical energy of nerve compulsions is impaired (Korver et al., 2017).

It is estimated that over 5% of the world's population or 466 million people (432 million adults and 34 million children) have disabling hearing loss and approximately 12,000

infants are born in the United States each year with hearing impairment. In addition, several studies reported that by 2050 over 900 million people or one in every ten people will have disabling hearing loss. (Nunes et al., 2019).

In Egypt, the accurate estimation of hearing loss among children is challenging to be determined and the estimation depends only on the hospital-based academic studies. Which indicated that 20.9% of hearing loss in Egypt among children. Newborn hearing loss is one of the important problems that require more attention from the community as a whole (Elbeltagy et al., 2019).

The causes of hearing loss can be divided into congenital causes and acquired causes. Congenital causes may lead to hearing loss being present at or acquired soon after birth. Hearing loss can affect a child's ability to develop speech, language, and social skills. It also leads to delayed education and poor academic level due to poor educational attainment. In addition, it leads to psychological, social, financial problems, family fear and social shame (Khan, 2022; Poonual et al., 2022).

One of the main roles of the primary health care (PHC) nurse is to perform hearing screening for newborn, record the hearing screening results and notify the family. The findings will have implications for managing prelingual infants with hearing loss at community level (Khan et al., 2018).

In Egypt, The Ministry of Health announced on July, 2019 the importance to identify infants with hearing loss by three months of age and provides appropriate early intervention no later than six months of age to discover and treat hearing loss and impairment in newborns. This examination is preferably performed 3-7 days after birth. The result of the test shows whether the child is normal or suspected of hearing impairment. If the child fails in the first test, the second test will be one week after the first (Ministry Of Health, 2019).

Community health nurse plays an important role through contact with the families and encouraging them for follow-up services. They can educate and counsel expectant mothers as well as during the postnatal time on the need and importance of newborn hearing screening test that should be done for early identification, intervention, and time for follow-up. Also, they can provide valuable information on motor, sensory and language developmental signs, and form essential emotional support for families of diverse socio-economic and cultural backgrounds during the newborn hearing screening (Ravi et al., 2017).

**Purpose:**

The purpose of this study is to assess effect of training intervention on enhancing knowledge and practice of primary health care nurses regarding newborn hearing screening.

**Research hypotheses**

1) Nurses who attend service-training intervention about newborn hearing screening will have higher knowledge scores on post-intervention compared to pre-intervention.
2) Nurses who attend service-training intervention about newborn hearing screening will have higher scores of practice post-intervention compared to pre-intervention.

**Methods**

**Research design: -**

Quasi- experimental design was used to achieve the purpose of this study.

**Research settings:**

A multistage random technique was used to select the setting according to the following stages:

- The first stage was random selection of one center from fifteen centers in El Beheira Governorate. The selected center was Kom Hamada center.
- The second stage was random selection of five villages from ten villages by selection of an odd numbers (1, 3, 5, 7, 9). The selected villages were Wakid, Bareem, Safat El Enab, Kafr Bolen and Dest Elashraf. Each selected village has family health unit from which the sample was taken.

**Sampling:**

All primary health care nurses (116) who were working in the selected five family health units were included in this study. 17 nurses were selected from Wakid, 35 were selected from Bareem, 10 from Safat El Enab, 9 from Kafr Bolen and 45 from Dest El Ashraf.

**Instruments:**

The researchers used two instruments in order to collect the necessary data and achieve the study purpose as follows:

**Instrument One: A structured interview questionnaire**

It was developed by the researchers after reviewing the related literature. It is used to assess social characteristics and nurses, knowledge. It includes two parts:

- **Part One:** Social characteristics of nurses such as age, marital status, educational level and experience years.
- **Part two:** Nurses', knowledge regarding hearing loss disease of newborn and hearing screening test. This part consisted of fourteen closed- ended questions which classified into two sub items as the following:-
  - **Subpart one: Nurses, knowledge regarding** hearing loss disease of newborn, this part consisted of six closed- ended questions Five questions were developed by the researchers. Their numbers were 1-5 (e.g. definition of newborn, stages of hearing development and speech, the functions of the hearing nerve, causes of hearing loss among newborns and definition of neonatal hearing loss). The sixth question was complications of hearing loss. It was developed by Barbosa et al., (2013).
  - **Subpart two: Nurses, knowledge regarding hearing screening test.** This part was consisted of eight closed- ended questions. Five questions were developed by the researchers. These questions were numbers 7-8-10-11 – 12 (e.g. reasons for performing the hearing test for newborns, the importance of hearing screening, methods of performing the hearing test, and obstacles that may prevent completion of examination. Meanwhile, three questions were developed by Barbosa et al., 2013.They were numbers 9-13-14 (e.g. time of performing hearing screening test, ideal age to diagnose the newborn hearing loss and ideal age to start an intervention to treat hearing loss).
  - Each correct answer was given 1score while incorrect answer was given zero. The total score of knowledge ranged between 0-14 scores.

**Knowledge scoring system:**

The scoring system was categorized according to Mazlan et al., (2018). Scores of good knowledge ranged

between 11-14 (>75% of total). Fair knowledge ranged between 7-10 scores (50-75%). Poor knowledge ranged between 1-6 scores (<50%)

**Reliability of the instrument one (part two)** was estimated by using test retest method which was performed by the researchers to test internal consistency through administration of the same questionnaire to the same subjects under same conditions with two weeks a parts. The repeated test answers were compared and confirmed to be strongly reliable. Correlation coefficient was 0.89 that indicated the tool was reliable.

**Instrument Two: Observational checklist to assess nurses' practices regarding hearing screening test.**

This instrument was developed by the researchers based on a review of literature about hearing screening test. It contained twenty four closed ended questions answered by done or not done and classified into three parts:

- **Part one:** Preparation of equipment
  This part contained four questions (numbers 1-4) e.g. washing hands before dealing with hearing equipment, checking the device battery, disinfecting probe with alcohol before use.
- **Part two:** Child care during the examination
  This part contained twelve questions (number 5- 16) e.g. checking the newborn's ear before the test, clean the newborn's ear out of the wax, choose the right size sensor, put the newborn on the side during the test, gently insert the sensor and probe with the outer ear attracted when inserting, take out the sensor
- **Part three:** Care of equipment.
  This part contained eight questions (numbers17-24) e.g. wearing gloves, washing plugs with clean water, drying plugs with a clean towel
- **Scoring system** for each item was 1 for done items and zero for not done.The total scoring system of nurses, practice was categorized according to Akram et al., 2018. Scores of good practice ranged between 21-24 (>85% of total) and poor practice ranged between 1-20 scores (<85%)
- **Reliability of the instrument two** was estimated by using test retest method. The instrument was reliable.

**Validity of the instruments: -**

All instruments were tested for content validity by five experts, four experts in the field of Family and Community Health Nursing (two professors and two assistant professors) and one professor in pediatric Nursing. All instruments were tested for its content accuracy and internal validity, completeness and clarity. Suggestions were incorporated into all instruments.

**Ethical considerations:**

An approval of the Faculty of Nursing, Menoufia University Ethical and Research Committee was obtained to carry out the current study.. All nurses were informed of the study purpose, methods of the study and that participation in the study is voluntarily (they have the right to withdraw at any time). Then, a written consent was obtained from each nurse related to their acceptance to share in the study. Nurses were reassured of the confidentiality of their information and they will be kept private and not shared with others.

**Pilot study:**

A pilot study was carried out on 11 nurses (10%) in order to test the clarity, feasibility and applicability of the instruments. The pilot study was

done to estimate the time needed to fill in the questions. Nurses who participated in the pilot weren't included in the main study sample. Modifications were done based on the results of the pilot study.

**Procedure:**

- An official letter was sent from the Dean of the Faculty of Nursing to the directors of selected settings for data collection containing the purpose and methods of data collection.
- The data collection started from the first of August 2020 to the end of March 2021.The data was collected during eight months (5 months for pre-test data collection, intervention application, and post-test while the remaining 3 months for retention test collection).
- After attaining the approval of the directors of study settings, the researchers made a plan to classify settings to collect data according to their routine days for performing hearing screen test procedure at each family health unit.
- All nurses were interviewed at their workplace during established routine days for newborn hearing screening. A pretest was conducted to collect data about nurses knowledge and practice related to newborn hearing screening using instrument one (for knowledge) and instrument two (for practice) . Accordingly, a health education program was planned and developed.
- The researchers established a relationship with the nurses and laying foundation of trust. Then, the researchers distributed the questionnaire to the nurses in order to fill in the pre-test on social data, their knowledge about hearing screening disease and hearing screening test. Pre test took about 20-25 minutes and was done in first day of determined days of the week.
- Health education was conducted in three sessions.: Nurses were divided into small groups. Each group contained six nurses who were observed weekly. Each educational session started by conducting a pretest on the topic of the session and ended by a posttest.
  - **First session:** Health education was provided about procedure of hearing screening test The researcher used observational checklist and role play. Then, the researchers demonstrated the test. Re-demonstration was conducted about hearing screening test by asked each nurse to re-demonstrate on her colleague to observe their performance This session lasted for one hour
  - **Second session**, Health education was provided about hearing screening test to the nurses. The researcher used laptop system to present PowerPoint lecture about hearing screening test. This session lasted for 45 minutes to one hour
  - **Third session**, the researchers presented educational video gained from the Ministry of Health 2019 on hearing screening test of newborn knowledge and practice. After the session completed, group discussion, feedback, and further clarifications were done for missing items. This session lasted for 20-50 minutes.
- The researchers distributed the questionnaire to fill in post-test on knowledge. A post test was conducted immediately after the educational intervention. It lasted for 10-15 minutes.
- The researchers coordinated with the nurses for follow up and followed them by the phone for any question or knowledge about the procedure and determine their

improvement in hearing screening test.

- At the end of training intervention period A retention test was conducted two months after posttest.A retention test was filled by nurses to assess the improvement of nurses knowledge and practice regarding hearing screening test of newborn. It lasted for 45 minutes to one hour.

**Statistical analysis**

Data was coded and transformed into specially designed form to be suitable for computer entry process. Data was entered and analyzed by using SPSS (Statistical Package for Social Science) statistical package version 22. Graphics were done using Excel program. Quantitative data such as nurses' age were presented by mean (X) and standard deviation (SD). Paired t-test was used to compare all items related to knowledge aspects about newborn hearing screening. Also, it was used in all items of reported practice regarding hearing screening.

Regarding qualitative data were presented in the form of frequency distribution tables, numbers and percentage. It was analyzed by chi-square ($\chi 2$) test. However, if an expected value of any cell in the table was less than 5, Fisher Exact test was used ( if the table was 4 cells) , or Likelihood Ratio (LR) test (if the table was more than 4 cells). Level of significance was set as P value <0.05 for all significant tests.

**Results:**

**Table 1** shows that more than half of studied nurses (58.6%) aged between 40 years and more with mean age 46.1 ± 4.7. Regarding marital status, 91.4% of the studied nurses were married while 6.9% were widowed / divorced. Concerning years of experience, more than half of studied sample (53.5%) had experience more than 15 years while 11.2% of them had experience of 5 to 10 years.

Table (2): Mean score of nurses, knowledge about hearing loss disease of new born on pretest, posttest and retention test (n = 116)

**Table 2** shows mean score of the studied nurses, knowledge on pre. Post and retention test. On pretest, mean score of knowledge was 8.30 ± 2.7 which increased to 13.87±0.54 on posttest. Meanwhile, in retention test, it increased to 13.89± 0.55. Also, this table presents that there were very highly statistical significant improvements in studied nurses' knowledge on posttest and retention test than in pre-test ($p<0.0001$).

**Figure 1** presents distribution of nurses according to their level of knowledge on pre, post and retention test. Nurses who have good knowledge increased from 23.3% on pre-test to 86.2 % and 87.1 %on post and retention-tests. While in retention test it increased to 87.1 Also, it shows that a highly statistical significant differences in the different levels of knowledge ($p< 0.0001$).

**Table 3** shows mean score of nurses, practice related to hearing assessment for newborns pre, post, and retention test. The means score of studied nurses' practice pre-test was 2.1±1.1, which increased significantly after intervention become at 3.6 ± 0.3 while in retention test, it increased to 3.8 ± 0.5. Also, this table shows that the total mean score of studied nurse's practice during the hearing screening test was 9.6 ± 2.5 in pre-test which increased significantly after intervention to 11.0 ± 0.3. While in retention test was 11.8 ± 0.7. The mean total score of studied nurses' practice after taking care of device was 7.1 ± 1.5, which increased significantly post intervention to 7.8 ± 2.3 while increased to 7.9 ±1.6 in

retention test. Also, this table shows that there are a highly statistical significant improvement in post-test and retention test than in pre-test (P<0.0001).

**Figure 2** reveals distribution of nurses according to their level of practice on pre, post and retention test reveal that post and retention test shows a highly significant improvement in hearing screening practice than in pre-test (p<0.0001). The good practice responses increased from 57.8 % pre-intervention to 93.1% in post-test and 96.6 % in retention test. In addition, it shows the total mean practice score increased from 19.8±4.8 pretest to 24.0±0.31 posttest and 23.7±1.2 in retention test.

**Table 4** presents associative relation between knowledge and practice among studied nurses in retention test. It presents that 87.1% of the studied nurses show good Knowledge and good practice. But the table shows that There is no statistical significant difference between levels of knowledge and practice (P=0.56).

**Table 5** shows the associative relation between nurses'social characteristics and their level of pretest knowledge about hearing screening test of newborn that there are no statistical significant relations between the studied nurses' socio-demographic characteristics ( age and education) and their total score level of pre intervention knowledge about hearing loss disease and hearing screening test of newborn ( p >0.05). But this table presents that there is a high statistical significance relation between nurses, experience and their level of pre intervention knowledge. This difference is very highly statistically significant (p <0.003).

**Table (6)** shows the associative relation between nurses' social characteristics and their level of pre intervention practice related to hearing screening test of newborn It was clear that nearly one third of studied nurses aged 40 and more had good practice. There was a highlystatistical significant relationbetween age and practice (p<0.05). Also, this table shows that there is no-statistical significance relation between education, experience and practice (P > 0.05).

**Table (1): Distribution of the studied nurses according to their social characteristics.**

| Socio demographic characteristics | No. | % |
|---|---|---|
| **Age (Years) :** 20 - | 12 | 10.4 |
| 30 - | 36 | 31 |
| 40 – &more | 68 | 58.6 |
| **Mean ± SD** | 46.1 ± 4.7 | |
| **Marital status:** Single | 2 | 1.7 |
| Married | 106 | 91.4 |
| Widowed/divorced | 8 | 6.9 |
| **Years of Experience:** 5 - | 13 | 11.2 |
| 10- | 41 | 35.3 |
| 15-& more | 62 | 53.5 |
| **Total** | 116 | 100 |

**Table (2): Mean score of nurses, knowledge about hearing loss disease of new born on pretest, posttest and retention test (n = 116)**

| | The studied nurses (n = 116) | | test | $P_1$ | The studied nurses (n = 116) | t-test | $P_2$ | *$\chi^2$/LR | $P_3$ |
|---|---|---|---|---|---|---|---|---|---|
| | Pretest | Posttest | | | Retention test | | | | |
| | Mean ± SD | Mean ± SD | | | Mean ± SD | | | | |
| **Total knowledge score** | 8.30 ± 2.7 | 13.87±0.54 | 21.2 | 0.0001** | 13.89 ± 0.55 | 21.3 | 0. 001** | F=435 | 0.0001** |

**Figure (1): Distribution of nurses according to their level of knowledge on pre, post and retention test .**

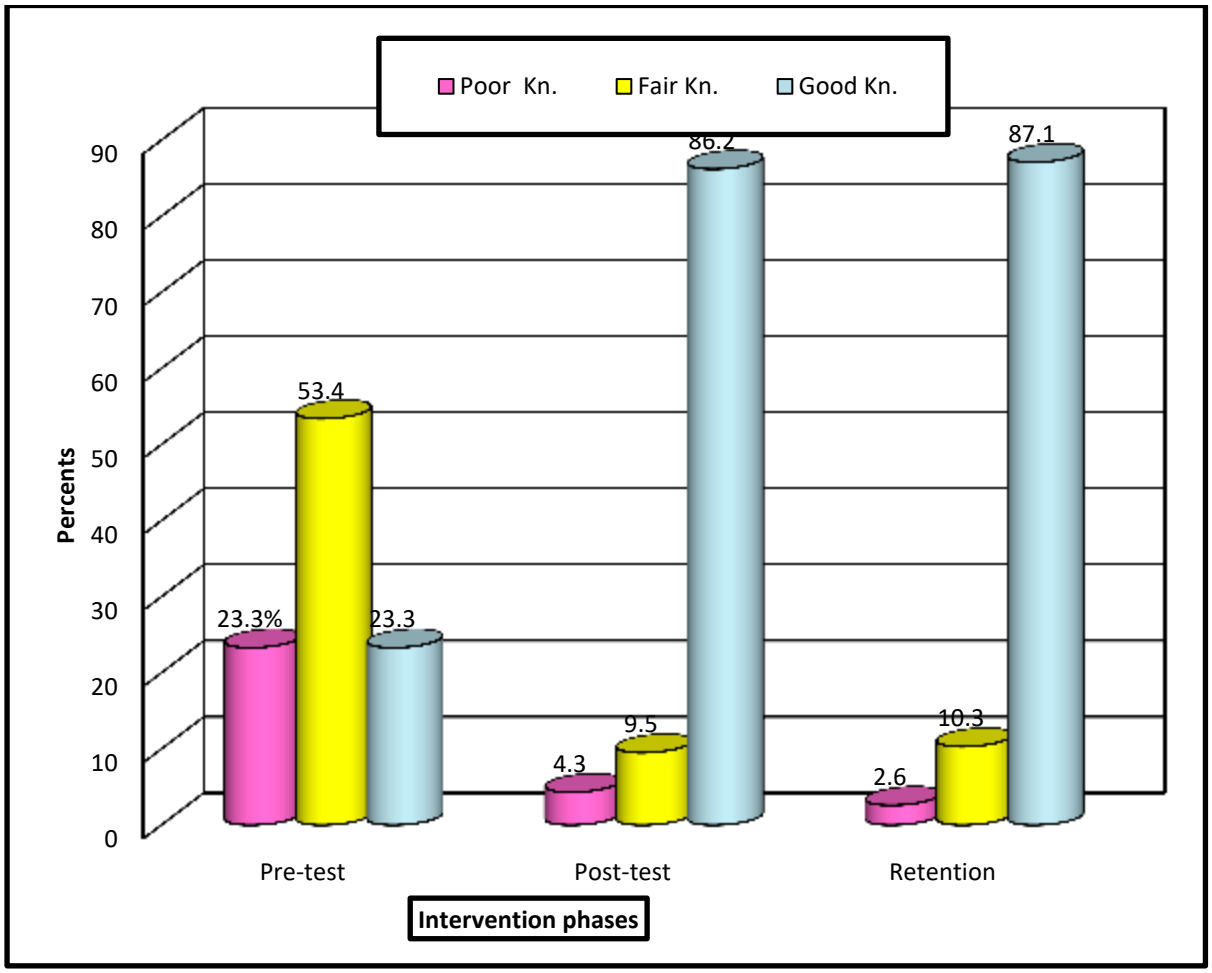

**Table (3): Mean score of nurses, practice related to hearing assessment for newborns pre, post, and retention test.**

| Total mean score of practice. | Pre-test | Post-test | t-test | $P_1$ | Retention test | t-test | $P_2$ | $\chi^2$/LR | $P_3$ |
|---|---|---|---|---|---|---|---|---|---|
| Preparing equipment before the test. | 2.1± 1.1 | 3.6± 0.3 | 5.2 | < 0.0001** | 3.8±0.5 | 6.5 | < 0.001** | F=43.9 | < 0.0001** |
| During the examination and dealing with the newborn. | 9.6 ± 2.5 | 11.0 ± 0.3 | 5.9 | < 0.0001** | 11.8± 0.7 | 9.0 | < 0.001** | F=86.2 | < 0.0001** |
| Taking care of the device. | 7.1± 1.5 | 7.8 ± 2.3 | 3.2 | < 0.01** | 7. 9±1.6 | 3.6 | < 0. 01** | F=35.7 | < 0.0001** |

**Figure (2): Distribution of nurses according to their level of practice on pre, post and retention test**

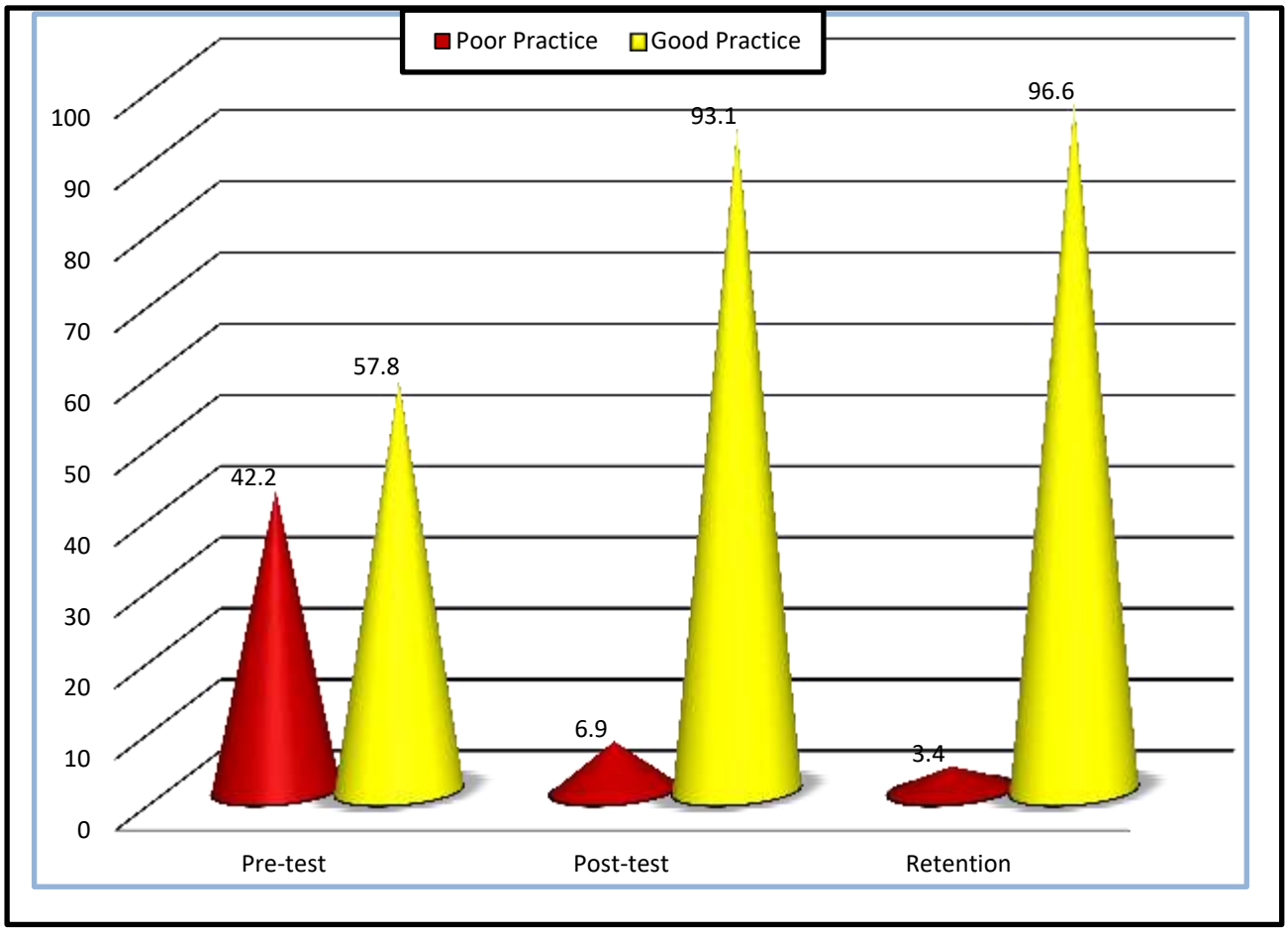

**Table 4: Associative relation between knowledge and practice among studied nurses in retention test**

| | Total practices | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Knowledge level** | **Poor practice** | | **Good practice** | | **Total** | | **LR** | **P** |
| | **No.** | **%** | **No.** | **%** | **No** | **%** | | |
| **Good** | 0 | 0 | 101 | 87.1 | 101 | 87.1 | 1.1 | 0.56 |
| **Fair** | 1 | 0.8 | 11 | 9.5 | 12 | 10.3 | | |
| **Poor** | 3 | 2.6 | 0 | 0 | 3 | 2.6 | | |
| **Total** | 4 | 3.4 | 112 | 96.6 | 116 | 100 | | |

LR= Likelihood Ratio

**Table (5): Associative relation between nurses' social characteristics and their level of pretest knowledge about hearing screening test of newborn.**

| **Social characteristics** | | **Pre intervention knowledge groups** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **Poor know.** | | **Fair Knowledge** | | **Good know.** | | **Chi-square** | |
| | | **N** | **%** | **N** | **%** | **N** | **%** | **$X^2$** | **P-value** |
| **Age (years)** | 20 - (n=12) | 3 | 2.5 | 4 | 3.4 | 5 | 4.3 | LR=3.5 | 0.48 |
| | 30 - (n=36) | 10 | 8.6 | 19 | 16.4 | 7 | 6.1 | | |
| | 40 &more (n=68) | 14 | 12.1 | 39 | 33.6 | 15 | 13 | | |
| **Education** | Diplom (n=97) | 24 | 20.7 | 54 | 46.6 | 19 | 16.4 | LR=5.2 | 0.26 |
| | Institute (n=12) | 2 | 1.7 | 4 | 3.4 | 6 | 5.2 | | |
| | Bachelor/Postgraduate (n=7) | 1 | 0.9 | 4 | 3.4 | 2 | 1.7 | | |
| **Experience** | 5 - ( n=13) | 0 | 0 | 6 | 5.2 | 7 | 6.1 | LR=15.9 | <0.003** |
| | 10 - ( n=41) | 13 | 11.2 | 17 | 14.7 | 11 | 9.4 | | |
| | 15&more (n=62) | 14 | 12 | 39 | 33.6 | 9 | 7.8 | | |

NS = No statistical significance (P > 0.05) HS= high statistical significance

**Table (6): Associative relation between nurses' social characteristics and their level of pre intervention practice related to hearing screening test of newborn.**

| Total practice / Social characteristics | | Pre intervention practice groups | | | | | |
|---|---|---|---|---|---|---|---|
| | | Poor practice. | | Good practice. | | Chi-square | |
| | | N | % | N | % | $X^2$ | P-value |
| Age (years) | 20 - (n=12) | 9 | 7.8 | 3 | 2.6 | 6.5 | 0.03* |
| | 30 – (n=36) | 12 | 10.3 | 24 | 20.6 | | |
| | 40 &more (n=68) | 28 | 24.1 | 40 | 34.5 | | |
| Education | Diplom (n=97) | 38 | 32.8 | 59 | 50.9 | 3.2 | 0.19 |
| | Institute (n=12) | 8 | 6.9 | 4 | 3.4 | | |
| | Bachelor/Postgraduate (n=7) | 3 | 2.6 | 4 | 3.4 | | |
| Experience | 5- (n=13) | 4 | 3.4 | 9 | 7.8 | 1.4 | 0.49 |
| | 10- (n=41) | 16 | 13.8 | 25 | 21.6 | | |
| | 15&more (n=62) | 29 | 25 | 33 | 28.4 | | |

## Discussion

Newborn hearing loss causes disability and affects quality of life in families who have the disease than the other population. Additionally, it causes economic burden on communities and places heavy burden on health care system all over the world (McDaid et al., 2021). So, implementing newborn hearing screening test with tracking and initiate appropriate interventions to identify and treat children with congenital or early onset hearing loss is very important. A newborn hearing screening program should follow a family-centered approach in which families are empowered to make decisions for their children (Maluleke et al., 2016).

Therefore, the purpose of the current study was to enhance knowledge and practice about newborn hearing screening test among primary health care nurses.

Regarding comparison between the studied nurses' knowledge about hearing loss disease of newborn in pre-test, post-test, and retention test , the current study revealed that there were highly statistical significant improvements in different item of knowledge in post-test and retention test than in pre-test. This finding was supported by Farias et al., (2013) who conducted a study at Brazilia to check knowledge of nursing professional after the educational actions on

pediatric hearing. They reported that educational programs on the hearing health of neonates and infants have significantly changed the knowledge of nursing professional after intervention.

Regarding to nurses' knowledge about newborn hearing loss, the present study reported that in pretest nearly one quarter of nurse had poor knowledge about hearing test but in the post-test and retention test, the majority of nurses reported that the newborn hearing loss refers to inability to hear the sound in one of the two ears. This finding was supported by Khan et al., (2018). They reported that one quarter of nurses did not identify hearing loss. But the difference between both studies could be due to the provision of a teaching intervention to improve knowledge of nurses

Regarding nurses' knowledge about the causes of hearing loss among newborns, the current study revealed that the majority of nurses reported that the causes of hearing loss among newborns were congenital infections in post-test and retention test. This finding was similar to the findings of a study performed by Mohamed et al., (2022). They performed a study at Minia City to detect hearing loss and identify risk factors by using Auditory Brainstem Response tests among neonates. They reported that congenital infection in newborn caused hearing loss. Also, the findings were in similarity with James, et al., (2018) who conducted a study on prevalence and risk factors of hearing impairment, among newborns in Alappuzha who stated that more than one-eighth of the study sample, which sufferedfrom hearing impairment, had a congenital infection. This similarity in the results assured that congenital infection was the main cause of congenital hearing loss among newborn.

Concerning nurses' knowledge about the importance of hearing screening, the current study reported that primary health nurses had poor knowledge in the pre-test but the most of nurses became aware with it after study intervention. This finding was supported by a study that was done by Ravi, et al., (2018) to review systematic review of knowledge of, attitudes towards, and practices for newborn hearing screening among healthcare professionals. They reported that the majority of the respondents were aware of the importance of NHS for children.

Regarding the best age for diagnosis and intervention for newborn hearing loss. The present study indicated that many nurses had basic knowledge about the best age for a newborn hearing screening to receive it. The majority of nurses reported correct response as it should be done before three months of age in post intervention and retention test than in pre-test. This finding is supported by a study that was done by Kamenov et al., (2021) that performed a study to review existing guidelines for universal newborn hearing screening (UNHS). They reported that most of the sample had correct answer regarding that hearing screening should be done before three months of age.

Also, the finding of the present study was supported by a study that was done by Mazlan et al., (2018) that performed a study to assess knowledge and attitude of Malaysian healthcare professionals towards newborn hearing screening program. They reported half of the participant who presented correctly answered that intervention for children with hearing impairment should begin by six months of age. This similarity of the result indicated the importance of hearing screening

test for detection of newborn hearing loss as early as possible.

Concerning the nurses' knowledge about hearing loss disease among newborn, the current findings revealed that there are a highly significant improvement in different item of knowledge in post-test and retention test than in pre-test ($p<0.0001$). These results were in similarity with the findings of a study performed by Zaitoun et al., (2021). That performed a study at Jordan to investigate knowledge, attitude, and practice of hearing loss among physicians in Jordan. They reported that the present study showed good overall knowledge by ear, nose and throat (ENT) physicians about the importance of hearing screening infants. Also, these findings were supported by another study performed by Oliveira et al., (2022). They performed a study at Brazil to evaluate the effectiveness of an online continuing education course on infant hearing health for primary care professionals. They reported that comparisons of pre and post training performances showed a significant improvement in knowledge.

On the other hand, this finding was inconsistent with the findings of a study conducted by Elrefaie et al., (2022). They performed a study at western district of Kingdom of Saudi Arabia (KSA) to assess parents and caregivers' knowledge, awareness and attitude toward childhood hearing loss in western district of KSA. They revealed that mothers and caregivers were unfamiliar with the problem. This difference might be explained as the current study provided an intervention to improve nurses' knowledge but the other study did not provide any training intervention

Regarding mean score of total knowledge of the studied nurses before intervention, the present study revealed that there was a statistically significant improvement in means score of total nurses, knowledge about hearing loss and hearing screening test as nurses, who attended nursing intervention on newborn hearing screening testing, had higher knowledge scores after the intervention compared to the pre intervention. This findings is consistent with a study conducted by Roberts et al., (2017) .They performed a study at Huntsville, Alabam to investigate the knowledge and understanding of universal newborn hearing screening in nursing professionals. They reported that their knowledge and practice improvedpost-training. Also, these findings were consistent with another study conducted by Oliveira et al., (2022). They reported that their post training scores were higher than their pretest scores. This consistency in results might be due to the effect of training in improving their knowledge about hearing screening test.

Regarding nursing intervention about newborn hearing screening test for the practice of preparing equipment before the test, the present findings illustrated that less than half of nurses had poor practice level about hearing screening test in pre-test while more than half of nurses had good practice in post-test and retention test. There was statistically significant improvement among the studied sample in the post test practice and retention test about newborn hearing screening. This result was similar to the study that was done by Kanji et al., (2018). It was conducted at South Africa to explore Feasibility of infant hearing screening from a developing country context: the South African. They reported that improvement among the studied sample in the post test practice and retention test about newborn hearing screening. This similarity indicated that application of intervention on the newborn hearing screening help in

changing practice level among PHC nurses.

Regarding nursing intervention about newborn hearing screening test for the practice items during the examination and dealing with the newborn. The present findings illustrated that about fifty percent of nurses had poor practice level as ear examination and cleaning of ear tips was not practised by nurses consistently. This result was similar to a study that was done by Joshi et al., (2021). The study was conducted at South India to investigate training nurses knowledge and practice. It was reported that certain steps such as ear examination and cleaning of ear tips were not practised by nurses consistently. These will affect both the results and increase the risk of cross infection. This similarity might be due to lack of hearing screening training interventions among health sector.

Regarding total mean score of studied nurse practice about newborn hearing screening test, the present study revealed that mean practice scores were improved among the studied sample in the post test intervention and retention test than pre-test. This finding is supported by a study that was done by Jones et al., (2018). The study was conducted at the Auburn University to obtain information concerning the effectiveness of a training program about nursing students: training and maintaining universal newborn hearing screening knowledge. They reported that there were high improvements in post- test and retention test than pre-test. This similarity in the result might be due to effectiveness of nursing intervention for primary health in improving their practice about hearing screening test.

Regarding relation between the nurses' socio-demographic characteristics and their level of pre intervention knowledge about hearing screening test of newborn, the current study reported that there were no statistical significant differences between the studied nurses' age, education and their total score of pre intervention knowledge about hearing loss disease and hearing screening test of newborn. But there was a high significant difference between nurses, years of experience and pre-test knowledge. This finding is supported by a study that was done by Hussein et al., (2018) who stated that no significant effect on participants' overall knowledge regarding childhood hearing impairment and their age but there was a significant relation between duration of experience and their knowledge.

On the other hand, these results are incompatible with Velonaki et al., (2015) who conducted a study in Attica, Greece to assess nurses' knowledge, attitudes, and behavior toward deaf patients. They reported that no statistically significant differences were found between nurses' age, years of experience of studied sample and their knowledge toward deaf people. The difference in the results might be due to that the more, the year of nurses, experience, the more knowledge they have.

Regarding relation between the nurses' socio-demographic characteristics and their level of pre intervention practice about hearing screening test of newborn, the present study stated that there were statistically significant relation between the level of nurses' practice and their age. This finding is supported by Zaitoun et al., (2022) who conducted a study in Jordan to assess knowledge, attitude, and practice of hearing loss among physicians. They reported that a high statistical significant relation between the level of physicians' practice and their age of studied sample. This difference in the result might be due to that the more, the year of nurses,

experience, and the more practice they have.

**Conclusion**

Based on the findings of this study, the study concluded that there was a significant improvement of nurses' knowledge level and practice about newborn hearing screening test post nursing intervention compared to pre intervention. Furthermore, nurses' level of practice regarding newborn hearing screening test was improved significantly after nursing intervention compared to pre intervention. Additionally, there was a statistically significant relationship between nurse's experience and their level of knowledge about newborn hearing screening test.

**Recommendation**

Focused on the results of the current study, it was recommended that:-

1. Continuous training and health teaching sessions should be conducted to enhance knowledge and practice of nurses about hearing screening test 2- Simplified booklet on newborn hearing screening should be made available for nurses.
2. Further studies should be conducted using other methods of health education should be done
3. Another study should be conducted using more sample size to increase the ability to generalize the findings.

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