



4-27-2018

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## Recommended Citation

Pope, Emily K.. (2018). Decibel Levels and Employee Perceptions of Noise Levels in Child Care Facilities. In *BSU Honors Program Theses and Projects*. Item 272. Available at: [http://vc.bridgew.edu/honors\\_proj/272](http://vc.bridgew.edu/honors_proj/272)  
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Submitted in Partial Completion of the  
Requirements for Commonwealth Honors in Communication Sciences and Disorders

Bridgewater State University

April 27, 2018

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Decibel Levels and Employee Perceptions of Noise Levels in Child Care Facilities

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### Abstract

This quantitative study investigated decibel levels and employee perceptions of the noise levels in four child care facilities. Using a sound level meter, the decibel levels of each facility were measured when the rooms were unoccupied and when they were occupied and, information about the acoustic environment was collected. Employees (n= 22) completed a survey rating noise levels during activities throughout the day and the potential implications of the noise levels on their voice and hearing. Results showed that the child care facilities adhered to OSHA standards for permissible noise in work environments (90dBA for 8 hours). The sound-level measurements of the unoccupied facilities ranged from 34dBA to 53dBA and the sound level measurements of the occupied facilities ranged from 60dBA to 89dBA. Three of the four facilities incorporated design elements to reduce noise levels in their facility. Approximately half of the employees reported that they frequently needed to repeat themselves (n= 9) and raise their voice (n= 11) in order to be heard in their work environment. While the majority of participants did not report ringing in their ears, all employees (n=2) working in the facility with minimal acoustic considerations reported ringing in their ears.

*Keywords:* decibel, noise, sound level, child care, school-age program

### Decibel Levels and Employee Perceptions of Noise Levels in Child Care Facilities

In the United States, an estimated 25.2% of the 20.4 million children under 5 years of age are cared for in an organized child care center and an estimated 5% of the 35.6 million children 5-14 years of age are cared for in a school-age program (Laughlin, 2013). A child care center is defined as, “a facility operated on a regular basis whether known as a child nursery, nursery school, kindergarten, child play school, progressive school, child development center, or preschool, or known under any other name, which receives children not of common parentage under 7 years of age” (Massachusetts General Laws, 15d, §1a, 2018). A school-age program is defined as, “a program or facility operated on a regular basis which provides supervised group care for children not of common parentage who are enrolled in kindergarten and are of sufficient age to enter first grade the following year, or an older child who is not more than 14 years of age” (Massachusetts General Laws, 15d, §1a, 2018).

Many child care facilities offer services for infants and toddlers (birth-3), pre-k children (3-5 years old), and school-age children (6-14 years old). As early enrollment in center-based child care has become a societal norm in the United States, the number of children in child care centers and school-age programs has increased (U.S. National Research Council & U.S. Institute of Medicine, 2000). Accordingly, interests in the effects of these centers on childhood development has substantially increased. One point of particular interest to researchers are the implications of child care centers and school-age programs on the vocal and acoustic health and development of children.

Noise levels in child care centers have been a source of concern in many communities for the past few decades. According to Kaysen (2016), child care centers in residential areas have received noise complaints from neighbors. The author cites disgruntled neighbors claiming that,

“the noise [from the child care facility] is constant and intolerable.” Nearly three decades earlier, Gardner (1988) reported noise complaints from about child care centers located in Massachusetts communities. Due to excessive noise, family day care centers in residential areas were under scrutiny and town neighbors attempted to prevent the establishment of day care centers in neighborhoods. In an effort to support these small businesses, the State of Massachusetts passed legislation prohibiting “local officials from regulating family day care unless a town’s zoning bylaws contain a specific amendment to that effect” (Gardner, 1988). As a result of the legislation, the majority of the towns in the State of Massachusetts developed zoning bylaws prohibiting child care facilities in residential areas due to noise complaints.

### **Research Questions**

Within the context of current research and legislation, the study aimed to answer the following questions:

1. What are the noise levels in child care facilities?
2. What are employees’ perception of noise levels within child care facilities?
3. Do noise levels in child care facilities impact the vocal and acoustic health of employees?

### **Literature Review**

Merriam-Webster (2017) defines noise as “any sound that is undesired or interferes with one’s hearing...” In children and adults, chronic, elevated exposure to noise above 70 dBA-80 dBA for 8 or more hours per day can have negative auditory and non-auditory health effects, including permanent noise-induced hearing loss (Veit, Dellarco, Dearborn, & Neitzel, 2015). Noise Induced Hearing Loss (NIHL) is a “[hearing loss] caused by exposure to excessively loud sounds and cannot be medically or surgically corrected; noise-induced hearing loss can result

from a one-time exposure to a very loud sound, blast, or impulse, or from listening to loud sounds over an extended period” (NICDC, 2017).

In the United States, there is an estimated 30 million adults and 5.2 million children with a noise-induced hearing impairment (Niskar, Kieszak, Holmes, Esteban, & Rubin, 2001; National Institute on Deafness and Other Communication Disorders, 2017). Furthermore, an estimated 20 million children and adults are exposed to dangerous noise levels every day (Tak, Davis, & Calvert, 2009). Reports of noise levels in child care centers and school-age programs have ranged from 75-81 dBA (Etzell, 2013) to 81-85 dBA (McAllister, Granqvist, Sjölander, & Sundberg, 2007). According to the US Occupational Safety and Health Administration (OSHA), at noise levels exceeding 80 dBA, people must speak very loudly to be heard. At noise levels of 85 dBA people must shout to communicate with coworkers who are within three feet of each other.

The reported noise levels of child care centers and school-age programs (75- 85 dBA) can cause hearing loss in children and adults (Anderson, 2011) and will negatively affect their communicative abilities. Repeated exposure to noise, like that which can occur in a child care center or a school age program, can negatively impact the speech perception of children (Anderson, 2011) and adversely affect their cognitive performance (Boman, 2004). In addition, children and employees must often raise their voices to communicate with others which, in turn, will negatively affect their vocal health (McAllister, et. al., 2007; Rantala, Hakala, Holmqvist, & Sala, 2015).

Although the literature has described the adverse effects of noise on children and adults in child care and school-age programs, it did not include children and adult perceptions of the noise levels within these facilities. Consequently, this study was designed to examine these

perspectives by investigating the noise levels in child care facilities and employees' judgment of those noise levels. Furthermore, the study examined the perceived effect of noise levels on the vocal and acoustic health of employees. The authors hypothesized that there was a direct relationship between sound level measurements and employee perceptions of noise levels in the facility. It was predicted that as sound level measurements increased, participants rating of the loudness of their work environment should also increase. Additionally, it was predicted that as noise levels in the environment exceeded 75 dBA, participants' ratings of their vocal and acoustic health would decrease.

### **Methods and Designs**

The purpose of this study was to examine the decibel levels in child care facilities and employees' perceptions of those noise levels. Institutional Review Board (IRB) approval was obtained prior to the launching of the study. Using a quantitative design, data collection included: the measurement of decibel levels and a survey of employee perceptions of noise levels in child care facilities. The instruments used to collect data included: a sound-level meter and an employee survey.

### **Participants**

Data were collected from 22 employees (18 years or older) at four different school age facilities located in southeastern Massachusetts. Consent to participate was first obtained by the managers of the facility and then from the employees. Of the participants, 12 were full-time employees ( $\geq 40$  hours or more per week) and 10 were part-time employees ( $< 40$  hours per week). In adherence to Massachusetts child care licensing regulations the provider-to-child ratio for pre-school age children was 1:10 and the provider-to-child ratio for school-age children was 1:13.

### **Sound Level Measurements**

Sound-levels of each child care facility were recorded using a RadioShack Digital Sound Level Meter. The sound level meter was adjusted to “A-weighted” setting. The frequency response of an A-weighted sound level meter is similar to the response of the human ear and is used by environmental and hearing conservation programs, such as the US Occupational Safety and Health Administration (OSHA, 2013). To ensure accuracy of measurements, each sound-level meter was tested prior to and immediately following data collection according to the RadioShack Digital Sound Level Meter 3300099 User Guide.

Sound-level measurements were recorded in nine classrooms in four child care facilities before the hours of operation (i.e., prior to the arrival of children and faculty) and during the hours of operation. In each facility, the sound-level measurements were collected throughout the day. Sound-levels were measured during various period of the day (e.g., breakfast, snack, lunch, free play, and small groups) according to the schedule of the facility. For accurate sound-level measurements, the researchers adhered to the technical procedures outlined by US OSHA Technical Manual (2013). In addition to sound-level measurements, information about the acoustic environment was obtained by taking photographs of the rooms while they were unoccupied; children and employees were not photographed. Data about the acoustic environment included information about design elements in the child care facility aimed at reducing noise levels.

### **Survey**

The survey collected data on employees’ rating of noise levels throughout the work day and employees’ rating of their vocal and acoustic health. At each facility, employees (n=23) were requested to complete an anonymous, voluntary survey about their perception of noise levels in

their work environment. If employees volunteered to participate, the participants were required to agree to an informed consent statement (n=22). Participants who did not agree to the informed consent statement were discarded (n=1). Once the participants completed the survey, the researchers collected the completed surveys for analysis (n=22).

The survey consisted of four sections: (1) informed consent, (2) demographic information, (3) employee perceptions of noise levels during various activities, and (4) vocal and acoustic health in child care settings. In section one, participants were required to read and agree to the informed consent statement in order to participate in the study. Completed surveys that did not include informed consent were excluded (n=1). Additional exclusion criteria included incomplete surveys (n=0). In section 2, participants reported demographic information about the number of days and hours they work per week at the facility. In addition, participants reported information about the age groups they supervised at the facility. In section three, participants rated the loudness of their work environment during specific activities (e.g., breakfast, free play, and small group) on an adapted version of the Likert scale. The modified scale required participants to rate their work environment during each activity as: comfortable, uncomfortable, or very uncomfortable. According to Bishop and Herron (2015), using an even-point scale forces participants to agree or disagree with each statement, rather than select 'neutral' as a response. In section 4, participants reported about their vocal and acoustic health. In this section, participants used a different 5-point Likert scale to indicate the degree to which they agreed with statements about their vocal and acoustic health in their work environment: The 5-point Likert scale included the following participant choices: strongly agree, agree, neutral, disagree, and strongly disagree. The complete survey is included in Appendix.

## Results

The purpose of this study was to examine the decibel levels in child care facilities and employees' perceptions of those noise levels. The study included 22 participants working in four different child care facilities. In contrast to the authors' hypothesis, results suggested there was no relationship between sound level measurements and participants rating of noise levels. As noise levels increased, participants rating of the loudness of their work environment remained comfortable. Additionally, the results suggested there was no relationship between noise levels and participants' rating of their vocal and acoustic health. However, the results indicated the duration of exposure to noise did impact participants reported vocal and acoustic health. In their work-environment, part-time participants reported more vocal and acoustic health problems than full-time participants.

### Sound-Level Measurements

Results of this study showed that all four facilities adhered to US OSHA standards for permissible noise in work environments, as sound level measurements did not exceed 90 dBA for 8 hours (See Figure 1). The noise level of the unoccupied facilities ranged from 34 dBA

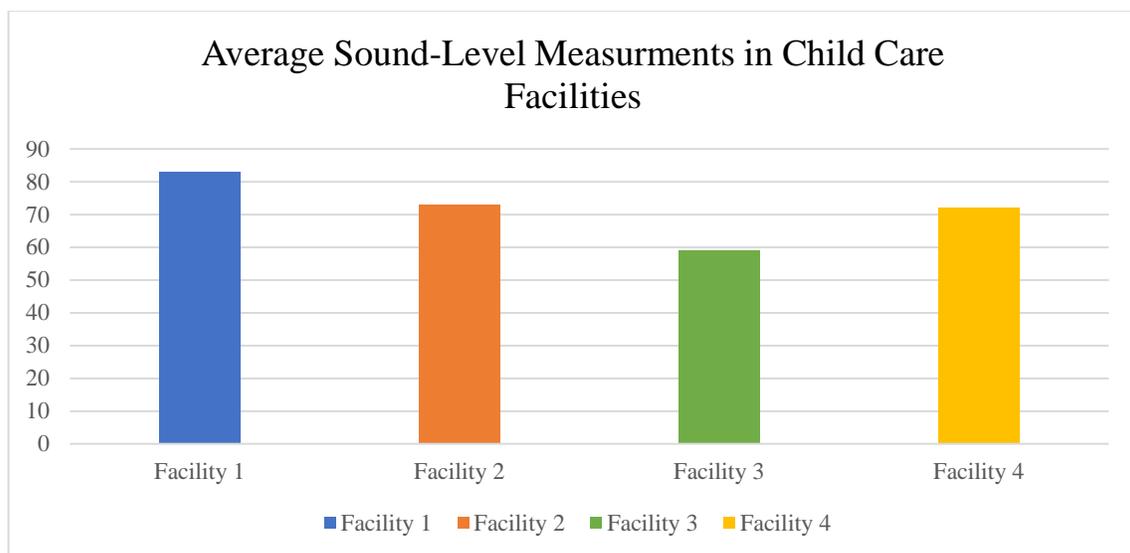


Figure 1. Average Sound-Level Measurements in Child Care Facilities

to 53 dBA, with an average noise level of 43 dBA. The noise levels of the occupied facilities ranged from 60 dBA to 89 dBA, with an average noise level of 73 dBA. In addition, sound level measurements were also obtained and analyzed based on activity type. The results indicated the noise levels during free-play activities were consistently loud in each facility, with an average noise level of 81 dBA.

Three of the four centers incorporated design elements to reduce noise levels in their facility. The design elements included: carpet, window treatments, soft-tack walls, and acoustic tile ceilings. As indicated by Figure 1, the facility with minimal acoustic considerations (i.e., Facility 4) had a higher average noise level (83dBA) than the other three facilities with acoustic considerations.

### **Survey**

The results of the survey showed that participants reported a significant number of child care activities had comfortable noise levels, with the exception of gross motor and free play activities. In gross motor activities, over half of the participants rated the noise level as comfortable (n=11) and the remaining participants rated the noise level as uncomfortable (n=7), very uncomfortable (n=1), or does not apply (n=2). In free play activities, the majority of the participants (n=12) rated the noise level as uncomfortable (n= 10) or very uncomfortable (n= 2). Approximately half of the participants reported that they frequently needed to repeat themselves (n= 9) and raise their voice (n= 11) in order to be heard in their work environment. The majority of participants did not report vocal tiredness (n=18) or difficulty hearing others (n=12) due to noise levels. While the majority of participants did not report ringing in their ears, the participants of the facility with minimal acoustic considerations reported ringing in their ears (n= 2).

Results suggest that the duration of exposure to noise did not impact participants' rating of noise levels. However, the results indicate the duration of exposure to noise did impact their reported vocal and acoustic health. In their work-environment, part-time participants reported more vocal and acoustic health problems than full-time participants. Of the 10 part-time participants, 6 reported that they needed to repeat themselves to be heard, while only 3 of the full-time participants (n=12) reported that they needed to repeat themselves. The majority of part-time participants also reported that they need to raise their voice to be heard (n=7). In contrast, only 4 full-time participants reported that they needed to raise their voice.

### **Discussion**

The data obtained during this study showed that all four child care facilities adhered to OSHA standards for permissible noise in work environments, as sound level measurements did not exceed 90 dBA for 8 hours. Additionally, the average noise levels of each facility did not exceed American Speech, Language, and Hearing Association's (ASHA) suggested 85 dBA dangerous decibel level with short bursts of noise exceeding the suggested level. Although brief, the repeated exposure to sounds at or above 85dBA can cause hearing loss (NIDCD, 2017). Full-time participants ( $\geq 40$  hours per week) are at a greater risk of NIHL due to the duration of their exposure to decibel levels at or exceeding 85 dBA. In order to protect the vocal and acoustic health of children and employees, it is imperative to educate child care centers and school-age programs about preventative measures to reduce dangerous noise levels in their facilities. The Acoustical Society of America (2002) provides acoustical performance criteria, design requirements, and design guidelines for school classrooms and other learning spaces, such as child care facilities and school age programs, to reduce background noise or reverberation that could negatively affect learning environments.

The importance of ASA standards is reinforced by Figure 1, where the facility with minimal acoustic considerations (i.e., facility 4) had a significantly higher average noise level (83 dBA) than facility 2, with the most acoustic considerations (59 dBA). Although there was a significant difference between the average noise levels of facility 2 and 4, the noise level differences were not reflected in the participant surveys. Participants from both facility 2 and 4 rated the noise levels of activities within their respective child care facility as comfortable. Participants from facility 2 did not report vocal or acoustic difficulties and participants from facility 4 did not report vocal problems. In facility 4, participants reported ringing in their ears. The survey responses from participants in facility 4 highlights the risk of noise-induced hearing loss. According to OSHA standards (2015), at noise levels exceeding 80 dBA, people are required to speak very loudly to be heard and at noise levels of 85 dBA people must shout to communicate with coworkers who are within three feet of each other. Although the participants were exposed to an average decibel level of 83 dBA, they did not report discomfort associated with increased sound levels.

### **Limitations**

There were two major limitations of this study, and they are related to duration and the technology used. Due to time limitations, sound-level measurements for each facility were recorded in one day. Future research should incorporate multiple measurements over an extended period of time. A longitudinal study would provide a more comprehensive report of noise levels in each facility in different activity conditions over a period of time. Obtaining sound-level measurements during each activity over the course of week would enable researchers to examine the average noise levels in each facility per day and per activity. The extended duration of data collection would enable researchers to determine outliers in the data and additional factors that

may influence noise levels. The second limitation was the technology used to record sound-level measurements. Sound-level meters provide a cross-sectional perspective of noise levels.

Although sound-level meters collect important data about noise levels in a facility, a noise dosimeter, which measures the noise levels an individual is exposed over an extended period of time, would provide a more comprehensive report of the noise levels each employee is exposed to during different activities (OSHA, 2013). According to OSHA (2013), “the dosimeter is actually worn by the worker to determine the personal noise dose during the work shift or sampling period... [the device] is a form of personal sampling, averaging noise exposure over time.”

### **Conclusion**

This quantitative study examined the noise levels in child care facilities and employees' judgment of those noise levels. Furthermore, the study examined the effect of noise on the vocal and acoustic health of employees. Within the context of the current research, the primary purpose of the study was to investigate employees' judgment of noise levels in child care facilities. In addition, the study was intended to contribute to literature on the effects of noise on children and adults in child care facilities. Further research is needed in order to investigate decibel levels in child care facilities and to develop educational and environmental strategies to effectively reduce potentially hazardous decibel levels in child care settings.

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Appendix

Participant Survey

<input type="checkbox"/> By checking this box, I acknowledge that I am an employee of this child care program and I understand that this survey will take approximately 10 minutes of my time and I will incur no risks.						
1. On average, how many days a week do you work? <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7						
2. On average, how many hours a day do you work? <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> Over 9 hours						
3. Which age group do you work with? (Check all that apply.) <input type="checkbox"/> Pre - K <input type="checkbox"/> K - 1 <input type="checkbox"/> Grade 2 - Grade 4 <input type="checkbox"/> Grade 5 - Grade 7						
Please rate the loudness of your work environment during the following activities:		Comfortable	Uncomfortable	Very Uncomfortable	Does Not Apply	
4.	Breakfast					
5.	Snack					
6.	Lunch					
7.	Free play					
8.	Project					
9.	Movie					
11.	Outside Play					
12.	Small Group					
13.	Other - Please list:					
Please indicate the degree to which you agree with the following statements		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
14.	At work, I find it difficult to hear others speaking.					
15.	At work, I frequently need to raise my voice to be heard.					
16.	At work, I frequently need to repeat myself to be heard.					
17.	After work, I experience ringing in my ears.					
18.	After work, my voice feels tired.					