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The Effects of Loud NICU Environments on Premature Infants and Interventions to Help Minimize Noise

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The Effects of Loud NICU Environments on Premature Infants and Interventions to Help Minimize Noise

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NURS 4500: Nursing Research and Senior Thesis
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Abstract

Noise in the Neonatal Intensive Care Unit (NICU) often exceeds recommended safe noise levels and has been found to have negative effects on premature infants and their health. Some of these effects can be changes in their heart rate, respiratory rate, and sleep patterns. In addition, negative effects, such as hearing loss, can cause permanent damage that impact children's long-term development. A preterm infant is an infant born before 37 weeks’ gestation. Being born prematurely comes with its own problems and many risks. Attempting to survive in an environment that causes more stress is not healing. Understanding the effects of noise on preterm infants’ physiological state and examining interventions to minimize NICU noise is essential. A review of the research literature was performed. Six primary studies exploring the effects of NICU noise on premature infants and interventions were found. The studies were divided into two categories: "Effects of noise exposure" and "Interventions." The studies highlight the effects seen in preterm infants when exposed to noise and show unique interventions that can help minimize these effects. Some interventions that have been found to help minimize noise include implementing quiet times on the units and the use of earmuffs over preterm infants' ears. Sound levels weren’t measured in the studies that implemented quiet times, so further research is needed to assess the effectiveness of the intervention. A quasi-experimental study is proposed, framed by Florence Nightingale's theory that a healthy environment is needed for patients' healing. With parents' consent, eligible NICU infants will be divided into an experimental group, receiving daily quiet time, and a control group, receiving care in the usual environment. The independent variable is sound level, and the outcome variable is infants' vital signs. This investigation may help nurses understand the effect of noise on premature infants' physiological status.
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Introduction

In 2021, 10.5% of babies born in the U.S. were born prematurely which is defined as being born before 37 weeks’ gestation (Centers for Disease Control, 2022). A full-term pregnancy lasts about 40 weeks, and in that timeframe, the fetus is growing and developing. Some medical conditions or other factors, though, may cause the pregnant woman to go into preterm labor and deliver their baby before they hit the 40-week mark. Being born prematurely puts the infant at risk for developing many conditions such as breathing, hearing, and vision impairments, becoming developmentally delayed, and having higher rates of death among other things. Premature infants are cared for by nurses, doctors, and other healthcare professionals who specialize in units called Neonatal Intensive Care Units (NICU). Parents and family members are also part of the collaborative care in the NICU.

NICUs are designed to care for infants born prematurely and in some cases for infants born at full term if they have any medical conditions such as hyperbilirubinemia. These infants may need to be on ventilators to help them breathe and improve gas exchange. They may need to receive tube feedings if unable to suck and swallow on their own, or if they aren’t gaining enough weight with just breastmilk or formula. In this environment, vital signs need to be monitored constantly for any changes in baseline. The machines used in the NICU aid with supporting premature infants in continuing to grow and develop outside the womb, but they may expose them to repeated noises. Repeated exposure to loud noises can cause negative physiological effects in the preterm infant such as an elevated heart rate, increased respiratory rate, and changes in oxygen saturation levels. From machines beeping, parents talking, nurses giving hand-off report, and telephones ringing, these noises can cause premature infants to be
overstimulated, and lead to the negative physiological risks stated above, and in severe cases, can lead to hearing loss and sleep changes in premature infants.

**Problem Statement**

Due to preterm infants in the NICU being exposed to repeated sounds in their environment, it can cause negative physiological effects such as elevated heart rates, changes in respiratory rates, and changes in oxygen saturation levels. To help minimize the risk and exposure to loud noises, interventions have been found to be helpful in both reducing the noise levels in NICU units and in turn lowering their heart rates and stabilizing their oxygen saturation levels. Interventions such as implementing quiet times in the unit and placing earmuffs on the unit have been found to be useful in reducing noise and providing a quiet environment.

**Research Question**

The research questions of this study are:

- In premature infants, what effects do loud NICU environments have on their physiological states?
- What interventions have been found to be helpful in minimizing the exposure to loud noises and thereby minimizing the effects it has on them?

**Relevance**

There are a variety of reasons for which a baby will need care in the NICU including circumstances like being born prematurely and birth defects. They go to the NICU to receive the extra care and attention they need but can often experience more health problems by being exposed to harmful stimuli in the NICU. Repeated exposure to loud noises has been found to have detrimental effects on premature infants and their health status. It is important to
acknowledge this so that improvements and changes can be made to NICU environments and in turn decrease the negative effects that come with being exposed to loud noises.

**Literature Review**

**Introduction**

The literature review of this paper is made of original research articles retrieved from Dominican Library Databases such as Iceberg and PubMed. A number of search terms were used to find articles related to the topic including: premature infants; loud NICU environments; vital signs monitoring; negative effects of noise; minimizing noise; interventions to decrease noise; and physiological status. Using these keywords, primary and secondary studies were revealed, however, only primary research sources were used for this review. Six research articles are used to illustrate the effects that loud NICU environments have on premature infants and interventions found to minimize noise. (See Appendix A: Literature Review Table for summary of the articles)

Research articles for this literature review are divided into two categories. The first category will focus on the effects that loud NICU environments have on premature infants. The articles illustrate changes in vital signs that occur as a result of being exposed to noise such as tachycardia, as well as more serious effects such as sleep deprivation and hearing loss in premature infants. The second category will focus on interventions to minimize noise in the NICU. Interventions aid in addressing or becoming aware of the problem and finding ways to decrease noise levels. The articles in this category will examine interventions that have either been found to help minimize noise or need more interventions or research to help combat this issue. It is important to first help staff in the NICU become aware of the problem before solving it.
**Category I: Effects of Noise Exposure on Premature Infants**

There are three studies in this first category which focus on observing the effects that loud noises and repeated exposure to noise have on premature infants and their physiological status as well as their health later on. Some of these effects as found in the studies in this category include high heart rates and sleep disturbances. These studies are generalized on the negative effects that noise have on premature infants in the NICU.

In the study done by Hassanein et al. (2013), the purpose is to assess the effect that loud noises have on both preterm and full-term infants in the NICU and make staff aware of the noise levels in efforts to help minimize and/or reduce it. This study was done in a NICU unit at Ain Shams University. There are 62 participants in this quantitative study; 36 of the participants are preterm infants (ranging from 28-34 weeks of pregnancy) and 26 full-term infants (37-40 weeks of pregnancy). For this study, noise levels in the NICU were measured throughout the day for three consecutive days. This was done to see if there is a difference in noise levels during different parts of the day, comparing noise levels during the day and at night. Noise levels were recorded both inside and outside incubators to compare noise levels and assess noise inside the incubator where the infant is. The researchers noted 6 noisy events and recorded them along with their noise levels. The 6 noise events noted in the NICU included phones ringing, alarms, loud speech, crying and suction sounds. These recordings were played for each infant and their vital signs were recorded before and after. There was a 15-minute break between recordings to allow the infants’ vital signs to return to baseline.

A major finding of the study is that noise levels were found to be above the maximum safe noise level. As stated in the research study, “The American Academy of Pediatrics recommends a maximum safe noise level of 45 dB in a NICU’ (Hassanein et al., p. 392). Noise
levels in the NICU at Ain Shams Hospital often exceeded this and would reach levels of 65 dB in some instances. Noise levels were found to exceed the safe noise level more during the day than at night because more things are going on during the day than at night from parents and family members visiting to telephones ringing. Helping staff become aware of noise levels helps them be more conscious about noise in their unit and do their best to minimize it when possible.

Another major finding in the study is that premature infants are more susceptible to physiological changes than full-term infants. Preterm infants often experienced episodes of tachycardia and tachypnea when exposed to the noisy events. The study has shown that increased noise levels have effects in NICU patients with not only fluctuations in their vital signs, but also disturbed sleep patterns and higher incidence of hearing loss in preterm infants. A strength of the study was the unique take on recording noise levels in both inside and outside the incubators, as well as describing differences between preterm infants and full-term infants. A limitation of the study is the sample size which could affect the generalizability of it.

The second study in this category from Smith et al. (2018) also aimed to assess and identify the noises found in the NICU and observe how it affects premature infants and their physiological states. For the study, 3 preterm infants in the NICU at St. Louis Children’s Hospital were observed: two in the open room setting and one infant in a private room. This was done to compare and contrast the noise levels within an open room area and that of in a private room. In this quantitative study, two infants were exposed to acoustic events in the open area and the other infant was exposed to acoustic events in their private room. The infants’ vital signs were obtained using the BedMaster system which is a system that records their vital signs. The researchers monitored the infants’ heart rates and respiratory rates to observe the changes that occur in relation to being exposed to the acoustic events. Acoustic events were recorded in both
environments and categorized into 4 groups: alarm noise, conversations, infant-generated noises, and transient noises such as doors closing.

The study found that there is variability in heart rate and respiratory rate in the infants when exposed to acoustic events. Changes in heart rate were noted during acoustic events as well as their respiratory rate. The study also found that although noise levels were higher in the open environment than the private room, both environments’ noise levels exceed the safe noise level recommended by the American Academy of Pediatrics. A limitation to the study is that although the infants did experience changes in their vital signs when exposed to acoustic events in both environments, they also experienced changes in their vital signs when there weren’t major acoustic events occurring, and this can be due to their medical conditions, hence why they’re in the NICU and need to be monitored carefully. Another limitation of the study is the small sample size, so the results of the study may not be generalizable. A strength of the study is comparing noise levels in both environments because not every NICU is designed the same way, and so it is important to assess noise levels in both to measure noise levels and the effects it has on premature infants’ wellbeing.

The final study in this category by Babu (2017) aimed to identify, measure, and record noise levels in a NICU at Bharati Hospital and Research Center, and how infants are affected by these noise levels. This non-experimental, co-relational descriptive design study has 60 infants, a mix of preterm and full-term neonates. The researcher identified sources of noise and categorized them into three groups: equipment, personnel, and other. The researcher also grouped noise levels into zones: quiet zone (40-60 dB), moderate (60-80 dB), and loud (80-100 dB), these were compared with sound level recommendations by the American Academy of Pediatrics. Mean
heart rate, respiratory rate, and oxygen saturation readings were analyzed in relation to noises that occur in the NICU and were compared when exposed to noise versus when they weren’t.

The study found that noise levels in the NICU often fell at the higher end of the moderate zone during the day, compared to noise levels in the evening and night, which fell in quiet zone. The study mentions that certain noise events can occur anytime throughout the day that may cause changes in the infants’ physiological state, but overall noise levels were identified as such. Infants experienced higher mean heart rates in the morning where noise levels were at its highest, and mean respiratory rate were elevated at night. The American Academy of Pediatricians also recommends screening for hearing loss in preterm infants due to the exposure to noise. The study found no significant difference between noise and oxygen saturation readings. A strength of the study is that it aimed to identify sources of noise because in order to solve a problem, it needs to be identified first. Sources of noise and noise level zones is a unique aspect of the study and found that high noise levels do have effects on infants in the NICU. Limitations of the study are the small sample size, and that the results weren’t divided between premature infants and full-term infants, so it’s not known whether preterm infants were more affected by noise events than full-term infants.

Summary of Category I

The three studies in this category highlighted the effects that loud noises or noisy events have on the physiological states of premature infants in NICUs. All three studies compared noise levels in their settings to the safe noise level established by the American Academy of Pediatrics. The results of the studies show that NICU noise environments often exceed those recommended by the American Academy of Pediatrics and the negative effects it can have on patients in the NICU including changes in baseline vital signs, and disturbances in sleep patterns. The main
limitation for the studies is that the sample sizes are small. More research needs to go into observing the effects noise has on premature infants along with measuring noise levels.

**Category II: Interventions to Minimize Noise**

There are three articles in this category and each one examines different interventions on how to minimize noise in the NICU and in turn minimize changes in vital signs in NICU patients and make staff aware of noise in their units. These studies will explore how these interventions can have positive effects such as decreasing heart and respiratory rates and decrease sleep interruptions but also have negative effects that can influence the preterm infants later in their lives.

In the study done by Zauche et al. (2020), the aim is to observe the impact that having quiet times on the unit has on NICU noise environment. This cross sectional, descriptive comparison study is done on 66 preterm infants who were born between 32-38 weeks gestation. If preterm infants’ mother didn’t understand or speak English, then they were not included in the study as well as those not expected to survive more than 72 hours. The researchers implemented quiet times on the unit for two 2-hour intervals, from 1:00-3:00 a.m. and 1:00-3:00 p.m. Quiet time included, “… dimming the lights, minimizing procedures, lowering voices, and posting a sign on the NICU door to indicate that it was quiet time” (Zauche et al. p. 69). The noise environment was compared during quite time and nonquiet time, and also compared noise from open room to private/single rooms. The study was done for a total of 48 hours, 8 hours total of quiet time. To measure noises during quiet and nonquiet time, the researchers used a digital language processor called the Language Environmental Analysis (LENA). This device was used to assess the auditory environment and evaluate noises such as people talking and electronic noises such as alarms. These devices were placed at the head of the crib.
The study found that during quiet time, silence was increased by 13% and exposure to sounds decreased for infants in the NICU. The study found that there 17% fewer electronic sounds during the implemented quiet time. Implementing quiet time in NICU units reduces the exposure to sounds and in turn helps make the NICU a more healing environment and more appropriate for the development of premature infants and all infants. Quiet time was found to be more helpful for those infants who are of higher acuity than for those who are of lower acuity, which demonstrates that excessive noise can have detrimental effects on their health. A strength of the study is that this study was done at two NICU units at two different hospitals in the U.S Southeast region. Another strength of study that is unique is that the researchers also measured speech during the quiet and nonquiet times, which was achievable with use of the LENA device. A limitation of the study is that although it assessed the auditory environment of the units, sound levels weren’t measured. Another limitation is that it decreased the amount of language that the infants were exposed to during the study. It also didn’t assess infant’s physiological status during quiet and nonquiet time.

The second study in this category by Zeraati et al. (2018), also aimed to implement quiet time and assess the effects it has preterm infants and their physiological statuses. This study was done in a NICU unit at the Ghaem Hospital in Mashhad. The study had a total of 120 preterm infants, and they were randomly divided into either an experimental group or a control group. The experimental group had quiet time for two hours from 4:00-6:00 p.m., while the control group didn’t receive quiet time and received their routine care from 11:00-1:00 p.m. During quiet time for infants in the experimental group, lights were dimmed, noise was reduced, and procedures were minimized or done quietly. Both groups were assessed for two hours, and the
researchers focused on measuring their oxygen saturation levels and their respiratory and heart rates to assess the effectiveness of implementing the quiet time protocol.

The study found that implementation of quiet time had significant changes in the preterm infants. With the implementation of quiet time, the heart rates of the infants decreased by at least 10 beats/minute compared to the infants in the control group. Respiratory rate was also lower for the premature infants in the experimental group than those in the control group. Oxygen saturation levels were more stable for those in the experimental group as well. Implementing quiet time has been found to be helpful in premature infants and their physiological status. Having a quiet environment provides them with an environment in which they can continue to develop and provides a healing environment for them. A strength of the study is the sample size; it included 120 preterm infants which is more than the other studies included in this literature review. Another strength of the study is that it provided a control group so that comparisons are able to be made between quiet and nonquiet time. The study was done from March to June of 2013, and this is another strength because there was a lot of time for the researchers to make observations of the effectiveness of implementing quiet noise during that time. A limitation of the study is that the infants’ vital signs in the control group weren’t monitored or observed during the quiet time, only during their normal routine time.

The final study in this category by Abujarir et al. (2012) aimed to assess the effect of use of earmuffs in term and preterm infants to minimize exposure to noise and assess the changes it has on their vital signs. The study is a randomized controlled study experiment and was done at the Women’s Hospital in Qatar for three months. The study had a total of 100 participants; participants were term and preterm infants born after 26 weeks gestation, and the participants were randomly divided into two groups – a control group and an experimental group. The
experimental group received earmuffs while the control group didn’t. The earmuffs used help decrease sound levels by seven dB and the infants in the experimental group wore them for 72 hours, beginning when they were admitted. In those 72 hours, the infant’s vital signs; including blood pressure, heart, rate, respiratory rate, and oxygen saturation, were taken every hour to be assessed and compared.

The study found that earmuff use in the NICU is indeed useful in minimizing noise and beneficial to both term and preterm neonates. The study found that infants who didn’t have earmuffs had significant changes in their vital signs including higher heart rates, blood pressures, and respiratory rates; this could indicate the signs of stress infants have in response to noise exposure. The infants who received earmuffs showed the opposite; they had stable, lower heart rates, blood pressures and respiratory rates. “Earmuffs were clearly demonstrated to have a beneficial effect on several important vital signs…” (Abujariir et al. p. 257). A strength of the study was the unique intervention to minimize noise and the exposure to noise for infants in the NICU that showed to have positive effects on them. Although the results didn’t differentiate between term and preterm infants, it proved to benefit both populations in this study. A strength was that it proved its aim to show the benefits of the use of earmuffs and did so without having any negative effects in the infants such as skin breakdown or infection from the earmuffs. A limitation of the study was that the use of the specific earmuffs used in the study was found to only lower sound levels by 7 dB whereas other earmuffs can lower sound levels up to 15 dB, but nonetheless was found to have beneficial outcomes.

Summary of Category II

The studies in this category explored unique ways in which to minimize sound levels and/or minimize the exposure to noise for preterm infants in the NICU. Implementing quiet time
on the NICU units has been found to help reduce noise caused by either staff and parents or electronic machines like ventilator alarms and telephones ringing, which in turn decreased neonates heart rates or helped them remain stable in their baseline vitals. The use of earmuffs was found to be beneficial in minimizing the exposure to noise for infants and therefore lead to positive changes in their vital signs, like a decreased heart rate, that aren’t caused by stress related to excess noise.

**Summary of Literature Review**

In all, the studies in this literature review demonstrated the effects that loud NICU environments can have on premature neonates and interventions that can be put into place to help minimize sound levels and exposure. For category one, a strength throughout all studies was that they consistently showed many NICUs often exceed recommended sound levels and affect preterm infants in their units. However, the studies were often limited by the sample size and relatively short time frame which could affect the generalizability of the studies. For category two, the studies explored ways in how to minimize noise in NICUs to better achieve recommended safe noise levels and mitigate the negative effects it can cause in infants. Limitations in the studies were specific things such as choosing the proper earmuffs to use and not measuring sound levels before and after implementing the interventions to assess the effectiveness of the intervention. Vitals signs and sound levels should be monitored for both groups during when the intervention is being implemented to truly observe the effects.

**Research Proposal**

**Overall Research Question**

In the second category of articles in the literature review, interventions that were implemented in the studies were shown to be effective in reducing noise in the NICU units and
in turn minimizing the negative effects associated with sound exposure in preterm neonates.

With this understanding of interventions that may be successful in reducing noise, a future study will be proposed to answer the following research question: What effect does implementing quiet times have on overall sound levels in NICUs and in turn have on the physiological status of preterm infants?

**Rationale for Proposed Study**

Preterm infants are admitted to the NICU because they need continuous monitoring and need an environment in which they receive close attention. The environment they are put into should be conducive to their healing, but often times, they are exposed to repeated stressors in their environment such as loud noise that can hinder their healing process and affect their baseline health status. The literature explores the effectiveness of unique interventions to minimize noise in the units, and this proposed study will further explore the effectiveness of implementing quiet time on reducing measurable sound levels and the effect it has on the physiological status of preterm infants.

**Theoretical Framework**

The theoretical framework that is used to support the proposed research study is Florence Nightingale’s Environmental Theory and this theory states that “The focus of nursing in this model is to alter the patient’s environment in order to affect change in his or her health” (Petiprin, 2023, para. 3). This theory focuses on 10 major concepts in a patient’s environment that can be altered to best suit the patient and their health needs. The 10 major concepts are: ventilation and warming, light and noise, cleanliness of the area, health of houses, bed and bedding, personal cleanliness, variety, offering hope and advice, food, and observation (Petiprin, 2023). In regard to noise, Nightingale viewed unnecessary noise as irritating to the patient, and
as observed in the studies in the literature review, we can see that noise can be harmful to preterm infants. Something she emphasized in her environmental theory was, “… providing a quiet or noise-free and warm environment… and evaluating its effects on the patient” (Petiprin, 2023, para. 3). Making appropriate changes to the patient’s environment is important to consider because providing patients with a healing environment is good for their health. This model relates to the proposed research study because it will examine how a change in the preterm infant’s environment can be healing for them.

**Primary Research Aims**

The aim of the proposed study is to identify the effectiveness of implementing quiet times in a NICU unit in reducing noise levels and measuring the effects it has on preterm infant’s health status.

**Ethical Considerations**

Conducting a research study on preterm infants will require parental consent. Ensuring that the parents understand all the aspects of the study and what it will mean for their infant to be involved in the study before they can give consent is essential. The babies are a vulnerable population.

Confidentiality will be ensured for the patients by using study ID numbers and only allowing those involved in the research study to obtain access to the data. The proposed study will be reviewed by the Dominican University Institutional Review Board and their approval will be obtained before the start of the study. Approval by the hospital’s NICU ethics committee will also be obtained before recruiting participants for the study as well as informing parents of the potential participants.
Research Design

The proposed study will be using a quasi-experimental quantitative research design. Participants will be randomly divided into two groups, an experimental and a control group.

Population

The population of this study will include preterm infants who are admitted to a NICU in the Bay Area. Their reason for being admitted to the NICU will be evaluated to see if they are eligible to participate in the study. The population to be included will be limited to preterm infants born before 37 weeks’ gestation.

Participants of the study will be recruited from a NICU unit in a Bay Area hospital to best assess the effectiveness of the intervention. Parents of the premature infants will be approached and informed of all aspects of the study and to see if they would allow their infant to be included in the study.

Sample Size

The study will include a convenience sample size of 50 preterm infants admitted to the NICU, male and female, 25 of whom will be randomly chosen to be in the control group. Those in the control group will not receive quiet time but will receive care in the usual environment and still be monitored for changes in vital signs. The other 25 in the experimental group will receive two 2-hour quiet times throughout the day and will be monitored for changes in their vital signs and overall state of wellbeing.

Methodology

After the study has been explained to the parents and they give consent for their infants, 50 preterm infants will be randomly categorized into two groups where one will receive the intervention of implementing quiet time while the control group doesn’t and receives their usual
care. They will be assigned Study ID numbers to remain confidential and to keep track of their data.

The experiment will last for a 3-month period to obtain accurate data that can be analyzed. The experimental group will be brought into a quiet room where no talking is allowed, lights are dimmed, volume of machines are lowered and reduce or eliminate any unnecessary sounds such as telephones ringing and doors shutting loudly. They will remain in this quiet environment for two hours and will be done two times throughout the day, once during the morning and once during the evening. Vitals signs that will be monitored during quiet time include heart rate, respiratory rate, and oxygen saturation. Sound levels will be measured in the quiet room in decibels which measures sound intensity. The participants in the control group will receive their usual care during this time without receiving quiet time. Sound levels will also be measured in the control group where no changes are made to reduce the sound levels. Their vital signs will also be measured during when those in the experimental group are receiving quiet time to analyze the effect a quiet environment has on their physiological status versus a loud environment.

Study Analysis

After all the data is collected, vital signs and sound levels, the results from the experimental group will be compared to that of the control group to assess the benefit of implementing quiet times in NICUs and the effect that a quiet environment has on the preterm neonates’ baseline status. This will highlight the relationship between noise and negative changes in vital signs. To ensure that the control group doesn’t receive quiet time and potentially alter the data, they will not be brought into the quiet room created for the experimental group, but interventions will be implemented if infants are gravely affected by the noisy environment.
The quantitative data will be collected from both groups and will be compared using a statistical computer software. Sound levels measured in decibels will be compared between both environments and analyzed if sound levels are in fact significantly lower than in the normal NICU environment. Vital signs between the two groups will also be compared to the other group. A p-value of less than 0.05 will be considered as statistically significant.

**Conclusion**

Being born prematurely comes with its own risks and being in an environment that is not conducive to premature infants and their healing brings along more risks of negative consequences such as changes in their baseline status. This research paper has provided studies that highlight those negative consequences and how often times NICU noise levels exceed the recommended level set by the American Academy of Pediatrics. This shows that changes need to be made and some interventions studied by researchers have been proven to be effective such as placing earmuffs on the infants as well as implementing quiet times.

To implement these changes, healthcare providers must be aware of the issue before it can be solved which is what some of the studies included in the literature review sought out to do along with viewing the effectiveness of their study. These interventions can help minimize the negative effects preterm infants experience in response to loud noises.

The proposal for further study in this paper includes implementing quiet times in NICU units and assessing the effects it has on lowering sound levels, something the other studies in the literature review lacked doing. Vital signs would also be measured to highlight the positive effects of having a quiet environment to heal and grow in for these premature infants. Becoming aware of the negative effects can help healthcare providers become aware of unnecessary noises.
in their units and hopefully make small changes that can make a big difference in the lives of the premature infants and full-term infants they care for in the NICU.
References


## Appendix A. Literature Review Table

<table>
<thead>
<tr>
<th>Authors/Citation</th>
<th>Purpose/Objective of Study</th>
<th>Sample - Population of interest, sample size</th>
<th>Study Design</th>
<th>Study Methods</th>
<th>Major Finding(s)</th>
<th>Strengths</th>
<th>Limitations</th>
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</thead>
<tbody>
<tr>
<td>Abujarir, R., Salama, H., Greer, W., Al Thani, M., &amp; Visda, F. (2012). The impact of earmuffs on vital signs in the neonatal intensive care unit. <em>Journal of Neonatal -- Perinatal Medicine</em>, 5(3), 249–259. <a href="https://doi-org.dominican.idm.oclc.org/10.3233/npm-2012-57511">https://doi-org.dominican.idm.oclc.org/10.3233/npm-2012-57511</a></td>
<td>The purpose of this study is to assess the effect of earmuff use to minimize noise on vital signs in term and preterm infants</td>
<td>This study had a total of 100 participants; randomly divided into two groups where one group received earmuffs and the other group didn’t</td>
<td>Quantitative study</td>
<td>-one group of infants received earmuffs, the other group didn’t -vital signs (VS) were recorded in both groups for a time period of 72 hours</td>
<td>-infants who had no earmuffs showed increased HR, BP, and RR -infants who had earmuffs showed decreased HR, BP, and RR -wearing earmuffs showed to have a positive effect</td>
<td>-unique intervention to minimize noise that was found to have positive effects</td>
<td>-one limitation of the study was that the earmuffs used in the infants didn’t decrease noise by much, but still shown to have a positive effect</td>
</tr>
<tr>
<td>Babu, D. (2017). Effect of noise level on selected physiological parameters among neonates admitted in NICU. <em>SSRG Int J Nurs Health Sci</em>, 3, 2454-7484.</td>
<td>The purpose of this study was to record noise levels in a NICU and how it affects infants in the NICU and their physiological status.</td>
<td>60 infants; mix of preterm and full-term neonates</td>
<td>Quantitative study</td>
<td>-Measure noise levels and sources of noise -Measure VS of infants when exposed to noise -Compare effects of noise on different physiological status.</td>
<td>-Noise levels in this NICU were found to be elevated, past the levels recommended for NICU units. -Infants had elevated heart rates with high noise levels. -States that in order to reduce sound levels in NICU, first must be measured and observed how it differs throughout the day.</td>
<td>Some strengths of this study were that it shows that high levels of noise do have effects in infants and their vital signs.</td>
<td>Some limitations about the study are the small sample size and it may not be generalizable.</td>
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<td>Hassanein, S. M., El Raggal, N. M., &amp; Shalaby, A. A. (2013). Neonatal Nursery Noise: Practice-based learning and improvement. <em>The Journal of</em></td>
<td>The purpose of the study is to assess the effect that loud noises have on infants in the NICU and encouraging interventions to help make staff aware of noise levels and the study was done on 36 preterm infants (ranging from 28-34 wks) and 26 full-term infants (37-40 wks).</td>
<td>Study design: quantitative</td>
<td>-Noise levels measured across three days throughout the day -Noise was recorded both inside and outside incubators -6 noisy events frequency and</td>
<td>-Noise levels found to be above the maximum safe noise level and more common to occur during day shift -Preterm infants more susceptible to physiological</td>
<td>-One strength of the study is that the researchers recorded noise levels both inside and outside the incubators. -Another strength is that they also</td>
<td>One limitation of the study is the sample size which can affect the generalizability of the study.</td>
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<td>Authors/Citation</td>
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<td>Sample - Population of interest, sample size</td>
<td>Study Design</td>
<td>Study Methods</td>
<td>Major Finding(s)</td>
<td>Strengths</td>
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<td>Maternal-Fetal &amp; Neonatal Medicine, 26(4), 392–395. <a href="https://doi.org/10.3109/14767058.2012.733759">https://doi.org/10.3109/14767058.2012.733759</a></td>
<td>therefore try to minimize it. This study was done in a NICU unit at Ain Shams University.</td>
<td>-3 infants; two in open room, one in private room</td>
<td>Quantitative study</td>
<td>-3 infants in this study; two were exposed to acoustic events in the open room, one was in a private room -Acoustic events were recorded in both environments and infants’ HR and RR were taken during acoustic events</td>
<td>-NICU noise levels exceed those recommended in both the open rooms and private rooms -premature infants HR increased w/ acoustic events</td>
<td>-one strength of this study was that it measured sound levels both in the open room and private room and found that both settings exceeded noise level recommendations -provided the nurses and other staff with interventions to minimize noise in their unit.</td>
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<td>Smith, S. W., Ortmann, A. J., &amp; Clark, W. W. (2018). Noise in the neonatal intensive care unit: a new approach to examining acoustic events. Noise &amp; health, 20(95), 121.</td>
<td>Purpose of this study is assess and identify the noises found in NICUs and how it affects infants and their physiological states.</td>
<td>66 preterm infants born at less than 38 wks gestation</td>
<td>Cross sectional, descriptive comparison study</td>
<td>-quiet time implements for 4 hours -compared noise environment in quiet vs nonquiet time -quiet time included dimming the lights, minimizing procedures, lowering voices, and signs indicating quiet time</td>
<td>-silence increased and exposure to sounds decreased for infants in the NICU -13% more silence and 17% fewer electronic sounds -decreased exposure to sounds during quiet time</td>
<td>-study done at two NICUs -measured speech during quiet time vs nonquiet time -A limitation is that it also decreased language exposure in the infants - sound levels weren’t measured</td>
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<td>Zauche, L. H., Zauche, M. S., &amp; Williams, B. L. (2020). Influence of Quiet Time on the Auditory Environment of Infants in the NICU. Journal of Obstetric, Gynecologic and Neonatal Nursing, 50(1), 68–77.</td>
<td>The purpose of the study is to observe the impact quiet time has on NICU noise environment.</td>
<td>66 preterm infants born at less than 38 wks gestation</td>
<td>Cross sectional, descriptive comparison study</td>
<td>-quiet time implements for 4 hours -compared noise environment in quiet vs nonquiet time -quiet time included dimming the lights, minimizing procedures, lowering voices, and signs indicating quiet time</td>
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<td>Zeraati, H., Nasimi, F., Ghorbanzade, M., &amp; Sarani, A. (2018). Effects of a quiet time protocol implementation on respiratory rate and SpO2 in preterm infants. Shiraz E-Medical Journal, 20(1). <a href="https://doi.org/10.5812/semj.84063">https://doi.org/10.5812/semj.84063</a></td>
<td>The purpose of this study is to assess the effect quiet time has on preterm infants’ SpO2 and RR, and if found to be positive, implement it as hospital standard.</td>
<td>120 preterm infants randomly divided into experimental and control groups</td>
<td>Quantitative study</td>
<td>-infants randomly divided into experimental and control groups; experimental group had quiet time for two hours while other</td>
<td>-implementation of quiet time can decrease HR and RR through decrease in environmental stimuli -by reducing stress, HR and RR also reduces/decreases so recommended to decrease stress in preterm infants</td>
<td>-unique intervention to reduce noise in NICU unit -population size is a good size with more than 100 infants</td>
<td>-a limitation of this study included different thresholds of pain in response to environmental stimuli</td>
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