UNIVERSITY OF CINCINNATI

Date: May 25, 2004

I, Myra Susan Jones,

hereby submit this work as part of the requirements for the degree of:

Doctor of Philosophy

in:

Nursing

It is entitled:

Predicting the Use of Personal Respiratory Protection Among Workers in Swine Confinement Buildings

This work and its defense approved by:

Chair: Donna Gates EdD, RN

Linda Baas PhD, RN

Margaret Miller EdD, RN

Deborah Reed PhD, RN

Predicting the Use of Personal Respiratory Protection among Workers in Swine Confinement Buildings

A dissertation submitted to the

Division of Graduate Studies and Research

of the University of Cincinnati

in partial fulfillment of the

requirements for the degree of

Doctor of Philosophy

In the College of Nursing

2004

by

Myra Susan Jones

B.S.N, University of Tennessee, Memphis, 1968

M.S.N., Vanderbilt University, 1972

Committee Chair: Associate Professor Donna G. Gates

UMI Number: 3146506

UMI Microform 3146506

ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

Predicting the Use of Personal Respiratory Protection by Workers in Swine Confinement Buildings

The purpose of this study was to identify the variables that influence the frequency of personal respiratory protection (PRP) use by workers in swine confinement buildings (SCBs). The study was designed to answer four research questions: 1). What is the validity and reliability of the Personal Respiratory Protection Survey (PRPS)? 2). How frequently do workers in SCBs wear PRP? 3). How do demographics, occupational histories, and self-reported respiratory health histories influence the use of PRP in SCBs? and 4). What are the relationships of the constructs (benefits, barriers, susceptibility, severity, norms) to the use of PRP by workers in SCBs? The investigator developed an instrument that included a questionnaire to elicit demographic information, occupational and respiratory histories, and frequency of PRP use among SCB workers. In addition, the instrument included the PRPS that contained five Likert scales developed to measure five constructs theorized to influence the frequency of PRP use by SCB workers. To establish the instrument's content validity a two-phase process included a critique by a group of eight experts and a pilot test with six SCB workers. Data for the study were collected from 503 SCB workers attending the 2003 World Pork Expo in Des Moines, Iowa. Principle component analysis (PCA) and varimax rotation were used to establish construct validity and resulted in the identification of eight factors (i.e., benefits, norms, severity, susceptibility, personal barriers, knowledge barriers, external barriers, and habit barriers). Cronbach alpha values for the factors ranged from .58 to .91. Descriptive analysis found that 36.3% of the workers never used and 21.2% seldom used PRP at the worksite during the past year. Stepwise hierarchical regression was used to predict the frequency of PRP use with 38.9 % of the total variance explained by the study's

variables. Twelve percent of the variance was explained by a combination of the demographic, occupational history, and respiratory history variables. An additional 27% of the variance was explained by six of the theoretical constructs: knowledge deficit barriers, external barriers, norms, severity, benefits, and personal barriers. Recommendations are shared for future research along with implications for theory and practice.

Acknowledgements

Goals are not accomplished alone and this dissertation is no exception. Returning to the academic setting to work toward a doctoral degree as a non-traditional student was met with unique opportunities and challenges. I deeply appreciate the support of many individuals who assisted me to endure the challenges and maximize the opportunities. I am especially indebted to the members of my dissertation committee. My committee chair, Dr. Donna Gates, is thanked for sharing her passion for occupational health nursing, her expert advice, and continuous encouragement during each step of the process. Drs. Baas, Miller and Reed each shared their unique area of expertise at just the right time. A special thanks is extended to Dr. John Bruni, Associate Professor of Psychology at Western Kentucky University, who donated his time and expertise to serve as my statistical mentor. I am also appreciative of the funding received from the Educational Training Center at the University of Cincinnati and from the Iowa Pork Producers Association to support my research study.

A special thanks is sent for my many friends and family members that energized me with best wishes and offers to assist with life's demands whenever possible. My children, Bart and Beth, and their spouses, have and will always be my number one motivating force. I felt their support throughout this educational process. My sister came to my rescue to care for ill family members on many occasions, which allowed me to continue working toward my goal. I dedicate this work to my multiple relatives and friends who died during my educational journey. They would have been so very proud of the achievement of this goal and I know their spirit will be present for the celebration. Words are inadequate to express my appreciation to a special friend, my husband,

Gordon. He has served as my mentor, my listener, my motivator, and my soul mate. But more important, he continued to believe in me during the darkest of days, and for that kind gesture, I will forever be grateful.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER ONE

Introduction

Occupational health nursing is practiced in a variety of workplace settings. During the past decade, the role of the occupational health nurse has expanded to include agricultural health (Connon, Freund, & Ehlers, 1993; Randolph & Migliozzi, 1993). The emergence of this new role occurred in response to the nationwide recognition that agricultural work is among the most dangerous occupations (National Safety Council, 1998). Each year thousands of agricultural workers experience occupational injuries and illnesses, many of which result in permanent disability or death (CDC, March 14, 2004).

In 2002, approximately 2 million workers in the United States were employed full time in the occupation of agriculture (U.S. Department of Labor, April 24, 2004). This is probably a low estimate of the true number of farm workers because there are a significant number of undocumented seasonal farm workers in the United States (Bernhardt, 1997). In 1999, the mortality rate for agricultural workers was 22.5 per 100,000, second only to mining with a rate of 23.1 per 100,000 workers (National Safety Council, 2000). Every day it is estimated that 500 agricultural workers suffer lost-work-time injuries, with approximately 5% of these injuries resulting in permanent impairment (CDC, March 14, 2004). In 1997, a study of children and adolescents 19 years and younger revealed an average of 104 deaths a year resulting from farm injuries (Rivera, 1997). The high rates of fatal and non-fatal injuries among farmers and their family members have been the focus of study during the past decade.

There are several reasons why agricultural workers are at increased risk for occupational illnesses and injuries. First, farms are one of the few occupational sites

where the entire family lives, works, and plays, making exposures frequent occurrences. Second, farms are also noted for having a variety of occupational exposures including dangerous equipment, loud noises, heavy lifting, pesticides, stress, and dust (Langley, McLymore, Meggs, & Roberson, 1997). In addition to injuries, these exposures have resulted in specific health concerns for agricultural workers such as noise-induced hearing loss, musculoskeletal disorders, pesticide toxicities, zoonotic diseases, depression, and respiratory illnesses (Kirkhorn & Schenker, 2002). Another situation contributing to the increased occupational risk for the agricultural worker and his family is the fact that agriculture, as an industry, is often exempt from Occupational Safety and Health Administration (OSHA) regulations. These regulations apply only to farms or agricultural operations that employ more than 10 full-time workers, excluding family members (Luginbuhl, 1997). As a result of this exemption, agricultural workers, when compared to other industries, have less access to formalized safety programs and medical surveillance at the worksite. In addition, when injuries do occur on the farm, there is a known delay in medical treatment due to the distance between the farm where the injury occurs and the location of the nearest health care provider (Kirkhorn & Schenker, 2002). Likewise, when illnesses occur, farm workers are forced to travel away from their work site to seek supportive and rehabilitative health care services.

A Specific Agricultural Hazard

Respiratory illnesses are some of the most common causes of morbidity and mortality for farmers because their work includes frequent exposures to toxic environmental dusts and gases. Agricultural workers are exposed to respiratory toxins in concentrations higher than in other industries (Kirkhorn & Schenker, 2002). In spite of

their low rates of cigarette smoking, agricultural workers have an increased prevalence of acute and chronic respiratory illnesses (Schenker, 1998). The respiratory disorders most commonly associated with agricultural work include Farmer's Lung, organic dust toxicity syndrome (ODTS), silo filler's disease, occupational asthma, and bronchitis (do Pico, 1994; Von Essen & Donham, 1997). The seriousness of these disorders ranges from acute mucous membrane irritation to chronic hypersensitivity pneumonitis (Farmer's Lung). In addition, these respiratory disorders can result in irreversible and disabling pulmonary conditions or death (do Pico, 1994). The common etiology for all these respiratory conditions includes environmental exposures to toxic dust or gases present at the agricultural work site (Donham & Rylander, 1986; Pedersen, S., et al., 2000; Schlenker, Lenardson, McClain, Barnes, & Parry, 1989).

One particular work environment that places workers at high risk for respiratory exposures and illnesses is the swine confinement building (SCB); this setting exposes workers to hazardous gases which are released as manure decomposes in the pits of the SCBs and from dust created primarily from feeding practices (Olson & Bark, 1997). SCB workers are at increased risk of respiratory symptoms, upper airway inflammation, bronchitis, occupational asthma, ODTS, and an emerging asthma-like syndrome (do Pico, 1994; Von Essen & Donham, 1997). In addition, SCB workers often suffer a decline in pulmonary function (Donham, 1990a; Donham, Zavala, & Merchant, 1984; Iverson, Kirychuk, Drost, & Jacobson, 2000). In a recent popular agricultural magazine article, respiratory problems were identified as the number one chronic health risk associated with the occupation of farming, and 25% of swine workers reported chronic respiratory distress (Miller & Hillyer, 2002). Two approaches are necessary to protect SCB workers

from incurring respiratory changes and disease. First, strategies must be implemented to reduce the levels of organic dust and bio-aerosols produced in the SCB and, thus, decrease the environmental hazards. Examples of such strategies include improved ventilation in the SCBs, use of fat in the feed rations, addition of sprinklers, and more frequent washing of the buildings (Pedersen, S. et al., 2000; Watson, 1986). Second, workers need to wear personal respiratory protection (PRP) to create a barrier between the environmental dusts and gases in SCBs and their respiratory tracts.

Although the need to wear PRP in SCBs to prevent acute and chronic respiratory problems is clearly documented in the literature (do Pico, 1994; Dosman, et al., 2000; Merchant, 1987; Pickrell, et al., 1995; Zejda, Hurst, Barber, Rhodes, & Dosman, 1993), many SCB workers do not wear PRP (Carpenter, Lee, Gunderson, & Stueland, 2002; Petrea, 1996; Zejda et al., 1993). Yet, the literature lacks research identifying the variables that influence the SCB workers' decisions whether to wear PRP. The agricultural health nurse needs to understand these variables and their interactions to plan interventions for this targeted population. Without understanding the root causes of a behavior, the likelihood of an intervention's success is diminished (Pender, Murdaugh & Parsons, 2002). This research was initiated to fill the information gap that exists regarding SCB workers' decisions about using PRP.

Purpose of Study

This study built on findings of a previous qualitative study with SCB workers that identified SCB workers' knowledge, attitudes, and practices regarding the use of PRP (Jones, 2000). Findings from that study and the literature (Carpenter, Lee, Gunderson, & Stueland, 2002; Ferguson, et al., 1989; Petrea, 1996) indicate the variables that influence

the decision of the SCB workers to wear PRP include the following: benefits, barriers, susceptibility, severity, and norms. The primary purpose of this study was to determine if specific variables (e.g., benefits, barriers, susceptibility, severity, and norms) influence SCB workers' behavior in regard to wearing PRP. A secondary purpose was to examine the relationships between SCB workers' use of PRP and the workers' demographics, occupational history**,** and respiratory health history.

Definition of Terms

For the purpose of this study, variables were conceptually defined as follows. The procedure by which the study variables will be measured or operationalized will be presented in Chapter 3.

1. Benefit is the belief by workers that wearing PRP while working in SCBs can reduce threats to their respiratory health.
2. Barrier is the belief by workers that wearing PRP while working in SCBs will result in negative consequences (i.e., discomfort, loss of time).
3. Susceptibility is the belief by workers that working in SCBs will increase their likelihood of developing a respiratory health problem.
4. Severity is the belief by workers that a respiratory illness resulting from working in SCBs causes an impact (i.e., physical, emotional, or financial) on the worker.
5. Norms are the beliefs by workers about the social pressures and influence of these pressures to either wear or not wear PRP when working in SCBs.

6. Workers are individuals spending at least 2 hours per day in SCBs performing specific work-related tasks.
7. Swine Confinement Buildings (SCBs) are enclosed buildings that house large numbers of swine.
8. Personal Respiratory Protection (PRP) is any device the worker chooses to place over the nose and mouth for the purpose of preventing particles in the air from entering the respiratory tract.
9. Demographics include personal characteristics (i.e., state of worksite, gender, race, age in years, martial status, and highest level of education completed) as reported by the workers.
10. Occupational history variables include the employment characteristics of the workers including their role in pork production, number of pigs and employees where they work, type of unit best describing work site, and time spent in SCBs (years, days per week, and hours per day).
11. Personal habits include those habits that could impact respiratory health directly (smoking) or indirectly by interfering with the use of protective respiratory equipment (use of smokeless tobacco).
12. Respiratory health history is the worker's self-assessment and report of knowing someone who became ill from not wearing PRP while working in SCBs, any breathing problems or respiratory symptoms associated with working in SCBs, along with any known respiratory medical diagnoses, respiratory medication use, or tobacco use.

Rationale for the Study

The rationale for this study was based on findings from a number of studies revealing an increased incidence and prevalence of acute and chronic respiratory disease, respiratory symptoms, and abnormal respiratory laboratory data among SCB workers (Donham, Zavala, & Merchant, 1984; Pedersen, Iversen & Dahl, 1990; Zejda, et al., 1993: Zhou, Hurst, Cockcroft, & Dosman, 1991), as well as the need to understand the behaviors of those workers in regard to their decisions to wear or not wear PRP.

The primary purpose of the study is to determine if the specific variables (e.g., barriers, benefits, susceptibility, severity, and norms) influence the workers' behavior in regard to wearing PRP. If these variables are found to be significant predictors of the workers' use of PRP, the information can be used to guide the development of interventions to increase the use of PRP. For example, if study findings indicate "benefits" to be a significant predictor of the workers' use of PRP, educational programs focused on the positive respiratory health outcomes of wearing PRP could be an effective strategy to reinforce the positive behavior of wearing PRP. If "barriers" are found to be a significant predictive variable influencing the use of PRP, the agricultural health nurse may work with the owner or operator of the SCB to remove worksite barriers known to influence the workers' behavior to not wear PRP. Information gained about "barriers" could also be shared with the PRP manufacturers in an effort to redesign the devices to make them more appealing to wear. If "susceptibility" is found to be a significant predictor of the workers' use of PRP, educational programs focused on the importance of wearing PRP to reduce the negative respiratory outcomes of not wearing PRP while working in SCBs could be planned and implemented. If "severity" is found to be a

significant predictor of the workers' use of PRP, specific educational programs designed to emphasize the association of wearing PRP at the worksite and the anticipated decrease in the physical, financial, and emotional impact of a respiratory disorder from working in a SCB could be provided. Lastly, if "norms" are found to be a significant predictor, the agricultural health nurse could use social pressure in an attempt to change the workers' behavior. For example, the nurse could educate the SCB worker's significant others and elicit their help to influence SCB workers to use PRP.

In addition to helping individual workers, findings from this study could be of value to numerous groups. Such groups include governmental agencies charged with protecting the health of all workers, swine commodity groups working to implement a swine farm family and employee health assurance program, and private companies competing to manufacture the most desirable PRP.

Summary

Agricultural work is among the most dangerous occupations, with agricultural workers known to have a higher incidence and prevalence of injuries and illnesses than most other occupations. Examples of common agricultural illnesses include the diverse respiratory disorders associated with working in SCBs. The common etiology for all these respiratory conditions includes environmental exposures to toxic dust or gases present in SCBs. Despite the protective effects of PRP, many SCB workers do not use the devices. Also, there is a gap in the literature regarding the reasons for the lack of use. This study was designed to investigate how specific variables (e.g., barriers, benefits, susceptibility, severity, and norms) predict the use of PRP by SCB workers and to examine the relationships between SCB workers' use of PRP and demographics,

occupational history, and respiratory health. Information gained from this study may serve as the basis of intervention research studies, in-service and continuing educational programs, and design changes for PRP devices. These efforts would ultimately lead to health improvements for workers in SCBs.

CHAPTER TWO

Review of the Literature and Theoretical Framework

Introduction to Literature Review

The literature review provides information to support the significance, rationale, and theoretical framework for the study. The review provides background information about the following issues and topics:

1. Trends in the swine industry are discussed highlighting changes in swine production worksites from small family operations to large swine confinement buildings (SCBs), changes in the geographic distribution of pork production, and changes in the demographics of the workforce.
2. Potential environmental exposures of individuals working in SCBs are presented along with the health risks associated with these worksite exposures.
3. Strategies to reduce the workers' exposure to environmental hazards within the SCB worksite are discussed.
4. Types of personal respiratory protection (PRP) devices are discussed, along with the techniques for selecting and caring for the PRP devices.
5. Research findings from the limited studies that address the factors that influence the use of PRP are summarized.
6. The role of the agricultural health nurse in promoting the general health, including the respiratory health of SCB workers is described.
7. The theoretical framework for the study is presented.

Trends in the Swine Industry

Change in Worksite. During the past two decades, no segment in agriculture has changed more than the swine industry. To improve production efficiency and manage large populations of pigs, the industry has shifted from small family farms to larger production units, many owned by large corporations. From 1980 to 1998, the number of swine operations decreased from approximately 700,000 to 120,000, with less than 10 percent of the producers marketing 80 to 85 percent of all hogs slaughtered in the United States (Cunningham & Acker, 2001). To manage the increased volume of production, these large operations often have multiple SCBs designed to house large numbers of animals at various stages of production. These buildings include breeding and gestation barns, farrowing (birthing) rooms for sows and piglets, nursery units for housing pigs immediately after they are weaned, and growing/finishing units for housing pigs from about 8-9 weeks of age until they reach market weight. These SCBs, with built-in feeding, temperature control, and waste management systems, are designed to promote animal growth and efficiency of production (Cunningham & Acker, 2001; Miller & Hillyer, 2002; Tripp, Shutske, Olson, & Schermann, 1998.)

The industrialization of the swine industry has increased the respiratory health risks for the estimated 250,000 individuals working in SCBs across the United States (Von Essen & Donham, 1999). Due to this increase in industrialization, there are at least three reasons for the increased respiratory risk of this group of workers. First, the introduction of a "confined space" worksite has increased the respiratory exposure of the workers to dust and toxic gases when compared to those individuals working with a few pigs in an "open" space on the family farm. Second, the increased industrialization has

created full-time positions in SCBs, thus, increasing the time that workers are exposed to the environmental risks associated with the confined space worksite. Lastly, when compared to other industries, agriculture has traditionally been exempt from environmental safety, health, and labor regulations designed to protect the industry's workers. OSHA standards apply only to farms having more than 10 full-time farm workers excluding family members (Luginbuhl, 1997). With the increased automation involved with swine production, fewer workers are needed to run large confinement operations, and these individuals may work without any regulations designed to protect the respiratory health of workers in SCBs.

Change in Production Site. Another change in the swine industry is the shift in the geographic location of swine production. Traditionally, swine production in the United States has been concentrated in the Midwest, the area known to produce large quantities of grain. In recent years, large numbers of pigs have been produced outside this geographic area. In 1999, North Carolina ranked second to Iowa in breeding stock and pig inventory followed by the states of Minnesota, Illinois, Indiana, Nebraska, Missouri, Oklahoma, Ohio, and Kansas (Cunningham & Acker, 2001). With the shift in swine production to geographic areas outside the grain belt in the United States, health professionals in these new areas of production have been challenged to address occupational hazards unknown to them in previous years.

Change in Workforce in SCBs. In addition to changes in the geographic location of swine production and the use of SCBs as the primary worksite for swine production, there have been changes over the last decade in the demographics of both producers and employees engaged in the production of swine. The results of a national survey

described several changes in swine producers and employees over a ten-year period from 1990 to 2000 (Hurley, Kliebenstein, & Miller, 2000). In comparison to 1990, producers and employees in 2000 were more educated, older in years, working on larger swine operations, and having less prior work experience in pork production. These same workers reported to be working more hours per week (49 hours per week compared to 45.2 hours per week in 1990), subsequently increasing the workers' exposure time to organic dust, bio-aerosols, and toxic gases. Exposure for two hours per day for six or more years in SCBs has been associated with the development of sinusitis, mucous membrane inflammation, non-immunogenic bronchospasms, and bronchitis (Thorne, et al., 1995).

Healthy workers are an important resource for all industries. Efforts to promote the respiratory health of workers in SCBs by decreasing their environmental exposures are important to the future of the pork industry. It is encouraging that Hurley, Kliebenstein, and Miller (2000) found that both producers and employees believe that the work environment in SCBs had improved during the last decade, including a decrease in the dust and gas levels. It is also encouraging that farmers, in general, smoke less than persons in most other occupations (Schenker, 1998); and this trend has been supported by the findings from general health surveys, cancer case-control studies, and studies of respiratory disorders among farmers and rural populations (Schenker, 1998). Stellman, Boffetta, and Garfinkel (1988) studied the smoking habits of over 800,000 U.S. men and women by occupational groups and found the percentage of male farmers who had never smoked to be 39.5 percent, which was second to the occupation of the clergy. Whereas these findings are positive, the reported use of PRP declined among both the producers

(27.3% to 25.1%) and the employees (26.9% to 19%) during the same decade.

Environmental Exposure at the Worksite

Individuals working in an agricultural setting could potentially be exposed to a wide range of environmental agents including inorganic dust from the soil, pesticides, toxic gases, or organic dust containing microorganisms, endotoxins, or allergens (Schenker, 1998). The SCB is a complex work environment with the air characterized by the presence of a large variety of gases along with high levels of dust (Von Essen & Donham, 1997). Thus, workers in SCBs potentially have increased exposure to specific environmental agents including toxic gases and organic dusts (Donham, Haglind, Peterson & Rylander, 1986; Donham, Popendorf, Palmgren, & Larsson, 1986: Donham, et al., 1995; Schenker, 1998; Von Essen & Donham, 1997; Von Essen & Donham, 1999). The increase in these environmental agents and the subsequent exposure of the SCB worker to the agents is an outcome of producing swine in confined spaces.

Toxic Gases. The major source of toxic gases in SCBs results from decomposition of the manure contained in pits under the slatted floors of the SCBs. While over a hundred different gases have been identified in SCBs, the gases that create the most respiratory risk for SCB workers are hydrogen sulfide and ammonia (Von Essen & Donham, 1999). Hydrogen sulfide, known to be heavier than air, is concentrated in the manure pit of the SCB and present in small amounts (< 5 ppm) in the ambient air of SCBs (Von Essen & Donham, 1999). Exposure to this toxic gas occurs when the SCB worker begins the process of agitating the manure in preparation for manure removal or when the worker enters the pit to repair the equipment. When exposed to elevated levels

of hydrogen sulfide, the worker can develop acute pulmonary edema or experience sudden death from acute poisoning (Donham, 1990a).

In regard to the respiratory health of SCB workers, the second toxic gas of concern is ammonia. Ammonia is released into the air of SCBs when urea in the animal urine decomposes, and levels in SCBs have been reported as high as 9 ppm (Holness, 1987). Donham (1995) reported an association between ammonia levels exceeding 7.0 ppm and the presence of respiratory complaints in SCB workers. Exposure to ammonia is also known to cause irritation to the eyes and upper respiratory tract.

Organic Dust. In the field of occupational hygiene, particulate material of biologic origin that is located in the air or has settled is referred to as organic dust (Schenker, 1998). The dust found in SCBs is heterogeneous and comes from two primary sources--the animals and the animal feed (Donham, Rubino, Thedell, & Kammermeyer, 1977; Donham, Scallon, Popendorf, & Treuhaft, 1985) The dust is a composite of animal dander, dried feces, urine, bacteria, bacterial endotoxins, and fungal spores and contains approximately 25% protein (Donham, 1995; Donham, Popendorf, Palmgren, & Larsson, 1986; Pedersen, et al., 2000). These dust particles range in size from 2 microns to 50 microns in diameter (Donham, Scallon, Popendorf, & Treuhaft, 1985). Approximately one-third of these bio-aerosol dust particles are in the respirable range (less than 10 microns in diameter), which allows the minute particles to be inhaled deep into the lung tissue (Donham, Scallon, Popendorf, & Truhaft, 1985; Schenker, 1998). The major alveolar burden is the small fecal material particles such as proteins from the gut epithelium of the swine, while the major airway burden is the larger particles of feed grains (Donham & Gustafson, 1982).

Each SCB has its own mixture of dusts and gases; and, therefore, the dust and gas loads are not consistent among workers in SCBs. The variation in the mixture of dusts and gases changes based on the specific activity in the SCB, the techniques used to feed the animals and handle the animal waste, along with the ventilation in the SCBs. The levels of dust are expected to rise when pigs are moved or fed and also during the winter months when ventilation in the building is decreased to conserve heat. Even though the environmental exposure to dust and toxic gases differs among workers in SCBs, findings in the literature support the presence of increased respiratory symptoms, changes in respiratory clinical parameters, and evidence of both acute and chronic respiratory health problems associated with working in SCBs.

Workers in other confinement buildings such as poultry confinement buildings (PCBs) are exposed to somewhat similar environmental dust and gas levels. The exposure to high ammonia levels from the poultry waste and to organic dust particles in the PCBs are a major concern. In a study conducted in North Carolina, Lenhart, Morris and Akin (1990) found the ammonia levels in PCBs to range from 6 to 19 ppm while the mean value of the organic dust was 2.5 times higher than the limit suggested by Donham, et al., (1995). Morris, Lenhart & Service (1991) and Reynolds, Parker, Smoth & Woellner (1993) reported workers in PCBs to manifest respiratory symptoms of coughing, wheezing, and sputum production; all of which are common among SCB workers. However, workers in PCBs have been found to experience some infectious respiratory diseases (i.e., psittacosis, aspergillosis, and histoplasmosis) not found among SCB workers (Olson and Bark, 1996).

Respiratory Response of the Exposed SCB Worker

Activation of Defense Mechanisms. When toxic gases or organic dusts enter the respiratory system, the body recognizes the substances as foreign, and the body's defense mechanisms are activated to protect the body (McCance & Huether, 2002). Irritant receptors located in the nostril, trachea, and large airways are stimulated by the presence of foreign substance and trigger the sneeze and cough reflexes in an attempt to rid the body of the foreign substance. The nasal hairs and turbinates along with the nasal mucus combine to trap foreign particles and bacteria from reaching the upper airways. Nasal cilia propel the mucus with entrapped particles toward the oropharynx allowing the mucus to be expectorated or swallowed. Alveolar macrophages serve to ingest and remove foreign material from alveoli by a process called phagocytosis (McCance & Huether, 2000). If the body's defenses fail to remove the foreign substance, the body activates its complex inflammatory response to protect the body. The respiratory symptoms observed among workers in SCBs are a manifestation of the body's attempt to remove foreign substances from the body.

Respiratory Symptoms. Respiratory symptoms associated with working in SCBs were first studied two decades ago. In an early 1977 study of workers in SCBs, 63.3% of the workers reported experiencing increased coughing and phlegm production, while 54.5% reported chest tightness and wheezing as a result of working in SCBs (Donham, Rubino, Thedel, & Kammermyer, 1977). Later in the 1980s, a study by Donham, Zavala, and Merchant (1984) reported that chronic respiratory symptoms (cough, phlegm production, and wheezing) were significantly ($p = .008$) more prevalent in SCB workers than non-confinement workers matched for age, gender, and smoking history.

Abnormal Clinical Laboratory Findings. A study by Zhou, Hurst, Cockcroft, and Dosman (1991) examined pulmonary function tests and airway responsiveness along with the reported respiratory symptoms of 20 swine farmers and 20 control workers. Findings revealed that SCB workers had significantly ($p = < 0.05$) increased acute and chronic respiratory symptoms and significantly ($p = < 0.05$) lower baseline levels of forced expiratory volume in one second (FEV1) and forced vital capacity (FVC) ($p = < 0.05$) when compared to the control group, indicating an obstructive disorder. A seven-year study of 181 Danish farmers by Iversen and Dahl (2000) examined the respiratory impact of working in SCBs. They found that farmers working exclusively with swine ($n = 135$) likewise had a significant ($p = < 0.04$) decline in FEV1 but not in FVC when compared to workers in dairy barns ($n = 46$). A Danish study by Pedersen, Iversen & Dahl, (1990) used bronchoscopies to examine the bronchial mucosa of 26 SCB workers who volunteered to participate in the study. The workers were non-smokers with a mean age of 38. Prior to the study, 20 of the workers reported no lung symptoms while six had symptoms of bronchitis. Seventeen of the workers were found to have signs of bronchial inflammation along with neutrophila in the bronchial system.

Respiratory Disorders Associated with Working in SCBs. A limited number of specific respiratory illnesses have been associated with working in SCBs. Organic Dust Toxicity Syndrome (ODTS) is the oldest known and best studied respiratory disorder associated with exposure to organic dust from working in grain dust or confinement buildings and has been documented as a prevalent acute respiratory disorder among SCB workers (Von Essen & Doham, 1997). This respiratory disorder is a febrile illness that follows exposure to organic dust (do Pico, 1992; Von Essen & Donham, 1997).

Approximately 20 to 30% of SCB workers manifest a dry cough, fever, chills, dyspnea, muscle aches, chest tightness, and headache two to six hours after respiratory exposure to organic dust (Donham, 1990a; Donham, et al., 1977; Donham, Merchant, Lassise, Popendorf, & Burmeister, 1990b; Zhou, et al., 1991).

Another respiratory condition associated with work in SCBs is an asthma-like, non-allergic syndrome. The condition is clinically similar to asthma but is not immunoglobulin E (IGE) mediated or associated with persistent airway inflammation or airway hyperactivity (Kirkhorn & Schenker, 2002). The syndrome is manifested with cough, wheezes, and a sensation of chest tightness (Von Essen & Donham, 1999). These symptoms have been identified as a daily complaint in 2% to 40% of SCB workers and an occasional complaint in 38 to 63% of workers in SCBs (Donham, et al., 1984; Zhou, et al., 1991). The symptoms associated with this asthma-like syndrome are more prevalent in older farmers and farmers who have worked at least two hours per day for six years in SCBs (Dosman, et al., 1988). These asthma-like symptoms have been found to be twice as prevalent in SCB workers who smoke cigarettes (Von Essen & Donham, 1997). This syndrome is a self-limiting inflammatory event that does not involve persistent airway hyperreactivity (Schenker, 1998).

Impact of the Respiratory Responses on the Worker. Little is known about the personal impact of these respiratory illnesses on SCB workers. The loss of work when experiencing respiratory symptoms could decrease income that would influence the standard of living and quality of life of SCB workers. In spite of the fact that farmers have lower prevalence of smoking when compared to the general population, studies

have demonstrated a significantly increased risk of respiratory morbidity and mortality among farmers (Schenker, 1998).

Strategies to Decrease Environmental Exposure for Workers in SCBs

A multi-dimensional plan that includes improvements in the environment and protection of the worker is needed to decrease environmental exposures for SCB workers. First, it is critical to initiate management practices to control the source of dusts and gases in SCBs. Installing enclosed feeding systems is an excellent strategy to decrease dust formation associated with feeding. Other practices (e.g., reducing the number of pigs, adding fat to the ration, sprinkling with oil and water) have been investigated and recommended to reduce the dust in SCBs, but only the procedure of sprinkling oil or a mixture of oil and water has been shown to significantly reduce the concentrations of dust (Pedersen, S. et al. 2000). Second, dilution ventilation is currently the most commonly used environmental engineering control strategy used in SCBs to reduce air contaminants (Nonnenmann, et al., 2004). Agricultural engineers are challenged with designing, implementing, and evaluating ventilation systems to reduce environmental exposures in SCBs in the most efficient and cost effective manner. The third strategy necessary to protect workers in SCBs from respiratory disorders entails the use of PRP by SCB workers (Von Essen & Donham, 1999).

Standards and Recommendations for PRP Use

The National Institute for Occupational Safety and Health (NIOSH) is responsible for the respirator certification program. The goal of the program is to assist workers to protect themselves from exposure to airborne contaminants by certifying respirators that meet the minimum performance requirements that appear in Title 30, Code of Federal

Regulation, part 11 (CDC, NIOSH, April 29, 2004). The OSHA respiratory protection standard only applies to agricultural operations having more than 10 full-time farm workers excluding family members (Luginbuhl, 1997). The standard is recognized as an accepted standard of minimal protection and could be used as a guide in developing a respiratory protection program for all workers. The two broad types of respirators are the (a) air-purifying respirators and (b) air-supplying respirators. Any respirator selected by the worker should have a National Institute for Occupational Safety and Health/Mine Safety and Health Administration (NIOSH/MSHA) approval number ("TC-xxx") stamped on the packaging and the mask (CDC, NIOSH, 2004). Specific information about the types of respirators can be found at www.cdc.gov/niosh/respinfo.html.

The powered air purifying helmets blow filtered air into a helmet-like face piece. An advantage of this type respirator, in comparison to the other air-purifying respirators, is that there is no breathing resistance; therefore, it is more comfortable for those individuals with preexisting respiratory disease. These devices are more expensive but provide a better choice when workers have facial hair (beards, long sideburns, and moustaches) that can interfere with the tight seal needed with the disposable respirator (CDC, NIOSH, 2004).

The air-purifying respirators are to be used only when adequate oxygen is available. The air-purifying respirators are approved to protect workers from dusts and mists in occupational sites such as SCBs and include the following types: (a) a single-use disposable respirator, (b) a non-powered respirator with a replaceable or reusable filter, and (c) a powered air-purifying respirator that blows filtered air into a half-face or full-face piece. If the single-use disposable respirator is used, the device should have two

straps for optimum fit and efficiency. Single-strap, nuisance dust masks are not recommended by NIOSH for use in SCBs. Pickrell, et al. (1995) reported a 75% decrease in exposure to total suspended particles when workers wore a NIOSH- certified two-strap disposable respirator in comparison to a 50% reduction when workers wore a one-strap nuisance dust mask. The disposable mask without a filter should also be discarded if the device loses its shape. If the worker is using a respirator with a disposable filter, the filter should be replaced with a new one or routinely cleaned, dried, and replaced in the respirator when the worker notes an increase in breathing resistance (CDC, NIOSH, 2004).

The air-supplying respirators sometimes referred to as powered air-purifying helmets, supply air to the worker independent of the environment. These respirators should be used in atmospheres known to be low in oxygen or high in dangerous gases such as manure pits of confinement buildings (CDC, NIOSH, 2004).

Workers required to use respirators should receive training on their use. This standard training should include the nature of the respiratory hazard, the appropriate respirator to minimize the risk of the hazard, the procedure for determining the proper selection of size and fit of the respirator, and care of the respirator (CDC, NIOSH, 2004). It is recommended that this training be documented and that the worker be retrained on an annual basis. The fit test is most important, as it ensures the workers are receiving the most protection from their PRP. Conditions or habits known to present problems in correct respirator fitting include prior respiratory conditions, eye glasses, claustrophobia, beards, and personal habits such as smoking or using oral smokeless tobacco products (CDC, NIOSH, 2004; Von Essen & Donham, 1999).

Use of PRP by Workers in SCBs

Many experts advocate the use of PRP to reduce the risk of respiratory exposure for workers in SCBs (do Pico, 1994; Merchant, 1987; Zejda, et al., 1993). However, the majority of workers in SCBs do not wear PRP. Findings from a cross-sectional survey (Zejda et al., 1993) of swine farmers revealed that only 30% of these farmers (N = 301) wore PRP at the worksite. Petrae (1996) conducted a study to elicit the behavioral intentions and the attitudes, subjective norms, and beliefs of swine producers toward using PRP while in SCBs. Based on 182 usable responses, findings from Phase I revealed that 42 (22.6%) of the swine farmers used the two-strap Toxic Dust /Mist Respirator, 12 (6.3%) used the Cartridge Respirator with a filter, and 12 (6.3%) used the Power Air Purifying with Helmet/Respirator. When asked specifically about their beliefs about the two-strap toxic dust/mist respirator, the swine farmers indicated their salient beliefs that dust masks (a) are hot and uncomfortable, (b) help to keep dust out of lungs, (c) are difficult to keep where needed, and (d) that health professionals and spouses can motivate PRP use. Carpenter, Lee, Gunderson, and Stueland (2002) conducted a mail survey of 2,483 mid-western farmers to learn more about the farmers' use of all personal protective equipment. Four hundred and seventy-eight (32%) of the 1,493 farmers returning the survey primarily worked in animal confinement buildings. On a five-point scale from *never* to *always,* fewer than 3% of these workers reported wearing any respiratory protection *most of the time* or *always* at the worksite.

While studies have demonstrated that only a limited number of workers wear PRP at the worksite, few studies have focused on the factors that influence SCB workers' decisions about wearing PRP at the worksite. Ferguson, et al. (1989) conducted an

experimental study to test the effectiveness of an educational intervention program to increase knowledge; the intervention was composed of six booklets addressing specific health issues associated with working in SCBs. The entire sample for the study was 198 SCB workers, half of whom were assigned to an intervention group and half of whom served as the control group. The study assessed the attitudes and knowledge toward respiratory health among the 198 workers. A pre-test/post-test design was used to detect differences between the two groups. Following the educational intervention, a significant ($p = < 0.05$) increase in knowledge among the workers receiving the intervention was reported when compared to the scores of the control group. To determine changes over time, Gjerde, Ferguson, Mutel, Donham, and Merchant (1991) conducted an educational intervention with 198 swine confinement operators and assessed for changes one year after the intervention. The researchers reported significant changes in knowledge, attitude, and behavior scores for the intervention group in comparison to the control group. Recognizing the benefits of wearing a dust mask was one of four attitudinal items that improved significantly for the intervention group along with the behavior of wearing a mask while working (Gjerde, et al., 1991). In addition to this intervention study, an epidemiological study was simultaneously conducted on the same sample. The objective of the study was to define the respiratory status of the workers in the sample when compared to a comparison group of blue-collar workers (Donham, Merchant, Lassise, Popendorf, & Burmeister, 1990b). Findings indicated that symptoms of chronic cough and reported phlegm were significantly more prevalent in the SCB workers compared to the blue-collar comparison group. However, reliability and validity estimates of the

instrument used to collect data for this five-year combined epidemiological and intervention study were not reported in the literature.

Petrea (1996) used the Theory of Planned Behavior (TPB) to explain the use of PRP among workers in SCBs and to test an intervention to improve the use of a two-strap dust/mist respirator among SCB workers. The study consisted of two phases. In phase I, a questionnaire was mailed to SCB workers (N=342) in Illinois to elicit their attitudes and perceived control regarding the use of PRP, the subjective norms related to their use of PRP, and their intentions for using PRP. When asked about the reasons to not use or use the two-strap toxic dust/mist respirator, the SCB workers indicated that the masks are hot and uncomfortable, are difficult to keep in an accessible location, help keep dust out of lungs, and that health professionals and spouses are motivating influences to wear dust masks. Information about these beliefs was then used to design an intervention program that consisted of educational sessions and provided the workers with a supply of respirators. During phase II, 80 farmers attended an educational program. One-half of the questionnaire respondents attending the educational session and one-half of the questionnaire respondents not attending the educational session were randomly assigned to receive dust masks through the mail. A survey questionnaire was used to test the following research hypotheses: (a) no difference would be seen between six-month intentions and self-reported behaviors (use of dust mask) for any of the four quasi-experimental groups, and (b) six-month intention as assessed in the primary survey would contribute to prediction of self-reported behavior (use of dust mask). The reliability of the primary survey questionnaire (α =. 73) was computed using Cronbach's Coefficient Alpha. Findings indicated that the first hypothesis was not supported, with use of dust

masks nearly doubling and the frequency of use likewise increasing. Findings indicate that the second hypothesis was supported with the six-month intention substantially correlated with self-reported behavior ($r = 0.52$). This study demonstrated that the beliefs identified using TPB to guide interventions could increase the frequency of PRP use beyond pre-intervention levels (Petrae, 1996).

There remained a gap in the literature after the report of these two intervention studies, each using a specific educational program to increase the use of PRP by workers in SCBs. The purpose of both studies, conducted with SCB workers in two different states, was to measure the effectiveness of an intervention within the context of two specific theoretical frameworks. The Gjerde, et al. (1991) study, conducted over a decade ago with swine farmers from Iowa, found workers in SCBs to be responsive to education and that educational interventions can improve the safety and health practices of SCB workers, including the use of PRP. However, the study findings reported no reliability or validity estimates for the instrument used in the study. Using the Theory of Planned Behavior, findings from Petrae's study (1996) indicated that targeting interventions based on the beliefs of the workers in SCBs about PRP could increase the use of PRP. The Petrae (1996) study, conducted with SCB workers in Illinois, did address content validity and included reliability estimates. However, the instrument was developed for use within the context of one specific theoretical framework that limits the available constructs to fully explain the variation in PRP use. Therefore, the primary gap in the literature was the lack of a reliable and valid instrument to measure the constructs that influence the SCB worker's decision to use PRP at the worksite. This study was designed to fill that void.

Role of the Agricultural Health Nurse

Agricultural health nursing, a subspecialty of occupational health nursing, is charged with promoting the health of the agricultural workforce. This goal is achieved through the implementation of primary, secondary, and tertiary prevention strategies. The agricultural health nurse (AHN) is challenged to create, implement, and evaluate strategies to protect SCB workers from the respiratory risks associated with working in SCBs. To protect these workers, the AHN is challenged to practice the following seven OHN roles: clinician, health promoter, case manager, consultant, manager, educator, and researcher (Rogers, 2003). AHNs need to assist workers in acquiring the knowledge, skills, and attitudes necessary to empower them to wear respiratory protection when at risk for occupational exposures.

Development of a Framework

Preliminary Study

To validate constructs generated from previous studies and identify other potentially unknown constructs, Jones (2000) conducted a focus group study with 22 workers in SCBs at two geographic sites in Kentucky to investigate the knowledge, attitudes, and practices of workers regarding their use of PRP. The study used both qualitative and quantitative research methods. First, qualitative data were collected from two groups of workers using focus group interviews. To be included in the study, participants had to be workers in SCBs, 18 years of age or older, and able to read and write English. Pre-established questions were used to guide the interviews. The questions were designed to encourage the workers to describe their work in swine production, the association of their work to their respiratory health status, their use of respiratory

protection at the worksite, and their reasons for using or not using PRP while working in SCBs. The length of time the workers had worked in SCBs ranged from 8 months to 40 years. The interviews were audio recorded, transcribed, and examined for common themes and concepts. A survey composed of statements summarizing these common themes was formulated and mailed to each individual who participated in the interviews with a request that they review the statements, judge if each statement reflected what they believed had been shared during the interview, and return the survey. The return rates were 100% (n=10) and 92% (n=13) for Group I and Group II, respectively. Financial incentives were given to each individual for participating in the interview and for returning the survey. All participants in Group I agreed with nine of the ten statements, while nine (90%) agreed with the remaining statement. Seventy-five to 100% of the participants in Group II agreed with seven of the nine statements. There was strong disagreement with two of the nine statements.

Findings from the preliminary study indicated a general lack of knowledge regarding the health risks associated with working in SCBs. Dust exposure was generally accepted as an occupational risk associated with the work environment. One participant stated, “Any time you are a farmer, you’re going to be around dust and a lot of stuff like that. I don’t care if you have hogs or cattle or tobacco or whatever, … that’s part of the trade I guess you could say.” There was a lack of knowledge about the need for respiratory protection and the criteria for appropriate respirator selection. One participant stated, “We haven’t had any training. We just got them (respirators) so we can keep our breathing cleaner …I mean, ain’t nobody come around and showed us how to use them.” The perceptions of the workers were that the need for a respirator was greater when

performing specific activities on the farm and in the SCB. For example, all (n=10) workers in one focus group agreed that the need for a respirator was greater when working with grain and tobacco dust than when exposed to dust in SCBs. They also stated that the need for a respirator was greater when they were performing specific tasks such as moving and loading pigs in the SCBs. One participant stated,

> "Moving or loading pigs…stirring up the dust is the worst of it, of course we wear respirators then, if you don't you will pay for it. You can feel it coming on…the back of your throat gets to where it's not exactly a tickle, but it's where you want to drink something all the time…. It's like something back there you can't get rid of….you put on a respirator, no problem."

The workers believed that improved ventilation in SCBs, along with the implementation of specific strategies (e.g., use of fat in rations, sprinklers, and frequent washings) decreased dust exposure and thus eliminated or reduced the need for respirators. Another participant stated, "The older buildings are cross ventilated, and the dust may get or could build up to one-half inch if you don't run through a blower and blow it out." Comfort was identified by the participants at one geographic site as the most important factor influencing the use of respirators. Fogged eyeglasses were one of the main reasons given by participants for not using or curtailing respirator use. Easy accessibility at the worksite and reminders to wear the respirators were other factors noted as increasing respirator use (Jones, 2000).

Theoretical Framework

The theoretical framework for this research study was conceptualized using the constructs of benefits, barriers, susceptibility, and severity from the Health Belief Model (HBM) (Janz & Becker, 1984; Rosenstock, 1974) and the construct, norms, from the Theory of Planned Behavior (TPB) (Ajzen & Fishbein, 1980). Findings from the

previously described preliminary focus group study (Jones, 2000) and from the review of the literature supported the selection of these constructs in the proposed theoretical framework. The following discussion provides the relevance of each construct to the adoption of the theoretical framework for this research study.

Both the HBM and the TPB have been used extensively to predict behaviors based on attitudes and personal beliefs. Proposed in the 1960s, the HBM has been widely used as the framework to understand behaviors related to general health practices, such as predicting those individuals who would or would not use preventive measures to promote and protect their health (Pender, Murdaugh, & Parson, 2002). More recently, the HBM has been used to predict such behaviors as tuberculosis screening practices of Mexican migrant farm workers (Poss, 1999) and the benefits and barriers for mammography screening (Champion, 1999). In the agricultural arena, Hodne, Thu, Donham, Watson, and Roy (1999) used the HBM constructs to develop a 24-item Farm Safety and Health Beliefs Scale for the purpose of exploring farmers' safety and health beliefs as part of a Certified Safe Farms project. Thirty-nine original items were written based on farm safety and health promotion topics and the core meanings commonly attached to the four HBM constructs (i.e., benefits, barriers, susceptibility, and severity). A primary purpose of the study was to explore the extent to which farmers' safety and health beliefs are related to the theoretical constructs of the HBM. The Farm Safety and Health Beliefs Scale was tested among Iowa farmers (n = 259). Using factor analysis to analyze the responses to the 39 original Farm Safety and Health Beliefs Scale items, five HBM related factors were determined. The factors were: (a) susceptibility to a farm-related accident/illness, (b) benefits of performing safety and health behaviors, (c) barriers to

performing these behaviors, (d) self-efficacy regarding performing of these behaviors, and (e) severity/finances regarding the consequences of an accident/illness.

The TPB (Ajzen & Fishbein, 1980) identifies intention as the common immediate determinant of performing a specific behavior. This framework proposes that each individual has beliefs about specific constructs (attitude, perceived control, and subjective norms) and these beliefs combine to determine the intention of performing or not performing a specific behavior. The TPB has been used as the framework in health promotion studies in an attempt to understand health related behaviors (Craig, Goldberg, & Dietz, 1999; Levin, 1999).

Several studies in the agricultural arena (Aherin, 1988 ; Debarr, 1994; Perkins, Crown, Rigakie, & Eggertson, 1992; Petrae, 1996) support the use of the theoretical construct, subjective norms, to explain the behavior of individuals engaged in farm related activities. Using the Theory of Reasoned Action, a precursor to the TPB, Perkins et al. (1992) studied the intention of grain farmers in Canada toward the use of disposable coveralls when working with pesticides on the farm. Findings from the study revealed that attitude and subjective norm were both positive influences on the intention to wear disposable coveralls, with attitude contributing the most. Both Debarr (1994) and Aherin (1988) used the Theory of Reasoned Action when studying tractor safety. Studying a group of adolescents in Illinois, Debar (1994) reported that subjective norm was the single best predictor of the intention toward the behavior of safely operating a tractor. Aherin (1988) studied dairy farmers in Wisconsin and found that attitudes about child safety were the primary predictors of the intentions toward the behavior of keeping extra riders off tractors and preventing youth from operating tractors.

Four constructs (benefits, barriers, susceptibility, severity) derived from the HBM and one construct (norms) derived from the TPB were determined by the investigator to be important variables for understanding the behavior of workers in SCBs regarding their use of PRP at the worksite. It is proposed that workers' decisions to use or not use PRP in the SCB worksite is influenced by the following:

1. the positive or negative beliefs about performing the behavior (perceived benefits or perceived barriers).
2. the belief that SCBs, as an occupational site, pose a threat to one's respiratory health (susceptibility),
3. the belief that the development of a respiratory disorder from working in SCBs would impose a major hardship (severity), and
4. outside social pressures (norms) that influence the behavior to wear or not wear PRP.

This study was designed to develop a valid and reliable instrument to identify and study the relationships of the proposed variables as a means to explain the behavior of workers toward wearing PRP while working in SCBs.

Summary

During the past two decades, swine production has shifted from family farms to larger production operations that are composed of multiple SCBs. These SCBs are designed to house large numbers of animals at various stages of production. Changes in swine production have increased the occupational risks for SCB workers. The SCB is a complex work environment with workers often exposed to environmental gases and organic dusts. Studies have found that these environmental exposures are related to the

increased prevalence of respiratory symptoms and disorders among SCB workers. Strategies known to decrease the environmental exposure for SCB workers include improved management practices, improved ventilation systems in the SCB, and the use of PRP by SCB workers. There are limited studies that examine SCB workers' beliefs about wearing PRP and how those beliefs influence their choices to wear or not wear PRP. Although there were two intervention studies that evaluated the effectiveness of specific interventions, there is a lack of reliable and valid instruments to measure the variables that predict SCB workers' use of PRP. This study was designed to fill that void. Understanding these beliefs will assist in designing theory-based educational programs to promote the use of PRP for the estimated 250,000 individuals working in SCBs across the United States (Von Essen & Donham, 1999). Results from the study will also provide direction for future research studies designed to evaluate the impact of specific interventions on behavioral change. In addition, the study will provide future direction for the expansion of the role of the agricultural health nurse in implementing primary, secondary, and tertiary prevention strategies with this specific targeted population of agricultural workers.

CHAPTER THREE

Method

Introduction

This chapter describes the methods used to conduct the study and is organized around the following sections: setting, data collection procedures, the sample, human workers protection, data management, and plan for data analyses. The primary purpose of this cross-sectional research study was to determine if specific variables (e.g., barriers, benefits, susceptibility, severity, and norms) influence SCB workers' behavior in regard to their frequency of using PRP. The study also examined the relationships of selected demographics and self-reported occupational and respiratory health histories of SCB workers to their use of PRP at the work site. An instrument was developed by the investigator for this study. The Personal Respiratory Protection Survey (PRPS) had five constructs (barriers, benefits, susceptibility, severity and norms) rated on a five point Likert-type scale. An in-depth discussion about the development of the instrument and its psychometrics is included in a later chapter (see Chapter Four). The study was designed to answer the following research questions:

1. What is the validity and reliability of the Personal Respiratory Protection Survey (PRPS)?
2. How frequently do workers in SCBs wear PRP?
3. How do demographics, occupational histories, and self-reported respiratory health histories influence the use of PRP in SCBs?
4. What are the relationships of the theoretical constructs (benefits, barriers, susceptibility, severity, norms) to the use of PRP by SCB workers?

Setting

Data were collected at the 2003 World Pork Expo (WPX) in Des Moines, Iowa. The WPX, held annually for the past 15 years, is noted for being the largest swine specific event of its kind in the world with over 50,000 individuals having an interest in swine production attending the 3-day event. Data were collected in the trade show area; two booths were made available by the National Pork Producers Council. The booths were equipped with tables and chairs and separated from the adjacent booths by a curtain. A large sign titled, "Breathing or Respiring: I Want Your Opinion" was posted on the curtain at the back of the booths. Two recruitment posters with large pictures of pigs were displayed on easels in front of the booths (see Appendix A).

Data Collection Procedures

Three strategies were used to recruit the study participants at the WPX trade show. First, nine agricultural students from a local Iowa high school disseminated an invitation to visit the booth titled, "Breathing or Respiring: I Want Your Opinion" at the entrance gate to the WPX (see Appendix B). Second, a university professor with experience and contacts in the swine industry assisted at the booth to recruit and explain the purpose of the survey. Third, individuals visiting the booth and completing the survey instrument were offered a $10.00 incentive for their time and effort. Both the recruitment flyers disseminated by the FFA students and the posters located on the easels in front of the booths contained information about the $10.00 incentive.

Upon arrival at the booth, each potential subject was screened by asking them if they met the following inclusion criteria for the study:

- 18 years of age or older

- worker in SCBs for at least 2 hours per day
- able to read and write English

Individuals who were 18 years of age were recognized as adults and, therefore, could legally consent to participate in the study. Limiting the study participants to individuals who work in SCBs for at least 2 hours per day ensured that the workers did represent workers in SCBs. The communication skills of reading and writing English language were essential to complete the items on the questionnaire.

It is estimated that 90 percent of the individuals visiting the booth and indicating a desire to participate in the study met all inclusion criteria. The two reasons for willing individuals not meeting the inclusion criteria were being less than 18 years of age and not currently working in SCBs. No non-English speaking individuals were identified.

Each individual meeting the inclusion criteria was given an informed consent document describing the purpose, procedures, risks, and benefits of the study (see Appendix C). After reading the informed consent document, those individuals desiring to participate in the study were given a copy of the instrument to complete. All those who read the informed consent document indicated their wish to participate in the study. Directions for completing the survey instrument were written at the beginning and throughout the survey (see Appendix D). The investigator was also present to provide a brief verbal explanation and to answer questions about the study. Participants completed the survey instrument independently. On the last page of the questionnaire, study participants had the option to record their names and addresses requesting a summary of the study findings to be mailed at a later date. When each worker turned in the completed instrument, the last page was separated from the questionnaire to remove any identifying

information attached to the survey. To ensure anonymity, the completed instrument and the last page were placed in two separate secure file containers. This procedure was verbally explained to each worker by the investigator as the workers turned in their questionnaire. Thus, there were no personal identifiers on the completed instruments. Upon completion of the instrument, in order to receive the $10 incentive, each study participant was asked to sign a sheet of paper, completely separate from the instrument. On each signature sheet, the study participants were informed in writing that the signature sheet would be used for accounting purposes only and in no way be linked to the questionnaire.

Sample

The subjects for this study were SCB workers who attended the WPX in June 2003 and volunteered to participate in the study. The sample was composed of 503 SCB workers from 27 states and 3 Canadian provinces with one half of the workers from Iowa and South Dakota (see Table 1). The sample was composed primarily of white, married males (see Table 2 and 3). The workers' ages ranged from 18 to 77 (M = 39.10, SD = 12.43) (see Table 4). There was much variation in the educational level of the study participants with the majority of the participants having a high school education or greater (see Table 5).

Table 1
Residence of the Workers in the Sample

Site of Residence	Number of Workers	Percent of Workers
Iowa	200	38.8
South Dakota	52	10.3
Minnesota	40	8.0
Illinois	33	6.6
Oklahoma	26	5.2
Ohio	12	2.4
Missouri	12	2.4
Kansas	11	2.2
Remaining 19 states	69	13.7
Canada	38	7.6
Missing data	10	2.0

Table 2
Gender and Race of Workers in Sample

	Number of Workers	Percent of Workers
Gender		
Male	404	80.3
Female	99	19.7
Race		
White	483	96.0
American Indian/Eskimo	13	2.6
Hispanic	4	.8
Other	1	.2
Missing Data	2	.4

Table 3
Marital Status of Workers in Sample

Marital Status	Number of Workers	Percent of Workers
Married	375	74.6
Single	108	21.5
Divorced	7	1.4
Separated	6	1.2
Widowed	1	.2
Other	1	.2
Missing data	5	1.0

Table 4
Age of Workers in Sample

Age Range in Years	Number of Workers*	Percent of Workers
18-28	116	23.2
29-38	122	24.3
39-48	149	29.6
49-58	79	15.7
59-77	35	6.9

*2 (.2%) of the workers did not record their age

Table 5
Educational Level of Workers in Sample

Educational Level	Number of Workers	Percent of Workers
No formal education	1	.2
Some grade school education	33	6.6
Some high school education	40	8.0
High school diploma/GED	142	28.2
Vocational degree	32	6.4
Two-year Associate degree	66	13.1
Some four-year college education	46	9.2
Completed four year college degree	111	22.1
Master's degree or equivalent	24	4.8
PhD degree or equivalent	4	.8
Did not identify educational level	4	.8

Human Workers Protection

Approval of the University of Cincinnati's Institutional Review Board was obtained prior to the beginning of each phase of instrument development and data collection. The purpose of the study, along with the procedures for the study, and the potential risks and benefits of participating in the study were outlined in an informed consent document and given to each study participant. No known risks for the participants were identified. Participation in the study posed only potentially minor discomfort to the participants such as inconvenience, the use of personal time, and/or increased awareness/concern about respiratory health. If participation in the study caused

unusual concern about respiratory health issues, the investigator was prepared to refer those individuals to an appropriate health care provider. The study participants were assured that participation (completion of the instrument) was strictly voluntary and that all data would be anonymous.

Data Management

A code sheet was developed for use in entering the data into an Excel spreadsheet (see Appendices E and F). Data were entered into the spreadsheet by an individual with expertise in data entry and randomly checked by the investigator for accuracy. Once entries were made, a graduate nursing student checked every entry with supervision from the investigator. Ten errors were found and corrected by the investigator. One error detected was the inclusion of a 16-year-old worker. This worker was deleted from the database because the worker did not meet the inclusion criteria. Thirty additional questions about data entries resulted in judgment calls by the investigator. For example, when asked the number of years they had worked in SCBs, 12 individuals recorded a range of years. The years listed were averaged, and the averaged value was entered in the database. Another judgment call was used when entering the educational level of the workers with eight workers selecting two options: an AD degree and some four-year college education. When these two options appeared, the AD degree was consistently entered into the database because the question asked for the highest level of education completed. The database for this study was kept confidential and secured in a locked file cabinet. Only the investigator and the individuals entering and checking the data had access to these files.

Plan for Data Analyses

Data analysis for this study was conducted using Statistical Package for the Social Sciences (SPSS) for Windows, Version 11.5 (2002). The following discussion outlines the plan to analyze the data along with the rationale for the selection of each statistical method. The plan to analyze the data was guided by the study's four research questions:

1. What is the validity and reliability of the Personal Respiratory Protection Survey (PRPS)?
2. How frequently do workers in SCBs use PRP?
3. How do demographics, occupational histories, and self-reported respiratory health histories influence the use of PRP in SCBs?
4. What are the relationships of the theoretical constructs (benefits, barriers, susceptibility, severity, norms) to the use of PRP by SCB workers?

Question # 1: What is the validity and reliability of the Personal Respiratory Protection Survey (PRPS)?

Prior to data collection at the World Pork Expo, a two-phase process was used to establish the instrument's content validity (see Chapter Four). To establish an initial estimate of content validity, a panel of experts was used to judge the content validity for the proposed PRPS. Both specific item and global content validity indices were calculated. The entire instrument was then pilot tested with a sample of six SCB workers. After this second phase, the survey was distributed at the World Pork Expo in Des Moines, Iowa. Principle component analysis (PCA) and varimax rotation was used to establish the construct validity for the 38 items composing the PRPS. To test reliability or the internal consistency of each scale, a Cronbach's alpha value was computed for each

of the factors identified by the PCA. See Chapter Four for detailed information about the development and psychometrics of the instrument.

Question # 2. How frequently do workers in SCBs use PRP?

To answer this question, descriptive statistics including frequencies, means, ranges, standard deviations, and percentages were used to describe the dependent variable, the self-reported use of PRP among workers in SCBs. Workers were asked to indicate their use of PRP on a seven-point scale with one representing *never* and seven representing *always*.

To assist in better understanding PRP use among the workers, data were also collected about the number of years the workers had worn PRP, the type used, types of prior information received about PRP use, and the source of this information. Descriptive statistics were again used to analyze this data.

Question # 3: How do demographics, occupational histories, and self-reported respiratory health histories influence the use of PRP in SCBs?

First, descriptive statistics including frequencies, means, ranges, standard deviations, and percentages were used to describe the sample in terms of the demographic, occupational history, and respiratory health history variables. The demographic variables included each worker's state of residence, gender, race, age in years, marital status, and highest level of education completed. The work history variables included the workers' role in pork production including the production size of their swine farm, number of workers, and the type work unit (i.e., farrowing [birthing], nursery, grow /finish, breeding/gestation, feed mill) that best described their work site. In addition, data were collected about the current and past length of time (i.e., hours, days,

years) the workers had spent in SCBs. Data regarding the respiratory health history (i.e., known breathing problems, respiratory symptoms, and /or respiratory diagnoses; use of respiratory drugs, cigarettes, or smokeless tobacco; or their awareness of someone becoming ill from not wearing PRP) were also collected.

Next, three hypotheses were generated for statistical testing purposes to determine the relationship of the independent variables (factors related to the demographics, occupational history, and respiratory history) to the dependent variable, the use of PRP by workers in SCBs. The first hypothesis stated that there would be a positive relationship between the demographic variables (i.e., gender, race, age, martial status, educational level) and the use of PRP by workers in SCBs. Student's *t* test was used to test the difference between two independent group means for PRP use between gender and marital status. The differences in mean scores for PRP use between race groups was not computed because 96% of the sample was white. A correlation was used to analyze the relationship between the education level of the workers and the use of PRP.

The second hypothesis stated that there would be a significant relationship between the occupational history variables and the use of PRP by workers in SCBs. Analysis of variance (ANOVA) was used to determine if the use of PRP was influenced by the independent variables (size of farm, the number of employees on the farm, and the time [i.e., hours, days, years] spent working in SCBs). This statistical method allowed the investigator to compare the variance within each group with the variance between groups assuming the amount of variation about the mean in each group to be equal.

The third hypothesis stated that there would be a significant relationship between the respiratory history variables and the use of PRP by workers in SCBs. The workers

responded with a *yes* or *no* to the seven respiratory questions; student's *t*- test was used to test the difference between two independent group means for each of the seven questions.

Question # 3: What are the relationships of the theoretical constructs (benefits, barriers, susceptibility, severity, norms) to the use of PRP by SCB workers?

Next, five hypotheses were generated for statistical testing purposes to determine the relationships of the proposed constructs to the use of PRP by the SCB workers. These hypotheses were:

1. There will be a positive significant relationship between the model's benefits construct and the use of PRP by workers in SCBs.
2. There will be a positive significant relationship between the model's barrier construct and the use of PRP by workers in SCBs.
3. There will be a positive significant relationship between the model's susceptibility construct and the use of PRP by workers in SCBs.
4. There will be a positive significant relationship between the model's severity factor and the use of PRP by workers in SCBs.
5. There will be a positive significant relationship between the model's norms construct and the use of PRP by workers in SCBs.

Next, principle component analysis (PCA) was conducted to establish construct validity for each of the proposed constructs in the PRPS (see Chapter 3). The means and standard deviations for the Likert –scale items along with the means of the factors resulting from the principle component analyses were computed. Having met the assumptions (Burns & Grove, 1995) for the use of Pearson's correlation (i.e., interval measurement of both independent and dependent variables, normal distribution of at least

one variable, independence of observational pairs, and homoscedasticity), simple correlations between the use of PRP and the independent variables (factors) were used to test the proposed hypotheses.

Using the behavior of using PRP as the dependent variable, hierarchical blockwise regression was used as the last statistical method. This method allowed the investigator to determine which independent variables were the best predictors of the dependent variable. The independent variables were entered as blocks and the variables in the first block competed for entry into the regression equation while variables in other blocks were ignored. This step was followed by adding a second block of variables while the predictors found to be significant in the first block remained in the equation. This process of adding blocks of variables to the equation continued in an effort to account for the variance of each variable that entered the equation. This strategy allowed the investigator to determine the amount of variance explained by one block of variables and then determine if adding additional blocks of variables would significantly increase the amount of variance explained in the use of PRP. This statistical method allowed the investigator to test the significance of the contribution of each block toward explaining the use of PRP by the workers. It was assumed that the blocks were composed of variables that were conceptually grouped to explain the use of PRP by workers in SCBs. The order of the entry of blocks was determined by the investigator and entered based on the independent variable judged to be the least likely to change to that predicted to be the most likely to change. For this study, only the independent variables that were significantly ($p = < .05$) associated with the dependent variable were included in the

hierarchical blockwise regression analysis. For example, age and gender are variables that the worker cannot control; thus, these variables were included in the first block.

Summary

In summary, this chapter describes the methods used to conduct the study. The setting, data collection procedures, workers, steps to protect human workers, procedures used to manage the data, and the data analyses used to answer the research questions are described. The results will be discussed in Chapter Five.

CHAPTER FOUR

Instrument Development

Introduction

The instrument, Respiratory Health of Workers in Swine Confinement Buildings (RHWSCB), was developed by the investigator for this study. The instrument consisted of a questionnaire that elicited data regarding the demographics and occupational and respiratory health histories of workers in SCBs, along with their reported use of PRP. The instrument also included a survey, Personal Respiratory Protection Survey (PRPS) that contained five Likert type scales to measure the following theoretical constructs: benefits, barriers, susceptibility, severity, and norms. The literature is void of a valid and reliable survey to measure the constructs of interest for this study with SCB workers (see Chapters One & Two). The development of the scales and the overall instrument are described in the following sections.

Scales Development: Initial Work. A fundamental task in the instrument development process was to create valid and reliable scales to measure the beliefs of workers in SCBs regarding their use of PRP. This process involved two steps. First, several variables (e.g., accessibility, comfort, reminders) reported to influence a worker's decision whether to wear PRP at the worksite were derived from the literature (see Chapter Two) and provided support for a preliminary study to examine these variables in more depth. A focus group study with 22 workers in SCBs at two geographic sites in Kentucky identified the preliminary content domain of the knowledge, attitudes, and practices of workers toward the use of respiratory protection within SCBs as described by

the workers themselves. Findings from this study served as the foundation for the PRPS (Jones, 2000). See Chapter Two for in-depth discussion of focus group findings.

Based on findings from the focus group study and the theoretical discussion in Chapters One and Two, the investigator identified and grouped 37 items into the following five conceptual constructs: benefits, barriers, susceptibility, severity, and norms (see Appendix G). The constructs of benefits, barriers, susceptibility, and severity were derived from the Health Belief Model, while the norms construct was derived from the Theory of Reasoned Action, later revised and renamed the Theory of Planned Change. Both theoretical models have been used to understand and predict a wide range of health behaviors (Pender, Murdaugh, & Parsons, 2002)

Twenty-eight of the original 37 scale items were developed to measure four constructs included in the Health Belief Model. Four items were developed to measure the workers' beliefs about the benefits of wearing PRP, and 15 items were developed to measure the workers' beliefs about the barriers that make PRP more difficult to use. Examples of the benefits of wearing PRP at the worksite include improved health now and in the future, while examples of barriers that decrease use of PRP include cost and discomfort. Four additional items were developed and added to the item pool to measure susceptibility, the belief that SCBs, as occupational sites, would pose a threat to the respiratory health of the workers. The last five items were developed to measure severity, the belief that the manifestation of a respiratory disease from working in SCBs would pose a major hardship on the workers' finances, family, or the ability of the workers to perform activities of daily living.

The last nine items of the original survey were developed to measure norms, a major construct included in the Theory of Planned Behavior. These nine items were designed to measure SCB workers' beliefs regarding the social pressures that influence their decision whether to wear PRP. Sources of this social pressure may be family members, supervisors, or regulatory agencies.

Content Validity. After developing the original 37-Likert scale items, it was essential to determine to what degree the proposed items represented the content domain to be measured. Thus, the next step in creating the scales involved a two-phase procedure to establish content validity. To ensure that the developed items represented the proposed constructs, all salient items were included.

Phase I of Tool Development. Using processes proposed by Lynn (1986), Martuza (1977), and Veneziano and Hooper (1997) a panel of experts was used to judge the content validity for the proposed PRPS. Eight professionals with expertise in the health risks associated with working in SCBs were selected to participate in the process to establish an initial estimate of content validity. These experts, located across six states, included two occupational health nurses and two occupational physicians with a special interest in agricultural issues, two agricultural safety and health researchers, and two doctorally prepared individuals employed as swine extension specialists.

These experts were mailed a packet containing a cover letter thanking them for their willingness to participate as expert panel members (see Appendix H), a Validity Questionnaire for the PRPS, a list of definitions for the theoretical constructs, and instructions on how to complete the questionnaire (see Appendix I). Members of the expert panel were requested to scrutinize the PRPS and complete the questionnaire. On

the questionnaire, each person was asked to rank each Likert item on a scale ranging from 1 to 5 for relevance as a measure of the constructs identified and defined in the PRPS. These reviewers were also asked to provide open-ended comments related to the following: (a) specific constructs included in the scale items, (b) any constructs or scale items believed to be omitted from the survey, (c) the time required to complete the scales, (d) the clarity of the items, (e) the design of the format, and (f) the ease of administration.

All eight expert panel members returned the questionnaire with meaningful comments, and seven of the eight experts ranked 35 of the 37 items on a 5-point scale, with 1 being not relevant and 5 being very relevant. One panel member questioned the intent of the relevancy exercise and elected not to score the items on the relevancy scale. However, the reviewer provided comments regarding the items. The content validity index (CVI) was determined for each item based on the proportion of experts who scored the item to be relevant to the specific concept (see Appendix J). As suggested by Davis (1992) and Lynn (1986), the global index scores were determined by averaging the content validity index scores for each item developed to specifically measure one of the five proposed constructs. These results are recorded in Table 6.

The CVI scores for the 37 items ranged from .43 to a perfect score of 1.00, with 13 of the items scoring $\geq$ .80 and an additional 12 items scoring between .70 and .79. A new scale judged to have good content validity will have a minimum CVI score of .80 (Davis, 1992; Polit & Hungler, 1999). The global index for each of the five constructs (scales) ranged from .69 (susceptibility) to .81 (benefits), with the constructs of barriers, severity, and norms achieving scores of .71, .79, and .77, respectively.

Table 6
Content Validity Indices for Global Relevance for Each Construct of the Personal Respiratory Protection Survey

Construct	Global indices
Benefit	.81
Severity	.79
Norms	.77
Barriers	.71
Susceptibility	.69

After computing the CVI, the investigator and a panel of two doctoral-prepared nurses reviewed the CVI score for each item, along with the feedback received from the expert panel members. The information obtained from the expert panel members was used to delete items considered to be non-relevant, make editorial changes to improve the clarity and readability of the items, and to clarify the definition of one construct. The original definition of the construct "barrier" was confusing as the definition implied the construct to be a negative consequence from not wearing PRP. Changes in each original item based on the CVI scores and the feedback from the panel of experts were documented in detail (see Appendix K).

In addition to the changes in the original items, four additional scale items were added to the instrument at the suggestion of the expert panel members. These new items, listed below, were included with the barrier construct and became items 5, 6, 20 and 21, respectively.

Wearing personal respiratory protection makes me feel like I am smothering.

- Wearing personal respiratory protection makes the air smell bad.

- Wearing personal respirator protection interferes with my smoking habit.
- Wearing personal respiratory protection interferes with my chewing tobacco.

Following revision, the PRPS contained 38 items distributed as follows: Benefit scale, 4 items; Barriers scale, 17 items; Susceptibility scale, 4 items; Severity scale, 4 items; and norms scale, 9 items. To answer the research questions, four additional sections were added to the instrument for the purpose of soliciting information regarding: (a) demographics; (b) occupational history; (c) respiratory health; and (d) use of PRP devices (see Chapter 3).

An individual with expertise in editing documents for appropriateness, grammar, punctuation, writing style, spelling, overall appearance, and readability then critiqued the instrument. The suggestions for revision of the instrument were incorporated and included minor changes to maintain consistency in formatting, style, and spacing. All changes in the questionnaire were reported to the Institutional Review Board at the University of Cincinnati and permission granted before proceeding with Phase II of the study.

Phase II of Tool Development. The instrument was pilot tested with a convenience sample of six SCB workers who were invited to attend a dinner meeting (see Appendices L and M). Following a light meal, each worker was given a copy of the entire instrument to review along with two forms (see Appendix N) to evaluate the instrument regarding format, wording, and ease of completion. The evaluation forms also provided an opportunity to offer suggestions to improve the clarity of the instrument and suggestions for improving the instrument. The pilot provided an overwhelming

positive evaluation of the instrument with no suggestions for changes. A summary of these evaluative findings is found in Tables 7 and 8.

Table 7
Summary of Evaluation for Demographic, Occupational History, Respiratory History, and Personal Respiratory Protection Use Sections of Instrument by Panel of Workers (N=6)

Criteria for Evaluation		Summary of Responses
Average Time to Complete		7 minutes
Easy to Complete		Yes = 6 (100%) No = 0
Questions Made Sense		Yes = 6 (100%) No = 0
Questions Clear & Concise		Yes = 6 (100%) No = 0
Format		Poor Fair Good Excellent 0 (0%) 1(17%) 3 (50%) 2 (33%)
Suggested Changes		None
Other Comments		• "Excellent questions and pertinent!" • "Excellent composition of questions."

Table 8
Summary of Procedural Evaluation of Personal Respiratory Protection Survey by Panel of Workers (N=6)

Criteria for Evaluation		Summary of Responses
Average Time to Complete		7 minutes
Easy to Complete		Yes = 6 (100%) No = 0
Statements Clear & Concise		Yes = 6 (100%) No = 0
Format		Poor Fair Good Excellent 0 (0%) 1(17%) 0 (0%) 5 (83%)
Suggested Changes		None
Other Comments		• "Questions all went together." • "Very straight forward." • "Very applicable to workers in swine confinement buildings."

Operational Definitions. Before proceeding with the next step of the study, it was essential to define how the variables in each section of the instrument would be observed and measured. For the purpose of this study the variables were operationally defined as follows.

1. Frequency of use of PRP (dependent variable) was measured on a single item with a scale of one (never) to seven (always) as reported by the workers.
2. Demographic variables were self reported responses on the demographic section of the tool. The workers recorded their actual age and selected one of two possible categories to indicate their gender, one of six possible categories to indicate marital status, and one of six possible categories to indicate their race. Workers selected one of 10 options to indicate their educational level.
3. Occupational variables (role of worker in swine production, number of pigs and employees where they work, type of unit best describing their work site, along with the time spent in the SCB) were measured as self reported by the workers on the occupational section of the instrument. Of the nine items in this section, workers were restricted to one choice for six items and were instructed to check all categories that applied for the remaining three items. The questions with multiple responses were reported as a percentage of the total possible responses.
4. Respiratory health history variables (presence of breathing problem, respiratory symptoms associated with working in SCB, any known respiratory medical diagnoses, respiratory medication use, tobacco use or knowing someone who became ill from not wearing PRP while working in SCB) were treated as dichotomous variables and assigned a numerical value of one if the workers checked *yes* and a two if the worker checked *no*.
5. The PRPS was composed of five Likert scales containing 38 items representing the five proposed constructs. The 38 items distributed as follows: Benefit scale, 4 items; Barriers scale, 17 items; Susceptibility scale, 4 items; Severity scale, 4

items; and Norms scale, 9 items. Twenty-seven of the items were assigned a numerical value of one to five that reflected the beliefs of the workers toward PRP use. The possible range of options for 11 of the 38 items was one to six providing the workers the option of not responding to the item if the item was not applicable to the worker.

Phase III of Scales Development. The results of Phase II were reported to the Institutional Review Board at the University of Cincinnati, and permission was granted before proceeding with the next phase of the study (see Chapter Three). Construct validity and internal consistency were assessed after the data collection and are discussed in Chapter Five.

Summary

In summary, this chapter addressed the development of an instrument used to collect data from workers in SCBs about their beliefs and use of PRP. Based on the literature review and a previous focus group study with workers in SCBs, 37 items were generated and grouped into five conceptual constructs: benefits, barriers, severity, susceptibility, and norms. The establishment of content validity involved a two-phase process. First, the survey was critiqued by a panel of eight professionals with expertise in the health risks associated with working in SCBs and subsequently revised based on the input from these experts. Demographic, occupational history, and respiratory health history sections were added to the instrument; and the tool was then pilot tested by a group of workers in SCBs. The variables were operationally defined to identify the procedures for which the variables will be measured. After obtaining IRB approval, the instrument was used to collect data for this study.

CHAPTER FIVE

Results

This chapter presents the results of the study and is organized around the following sections: a description of the survey's psychometrics (e.g., validity and reliability), descriptive data for the individual Likert scale items and the factors composing the Personal Respiratory Protection Survey (PRPS), descriptive data regarding the workers' use of personal respiratory protection (PRP) and the workers' occupational and respiratory health histories, the results of the hypotheses testing, and the results of the regression analyses.

Psychometrics of Survey

The validity and reliability of any quantitative instrument must be evaluated to determine the adequacy of the chosen measurement instrument. Two phases were used to establish content validity and were presented in Chapter Four. This section will present the results of the statistical methods used to establish construct validity for 38 items on the PRPS and to assess the internal consistency of each scale. The findings from both statistical methods were needed to answer the first research question, what is the validity and reliability of the PRPS?

Construct Validity. Principle factor analysis (PCA) and varimax rotation were used to establish the construct validity for the 38 items composing the PRPS. The investigator had limited expectations about the factor structure; therefore, exploratory factor analysis was used rather than the confirmatory factor analysis (Burns and Groves, 1995). Using .30 as the recommended minimum value (Burns & Groves, 1995), the factor loadings for the variables were evaluated. Principle factor analysis determined the presence of nine factors

with eigenvalues of 1.00 or greater; however, one factor had no loadings equal to or greater than .30; therefore, only eight factors were retained. The results are presented in Tables 9, 10, 11, 12, 13, 14, 15 and 16.

Table 9

Loadings for the Likert-Scale Items Using Principle Factor Analysis (PCA) and Varimax Rotation for Factor 1 (Personal Barrier Scale)

Survey Items	Factor 1 Loading
9. Wearing PRP causes me discomfort.	.83
13. Wearing PRP makes breathing more difficult.	.79
14. Wearing PRP interferes with my ability to do my job.	.76
8. Wearing PRP causes me to get hot.	.76
5. Wearing PRP makes me feel like I am smothering.	.75
7. Wearing PRP interferes with my vision.	.70
15. Wearing PRP takes too much time.	.58
6. Wearing PRP makes the air smell bad.	.57
10. PRP equipment costs me too much to buy.	.46
19. Wearing PRP makes my eyeglasses fog.	.45

Items 5 through 21, which comprised the barriers scale, loaded on four factors. Items 5, 6, 7, 8, 9, 10, 13, 14, 15, and 19 loaded on a single factor, subsequently named the personal barriers scale (see Table 9). Items 11 and 12 loaded on a second single factor, subsequently named external barriers scale (see Table 14). Items 20 and 21 loaded on a third single factor, subsequently named habit barriers scale (see Table 15); while items 16, 17, and 18 loaded on a fourth single factor, subsequently named knowledge deficit barriers scale (see Table 16).

Table 10
Loadings for the Likert-Scale Items Using Principle Factor Analysis (PCA) and Varimax Rotation for Factor 2 (Norms Scale)

Survey Items	Factor 2 Loading
36. My boss (supervisor) wears PRP when working.	.86
32. My boss (supervisor) encourages me to wear personal PRP when working.	.82
38. I am more likely to wear PRP when my boss (supervisor) reminds me to do so.	.78
35. My coworkers encourage me to wear PRP when working.	.76
34. My coworkers wear PRP when working.	.69
33. OSHA influences my use of PRP when working.	.65
37. I am more likely to wear PRP when my family members remind me to do so.	.42

Table 11
Loadings for the Likert-Scale Items Using Principle Factor Analysis (PCA) and Varimax Rotation for Factor 3 (Benefit Scale)

Survey Items	Factor 3 Loading
2. Wearing PRP now protects my health in the future.	.88
3. Wearing PRP now influences my ability to work in the future.	.85
1. PRP protects my lungs while working.	.81
4. Wearing PRP decreases my chances of having respiratory symptoms such as cough and chest tightness.	.80

Table 12
Loadings for the Likert-Scale Items Using Principle Factor Analysis (PCA) and Varimax Rotation for Factor 4 (Severity Scale)

Survey Items	Factor 4 Loading
28. My ability to continue my activities of daily living.	.86
29. My family.	.81
27. My ability to continue working in SCBs.	.81
26. My finances.	.80

Table 13
Loadings for the Likert-Scale Items Using Principle Factor Analysis (PCA) and Varimax Rotation for Factor 5 (Susceptibility Scale)

Survey Items	Factor 5 Loading
23. I am more likely to develop lung disease (asthma, bronchitis, emphysema) than workers who do not work in SCBs.	.87
24. I am more likely to get a lung infection such as pneumonia than workers who do not work in SCBs.	.85
22. It is likely that I will develop lung damage from working in SCBs.	.80
25. I am more likely to wear PRP when I do chores that cause more dust such as moving and loading pigs.	.38

Items 1-4 loaded on a single factor named benefits scale (see Table 11), items 26, 27, 28 and 29 loaded on a single factor comprising the severity scale (see Table 12), and items 22, 23, 24, and 25 loaded on the single factor named susceptibility scale (see Table 13). Although items 32, 33, 34, 35, 36, 37, and 38 loaded on the single factor named norms, item 31, *my family encourages me to wear PRP when working*, loaded with the external barrier scale (see Table 10) and item 30, *being exposed to dust is part of working on a farm*, did not load on any factor. Even though item 38, *I am more likely to wear PRP when my boss (supervisor) reminds me to do so*, loaded with a value of .38, conceptually this item does not fit with the other two loadings and was deleted in future analysis. Likewise, item 16, *there is no good place to store my PRP equipment at work*, loaded with a value of .41; but, conceptually, this item did not fit with the other two loadings and was also deleted in future analysis.

Table 14
Loadings for the Likert-Scale Items Using Principle Factor Analysis (PCA) and Varimax Orthogonal Rotation for Factor 6 (External Barrier)

Survey Items	Factor 6 Loading
11. PRP equipment is conveniently located at my worksite.	.82
12. PRP equipment is located at businesses that make it easy to to purchase.	.79
*31. My family encourages me to wear PRP when working.	.38

* Deleted from item pool

Table 15
Loadings for the Likert-Scale Items Using Principle Factor Analysis (PCA) and Varimax Orthogonal Rotation for Factor 7 (Habit Barrier)

Survey Items	Factor 7 Loading
20. Wearing PRP interferes with my smoking habit.	.82
21. Wearing PRP interferes with my chewing tobacco.	.82

Table 16
Loadings for the Likert-Scale Items Using Principle Factor Analysis (PCA) and Varimax Orthogonal Rotation for Factor 8 (Knowledge Deficit Barrier)

Survey Items	Factor 8 Loading
18. I don't understand why I should use PRP when working.	.80
17. I don't know how to correctly use PRP equipment.	.77
*16. There is no good place to store my PRP equipment at work	.41

*Deleted from item pool

Using PCA to establish construct validity resulted in the reduction of the total items from 38 to 35 grouped in eight factors. The factors were composed of four subscales (personal, external, habit, and knowledge deficit) of the barrier scale along with the remaining four scales (benefits, norms, susceptibility, and severity) as originally hypothesized. The next step was to assess the factors for internal consistency or reliability.

Assessing Internal Consistency. To test reliability or the internal consistency of each scale, a Cronbach's alpha value was computed for each of the eight factors identified by the factor analysis. The results are presented in Table 17. Reliability coefficients ranged from .58 to .91. Alpha values can theoretically range from 0.0 to 1.0, but both of these values are extreme. Nunnally (1978) recommended a value of .70 as the lowest acceptable

alpha level for a new instrument. DeVellis (1991) suggested acceptable ranges for research scales to be *unacceptable* if below .60; *undesirable* if between .60 and .65; *minimally acceptable* if between .65 and .70; *respectable* if between .70 and .80; and *very good* if between .80 and .90. The alpha values were .77 or above for all scales except the knowledge deficit barrier and habit barrier scale which were .62 and .58

Table 17

Assessing Internal Consistency

Factor Name	# of Items	Cronbach Alpha	N
Personal Barriers	10	.87	500
Norms	7	.86	489
Benefits	4	.91	499
Severity	4	.86	499
Susceptibility	4	.78	500
External Barriers	2	.77	496
Habit Barriers	2	.62	144
Knowledge Deficit Barriers	2	.58	497

The next analysis involved the examination of the interscale correlations. The interscale correlations ranged from -.030 to .395 indicating minimum redundancy in factors. These results are presented in Table 18.

Table 18
Correlation Coefficients of Factors (Subscales)

	1	2	3	4	5	6	7	8
1. Suscepti-bility	1.00							
2. Personal Barriers	.173**	1.00						
3. Norms	.026	0.95*	1.00					
4. Knowledge Deficit Barriers	.066	.307**	-.030	1.00				
5. Habit Barrier	.132	.134	.037	.021	1.00			
6. External Barrier	.113*	.303**	-.085	.082	-.074	1.00		
7. Severity	.261**	.099*	.130**	.006	.066	.057	1.00	
8. Benefits	.396**	-.124**	.204*	-.71	-.044	.233**	.308**	1.00

* $p < .05$ **$p < .01$

Responses on the Likert Personal Respiratory Protection Scale Items

Descriptive data are presented for each of the 35 individual survey items in Table 19. Questions 1-26 were not Likert scale items but were designed to elicit demographic, occupational and respiratory history data along with information about the frequency of the workers' PRP use. Therefore, the scales items begin with number 27. On a scale of one to five, with one being *not at all* and five being to a *very great extent*, workers were asked to indicate to what degree specific statements or phrases represented their beliefs about using PRP when working in SCBs. Observed ranges equaled possible ranges in all cases except item numbers 38, 45, 46 and 55 –61. The possible range for these items was 1 to 6. Items with the highest means on a five-point Likert scale were items related to the workers' beliefs about how a serious lung problem would affect their life (severity scale). The items with the highest means focused on the impact of a serious lung problem on the workers' ability to continue work (M = 4.02), ability to continue activities of daily living (M = 3.90),

and impact on family (M = 3.88). The items with the lowest means (M = 1.39 and M = 1.75) were the items *wearing PRP interferes with my smoking habit* and *wearing PRP interferes with my chewing tobacco*, respectively. These items with the lowest means were items that included a *not applicable* option; thus, the items addressing smoking had only 175 valid responses, while the item addressing chewing tobacco had 177 valid responses. The items with the next lowest means (M = 1.84 and M = 1.77) dealt with items addressing the workers' prior education and their knowledge about the use of PRP at the worksite.

Descriptive data are presented for the eight factors (constructs) in Table 20. The factor with the highest mean (M = 3.85) is the Severity construct, followed by the Benefits construct with a mean of (M = 3.74). The lowest mean (M = 1.73) is for the Habit Barrier construct, followed by the Knowledge Deficit Barrier construct with a mean of (M = 1.80).

Table 19
Likert Scale Items – Means and Standard Deviations

Item # and Statement	Mean	SD
27. PRP protects my lungs while working.	3.65	1.06
28. Wearing PRP now protects my health in the future.	3.86	1.09
29. Wearing PRP now influences my ability to work in the future.	3.69	1.14
30. Wearing PRP decreases my chances of having respiratory symptoms such as cough and chest tightness.	3.75	1.15
31. Wearing PRP makes me feel like I am smothering.	3.17	1.31
32. Wearing PRP makes the air smell bad.	2.01	1.15
33. Wearing PRP interferes with my vision.	2.36	1.31
34. Wearing PRP causes me to get hot.	3.27	1.25
35. Wearing PRP causes me discomfort.	3.06	1.27
36. PRP equipment costs me too much to buy.	1.93	1.12

Table 19 (continued)
Likert Scale Items – Means and Standard Deviations

Item # and Statement	Mean	SD
37. Wearing PRP makes breathing more difficult.	2.73	1.19
38. Wearing PRP makes my eyeglases fog.	3.32	1.55
39. Wearing PRP interferes with my ability to do my job.	2.23	1.16
40. Wearing PRP takes too much time.	1.97	1.05
41. PRP equipment is conveniently located at my worksite.	3.06	1.42
42. PRP equipment is located at businesses that make it easy to purchase.	3.41	1.23
43. I don't know how to correctly use PRP equipment.	1.84	1.15
44. I don't know why I should use PRP when working.	1.77	1.17
45. Wearing PRP interferes with my smoking habit.	1.39	.99
46. Wearing PRP interferes with my chewing tobacco.	1.75	1.34
47. It is likely that I will develop lung damage from working in SCBs.	2.51	1.07
48. I am more likely to develop lung disease (asthma, emphysema) than workers who do not work in SCBs.	2.70	1.16
49. I am more likely to get a lung infection such as pneumonia than workers who do not work in SCBs.	2.61	1.18
50. I am more likely to wear PRP when I do chores that cause more dust such as moving and loading pigs.	3.32	1.39
51. My finances.	3.60	1.21
52. My ability to continue working in SCBs.	4.02	1.03
53. My ability to continue my ADL.	3.90	1.04
54. My family.	3.88	1.13
55. My boss (supervisor) encourages me to wear PRP when working.	3.69	1.95
56. Occupational Safety and Health Administration (OSHA) influences my use of PRP when working.	2.94	1.99
57. My coworkers wear PRP when working.	3.08	1.72
58. My coworkers encourage me to wear PRP when working.	2.72	1.88
59. My boss (supervisor) wears PRP when working.	3.65	2.09
60. I am more likely to wear PRP when my family members remind me to do so.	2.97	1.57
61. I am more likely to wear PRP when my boss reminds me to do so.	3.81	1.95

Table 20
Factors: Means and Standard Deviations

Factor	N	# Items	Mean	SD
Personal Barrier	501	10	2.56	.858
Norms	501	7	3.24	1.433
Benefits	501	4	3.74	.989
Severity	500	4	3.85	.926
Susceptibility	501	4	2.61	1.024
External Barriers	501	2	2.67	.736
Habit Barriers	208	2	1.73	1.239
Knowledge Deficit Barriers	497	2	1.80	.975

Descriptive Findings

The first part of this section presents descriptive data to answer the research question, how frequently do workers in SCBs wear PRP? For the purpose of this study, PRP was defined on the questionnaire as: *Any device you chose to place over your nose and mouth for the purpose of preventing particles in the air from entering the respiratory tract.* The workers were asked to respond to five questions related to their use of PRP. The findings from these questions are outlined next.

Reported Frequency of Using PRP Devices. From a list of seven options on the questionnaire, the workers were requested to indicate the amount of time they had worn PRP during the past year when working in SCBs. Of the workers responding, the results were as follows:

- 183 (36.3%) workers had never worn PRP
- 107 (21.2%) workers had seldom worn PRP
- 87 (17.3%) workers had sometimes worn PRP
- 41 (8.1%) workers had often worn PRP
- 31 (6.2%) workers had very often worn PRP
- 27 (5.4%) workers had most always worn PRP
- 25 (4.9%) workers had always worn PRP when working in SCBs
- 2 workers (<1%) did not respond to the question and were recorded as missing data

The 183 (36%) workers who indicated that they never wear PRP were requested to skip the next two questions on the questionnaire.

Number of Years Wearing PRP. The 318 workers who reported to have worn PRP during the previous year were asked to report the number of years they had been wearing PRP. The responses ranged from 1 to 30 years with a mean of 6.56 years. Of the workers responding the results were as follows:

- 170 (53.5%) workers had worn PRP for 1 to 5 years
- 74 (23.3%) workers had worn 6 to 10 years
- 40 (12.6%) workers had worn 11 to 15 years
- 13 (4.1%) workers had worn 16 to 20 years
- 3 (< 1%) workers had worn PRP more than 20 years
- 18 (5.7%) workers did not respond to the question and were recorded as missing data

Type of PRP Worn. From a list of seven choices on the questionnaire, the 318 workers who reported to have worn PRP were asked to report the type of PRP they had used during the past year while working in SCBs. The workers were instructed to select all types of PRP that applied. Of the workers responding, the results were as follows:

- 125 (39.3%) workers had worn a one-strap dust mask
- 155 (48.7%) workers had worn a NIOSH approved two-strap disposable dust mask
- 9 (2.8%) workers had worn a half mask with a replaceable cartridge
- 4 (<1%) workers had worn a full-face mask with replaceable cartridge
- 4 (<1%) workers had worn a piece of fabric covering the face
- 2 (<1%) workers had worn something else for respiratory protection
- 9 (2.8%) workers selected the "not applicable" option for this question
- 14 (4.4%) workers selected the remaining 6 combinations each representing < 1% of the total responses
- 181 (36%) workers did not respond to this question

Type Information Received about PRP. From a list of five choices on the questionnaire, workers were asked to report if they had received information in the past about specific topics related to PRP devices and the use of such devices. The workers were told to select all topics that applied. A total of 702 single and combination responses were recorded from 365 (73%) of the workers. Of these 702 responses, the workers reported to have received information about specific topics related to PRP devices as follows:

- 292 (41.6 %) workers selected health risks associated with working in SCBs
- 128 (18%) workers selected ways to select the best PRP devices

- 81 (11.5%) workers selected ways to take care of PRP devices
- 86 (12.3%) workers selected how to determine the right size PRP when purchasing a PRP
- 115 (16.4%) workers selected the conditions or habits that can cause breathing problems when wearing PRP devices
- 138 (27%) workers did not select any response and were recorded as missing data

Source of Information about PRP. From a list of 11 choices on the questionnaire, workers were asked to identify the source(s) of the information about PRP received in the past. Workers were told to select all sources that applied. A total of 731 single and combination responses were recorded from 453 (90%) of the workers. Of these 731 responses, the workers reported their source of information as follows:

- 39(5.4 %) workers selected the spouse
- 75 (10.3%) workers selected the employer
- 54 (7.4%) workers selected the health care provider
- 52 (7%) workers selected the local extension office
- 51 (7%) workers selected the state pork producers association
- 40 (5.5%) workers selected the National Pork Board
- 66 (9%) workers selected a national pork publication
- 188 (25.7%) workers selected farming magazines
- 63 (8.5%) workers selected mail order catalogs
- 30 (4%) workers selected “other” as the option

- 73 (10%) workers selected the option indicating they had never received any information
- 50 (10%) workers did not select an option and were recorded as missing data

The second part of this section, presents descriptive data about the independent variables (demographics and occupational and respiratory histories) of the workers. These data are essential to answer the second research question, how do demographics, occupational histories, and self-reported respiratory health histories influence the use of PRP in SCBs? Data describing the occupational history of the workers will be presented first followed by information describing the respiratory history of the workers in SCBs.

Occupational History

Role in Pork Production. From a list of five choices on the questionnaire, the workers were asked to identify their role in pork production. The workers were instructed to select all answers that applied. Of the workers responding, the results are as follows:

- 171 (33.9%) workers selected principle owner of the swine farm
- 101 (20.1%) workers selected family member of the swine farm's principle owner or operator
- 80 (15.9%) workers selected paid employee working on a swine farm
- 43 (8.5%) workers selected both principle owner and the principle operator of the swine farm
- 41 (8.2%) workers selected the principle operator of the swine farm
- 38 (7.6%) workers selected ten combinations of the five choices

- 25 (5%) workers did not report their role and thus selected the "other" category
- 4 (<1%) workers selected no option and were recorded as missing data.

Farm Size. From a list of seven choices on the questionnaire, the workers were asked to identify the size of the farm where they worked. Of the workers responding, the results are as follows:

- 83 (16.5%) workers reported to be associated with farms producing fewer than 1,000 pigs per year
- 58 (11.5%) workers reported to be associated with farms producing 1,001-2,000 pigs per year
- 49 (9.7%) workers reported to be associated with farms producing 2,001-3,000 pigs per year
- 27 (5.4%) workers reported to be associated with farms producing 3,001-4,000 pigs per year
- 22 (4.4%) workers reported to be associated with farms producing 4,001-5,000 pigs per year
- 71 (14.1%) workers to be associated with farms producing 5,001-10,000 pigs year
- 192 (38.1%) workers to be associated with farms producing over 10,000 pigs annually
- One worker chose no option and was recorded as missing data

Employees on Farm: Excluding Family Members. From a list of four choices on the questionnaire, the workers were asked to report the number of employees, excluding

family members, who were employed on the farm where they worked during the past year. Of the workers responding, the results are as follows:

- 145 (28.8%) workers reported no additional employees
- 263 (52.2%) workers reported one to five additional employees
- 45 (9%) workers reported 6 to 11 additional employees
- 50 (10%) workers reported more than 11 additional employees, excluding family members

Family Members Employed On Farm. From a list of four choices on the questionnaire, the workers were asked to report the number of family members employed on the farm where they worked during the past year. Of the workers responding, the results are as follows:

- 108 (21.4%) workers reported there were no family members
- 359 (71.4%) workers reported there were 1 to 5 family members
- 18 (3.6%) workers reported there were 6 to 11 family members
- 18 (3.6%) workers reported more than 11 family members

Type of Unit. From a list of six choices on the questionnaire, workers were asked to report the type of unit in the swine confinement building (SCB) where they had worked during the past year. Workers were instructed to identify all units that applied. Of the workers responding, the results are as follows:

- 28 (5.5%) workers reported to work only in farrowing units
- 12 (2.4%) workers reported to work only in nursery units
- 89 (18%) workers reported to work only in grow/finish units
- 22 (4.4%) worker reported to work only in breeding/gestation units

- 5 (< 1%) workers reported to work only in feed mills
- 145 (28.8%) workers reported to work in all units
- 3 (< 1%) workers did not enter a response and were recorded as missing data

The remainder of the workers reported to work in 20 different combinations of the worksite choices, with the most frequently selected combinations being:

- 60 (11.9%) workers selected farrowing, nursery, grow/finish and breeding/gestation units
- 23 (4.6 %) workers selected farrowing, nursery, and grow/finish units
- 20 (4%) selected farrowing and breeding/gestation unit
- 20 (4%) selected nursery and grow/finish units
- 76 (15%) selected the remaining 14 combinations, each representing < 3% of total

Years Worked in Swine Confinement Buildings. From a list of nine choices on the questionnaire, the workers were asked to report the number of years they had worked in SCBs. Of the workers responding, the results are as follows:

- 9 (1.8%) workers had worked less than 1 year
- 47 (9.3%) workers had worked 1-3 years
- 47 (9.3%) workers had worked 4-5 years
- 51 (10.1%) workers had worked 6-7 years
- 26 (5.2%) workers had worked 8-9 years
- 41 (8.1%) workers had worked 10-11 years
- 30 (6%) workers had worked 12-13 years

- 28 (5.6%) workers had worked 14-15 years
- 224 (44.6%) workers had worked more than 15 years in SCBs

Days Worked in Swine Confinement Buildings. The workers were asked to report the average number of days per week they had worked in SCBs during the previous year. Of the workers responding, the results are as follows:

- 19 (3.8%) workers reported to work 1 day per week
- 28 (5.6%) workers reported to work 2 days per week
- 25 (5.0%) workers reported to work 3 days per week
- 23 (4.6%) workers reported to work 4 days per week
- 67 (13.3%) workers reported to work 5 days per week
- 91 (18.1%) workers reported to work 6 days per week
- 246 (48.8%) workers reported to work 7 days per week.
- 4 (1%) workers did not respond to the question.

Hours Worked/Day in Swine Confinement Buildings. From a list of eight choices on the questionnaire, the workers were asked to report the average number of hours per day they worked in SCBs during the previous year. Of the workers responding, the results are as follows:

- 28 (5.6%) workers reported to work less than one hour per day
- 110 (21.9%) workers reported to work 1 to 2 hours per day
- 136 (27%) workers reported to work 3 to 4 hours per day
- 100 (19.9%) workers reported to work 5 to 6 hours per day
- 70 (13.9%) workers reported to work 7 to 8 hours per day
- 41 (8.1%) workers reported to work 9 to 10 hours per day

- 7(1.4%) workers reported to work 11 to 12 hours per day
- 9 (1.8%) workers reported to work more than 12 hours per day
- 2 (< 1 %) workers did not respond to the question and were entered as missing data

Hours Worked/Week in Swine Confinement Buildings. From a list of seven choices on the questionnaire, the workers were asked to indicate the average number of hours per week they worked in SCBs. Of the workers responding, the results are as follows:

- 83 (16.5%) workers reported to work 0 to 10 hours per week
- 110 (21.8%) workers reported to work 11 to 20 hours per week
- 88 (17.5%) workers reported to work 21 to 30 hours per week
- 89 (17.7%) workers reported to work 31 to 40 hours per week
- 70 (12.9%) workers reported to work 41 to 50 hours per week
- 45 (9.1%) workers reported to work 51 to 60 hours per week
- 14 (2%) workers reported to work more than 60 hours per week
- 4 (<1%) workers did not respond to the question and were entered as missing data.

Respiratory Health History. The workers were asked to indicate their beliefs about respiratory health by responding to seven questions with a yes or no answer. A summary of the responses is presented in Table 21.

Table 21
Responses of SCB Workers to Respiratory History Questions

Questions	Number and Percent of Responses			
	Yes	%	No	%
1. Have you ever had a breathing problem you think was related to farming activities?	185	37	317	63
2. Have you ever had flu-like symptoms (fever, shivering, cough, tiredness, weakness, muscle and joint pain) associated with working in swine confinement buildings?	170	34	317	63
3. Have you ever been told by your physician that you have bronchitis, asthma, or emphysema?	83	6.5	417	82.9
4. Do you take any breathing medication (pills or use inhalers)?	44	8.7	456	90.5
5. Do you use smokeless tobacco?	70	14	431	85
6. Do you smoke cigarettes?	58	12	441	88
7. Do you know of a co-worker or family member who became ill from not wearing personal protection when working in swine confinement buildings?	132	26	371	74

*Some responses may not add up to 100% due to missing data.

Hypotheses Testing

The third section of this chapter presents the results of hypotheses testing. Since this study was designed to investigate how specific variables may be used to predict the use of PRP by SCB workers, it is most important to examine the relationship between the use of PRP among the workers in SCBs and the independent variables described in Chapter 3.

Hypothesis 1

This hypothesis stated that there would be a positive significant relationship between the demographic variables and the frequency of PRP use by workers in SCBs. Student's *t* test was used to test the difference between two independent group means. The mean PRP use score for men (M = 2.62, SD = 1.71) did not differ significantly (p = .099)

from the mean PRP use for women (M =2.62, SD = 2.01). Before conducting the *t* test, the responses to the marital variable were collapsed into a categorical or dichotomous measure, married or non-married. There also was no significant difference (p = .06) between the mean score for PRP use for the single workers (M = 2.43, SD = 1.62) and the mean score for PRP use for married workers (M = 2.71, S.D. =1.82). The differences in mean scores for PRP use between race groups was not computed because 96% of the sample was white. The educational level of the workers was determined to be interval data; therefore, the correlation between the educational level of the workers and the use of PRP was calculated and determined to be -.111 (p = .007). This negative correlation implies that as the educational level of the workers increases, the use of PRP decreases. Therefore, educational level was the only demographic variable used in the regression analysis.

Hypothesis 2

This hypothesis stated that there would be a positive significant relationship between the occupational history variables and the use of PRP by workers in SCBs. Analysis of variance (ANOVA) was used to determine if the use of PRP was influenced by the independent variables (size of farm, the number of employees on the farm, and the time [hours, days, years] spent working in SCBs). The results are presented in Table 22 and indicated the size of the swine farm, the number of family members employed on the swine farm, and the hours per day the workers spent in the SCB to significantly influence the use of PRP: Therefore, the size of the swine farm, the number of family members employed on the swine farm, and the hours per day the workers spent in the SCB were used in the regression analysis.

Table 22
Influence of Occupational Variables on Personal Respiratory Protection use

Variable	df	F	P
Farm size	7: 49	6.49	.000
Family members employed	3: 497	3.26	.021
Hours worked per day	7: 490	3.26	.002
Total number of employees	3: 497	2.42	.066
Years worked in SCBs	8: 492	1.43	.181
Days worked per week in SCBs	7: 490	2.02	.051
Hours worked per week in SCBs	6: 490	3.26	.080

Hypothesis 3

This hypothesis stated that there would be a positive significant relationship between the respiratory health history variables and the use of PRP by workers in SCBs (see Table 23). Student's *t* test was used to test the difference between two independent group means.

Table 23
Means of the Frequency of Personal Respiratory Protection Use Related to the Workers' Respiratory History

Question	Yes	No	*t*
1. Have you ever had a breathing problem that you think was related to farming activities?	2.84	2.50	2.08*
2. Have you ever had flu-like symptoms associated with working in SCBs?	2.85	2.51	2.04*
3. Have you ever been told by your physician that you have bronchitis, asthma or emphysema?	2.67	2.60	.328
4. Do you take any breathing medication (pills or inhalers)?	2.80	2.60	.702
5. Do you use smokeless tobacco?	2.36	2.66	-1.318
6. Do you smoke cigarettes?	2.46	2.64	-.749
7. Do you know of a co-worker or family member who became ill from not wearing PRP when working in SCBs?	3.00	2.48	2.92**

* P = < .05 ** P = < .01

Workers were more likely to use PRP if they had experienced a breathing problem they perceived to be related to farming activities, had experienced flu-like symptoms

associated with working in SCBs, and had known someone who became ill from not using PRP while working in SCBs; therefore, these independent variable were used in the regression analysis.

Simple coefficients of correlations between the use of PRP and the independent variables (factors) were used to test hypotheses 4 through 11 (see Table 24).

Hypothesis 4

This hypothesis stated that there would be a positive significant relationship between the proposed theoretical framework's personal barriers factor and the use of PRP by workers in SCBs. This hypothesis was supported (see Table 24). The simple correlation between the personal barriers factor and the use of PRP was -.335 (p= .000). The negative correlation implies that as the personal barriers increase, the use of PRP decreases.

Table 24
Coefficients of Correlation between Independent Variables (Factors) and Use of PRP

Independent Variables (Factors)	Pearson Correlation	N	p
Personal barrier	-.335**	499	.000
Norms	.246**	500	.000
Benefits	.430**	499	.000
Severity	.108*	498	.016
Susceptibility	.070	499	.116
External barrier	.125**	499	.005
Habits barrier	-.052	207	.459
Knowledge deficit barrier	-.234**	495	.000

*P= < .05 **P= < .01

Hypothesis 5

This hypothesis stated that there would be a positive significant relationship between the proposed theoretical framework's norms factor and the use of PRP by workers

in SCBs. This hypothesis was supported (see Table 24). The simple correlation between the norms factor and the use of PRP was .246 (p=.000).

Hypothesis 6

This hypothesis stated that there would be a significant relationship between the proposed theoretical framework's benefits factor and the use of PRP by workers in SCBs. This hypothesis was supported (see Table 24). The simple correlation between the benefits factor and the use of PRP was .430 (p= .000).

Hypothesis 7

This hypothesis stated that there would be a significant relationship between the proposed theoretical framework's severity factor and the use of PRP by workers in SCBs. This hypothesis was supported (see Table 24). The simple correlation between the severity factor and the use of PRP was .108 (p= .016).

Hypothesis 8

This hypothesis stated that there would be a positive significant relationship between the proposed theoretical framework's susceptibility factor and the use of PRP by workers in SCBs. This hypothesis was not supported (see Table 24). The simple correlation between the susceptibility factor and the use of PRP was .070 (p= .116).

Hypothesis 9

This hypothesis stated that there would be a positive significant relationship between the proposed theoretical framework's external barriers factor and the use of PRP by workers in SCBs. This hypothesis was supported (see Table 24). The simple correlation between the external barriers factor and the use of PRP was .125 (p= .005).

Hypothesis 10

This hypothesis stated that there would be a positive significant relationship between the proposed theoretical framework's habit barriers factor and the use of PRP by workers in SCBs. This hypothesis was not supported (see Table 24). The simple correlation between the habit barriers factor and the use of PRP was -.052 (p= .459).

Hypothesis 11

This hypothesis stated that there would be a positive significant relationship between the proposed theoretical framework's knowledge deficit barriers factor and the use of PRP by workers in SCBs. This hypothesis was supported (see Table 24). The simple correlation between the knowledge barriers factor and the use of PRP was -.234 (p=. 000). This negative correlation implies that as the knowledge deficit barriers increase, the use of PRP decreases.

Results of Regression Analyses

To identify the variables that predict the frequency of PRP use by workers in SCBs, hierarchical blockwise forward regression analyses were performed using the frequency of PRP use as the dependent variable. Only independent variables that were found to be significantly ($p < .05$) associated with the dependent variable were included in the hierarchical blockwise regression analysis. Variables were entered into the statistical equation in four blocks. The variables entered by blocks and the results of the regression analyses are presented in Table 25.

Table 25
Hierarchical Blockwise Regression of Independent Variables by Block on the Use of PRP by Workers in SCBs

Independent Variables	R	R^2	p
Block 1 (Demographics)	.120	.014	.008
Education level			
Block 2 (Occupational History)	.300	.090	.000
Size of swine farm			
Family members working			
Hours spent in SCB per day			
Block 3 (Respiratory History)	.348	.121	.001
Awareness of illness			
Experienced flu-like symptoms			
Experience breathing problem			
Block 4 (Factors)	.623	.389	.000
Personal barrier			
Benefits			
Norms			
External barrier			
Knowledge deficit barrier			
Severity			

The stepwise regression analysis for Block 1 (demographics) found educational level of the workers to be a significant predictor of PRP use. However, this single independent variable only accounted for 1.4% of the total variance in the use of PRP.

In Block 2, regression analysis found that the size of the farm, family members employed on the farm, and the hours the worker spent per day in the SCBs to be a significant predictor of PRP use accounting for an additional 7.6% of the total variance in the use of PRP.

In Block 3, regression analysis found that if workers had previously experienced a breathing problem perceived to be related to farming activities, had experienced flu-like symptoms associated with working in SCBs, and had prior knowledge of someone who

became ill from not using PRP while working in SCBs to be a significant predictor of PRP use explaining an additional 3.1% of the total variance.

In Block 4, six of the eight factors (i.e., personal barriers, norms, benefits, external barriers, knowledge deficit barriers, and severity) were significantly correlated to the use of PRP. Block 4 was composed of these six independent variables: personal barriers, norms, benefits, external barriers, knowledge barriers, and norms. This block of variables was found to be a significant predicator of PRP explaining an additional 26.8% of the total variance. A total of 38.9% of the variation in the use of PRP was associated with these 4 blocks of independent variables.

Summary

This chapter presented the results on the study's findings. The study's research questions served as the framework for organizing the findings. First, factor analysis was computed to establish construct validity and resulted in the identification of eight factors. To assess the internal consistency of the factors, Cronbach's alpha values were computed. Next, frequencies, means, standard deviations, and percentages were calculated for each of the Likert scale items. Hypotheses' testing was conducted using correlational analyses, student's *t* test for independent samples, and analysis of variance. Correlations were calculated between each of the eight factors and the dependent variable. Heirarchical blockwise regression analyses were used to predict the relationship between the independent variables and the use of PRP by workers in SCBs.

The descriptive analysis of the data revealed that the study population varied in age, educational level achieved, specific type worksite on the swine farm, and the hours per week the workers spent in the SCBs. The majority of the workers were married, white

males functioning in the role of either the principle owner or a family member of the principle owner or operator of the swine farm. Also, the majority of the workers were associated with farms producing over 5,000 pigs annually, worked on farms with 1 to 5 additional employees excluding family members, and reported to have worked over 14 years in SCBs. The majority of the workers reported to work more than 3 to 4 hours per day, more than 20 hours per week, and over 6 days per week in SCBs.

Over half of the workers reported they never or seldom wore PRP use at the worksite, and few of the workers reported to have received information about the need for PRP and instructions in selecting the appropriate type of PRP. Information received by the workers originated from multiple sources. Over one-fourth of the workers reported to have experienced a breathing problem they believed to be related to farming, to have experienced flu-like symptoms associated with working in SCBs, and to have known someone who became ill from not wearing PRP while working in SCBs. The means and standard deviations for the Likert-scale items along with the measures of central tendency for the factors were presented. The items and factors with the highest means focused on the impact of a serious lung problem on the worker (severity construct), and the items and factors with the lowest means addressed tobacco habits (habit barriers).

Correlational analyses, students *t* tests for independent samples, and analysis of variance were used for hypotheses testing. Based on these findings, hypotheses 4, 5, 6, 7, 9, and 11 were supported; and hypotheses 8 and 10 were not supported. Hypotheses 1, 2, and 3 were partially supported.

Hierarchical stepwise regression analysis was used to predict PRP use by the independent variables in each of four data blocks. The factor's block resulted in the equation with the highest

predictive value by including six independent variables. The resulting R^2 value for the equation using 4 blocks of independent variables was 38.9%.

CHAPTER SIX

Discussion

This chapter is divided into three sections. In the first section, the research questions along with the purposes of the study will be used to frame the discussion. Also, when appropriate, the findings will be discussed in relation to the proposed theoretical framework and findings from the literature review. The second section will include a discussion of the study's validity and reliability estimates along with the study's limitations. The third section will address recommendations for additional research studies along with implications for theory and nursing practice.

Discussion of Study Findings in Relation to Research Questions

The primary purpose of this cross-sectional study was to investigate the relationship of benefits, barriers, susceptibility, severity, and norms to the use of PRP by SCB workers. A secondary purpose was to examine the relationships between SCB workers' use of PRP and the workers' demographics, occupational histories, and respiratory histories. An examination of the descriptive data about selected demographics and self-reported occupational and respiratory health histories of SCB workers provided useful information about the workers' respiratory health, work practices, and use of PRP. The study findings also provided meaningful data about the relationship of the proposed theoretical constructs of benefits, barriers, susceptibility, severity, and norms to the behavior of SCB workers to wear PRP. The agricultural health nurse and other health care professionals need to understand these independent variables and the interaction among these variables to plan interventions that are effective in increasing the use of PRP by this targeted population.

Findings obtained from this cross-sectional study were used to answer three research questions.

Research Question #1: How frequently do workers in swine confinement buildings (SCBs) wear personal respiratory protection (PRP)?

Study findings revealed that only 20% of the workers in SCBs used PRP *often* or *most always* at the worksite. This finding of PRP use is lower than the 30% use recorded by Zejda (1993) and the 36% reported by Petrae (1996) but higher than the 3% PRP use reported by Carpenter, Lee, Gunderson, and Stueland (2002) when using similar qualifiers including *most* or *all of the time*. It is alarming that 36% of the workers reported to have *never* worn PRP, and 21% reported they *seldom wore* PRP at the worksite. Among the workers indicating PRP use at the worksite, 43% had been using PRP for over 6 years, with 5% reporting use for over 16 years. A possible explanation for this finding would be that respiratory problems increase in relation to the years the workers spend in SCBs, thus the workers choose to wear PRP to curtail the respiratory symptoms. However, a significant relationship was not found between the length of PRP use and the frequency of use. Additional study is needed to explore the rationale for why some workers have chosen to use PRP for a number of years.

Workers in SCBs are in need of an extensive educational program designed to address the health risks when not wearing PRP while working in SCBs, the criteria for selecting the appropriate type and fit of the PRP devices, and the care of the PRP devices. Study findings provide direction for planning effective methods to disseminate the needed educational content. There was extreme variation in the responses of the workers with regard to the source of the information received on PRP devices and the use of these

devices. To reach the largest number of workers, educational messages about PRP use must be disseminated using multiple and diverse methods of delivery. It is recommended that farming magazines be routinely targeted as one means of disseminating information to SCB workers. Agricultural health nurses along with other health care providers should take the lead in developing, disseminating, and evaluating appropriate health information to this vulnerable population group.

Research Question # 2: How do demographics, occupational histories, and self reported respiratory health histories influence the use of PRP in SCBs.

Demographics. Data were collected at a national swine event, and the majority of the sample was white, married males. It is interesting to note that 78% of the workers were younger than 49 years of age. In fact, there was a 50% reduction in the number of workers from the 39 to 48 year age range (29.6%) compared to the 49 to 58 year age range (15.7%). It is unknown if these workers change occupations, retire at an earlier age than the general population, develop a disability, or some other alternative such as a younger family member taking over the operation of the swine production. Additional investigation is needed in an attempt to understand this occurrence.

It was predicted there would be a significant relationship between demographics and the use of PRP. There were no significant differences between the demographic variables of gender, age, race, and marital status and the use of PRP by workers in SCBs. There was much variation in the educational level of the workers ranging from no formal education to a PhD or equivalent. The negative correlation between the educational level of the worker and the use of PRP implies that the PRP use decreases as the educational level of the worker increases. This relationship could possibility be explained by the fact that

individuals with higher levels of education assume roles such as managers or consultants and therefore spend less time in the SCBs.

Occupational History. Study findings are influenced by a mix of workers from both small family farms that are exempt from OSHA respiratory protection standards and much larger swine farms. Based on the findings that 71.4% of the workers reported there were 1 to 5 family members employed on the swine farm suggests that the workers were from family farms. Support of this conclusion is based on the fact that only 10% of the workers indicated there were more than 11 employees, excluding family members, on the farm where they worked; and 16% of the workers reported to be paid employees on the swine farm. Furthermore, findings indicated that 35% of the workers reported to work in specific units on the swine farm, a work practice that is not typical for a worker on a family farm. It is estimated that the remaining 65% of the workers who reported working in all areas of swine production or a combination of the units represent family swine farms. The amount of time spent in SCBs also supported the assumption that the majority of the workers were from family swine farms. Sixty-seven percent of the workers reported to work six and seven days a week, 75% of the workers reported to work less than seven hours a day in the SCB, and over 70% of the workers reported to work under or over 31 to 50 hours per week. These work schedules do not support what one would expect for a typical paid employee. Also, the fact that 61% of the sample was the principle owner or operator of the swine farm or a family member of the owner or operator supports the fact that the majority of the workers were from small family farms.

The significance of these study findings is that workers on family farms would most likely not have access to formalized safety programs and medical surveillance at the

worksite. While not documented, it is anticipated that many of these family farms are the homes, play grounds, and work sites for children of the swine farm owner and or operator. A favorite activity of young children is to see and feed baby animals. Visits to the SCBs could increase exposure for these young children to the toxic gases and dusts present in the SCB, and PRP devices are not available in sizes appropriate for children to protect them from such exposure. Also, it is anticipated that adolescents would be at increased risk for early damage to the respiratory system from working in the family's SCB. Adolescents are noted for participating in risky behavior; therefore, it is anticipated that adolescents working on a family swine farm would not wear PRP as they generally do not perceive themselves as being vulnerable to harm from outside sources such as toxic gases or dusts in the SCB. Accessing this population and designing creative programs to promote the respiratory health of all farm residents, including children, presents a challenge for agricultural health nurses and other health care professionals.

Self-Reported Respiratory History. Workers were asked to perform a self-assessment of their respiratory health by reading six questions and answering each question by circling *yes* or *no*. Analyses indicated that many workers recognize the SCB as a worksite that could have a negative impact on their respiratory health. Over one-fourth of the workers have associated the SCB, as a worksite, to the development of breathing problems, flu-like symptoms, and an illness of someone they know resulting from not wearing PRP at the worksite. These findings related to breathing problems and flu-like symptoms are similar to those reported in the literature (Donham, Zazala, & Merchant, 1984; Schenker, 1998; Von Esson & Donham, 1997). Likewise, findings indicate that only 12% of the workers smoked cigarettes. This is a lower percentage of smokers than the

39.5% of male farmer smokers reported by Boffetta and Garfinkel (1988) when they studied smoking habits by occupation. A study investigating the relationship of the use of PRP and the respiratory history variables for the workers reporting to smoke cigarettes is indicated. This type study would allow the investigator to explore the influence of personal habits such as cigarette smoking and the respiratory symptoms associated with such a habit on the use of PRP among SCB workers.

Research Question # 3: What is the relationship of the constructs (benefits, barriers, susceptibility, severity, norms) to the use of PRP by SCB workers?

This study developed and tested a theoretical framework to explain SCB workers' decisions about using PRP. The original framework consisted of five independent variables. These variables were benefits, barriers, susceptibility, severity, and norms. Principle component analysis determined that there were four subscales for barriers (i.e., personal, knowledge deficit, external, and habits) increasing the factors to eight in number.

It was predicted that each of the eight factors (independent variables) would be significantly associated with the use of PRP by SCB workers. Two of these factors (habit barrier and susceptibility) were not significantly associated with the use of PRP by workers in SCBs. However, findings indicated that six of the eight factors were significantly associated with the use of PRP by workers in SCBs. The independent variables positively associated with the use of PRP were the benefit factor, the norms factor, the external barrier factor, and the severity factor. The independent variables negatively associated with the use of PRP were the personal barrier factor and the knowledge deficit barrier. Thus, findings support the fact that there is less use of PRP among workers as their personal barriers and

their deficit of knowledge increases. Regression analysis showed that together these factors explained an additional 26.8% of the variance in the PRP use.

The correlation between the susceptibility component and the use of PRP was .070 (p= .116). Furthermore, this variable was not found to be a significant contributor to the regression equation explaining the use of PRP by workers in SCBs. The likely reason this variable made no additional significant contribution in explaining the use of PRP is because the variable was highly correlated to the benefits factor; the correlations (see Table 24) between the benefits factor and susceptibility factor was .396.

Discussion of the Study's Validity and Reliability Estimates and Limitations of the Study

The most serious limitation of this study is the development of a new tool used for data collection. Although steps were taken to establish a valid and reliable instrument (see Chapters 3 and 4), there are limitations in the interpretation of the findings. Nunnally (1978) recommends the use of a Cronbach's alpha of .70 for the internal consistency of all new instruments. Two components, the knowledge barrier and habit barrier, did not meet these criteria but were included in the statistical analysis with values of .58 and .62, respectively. Each of these components is composed of two items. In future research it would be important to add additional items to these two factor scales to improve the alpha scores to the desirable .70, as recommended by Nunnally (1978). Another approach to improve alpha scores would be to combine the four barrier subscales into one construct as originally conceptualized.

A second limitation of the study is the fact that only workers attending the World Pork Expo (WPX) in June 2003 and volunteering to participate in the study were included

in this study. Even though the workers participating were from 27 states, it was obvious that some states were not represented. The travel to the national trade show could have prevented some workers from participating in the study. It is unknown if the workers attending the WPX are representative of all workers in SCBs. A random sample of the SCBs workers would improve generalizability of study findings.

A third limitation of the study was the fact that 28 workers did not meet the inclusion criteria of working in SCBs at least 2 hours per day. The workers verbally indicated they met the inclusion criteria when screened but later reported on the questionnaire to work less than one hour per day in SCBs. Due to the potential for high exposure to environmental dusts and gases at the work site, the decision was made to include these 28 workers in the study.

A fourth limitation of the study was that all data was self-reported from the workers. The validity and accuracy of self-reported data must always be questioned: this is particularly true when subjects are asked to report unhealthy behaviors such as not wearing PRP to protect their respiratory health or not being compliant to legal regulatory standards at the work site.

A fifth limitation is the fact that the convenience sample and correlational design of the study does not imply causation. However, the study is a step that is needed prior to planning an intervention study to promote PRR use. Study findings enhance the understanding of SCB workers' behavior in regard to the use of PRP.

Recommendations for Research, Theory, and Practice

Findings from this study can serve as the basis for intervention research studies and also guide the development and dissemination of educational programs designed to

promote health improvements for workers in SCBs. Future research in this area of study is needed to design, implement, and evaluate theory-based interventions to promote the use of PRP by workers in SCBs. These studies should be designed using the six predictive variables to guide the interventions. This type of research can determine the most appropriate interventions to promote the positive behavior of PRP use by workers in SCBs and test the predictive model resulting from this study. In spite of the unexplained variation in PRP use, findings from this study suggest that interventions to increase PRP use among SCB workers should be guided by the variables of benefits, norms, severity, and barriers (personal, knowledge deficit, external). Because *benefits* were found to be the strongest predictor of the workers' use of PRP, educational programs should focus on the positive respiratory health outcomes of wearing PRP. Curricula content should include information about how PRP use protects the lungs and how using PRP now will protect the health of the worker in the future and decrease the chance of the worker developing respiratory symptoms.

Because *norms* were found to be a moderately strong predictor of the workers' use of PRP, programs should be designed to use social pressure in an attempt to change the worker's behavior. These programs should incorporate the assistance of the worker's spouse, co-worker, or farm owner/operator to help influence the SCB worker to use PRP. For example, photonovels, featuring a respected co-worker sharing an educational message promoting the use of PRP, could be shared with the workers and evaluated as an intervention to increase PRP use. Since *severity* was found to be a significant predictor of PRP use, strategies should be implemented to emphasize the association of using PRP and

the resulting decrease in the physical, financial, and emotional impact of a respiratory disorder resulting from working in a SCB.

Likewise, interventions to increase use of PRP will increase their likelihood of success if they utilize information gained from this study about *barriers* to PRP use. For example, the *knowledge deficit barrier* subscale should be addressed with the development, implementation, and evaluation of an educational program designed to inform workers in SCBs why they should wear PRP and how to correctly select, use, and care for PRP devices. However, before educating the workers, there is a need to educate health care providers about common agricultural illnesses including the respiratory disorders associated with working in SCBs, the appropriate use of PRPs to prevent these illnesses, and the best ways to reach this specific population group to share the needed education. Several strategies could be taken in an attempt to remove the *external barriers* that were found to be a significant predictor of PRP use, such as making it easier for the worker to purchase PRP and locate the devices at the worksite. The agricultural health nurse should work with the owner or operator of the SCB to ensure that PRP devices are conveniently located for the workers at the worksite. The nurse should also initiate dialogue with local agricultural businesses located in close proximity to the SCBs to discuss the possibility of the businesses making the NIOSH approved respirators available and easy to purchase by the workers. The third barrier subscale found to be a significant predictor of PRP use was the *personal barriers*. Information gained about personal barriers should be shared with PRP manufacturers in an effort to redesign PRP devices that will be more comfortable to wear, reasonably priced, and cause less interference with performing the activities associated with work in SCBs.

There are also practice implications surfacing from the study findings. Education regarding the need for PRP use in SCBs is essential. This education should occur on two levels. First, health care providers must be educated about health risks associated with working in SCBs and interventions that can improve the health of these workers. Only 22 (4%) of the workers reported to have received information about PRP from a health care provider. Health care providers should receive education in serving this vulnerable population group and be prepared to take advantage of teachable moments when they come in contact with workers in SCBs in the health care arena.

This model should be interdisciplinary and focus on strategies to promote the health outcomes of workers in SCBs. This curriculum should address such topics as the health risks of not wearing PRP at the worksite, the criteria for selecting the most appropriate PRP device, the implications of working in a SCB or other agricultural site on the client's health status, and the recommended treatment for the respiratory disorders resulting from working in SCBs. The curriculum should be developed and pilot tested before being widely disseminated to multiple health care professionals (i.e. nurses, physicians, respiratory therapists).

The second level of education should be designed for the numerous other individuals and agencies (i. e., employers, spouses, local extension agents, teachers, commodity groups, farming publications, youth groups in agriculture) concerned about the health of the SCB workers. Early education will have a more significant impact on the health practices of future owners or operators of swine farms; therefore, 4-H clubs, FFA chapters, farm safety day camps should be targeted to share the educational message with the youth at an early age. Brochures containing educational messages about the benefit of

using PRP at the worksite could be developed and disseminated at swine conventions, Farm Bureau meetings, or in country stores and markets where farmers gather to eat and socialize. Also, signs could be developed and posted at the worksite reminding the workers of the importance of wearing PRPs.

From the practice perspective, findings from this study can be used by the agricultural health nurse to call attention to a vulnerable group of workers in the agricultural work arena and subsequently support changes to increase the use of PRP among workers in SCBs. Study findings should be shared with other groups with a vested interest in promoting the health of workers. Such groups include governmental agencies charged with protecting the health of all workers, swine commodity groups with a vested interest in promoting the health of workers in the swine industry, and private companies that manufacture PRPs. Another appropriate strategy would be the development and evaluation of a Health Assurance Program for swine farms. An outcome of such a program would be that the swine farms could become certified after demonstrating that pre-established criteria had been met. This type assurance program would be similar to other National Pork Board Quality Assurance programs.

The agricultural health nurse (AHN), practicing in the roles of clinician, health promoter, case manager, consultant, manager, educator, or researcher (Rogers, 2003), is challenged to create, implement, and test interventions to protect SCB workers from the environmental exposures associated with working in SCBs. A major goal of the agricultural health nurse is to assist other health care providers, agricultural commodity and special interest groups, and SCB workers to acquire the knowledge, skills, and attitudes necessary to empower these workers to use PRP at the worksite.

Summary

This chapter includes a discussion of the study findings. This discussion is framed using the research questions, the study's validity and reliability estimates and limitations, followed by implications for future research studies, theory development, and practice. Implications for nursing include direction for future intervention research studies guided by the predictive model, the development of new educational programs, and planned changes in the clinical practice arena. These nursing activities should not be implemented independently. The nurse must collaborate with many disciplines in an effort to maximize the best health outcomes for workers in SCBs. Summary findings and recommendations include:

- Survey met minimum requirements for validity and reliability.
- The frequency of PRP use among workers in SCBs is limited.
- Few workers have received information about the need to use PRP or information on how to use PRP devices.
- Over one fourth of the workers have reported health problems related to working in SCBs.
- There is a need for an extensive educational program promoting the use of PRP among SCB workers using multiple and diverse methods to disseminate the educational message.

References

Aherin, R. A. (1988). The prediction and analysis of safety behaviors among dairy farmers in central Wisconsin (Doctoral dissertation, University of Minnesota, 1987). *Dissertation Abstracts International, 48*, 3035A.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior.* Englewood Cliffs, NJ: Prentice Hall.

Bernhardt, J. H. (1997). Health and Safety of Migrant and Seasonal Farmworkers and Their Families.In R. L. Langley, R. L. McLymore, W. J. Meggs, & G. T. Roberson (Eds.), *Safety and health in agriculture, forestry and fisheries* (469-482). Rockville, MD: Government Institutes, Inc.

Burns, N. & Grove, S. K. (1995). *The Practice of Nursing Research*. Philadelphia: W. B. Saunders Company.

Carpenter, W. S., Lee, B. C., Gunderson, P. D., & Stueland, D. T. (2002). Assessment of personal protective equipment use among Midwestern farmers. *American Journal of Industrial Medicine, 42*, 236-247.

Center for Disease Control. (n.d.). National Institute for Occupational Safety and Health (NIOSH), *National agricultural safety database*. Retrieved March 14, 2004, from http://www.cdc.gov/niosh/injury/traumaagric.html.

Champion, V. (1999). Revised susceptibility, benefits and barriers scale for mammography screening . *Research in Nursing and Health, 22*, 341-348.

Connon, C. L., Freund, E., & Ehlers, J. K. (1993). The occupational health nurses in agricultural communities program. *AAOHN Journal, 41*(9), 422-428.

Craig, S., Goldberg, J., & Dietz, W. H. (1996). Psychosocial correlates of physical activity among fifth and eighth graders. *Preventive Medicine*, *25*(5), 506-514.

Cunningham, M., & Acker, D. (2001). *Animal science and industry*. Upper Saddle River, NJ: Prentice Hall.

Davis, L. (1992). Instrument review: Getting the most from your panel of experts. *Applied Nursing Research, 5*, 104-107.

Debar, K. A. (1994). Predicting adolescents' behavioral intentions regarding safe farm tractor operation (Doctoral dissertation, Southern Illinois University, 1993). *Dissertation Abstracts International, 54*, 2903A.

DeVellis, R. F. (1991). *Scale development: Theory and applications*. Newbury Park, CA: Sage Publications.

Donham, K. J. (1990a). Health effects from work in swine confinement buildings. *American Journal of Industrial Medicine, 17*, 17-25.

Donham, K. J. (1995). Health hazards of pork producers in livestock confinement buildings. In H. H. McDuffie, J. A. Dosman, K. M. Semchuk, S. A. Olenchock, & A. Senthilselvan (Eds.), *Agricultural health and safety: Workplace, environment, sustainability* (pp. 38-43). Boca Raton, FL: CRC Lewis.

Dohnam, K. J. & Gustafson, K. E. (1982). Human health hazards in livestock confinement. *Annals American Conference of Governmental Industrial Hygienists, 2,* 137-142.

Donham, K. J., Haglind, P, Peterson, Y, & Rylander, R. (1986). Environmental and health studies in swine confinement buildings. *American Journal of Industrial Medicine, 10*, 389-293.

Donham, K., Merchant, J., Lassise, D., Popendorf, W., & Burmeister, L. (1990b). Preventing respiratory disease in swine confinement workers: Intervention through applied epidemiology, education, and consultation. *American Journal of Industrial Medicine, 18*, 241-261.

Donham, K. J., Popendorf, W., Palmgren, U., & Larsson, L. (1986). Characterization of dusts collected from swine confinements buildings. *American Journal of Industrial Medicine, 10*, 294-297.

Donham, K. J., Reynolds, S. J., Whitten, P., Merchant, J. A., Burmeister, L., & Popendorf, W. J. (1995). Respiratory dysfunction in swine production facility workers-response relationship of environmental exposure and pulmonary function. *American Journal of Internal Medicine, 27, 405*-418.

Donham, K. J., Rubino, M., Thedel, T. D., & Kammermeyer, J. (1977). Potential health hazards to agricultural workers in swine confinement buildings. *Journal of Occupational Medicine, 19*, 383-387.

Donham, K. J., & Rylander, R. (1986). Epilogue: Health effects of organic dusts in the farm environment. *American Journal of Industrial Medicine, 10*, 339-340.

Donham, K. F., Scallon, L. J., Popendorf, W., Treuhaft, M. W., & Roberts, R. C. (1985). Characterization of dusts collected from swine confinement buildings. *American Industrial Hygiene Association Journal, 47*(5), 404-410.

Donham, K. J., Zavala, D. C., & Merchant, J. A. (1984). Acute effects of the work environment on pulmonary functions of swine confinement workers. *American Journal of Industrial Medicine, 5*, 367-375.

do Pico, G. A. (1994). Farm-related lung diseases: Effects of organic dusts. *The Journal of Respiratory Diseases, 15*(6), 551-561.

do Pico, G. A. (1992). Hazardous exposure and lung disease among farm workers. *Clinical Chest Medicine, 13*, 311-327.

Dosman, J. A., Graham, B. L., Hall, D., Pahwa, P., McDuffie, H. H., Lucewicz, M., & To, Teresa. (1988). Respiratory symptoms and alterations in pulmonary function tests in swine producers in Saskatchewan: Results of a survey of farmers. *Journal of Occupation Medicine, 30*(9), 715-720.

Dosman, J. A., Senthilselvan, A., Kirychuk, S. P., Lemay, S. P., Barber, E. M., Wilson, P., Cormier, Y., & Hurst, T. S. (2000). Positive human health effects of wearing a respirator in a swine barn. *Chest, 118*(3), 852-860.

Ferguson, K. J., Gjerde, C. L., Mutel, C., Donham, K. J., Hradek, C., Johansen, K., & Merchant, J. (1989). An educational intervention program for prevention of occupational illness in agricultural workers. *The Journal of Rural Health, 5* (1), 33-47.

Gjerde, C., Ferguson, K., Mutel, C., Donham, K., & Merchant, J. (1991). Results of an educational intervention to improve the health knowledge, attitudes and self-reported behaviors of swine confinement workers. *The Journal of Rural Health, 7*(3), 278-286.

Hodne, C. J., Thu, K., Donham, K. J., Watson, D., & Roy, N. (1999). Development of the farm safety and health beliefs scale. *Journal of Agricultural Safety and Health, 5*(4), 395-406.

Holness, D. L., O'Blenis, E. L., Sass-Kortsak, A., Pilger, C., & Nethercott, J. (1987). Respiratory effects and dust exposures in hog confinement farming. *American Journal of Industrial Medicine, 11*, 571-580.

Hurley, T., Orazem, P., Kliebenstein, J., & Miller, D. (2000). Decade of employment data marks pork industry. *National Hog Farmer, 45*(6), E2-29.

Iversen, M., & Dahl, R. (2000). Working in swine-confinement buildings causes an accelerated decline in FEV1: A 7-yr follow-up of Danish farmers. *European Respiratory Journal, 16*, 404-408.

Iversen, M., Kirychuk, S, Drost, H., & Jacobson, L. (2000). Human health effects of dust exposure in animal confinement buildings. *Journal of Agricultural Safety and Health, 6*(4), 283-288.

Janz, N. K., & Becker, M. H. (1984). The health belief model: A decade later. *Health Education Quarterly, 11*, 1-47.

Jones, M. S. (2000). *Assessing factors contributing to the use of respiratory protection of workers in swine confinement buildings* (NIOSH-ERC Pilot Project #P021 040 F127, Grant #T42/CCT510420). Cincinnati, OH: University of Cincinnati Education and Research Center.

Kirkhorn, S. R., & Schenker, M. B. (2002). Current health effects of agricultural work: Respiratory disease, cancer, reproductive effects, musculoskeletal injuries, and pesticide-related illnesses. *Journal of Agricultural Safety and Health, 8*(2), 199-214.

Langley, R. L., McLymore, R. L., Meggs, W. J., & Roberson, G. T. (1997). *Safety and health in agriculture, forestry, and fisheries*. Rockville, MD: Government Institutes, Inc.

Lenhart, S. W., Morris, P. D., & Akin, R. E. (1990). Organic dust, endotoxin, and ammonia exposures in the North Carolina poultry processing industry. *Applied Occupational and Environmental Hygiene, 5* (9), 611-618.

Levin, P. F. (1999). Test of the Fishbein and Ajzen models as predictors of health care workers' glove use. *Research in Nursing and Health, 22*, 295-307.

Luginbuhl, R. C. (1997). Occupational safety and health regulations in agriculture. In R. L. Langley, R. L. McLymore, W. J. Meggs, & G. T. Roberson (Eds.), *Safety and health in agriculture, forestry and fisheries* (469-482). Rockville, MD: Government Institutes, Inc.

Lynn, M. (1986). Determination of quantification of content validity. *Nursing Research, 35*(6), 382-385.

Martuza, V. R. (1977). *Applying norm-referenced and criterion-referenced measurement in education*. Boston: Allyn & Bacon.

McCance, K. L., & Huether, S. E. (2002). Pathophysiology: The biologic basis for disease in adults and children. St. Louis: Mosby.

Merchant, J. A. (1987). Agricultural exposures to organic dusts. In D. H. Cordes & D. F. Rea (Eds.), *Occupation medicine: Health hazards of farming* (pp. 409-425). Philadelphia, PA: Hanley & Belfus, Inc.

Miller, D., & Hillyer, G. (2002). Facing up to farming's health risks. *Progressive Farmer, 11*(7), 20-25.

Morris, P. D., Lenhart, S. W., & Service, W. S. (1991). Respiratory symptoms and pulmonary function in chicken catchers in poultry confinement units. *American Journal of Industrial Medicine, 19*, 195-204.

National Safety Council. (1998). *Accident facts, 1998 edition.* Itasca, IL: Author.

Nonnenmann, M. W., Donham, K. J., Rautiainen, R. H., O'Shaughnessy, P. T., Burmeister, L. F., & Reynolds, S. J. (2004). Vegetable oil sprinkling as a dust reduction method in swine confinement. *Journal of Agricultural Safety and Health, 10*(1), 7-15.

Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). New York: McGraw Hill.

Olson, D. K., & Bark, S. M. (1996). Health hazards affecting the animal confinement farm worker. *American Association of Occupational Health Nurses, 44(*4), 198-204.

Pedersen, B., Iversen, M. & Dahl, R. (1990). Bronchoalveolar lavage of pig farmers. *American Journal of Industrial Medicine, 17*, 118-119.

Pedersen, S., Nonnenmann, M., Rautiainen, R., Demmers, T. G. M., Banhazi, T., & Lyngbye (2000). Dust in pig buildings. *Journal of Agricultural Safety and Health, 6*(4), 261-274.

Pender, N. J., Murdaugh, C. L, & Parsons, M. A. (2002). *Health Promotion in Nursing Practice.* Upper Saddle River, NJ: Prentice Hall.

Perkins, H. M., Crown, E. M., Rigakis, K. B., & Eggertson, B. S. (1992). Attitudes and behavioral intentions of agricultural workers toward disposable protective coveralls. *Clothing and Textiles Research Journal, 11*(1), 67-73.

Petrea, R. E. (1996). Applying the theory of planned behavior to respiratory protection use and behavior of East-Central Illinois pork producers. (Doctoral dissertation, University of Illinois at Urbana-Champaign, 1996). *Dissertation Abstracts International, 57-11A*, 4626.

Pickrell, J. A., Heber, A. J., Murphy, J. P., Henry, S. C., May, M. M., Nolan, D., Gearhart, S. K., Cederberg, B. L., Oehme, F. W., & Schoneweis, D. (1995). Total and respirable dust in swine confinement buildings: The benefit of respiratory protective masks and effect of recirculated air. *Vetinaritarn Human Toxicology*, *37*, 430-435.

Polit, D. F., & Hungler, B. P. (1999). *Nursing research: Principles and methods.* Philadelphia, PA: Lippincott, Williams, & Wilkins.

Poss, J. E. (1999). Developing an instrument to study the tuberculosis screening behaviors of Mexican migrant farmworkers. *Journal of Transcultural Nursing, 10*(4), 306-319.

Randolph, S. A., & Migliozzi, A. A. (1993). The role of the agricultural health nurse. *AAOHN Journal, 41*(9), 429-433.

Reynolds, S. J., Parker, D., Smoth, D. & Woellner, R. (1993). Cross-sectional epidemiological study of respiratory disease in turkey farmers. *American Journal of Industrial Medicine 24*, 713-722.

Rivara, F. P. (1997). Fatal and non-fatal farm injuries to children and adolescents in the United States, 1990-93. *Injury Prevention, 3*, 190-194.

Rogers, B. (2003). *Occupational and environmental health nursing*. Philadelphia: Saunders.

Rosenstock, I. M. (1974). Historical origins of the Health Belief Model. In M. H. Becker (Ed.), *The Health Belief Model and Personal Health Behavior* (pp. 1-8). Thorofore, NJ: C.B. Slack.

Schenker, M. B. (1998). Respiratory health hazards in agriculture. *American Journal of Respiratory and Critical Care Medicine, 158*(5), S1-S76.

Schlenker, E. H., Lenardson, G. R., McClain, C., Barnes, E., & Parry, R. R. (1989). The prevalence of respiratory symptoms among farmers and ranchers in southeastern South Dakota. In J. A. Dosman & D. W. Cockcroft (Eds.), *Principles of health and safety in agriculture* (pp. 85-87). Boca Raton, FL: CRC Press.

Stellman, S. D., Boffetta, P. & Garfinkel, L. (1988). Smoking habits of 800,000 American men and women in relation to their occupations. *American Journal of Industrial Medicine, 13*, 43-58.

Throne, P. S., Donham, K. J., Dosman, J., Jagielo, P., Merchant, J. A., Von Essen, S. (1995). Report of the occupational health group. *Proceedings of the Understanding the Impacts of Large Scale Swine Production: An Interdisciplinary Scientific Workshop,* Des Moines, Iowa, June 29-30, 1-41.

Tripp, R. S., Shutske, J. M., Olson, D. K., & Schermann, M. (1998). Needs assessment of employers in swine production facilities regarding employee health and safety. *Agricultural Safety and Health, 4*(4), 205-230.

United States Department of Labor. (n.d.) Bureau of Labor Statistics (BLS), *Career guide Of industries: Agriculture, forestery and fishing*. Retreived April 24, 2004, from http://www.bls.gov.oco/cg/cgs001.htm

Veneziano, L., & Hooper, J. (1997). A method of quantifying content validity of health related questionnaires. *American Journal of Health Behavior, 21*, 67-70.

Von Essen, S. G., & Donham, K. J. (1997). Respiratory diseases related to work in agriculture. In R. L. Langley, R. L. McLymore, W. J. Meggs, & G. T. Roberson (Eds.*), Safety and health in agriculture, forestry and fisheries,* (pp. 353-38). Rockville, MD: Government Institutes.

Von Essen, S. G., & Donham, K. J. (1999). Illness and injury in animal confinement workers. *Occupational Medicine: State of Art Reviews, 14*(2), 337-350.

Watson, R. D. (1986). Prevention of dust exposure. *American Journal of Industrial Medicine, 19*, 229-243.

Zejda, J. E., Hurst, T. S., Barber, E. M., Rhodes, C., & Dosman, J. A. (1993). Respiratory health status in swine producers using respiratory protective devices. *American Journal of Industrial Medicine, 23*, 743-750.

Zhou, C., Hurst, T. S., Cockcroft, D. W., & Dosman, M. D. (1991). Increased airways responsiveness in swine farmers. *Chest, 99*(4), 941-944.

Appendix A

Invitation to Recruit Study Participants at Booth

You will receive $10.00 to complete this survey!

Breathing or Respiring: I Want Your Opinion

The study is being conducted by

M. Susan Jones, MSN, RN

Doctoral Student at the University of Cincinnati

Appendix B

Invitation to Recruit Participants at Gate Entrance

You are invited to stop by the booth,

Breathing or Respirating: I Want Your Opinion,

Located in the Exhibit Hall

for the purpose of
participating in a research study designed to
learn more about the use of personal respiratory protection among
workers in swine confinement buildings.

The study is being conducted by
M. Susan Jones, MSN, RN,
Doctoral Student at the University of Cincinnati.

Following the completion of the survey, you will receive $10.00 to cover your time and effort.

Appendix C

Informed Consent Document

Project Title: A Descriptive Study of the Use of Personal Respiratory Protection among Workers in Swine Confinement Buildings

Investigator: M. Susan Jones, MSN, RN, Doctoral Student, University of Cincinnati

Before agreeing to participate in this study, it is important that the following explanation of the proposed procedures be read and understood. It describes the purpose, procedures, risks, and benefits of the study. It also describes the right to withdraw from the study at any time. It is important to understand that no guarantee or assurance can be made as to the results.

Nature and Purpose of the Project: I am a doctoral student at the University of Cincinnati. I have worked as a nurse in a variety of settings during the past 30 years; my most recent interest has been in the area of occupational nursing with an emphasis on agricultural health and safety practices. For many years, I have been interested in the respiratory health of workers in swine confinement buildings. I am particularly interested in the factors that influence workers to wear or not wear personal respiratory protection while working in swine confinement buildings. Based on prior studies, I have created a questionnaire composed of statements related to these factors. The questionnaire also asks some basic questions to describe you, your work history and respiratory health history, and your use of personal respiratory protection at the worksite.

You, along with other individuals attending your annual meeting of pork producers, have been recruited to participate in this study. Completion of this questionnaire will assist health care providers to better understand the work environment of workers in swine confinement buildings and their choices regarding the use of respiratory protection. Completion of the questionnaire should take approximately 45 minutes of your time. Your involvement with the study will conclude with the completion of the questionnaire. The project will last approximately six months and be finalized by July 2003.

Explanation of Procedures: You, along with others attending the annual convention of pork producers in your state, have been recruited to visit this booth through an announcement placed in your registration packet. Upon arriving at this booth, the investigator, Mrs. Jones, will ask you three questions to determine if you meet the inclusion criteria for the study (18 years of age, a worker in a swine confinement building, and can read and write English.) If the inclusion criteria are met, you will be given this Informed Consent document to read. After reading this document, you may notify Mrs. Jones if you wish to complete the questionnaire. The site for data collection will be walled or curtained to separate the area from the activities in the exhibit hall. You will be seated at an individual small table or requested to use alternative seating. You will also be requested to complete the questionnaire without any discussion of the topics with other participants.

Statement of Remuneration for the Participants: There is no compensation for completing the questionnaire. However, people completing the questionnaire will receive $10.00 for their time and effort. For tracking purposes only, you will be asked to sign a sheet indicating you have received

the $10.00 for participating in the research study. This signature will in no way be linked to the questionnaires or data collection sites.

Discomforts and Risks: Participation in the study requires that each participant complete a questionnaire independently in a familiar setting. As such, participation poses only minor discomfort to the participants such as inconvenience, the use of personal time, and/or increased awareness/concern about respiratory health. You have the option of withdrawing from the study at any time without fear of penalty. If participation in the study causes unusual concern about respiratory health, please inform the investigator, Mrs. Jones. A referral to a health care provider can be made at your expense.

Benefits: This research has no direct benefit to you; but participants, by the act of completing the questionnaire, may examine their own health practices in regard to use of personal respiratory protection at the worksite. Future workers and health care providers may benefit through better understanding of the factors that contribute to the use of personal respiratory protection by workers in swine confinement buildings.

Confidentiality/Security and Disposition of Data: All data will be anonymous. No names will be recorded on the survey instrument or the questionnaire. The questionnaire will be coded to identify the state where the questionnaire is completed, but no personal identifier will be associated with the code. All completed questionnaires will be placed and kept in a secure file container, and no one but the investigator will have access to the file. Participants desiring to receive results of the study should record their name, along with contact information, on the sheet attached to the end of the questionnaire. Upon completion of the questionnaire, this sheet will be separated from the questionnaire and placed in a separate box. You can be assured that this information will be destroyed immediately after the mailing of the results of this study.

Refusal/Withdrawal: Your participation is voluntary, and you may withdraw at any time and for any reason during the study. There is no penalty for not participating or for withdrawing.

If you have any questions about this study, or about research workers' rights, please contact M. Susan Jones, Doctoral Student, University of Cincinnati, at 270-745-3213, or e-mail me at susan.jones@wku.edu. Furthermore, should you have any questions about the nature of this study, you may contact my Dissertation Chair, Donna Gates, EdD, RN, at 513-558-3793. If you choose to send mail to her, the address is: University of Cincinnati, Proctor Hall-Room 211, PO Box 210038, Cincinnati, Ohio 45221. You may also contact the Chairperson of the University of Cincinnati Institutional Review Board—Social and Behavioral Sciences at 513-558-5784.

Completion of the questionnaire indicates your consent to voluntary participation in this pilot study for the research activity: *A Descriptive Study of the Use of Personal Respiratory Protection among Workers in Swine Confinement Buildings*.

Appendix D

Instrument

_____
State

Respiratory Survey of Workers in Swine Confinement Buildings

Completing this questionnaire indicates my consent to participate in this study. My responses are anonymous meaning my name is not associated with this survey.

Directions:

This questionnaire is divided into 5 sections. This first section is composed of questions that describe you. The second section includes questions related to your work history in pork production. The third section is composed of questions related to your use of personal respiratory protection. The fourth section is composed of questions related to your respiratory health. The last section is composed of statements related to your beliefs about using personal respiratory protection.

Please check the box that represents the most appropriate response, or fill in the blank where indicated.

Section I: Demographic Information:

1. Sex □ Male □ Female

2. Race □ American Indian/Eskimo □ Asian/Pacific Islander □ Black
□ Hispanic □ White □ Other

3. Age in Years? _____

4. Marital Status □ Single □ Married □ Separated □ Divorced □ Widowed □ Other

5. Highest Level of Education Completed (Check one.)

- □ No formal education
- □ Some grade school education
- □ Some high school education
- □ High school diploma or GED
- □ Vocational degree
- □ Two-year college degree (Associate)
- □ Some four-year college education
- □ Four-year college degree (Bachelors)
- □ Master's degree or equivalent
- □ PhD degree or equivalent

Section II: Work History

6. Which group best describes your role in pork production?

(Check ALL that apply.)

- □ Principal owner of swine farm
- □ Principal operator of swine farm
- □ Paid employee working on a swine farm
- □ Family member of swine farm's principal owner or operator who works on swine farm
- □ Other_____

7. Which of the following best describes the annual production of pigs on the farm where you live or work? (Check one.)

- □ Produced under 1,000 pigs
- □ Produced 1,001-2,000 pigs
- □ Produced 2,001-3,000 pigs
- □ Produced 3,001-4,000 pigs
- □ Produced 4,001-5,000 pigs
- □ Produced 5,001-10,000 pigs
- □ Produced OVER 10,000 pigs

8. On the average during the past year, how many individuals, excluding family members, were employed on the farm where you live or work? (Check one.)

- □ None
- □ 1-5 employees
- □ 6 -11 employees
- □ More than 11 employees

9. On the average during the past year, how many family members were employed on the farm where you live or work? (Check one.)

- □ None
- □ 1-5 employees
- □ 6 -11 employees
- □ More than 11 employees

10. Which of the following units best describes your current worksite on the swine farm? (Select ALL that apply.)

- □ Farrowing Unit
- □ Breeding/Gestation Unit
- □ Nursery Unit
- □ Feed Mill Unit
- □ Grow/Finish Unit
- □ Work in all the above units

11. How many years have you worked in swine confinement buildings?

- □ Less than 1 Year
- □ 10-11 Years
- □ 1-3 Years
- □ 12-13 Years
- □ 4-5 Years
- □ 14-15 Years

- □ 6-7 Years
- □ 8-9 Years
- □ More than 15 Years

12. On the average, how many days per week do you work in swine confinement buildings?

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7

13. On the average, how many hours per day do you spend in swine confinement buildings?

- □ Less Than 1 Hour
- □ 1-2 Hours
- □ 3-4 Hours
- □ 5-6 Hours
- □ 7-8 Hours
- □ 9-10 Hours
- □ 11-12 Hours
- □ More than 12 Hours

14. On the average, how many hours per week do you spend in swine confinement buildings?

- □ 0-10 Hours
- □ 11-20 Hours
- □ 21-30 Hours
- □ 31-40 Hours
- □ 41- 50 Hours
- □ 51-60 Hours
- □ More than 60 Hours

Section III: Self-Reported Use of Personal Respiratory Protection

(Check the box that represents the most appropriate response, or fill in the blank where indicated.)

For the purpose of this study, personal respiratory protection is defined as any device you chose to place over your nose and mouth for the purpose of preventing particles in the air from entering the respiratory tract.

15. On the average during the past year, how often did you wear personal respiratory protection when working in swine confinement buildings?

- □ Never ((0% of the time) **(If never, skip to Question 18.)**
- □ Seldom (1-5% of time)
- □ Sometimes (6-25% of the time)
- □ Often (26-50% of the time)
- □ Very Often (51-75% of the time)
- □ Most Always (76%-99% of the time)
- □ Always (100% of the time)

16. How many years have you been wearing personal respiratory protection?
_____ (Number in years)
17. If you used personal respiratory protection during the past year, which of the following best describes the type worn?

- □ One strap dust mask
- □ NIOSH approved two-strap disposable dust masks
- □ Half mask with replaceable cartridges
- □ Full-face mask with replaceable cartridges
- □ Piece of fabric covering the face
- □ Not applicable, did not wear respiratory protection
- □ Wore something else for protection (Please explain_____
_____

18. Have you received information about any of the following topics? (Please select ALL that apply.)

- □ Health risks associated with working in swine confinement buildings
- □ Ways to select the best personal respiratory protective device
- □ Ways to take care of personal respiratory protective devices
- □ How to select the right size when purchasing a personal respiratory protective device
- □ Conditions or habits that can cause breathing problems when wearing personal respiratory protective devices

19. Where do you get information about your personal respiratory protection device? (Please select ALL that apply).

- ☐ Spouse
- ☐ Employer
- ☐ Health care provider (physician, nurse, etc.)
- ☐ Local Extension Office
- ☐ State Pork Producers Association
- ☐ Other_____
- ☐ National Pork Board
- ☐ National Pork Publication
- ☐ Farming magazines
- ☐ Mail order catalog
- ☐ Never received information

Section IV: Respiratory Health History

(Please read and answer the following questions by circling "yes" or "no."

20. Have you ever had a breathing problem that you think was related to farming activities?	**Yes**	**No**
21. Have you ever had flu-like symptoms (fever, shivering, cough, tiredness, weakness, muscle and joint pain) associated with working in swine confinement buildings?	**Yes**	**No**
22. Have you ever been told by your physician that you have bronchitis, asthma, or emphysema?	**Yes**	**No**
23. Do you take any breathing medication (pills or use inhalers)?	**Yes**	**No**
24. Do you use smokeless tobacco?	**Yes**	**No**
25. Do you smoke cigarettes?	**Yes**	**No**
26. Do you know of a co-worker or family member who became ill from not wearing personal respiratory protection when working in swine confinement buildings?	**Yes**	**No**

Section V: Beliefs About Respiratory Protective Equipment

This last section is made up of 4 parts. There are no right or wrong answers. Please be completely honest with your responses. Carefully read the directions for each part and statement before circling the number which best describes your answer.

Part I

Directions:

On a scale of 1 to 5, with 1 being " not at all" and 5 being to a "very great extent", rate the extent to which the following statements describe your beliefs about wearing personal respiratory protection when working in swine confinement buildings.

	Not At All	Slight Extent	Moderate Extent	Great Extent	Very Great Extent
1. Personal respiratory protection protects my lungs while working.	1	2	3	4	5
2. Wearing personal respiratory protection now protects my health in the future.	1	2	3	4	5
3. Wearing personal respiratory protection now influences my ability to work in the future.	1	2	3	4	5
4. Wearing personal respiratory protection decreases my chances of having respiratory symptoms such as cough and chest tightness.	1	2	3	4	5
5. Wearing personal respiratory protection makes me feel like I am smothering.	1	2	3	4	5
6. Wearing personal respiratory protection makes the air smell bad.	1	2	3	4	5
7. Wearing personal respiratory protection interferes with my vision.	1	2	3	4	5
8. Wearing personal respiratory protection causes me to get hot.	1	2	3	4	5
9. Wearing personal respiratory protection causes me discomfort.	1	2	3	4	5
10. Personal respiratory protection equipment costs me too much to buy.	1	2	3	4	5
11. Personal respiratory protection equipment is conveniently located at my worksite.	1	2	3	4	5

12. Personal respiratory protection equipment is located at businesses that make it easy to purchase.	1	2	3	4	5
13. Wearing personal respiratory protection makes breathing more difficult.	1	2	3	4	5
14. Wearing personal respiratory protection interferes with my ability to do my job.	1	2	3	4	5
15. Wearing personal respiratory protection takes too much time.	1	2	3	4	5
16. There is no good place to store my personal respiratory protection equipment at work.	1	2	3	4	5
17. I don't know how to correctly use personal respiratory protection equipment.	1	2	3	4	5
18. I don't know why I should use personal respiratory protection when working.	1	2	3	4	5

If the following statements do not apply to you, select Not Applicable. For example, if you do not wear glasses, please mark not applicable for item 19.

	Not At All	Slight Extent	Moderate Extent	Great Extent	Very Great Extent	NA
19. Wearing personal respiratory protection makes my eyeglasses fog.	1	2	3	4	5	6
20. Wearing personal respiratory protection interferes with my smoking habit.	1	2	3	4	5	6
21. Wearing personal respiratory protection interferes with my chewing tobacco.	1	2	3	4	5	6

Part II

Directions:

On a scale of 1 to 5, with 1 being "not at all" and 5 being "to a very great extent," rate the extent to which the following statements describe your beliefs.

	Not At All	Slight Extent	Moderate Extent	Great Extent	Very Great Extent
22. It is likely that I will develop lung damage from working in swine confinement buildings.	1	2	3	4	5
23. I am more likely to develop lung disease (asthma, bronchitis, emphysema) than workers who do not work in swine confinement buildings.	1	2	3	4	5
24. I am more likely to get a lung infection such as pneumonia than workers who do not work in swine confinement buildings.	1	2	3	4	5
25. I am more likely to wear personal respiratory when I do chores that cause more dust such as moving and loading pigs.	1	2	3	4	5

Part III

Directions:

How would a serious lung problem affect your life? On a scale of 1 to 5, with 1 being "not at all" and 5 being to a "very great extent", circle the number that best describes the extent a serious lung problem would affect your life.

	Not At All	Slight Extent	Moderate Extent	Great Extent	Very Great Extent
26. My finances	1	2	3	4	5
27. My ability to continue working in swine confinement buildings.	1	2	3	4	5
28. My ability to continue my activities of daily living.	1	2	3	4	5
29. My family.	1	2	3	4	5

Part IV

Directions: On a scale of 1 to 5, with 1 being "not at all" and 5 being to a "very great extent," circle the number that describes to what extent the following statements describe your current work situation. If the statement does not apply to you, select Not Applicable. For example, if you do not have co-workers, please mark not applicable for item 34.

	Not At All	Slight Extent	Moderate Extent	Great Extent	Very Great Extent	N/A
30. Being exposed to dust is part of working on a farm.	1	2	3	4	5	6
31. My family encourages me to wear personal respiratory protection when working.	1	2	3	4	5	6
32. My boss (supervisor) encourages me to wear personal respiratory protection when working.	1	2	3	4	5	6
33. Occupational Safety and Health Administration (OSHA) influences my use of personal respiratory protection when working.	1	2	3	4	5	6
34. My coworkers wear personal respiratory protection when working.	1	2	3	4	5	6
35. My coworkers encourage me to wear personal respiratory protection when working.	1	2	3	4	5	6
36. My boss (supervisor) wears personal respiratory protection when working.	1	2	3	4	5	6
37. I am more likely to wear personal respiratory protection when my family members remind me to do so.	1	2	3	4	5	6
38. I am more likely to wear personal respiratory protection when my boss (supervisor) reminds me to do so.	1	2	3	4	5	6

In the space below and on the back of this questionnaire, please provide any comments that you have related to specific concepts included in the scale and the subscale items, specific concepts or subscale items you believe are omitted from the tool, the time required to complete the scale, the clarity of the statements, the design of the format, and the ease of administration. Your participation in this study is appreciated. Please return this questionnaire in the enclosed self-addressed, stamped envelope.

Appendix E

Code Sheet for Data

Columns	Variable(s)	Value
Section I		
2	State	01-30…. See sheet of states
1	Sex	1 or 2
1	Rac	1-6
2	Age	18-99
1	Mar	1-6
2	Edu	01-10
Section II		
5	Role	1-5 or any combination of the 5
1	Prod	1-7
1	Emp	1-4
1	Fam	1-4
6	Unit	1-6 or any combination of the 6
1	Yrs	1-9
1	Dwk	1-7
1	HrD	1-8
1	HrWk	1-7
Section III		
1	RP	1-7
2	YRP	00-99
1	TRP	1-7
5	Inf	1-5 or any combination of the 5
12	Sou	1-12 or any combination of the 12
Section IV		
1	BP	1-2
1	Flu	1-2
1	MDD	1-2
1	Med	1-2
1	Stob	1-2
1	Cig	1-2
1	CFI	1-2
Section V		

Part I		
1	BeRP	1-5
1	BeNo	1-5
1	BeAb	1-5
1	BeSx	1-5
1	BaSm	1-5
1	BaAi	1-5
1	BaVi	1-5
1	BaHo	1-5
1	BaDi	1-5
1	BaCo	1-5
1	BaCon	1-5
1	BaEa	1-5
1	BaDif	1-5
1	BaJo	1-5
1	BaTi	1-5
1	BaSt	1-5
1	BaEd	1-5
1	BaKn	1-5
1	BaEy	1-6
1	BaSm	1-6
1	BaCT	1-6
Part II		
1	SuLD	1-5
1	SuDis	1-5
1	SuInf	1-5
1	SuCh	1-5
Part III		
1	SeFin	1-5
1	SeWo	1-5
1	SeAD	1-5
1	SeFa	1-5
Part IV		
1	NoEx	1-5
1	NoFa	1-6
1	NoBo	1-6
1	NoOS	1-6
1	NoCW	1-6
1	NoCWE	1-6
1	NoBoW	1-6
1	NoFaR	1-6
1	NoBoR	1-6

Appendix F

Code Names for Data

0	Stat	State
Section I		
1	Sex	Gender
2	Rac	Race
3	Age	Age
4	Mar	Marital Status
5	Edu	Highest Education Completed
Section II		
6	Role	Role in Pork Production
7	Prod	Annual Production of Pigs
8	Emp	Employees on farm, excluding family members
9	Fam	Family members employed on farm
10	Unit	Type of work unit
11	Yrs	Years worked in SCB
12	Dwk	Days/ wk worked in SCB
13	HrD	Hours/day worked in SCB
14	HrWk	Hours/week worked in SCB
Section III		
15	RP	Use of PRP
16	YRP	Years wearing PRP
17	TRP	Type of PRP worn
18	Inf	Type information re: PRP received
19	Sou	Source of information re: PRP
Section IV		
20	BP	Breathing problem
21	Flu	Experienced flu like sx
22	MDD	Physician diagnosis of respiratory disease
23	Med	Taking/using respiratory medication
24	Stob	Smokeless tobacco use
25	Cig	Cigarette use
26	CFI	Coworker/family member respiratory illnesses

Section V

Part I

1	BeRP	Benefit: Respiratory Protection
2	BeNo	Benefit: Wearing now protects health
3	BeAb	Benefit: Ability to do work
4	BeSx	Benefit: Decreasing respiratory symptoms
5	BaSm	Barrier: Causes smoothing
6	BaAi	Barrier: Causes unpleasant odor
7	BaVi	Barrier: Interferes with vision
8	BaHo	Barrier: Causes heat
9	BaDi	Barrier: Causes discomfort
10	BaCo	Barrier: Cost too much
11	BaCon	Barrier: Not conveniently located
12	BaEa	Barrier: Not easily located
13	BaDif	Barrier: Makes breathing more difficult
14	BaJo	Barrier: Interferes with doing job
15	BaTi	Barrier: Requires too much time
16	BaSt	Barrier: No good storage place
17	BaEd	Barrier: No education in use
18	BaKn	Barrier: No knowledge in use
19	BaEy	Barrier: Makes eyeglasses fog
20	BaSm	Barrier: Interferes with smoking
21	BaCT	Barrier: Interferes with chewing tobacco

Part II

22	SuLD	Susceptibility: Likely to develop lung damage
23	SuDis	Susceptibility: Likely to develop lung disease
24	SuInf	Susceptibility: Likely to develop lung infection
25	SuCh	Susceptibility: Likely to wear PRP with certain chores

Part III

26	SeFin	Severity: Impact of finances
27	SeWo	Severity: Impact on working
28	SeAD	Severity: Impact on ADL
29	SeFa	Severity: Impact on Family

Part IV

30	NoEx	Norms: Dust exposure part of work
31	NoFa	Norms: Family encourages use of PRP
32	NoBo	Norms: Boss encourages use of PRP
33	NoOS	Norms: OSHA encourages use of PRP
34	NoCW	Norms: Coworkers wear PRP
35	NoCW E	Norms: Coworkers encourages use of PRP
36	NoBoW	Norms: Boss wears PRP
37	NoFaR	Norms: Family reminders
38	NoBoR	Norms: Boss reminders

Appendix G

Original Items on Personal Respiratory Protection Survey

Benefits

1. The best way to protect my lungs is to wear personal respiratory protection when working in swine confinement buildings.
2. Wearing personal respiratory protection is one of the best ways to maintain my ability to work.
3. Wearing personal respiratory protection now will benefit my health in the future.
4. Wearing personal respiratory protection will decrease my chance of having respiratory symptoms such as coughs and chest tightness.

Barriers

5. Wearing personal protection interferes with my vision.
6. Wearing personal protection is hot when I am working.
7. Wearing personal respiratory protection is uncomfortable.
8. Wearing personal respiratory protection makes my eyeglasses fog.
9. Personal respiratory protection devices cost too much to use.
10. Personal respiratory protection devices are not easily accessible at my work site.
11. It is easy for me to purchase personal respiratory protection devices.
12. It is difficult for me to keep personal respiratory protection devices at the worksite.
13. Using personal respiratory protection makes breathing more difficult when working.
14. Using personal respiratory protection interferes with my performance at work.
15. It takes too much time to put on and take off personal respiratory protection.
16. There is no good place to store personal respiratory protection devices at the work site.
17. I have never been taught how to use personal respiratory protection.
18. I have never been taught the importance of using personal respiratory protection at the work site.

Susceptibility

19. It is likely that I will develop lung damage from working in swine confinement buildings.
20. I am more likely to develop lung damage than workers who do not work in swine confinement buildings.
21. I am more likely to get a lung infection such as pneumonia than workers who do not work in swine confinement buildings.
22. I am more likely to get bronchitis or asthma than workers who do not work in swine confinement buildings.
23. I wear personal respiratory protection when I perform certain chores such as moving pigs, loading pigs and cleaning the swine confinement building.

Severity

24. If I had a serious lung problem, I'd face a major financial hardship.
25. If I had a lung problem it would affect my ability to work in my current job in a swine confinement building.
26. If I had a lung problem, it would interfere with my activities of daily living.
27. If I had a lung problem it would cause serious stress on my family.
28. If I developed a respiratory problem (cough, sputum production or shortness of breath) that lasted longer than a year, I would consider changing occupations.

Norms

29. Being exposed to dust is just part of working on a farm.
30. Members of my family think I should wear personal respiratory protection when working in swine confinement buildings.
31. My boss (supervisor) thinks I should wear personal respiratory protection when working in swine confinement buildings.
32. Occupational Safety and Health Administration (OSHA) expects me to wear personal respiratory protection when working in swine confinement buildings.
33. My coworkers don't think it is important to wear personal respiratory protection when working in swine confinement buildings.
34. My coworkers wear personal respiratory protection when working in swine confinement buildings.
35. My boss (supervisor) wears personal respiratory protection when working in swine confinement buildings.
36. I am more likely to wear personal respiratory protection when my family members remind me to do so.
37. I am more likely to wear personal respiratory protection when my boss (supervisor) reminds me to do so.

Appendix H

Cover Letter to Expert Panel

Dear {name}

I am writing to enlist your expertise in a research study on the use of personal respiratory protection by workers in swine confinement buildings. I am a doctoral student at the University of Cincinnati. I have worked as a nurse in a variety of settings during the past 30 years; my most recent interest has been in the area of occupational nursing with an emphasis on agricultural health and safety practices.

I invite you to serve as an expert reviewer for the Personal Respiratory Protection Scale (PRPS). You have been selected for the expert panel based on your known interest and expertise in promoting the occupational health of workers in swine confinement buildings. While there is no compensation for your participation, your involvement will contribute to establishing a valid tool that may be used by health professionals engaged in occupational practice and research.

Participation in the validity testing of the PRPS requires approximately one hour of your time. There is no risk associated with your participation, and you are assured confidentiality. Your return of the completed questionnaire indicates your consent to participate in this study.

Enclosed you will find a copy of the PRPS and a brief description of the instrument. First, please review this information. Next, complete the enclosed Validity Questionnaire for the PRPS. Lastly, return the questionnaire to me using the self-addressed stamped envelope.

Please call me collect (270-745-3213) if you have any questions about the procedure or any comments. I can also be reached by e-mail at susan.jones@wku.edu. Should you have any questions about the nature of this study you may contact my Dissertation Chair, Donna Gates, EdD, RN, at 513-558-3793. If you choose to send mail to her, the address is: University of Cincinnati, Proctor Hall- Room 211, PO Box 210038, Cincinnati, Ohio 45221.You may also contact the chairperson of the University of Cincinnati Institutional Review Board—Social and Behavioral Sciences at 513-558-5784.

Your expert review of this instrument will assist not only my research efforts, but also the efforts of others who are engaged in occupational health research in the agricultural arena. Furthermore, the PRPS may serve as the beginning foundation for the development of survey tools to be used with other workers in a variety of occupational settings. Your participation in the validity testing of the PRPS is greatly appreciated.

Sincerely,

M. Susan Jones, MSN, RN
Doctoral Candidate
Address: 1009 Homestead Court, Bowling Green, KY 42104

Appendix I

Validity Questionnaire for the Personal Respiratory Protection Survey (PRPS)

Sent to Expert Panel

Each item used in the PRPS is listed below. You are asked to evaluate the relevance of each item as a specific measure of the concepts included in the blueprint of the PRPS. You are asked to evaluate each item on a scale of 1 to 5. A score of 1 indicates the item is not relevant at all. A score of 5 indicates that the item is very relevant. Indicate your response by circling the appropriate number.

For the purpose of this study, a definition of each concept is provided.

Personal Respiratory Protection is defined as any device placed over the nose and mouth for the purpose of preventing particles in the air from entering the respiratory tract.

Benefits are defined as the perceived belief by workers that wearing personal respiratory protection while working in swine confinement buildings can reduce threats to their respiratory health.

Barriers are defined as the perceived belief by workers that wearing personal respiratory protection while working in swine confinement buildings will result in negative consequences (i.e. discomfort, loss of time).

Susceptibility is defined as the perceived belief of workers that working in swine confinement buildings poses a threat to their respiratory health.

Severity is defined as the perceived belief by workers regarding the impact (i.e. physical, emotional and financial) of a respiratory illness from working in Swine confinement buildings.

Norms are defined as the perceptions of the workers of the social pressures and the influence of these pressures to either wear or not wear personal respiratory protection when working in swine confinement buildings.

	Benefits: **Benefits are defined as the perceived belief by workers that wearing personal respiratory protection while working in swine confinement buildings can reduce threats to their respiratory health.**	**Not Relevant**				**Very Relevant**
1.	The best way to protect my lungs is to wear personal respiratory protection when working in swine confinement buildings.	1	2	3	4	5
2.	Wearing personal respiratory protection is one of the best ways to maintain my ability to work.	1	2	3	4	5
3.	Wearing personal respiratory protection now will benefit my health in the future.	1	2	3	4	5
4.	Wearing personal respiratory protection will decrease my chance of having respiratory symptoms such as coughs and chest tightness.	1	2	3	4	5
	Barriers: **Barriers are defined as the perceived belief by workers that wearing personal respiratory protection while working in swine confinement buildings will result in negative consequences (i.e. discomfort, loss of time).**					
5.	Wearing personal respiratory protection interferes with my vision.	1	2	3	4	5

		Not Relevant				**Very Relevant**
6.	Wearing personal respiratory protection is hot when I am working.	1	2	3	4	5
7.	Wearing personal respiratory protection is uncomfortable.	1	2	3	4	5
8.	Wearing personal respiratory protection makes my eyeglasses fog.	1	2	3	4	5
9.	Personal respiratory protection devices cost too much to use.	1	2	3	4	5
10.	Personal respiratory protection devices are not easily accessible at my work site.	1	2	3	4	5
11.	It is easy for me to purchase personal respiratory protection devices.	1	2	3	4	5
12.	It is difficult for me to keep personal respiratory protection devices at the worksite.	1	2	3	4	5
13.	Using personal respiratory protection makes breathing more difficult when working.	1	2	3	4	5
14.	Using personal respiratory protection interferes with my performance at work	1	2	3	4	5
15.	It takes too much time to put on and take off personal respiratory protection.	1	2	3	4	5
16.	There is no good place to store personal respiratory protection devices at the work site.	1	2	3	4	5

		Not Relevant				Very Relevant
17.	I have never been taught how to use personal respiratory protection.	1	2	3	4	5
18.	I have never been taught the importance of using personal respiratory protection at the work site.	1	2	3	4	5
	Susceptibility: **Susceptibility is defined as the perceived belief by workers that working in swine confinement buildings poses a threat to their respiratory health.**					
19.	It is likely that I will develop lung damage from working in swine confinement buildings.	1	2	3	4	5
20.	I am more likely to develop lung damage than workers who do not work in swine confinement buildings.	1	2	3	4	5
21.	I am more likely to get a lung infection such as pneumonia than workers who do not work in swine confinement buildings.	1	2	3	4	5
22.	I am more likely to get bronchitis or asthma than workers who do not work in swine confinement buildings.	1	2	3	4	5
23.	I wear personal respiratory protection when I perform certain chores such as moving pigs, loading pigs and cleaning the swine confinement building.	1	2	3	4	5

	Severity: **Severity is defined as the perceived belief by workers regarding the impact (i.e. physical, emotional and financial) of a respiratory illness from working in swine confinement buildings.**	**Not Relevant**				**Very Relevant**
24.	If I had a serious lung problem, I'd face a major financial hardship.	1	2	3	4	5
25.	If I had a lung problem it would affect my ability to work in my current job in a swine confinement building.	1	2	3	4	5
26.	If I had a lung problem, it would interfere with my activities of daily living.	1	2	3	4	5
27.	If I had a lung problem it would cause serious stress on my family.	1	2	3	4	5
28.	If I developed a respiratory problem (cough, sputum production or shortness of breath) that lasted longer than a year, I would consider changing occupations.	1	2	3	4	5
	Norms: **Norms are defined as the perceptions of the workers of the social pressures and the influence of these pressures to either wear or not wear personal respiratory protection when working in swine confinement buildings.**					
29.	Being exposed to dust is just part of working on a farm.	1	2	3	4	5

		Not Relevant				Very Relevant
30.	Members of my family think I should wear personal respiratory protection when working in swine confinement buildings.	1	2	3	4	5
31.	My boss (supervisor) thinks I should wear personal respiratory protection when working in swine confinement buildings.	1	2	3	4	5
32.	Occupational Safety and Health Administration (OSHA) expects me to wear personal respiratory protection when working in swine confinement buildings.	1	2	3	4	5
33.	My coworkers don't think it is important to wear personal respiratory protection when working in swine confinement buildings.	1	2	3	4	5
34.	My coworkers wear personal respiratory protection when working in swine confinement buildings.	1	2	3	4	5
35.	My boss (supervisor) wears personal respiratory protection when working in swine confinement buildings.	1	2	3	4	5
36.	I am more likely to wear personal respiratory protection when my family members remind me to do so.	1	2	3	4	5
37.	I am more likely to wear personal respiratory protection when my boss (supervisor) reminds me to do so.	1	2	3	4	5

In the space below and on the back of this questionnaire, please provide any comments that you have related to specific concepts included in the scale and the subscale items, specific concepts or subscale items you believe are omitted from the tool, the time required to complete the scale, the clarity of the statements, the design of the format, and the ease of administration. Your participation in this study is appreciated. Please return this questionnaire in the enclosed self-addressed, stamped envelope.

Appendix J

Content Validity Indices for Each Item and Scale of the Personal Respiratory Protection Scale Measured first as a Global Relevance then as Specific Relevance for a Concept (n=7)

Item	Indices	
	Scale	Item
Benefit	.81	
1. best way to protect lungs		.86
2. best way to maintain ability to work		.57
3. way to protect future health		.82
4. way to decrease respiratory symptoms		1.00
Barrier	.71	
5. interferes with vision		.61
6. uncomfortable due to heat		.86
7. wearing is uncomfortable		.82
8. makes eyeglasses fog		.93
9. cost too much		.71
10. not easily accessible		.75
11. easy to purchase		.68
12. difficult to keep at worksite		.61
13. makes breathing more difficult		.86
14. interferes with performance at work		.67*
15. takes too much time		.43
16. no good place to store		.54
17. never been taught to use		.71
18. never been taught the importance		.71
Susceptibility	.69	
19. likely to develop lung damage		.75
20. more likely to develop lung damage than other workers		.79
21. more likely to develop lung infection		.61
22. more likely to develop bronchitis/asthma		.75
23. more likely to wear with certain chores		.54*
Severity	.79	
24. lung problem would cause financial hardship		.86
25. lung problem would affect current work		.93
26. lung problem would interfere with ADL		.75

27. lung problem would cause family stress		.68
28. lung problem would lead to change in occupation		.75
Norms	.77	
29. expose to dust part of farm life		.75
30. family members encourages use of PRP		.89
31. boss encourages use of PRP		.79
32. OSHA expects use of PRP		.57
33. coworkers do not encourage use of PRP		.68
34. coworkers use PRP		.82
35. boss uses PRP		.86
36. more likely to wear PRP with family reminder		.71
37. more likely to wear PRP when boss reminds me		.82

Appendix K

Disposition of Each Original Item Based on Feedback from Expert Panel Members Completing Validity Questionnaire for the PRPS

Original Item #	Content Validity Index Score	Disposition of Items with Rationale
1	.86	Reworded: e.g., deleted qualifying word *best*
2	.57	Reordered to # 3 capturing *health* before *work* Reworded to establish present/future tense
3	.82	Reordered to #2 capturing *health* before *work* Changed word *benefits* to *protects*
4	1.00	Editorial change, deleted (s) from word cough
5	.61	No change
6	.86	Reworded: added c*auses me to* get hot
7	.82	Editorial change: *added causes me* discomfort
8	.93	Reordered: placed in non-applicable section
9	.71	Editorial change: changed *use* to *buy*
10	.75	Editorial change: changed *easily accessible* to *conveniently located*
11	.68	Rewrote to clarify intent of item about purchasing
12	.61	Deleted: determined to be same as #16
13	.86	Editorial change: deleted phrase *while working* and changed *using* to *wearing*
14*	.67	Editorial changes: *Using* to *wearing* and *performance at work* to *ability to do my job*
15	.43	Reworded to improve clarity
16	.54	Combined with #12. Deleted *site* from *work* and changed *devices* to *equipment*
17	.71	Reworded: changed *never been taught* to *don't know how to correctly use*
18	.71	Reworded: *never been taught the importance* to *don't know why I should use*
19	.75	No change
20	.79	Reworded: changed *lung diseases (asthma, bronchitis, emphysema* for *lung damage*
21	.61	No change
22	.75	Deleted: Concepts incorporated into #20
23	.54	Reordered phases to clarify; content unchanged
24	.86	Item shortened to two words to avoid forcing responses to the right
25	.93	Item changed to one phrase to avoid forcing responses to the

		right
26	.75	Item changed to one phrase to avoid forcing responses to the right
27	.68	Item shortened to two words to avoid forcing responses to the right
28	.75	Deleted: concept incorporated into #27
29	.75	Editorial change: deleted word *just*
30	.89	Editorial changes: substituted *encourages me for thinks I should*
31	.79	Editorial changes: substituted *encourages me* for *thinks I should*
32	.57	Editorial changes: *OSHA influences…*for *expects me to wear*
33	.68	Reworded: changed from *co-workers don't think it important* to co-workers *encourage use of PRP*
34	.82	Editorial change: deleted *swine confinement building*
35	.86	Editorial change: deleted *swine confinement building*
36	.71	No change
37	.82	No change

Appendix L

Invitation Sent to Workers to Establish Content Validity

You are invited to participate in a pilot research study
@ Time, Date, & Place
TBA

for the purpose of soliciting your input into a questionnaire designed to

learn more about the use of personal respiratory protection of workers in swine buildings.

This pilot study is part of a larger research study conducted by

Susan Jones, a doctoral student at the University of Cincinnati.

Following a meal, the completion of the evaluation of the questionnaire will take approximately 30 minutes.

If you desire to participate after reading the enclosed informed consent form, please sign the form and return to Susan Jones in the enclosed envelope.

Appendix M

Consent and Information Letter for Workers
Phase 2: Content Validity

University of Cincinnati
College of Nursing

Project Title: A Descriptive Study of the Use of Personal Respiratory Protection among Workers in Swine Confinement Buildings

Investigator: M. Susan Jones, MSN, RN, Doctoral Student, University of Cincinnati
Before agreeing to participate in this study, it is important that the following explanation of the proposed procedures be read and understood. It describes the purpose, procedures, risks, and benefits of the study. It also describes the right to withdraw from the study at any time. It is important to understand that no guarantee or assurance can be made as to the results.

If you decide to participate in this pilot study, please sign on the back page of this form and return the form in the enclosed envelope.

Nature and Purpose of the Project: I am a doctoral student at the University of Cincinnati. I have worked as a nurse in a variety of settings during the past 30 years; my most recent interest has been in the area of occupational nursing with an emphasis on agricultural health and safety practices. For many years, I have been interested in the respiratory health of workers in swine confinement buildings. I am particularly interested in the factors that influence workers to wear or not wear personal respiratory protection while working in swine confinement buildings. Based on prior studies, I have created a survey instrument composed of statements related to these factors. The survey instrument also asks some basic questions to describe the worker in swine confinement buildings in regard to their respiratory health and practices at the worksite. I am asking you to participate in this pilot study designed to evaluate the survey instrument.

You, along with five other individuals, have been selected for participation in this pilot study because you work in swine confinement buildings, are over the age of 18, and can read and write English. The development of this survey instrument will assist health care providers to better understand the choices of workers in swine confinement buildings regarding their use of personal respiratory protection. Your participation in this pilot study will conclude with the evaluation of the survey instrument. Once you complete the pilot test phase of the study and I revise the survey instrument (if necessary) based on your input, the survey instrument will be given to at least100 workers attending the annual Pork Producer's Association meetings in the states of Iowa, Kentucky, and Tennessee.

Explanation of Procedures: You, along with five other workers in swine confinement buildings, will be invited to attend a dinner meeting for the purpose of evaluating a survey instrument. Following a light meal, each worker will be given a copy of the survey

instrument to review along with a questionnaire to complete. This questionnaire will allow you to provide feedback about the format, wording, and ease of completing the survey instrument. The information obtained from you will be used to refine the survey instrument if needed. If no changes are needed, the six questionnaires will be included in the data pool for the next part of the study. The return of a signed consent form will indicate your willingness to participate in this study and will be used to plan the dinner meeting.

Discomforts and Risks: This pilot study entails participation in a group meeting for the purpose of reacting to and giving feedback to a survey instrument in a setting familiar to each invited participant. As such, participation poses only minor discomfort to the participants such as inconvenience, the use of personal time, and/or increased awareness/concern about respiratory health. You have the option of withdrawing from the study at any time without fear of penalty. If participation in the study causes unusual concern about respiratory health, please call M. Susan Jones at 270-745-3213. A referral to a health care provider can be made at your expense.

Benefits: This research has no direct benefit to you; but participants, by the act of reviewing the questionnaire, may examine their own health practices in regard to use of personal respiratory protection at the worksite. Future workers and health care providers may benefit through better understanding of the factors that contribute to the use of personal respiratory protection by workers in swine confinement buildings.

Confidentiality/Security and Disposition of Data: The information shared in the group meeting will be held in confidence and is not for public discussion. All data will be kept anonymous. No names will be recorded on the survey instrument or the questionnaire. All data will be kept in locked filing cabinets, and no one but the investigators will have access to the files.

Refusal/Withdrawal: Your participation is voluntary, and you may withdraw at any time and for any reason during the study. There is no penalty for not participating or for withdrawing.

If you have any questions about this study, or about research workers' rights, please contact M. Susan Jones, Doctoral Student, University of Cincinnati, at 270-745-3213, or e-mail me at susan.jones@wku.edu. Furthermore, should you have any questions about the nature of this study, you may contact my Dissertation Chair, Donna Gates, EdD, RN, at 513-558-3793. If you choose to send mail to her, the address is: University of Cincinnati, Proctor Hall-Room 211, PO Box 210038, Cincinnati, Ohio 45221. If you choose to participate in the study, you will be given a copy of this consent form for your reference.

I, the undersigned, understand the above explanations and give consent to my voluntary participation in this pilot study for the research activity: *A Descriptive Study of the Use of Personal Respiratory Protection among Workers in Swine Confinement Buildings*.

_____ _____

Signature of Worker Date

_____ _____

Signature of Investigator Date

Appendix N

Questionnaire to Evaluate Survey Instrument by Workers
Phase II of Content Validity

Directions: Please complete Sections I, II, III, IV of the Respiratory Survey for Workers in Swine Confinement Buildings and then answer the following questions.

1.	Time to Complete the Sections	I started Section I at:
		I completed Section IV at:
2.	The questions were easy to complete.	□ Yes □ No Comments:
3.	The questions made sense to me.	□ Yes □ No Comments:
4.	The questions were clear and concise. I understood them.	□ Yes □ No Comments:
5	The format of the Sections is	□ Poor □ Fair □ Good □ Excellent Comments:
6.	If I was the researcher, I would change	□Statement(s) (Specify)
7.	Other comments	

Next, complete Section V of the respiratory Survey for Workers in Swine confinement Buildings and then answer the following questions.

8.	Time to Complete Section V	I started Section V at:
		I completed Section V at:
9.	Section V was easy to complete.	□ Yes □ No Comments:
10.	The statements made sense to me.	□ Yes □ No Comments:
11.	The statements were clear and concise. I understood them.	□ Yes □ No Comments:
12.	The format of Section V is	□ Poor □ Fair □ Good □ Excellent Comments:
13.	If I was the researcher, I would change	□Statement(s) (Specify)
14.	Other comments	

Thank you for your participation in this study.