Florida International University

Robert Stempel College of Public Health and Social Work

Relationship between Risk Perception and Occupational Injuries in Laboratories and Manufacturing.

Yenny Fariñas Diaz1, Dr. Marcus Cooke1, Dr. Shanna Burke2

1 Department of Environmental Health Sciences, Robert Stempel College of Public Health and Social Work, Florida International University, Miami, FL 33199, USA

2 School of Social Work, Robert Stempel College of Public Health and Social Work, Florida International University, Miami, FL 33199, USA

**Abstract**

Understanding risk perception and the associated human behaviors are key in understanding how people react to hazards and how a culture of safety is developed. The human factor element and associated human behaviors are key in understanding how people react to hazards and how a culture of safety is developed. Though job hazards assessments are integrated as part of many regulatory requirements in the United States, how employees perceive the risks or stress in their work environment is not required. In laboratory settings, researcher’s focus is to carry out their research, which in most cases has an inherent risk associated with the tasks involved and a safety exposure may occur. How the individual perceives the risk associated with their work may determine how they will react in the event of an incident or a harmful exposure and this may be seen reflected in workplace injuries. This study is a secondary data analysis of documented workplace injuries of laboratory workers in educational and healthcare institutions and manufacturing. It will examine the **Relationship between Risk Perception and Occupational Injuries.** The general intent of the study is to understand how risk perception and injury experience affects safety behaviors in order to propose hazard mitigation interventions that consider the human factors.

**Specific Aims:**

**Aim 1:** To examine **the likelihood that risk perception is higher in laboratory professionals that have innate experience with previous injuries/fatalities.** Will evaluate: if the effect of variables such as: Length of service, Age, Gender, Country of Origin, Type of work has on risk perception.

**Aim2:** To examine **the likelihood that laboratory professionals in educational** (i.e.: Higher Education) **and Health care institutions have a** **lower incident experience than those in manufacturing** will evaluate: if there is a correlation between occupational injuries, illnesses and fatalities of laboratory professionals in educational and health care institutions and manufacturing.

We hypothesize that risk perception is higher in laboratory professionals that innately have a measure of previous injuries/fatalities. Also, that Laboratory professionals in educational and Health care institutions have a lower risk perception than those in Manufacturing.

This study poses minimum to no risk but in turn the expected outcomes will provide public health and safety benefits as it will aim to establish an understanding on whether there is a correlation on how risk is perceived and occupational injuries in laboratory settings compared to those in manufacturing.

***Keywords:*** *Risk perception; behavioral safety; safety risk; occupational risk; risk exposure; hazard analysis; environmental health and safety (EH&S).*

**Literature Review and Significance**

The National Safety Council formally defines risk as “a measure of the probability and severity of adverse effects” (National Safety Council, 2003).

How risk in a specific environment is perceived is important in determining the best intervention and communication methods for addressing exposure to environmental and safety hazards and sustaining risk management. How someone perceives risk is important in understanding what they believe to be an acceptable level of risk and what is acceptable as an inherent risk of the task. Understanding these perceptions of risks provides a further insight on potential behaviors and provides a different approach that considers the human factor in the reduction of injuries, illnesses and fatalities, as well in policymaking and in establishing hazard controls.

Risk Perception has been defined a subjective assessment of the probability of a specified type of accident happening and how concerned we are with the consequences. Risk perception is an effective factor in the determining of the incidence of unsafe behaviors and the occurrence of occupational accidents (Mohammad, Fahimeh, Ebrahim, Farid, 2019). Furthermore, an investigative study of risk perception, safety attitude and safety performance in construction supervisors in Iran defines risk perception as “an individual’s subjective judgment about the characteristics and severity of risks” (Jahangiri et, 2013).

***Fatalities, Injuries and Illnesses in the United States:***

Fatalities amongst **direct hires** in Educational and Health Services facilities are **higher** than fatality rates amongst **contractors** (U.S. Bureau of Labor Statistics, Current Population Survey, 2016). Similar risk factors to those leading to fatalities are also commonly found in laboratory settings at educational and healthcare facilities. Ex: roadway incidents, falls, slips, trips, chemical or harmful exposure, contact with objects and equipment fires and explosions are contributing factors to fatalities (U.S. Bureau of Labor Statistics, Current Population Survey, 2016).

According to the National Safety Council, in 2017 the US experienced 169,936 preventable deaths, 47.2 million injuries costing $1,034.6 billion (NSC Injury Facts, 2017). In 2018 preventable deaths accounted for 167,127 cases. Only a 1.7% year over year decrease. However, when normalizing the data per 100,000 population, in 2018 the recordable incident rate was 51.1 per 100,000 population, which represented a 2.1% decrease from 2017 but a staggering 50% increase over the rate in 1992, which was the lowest recorded of 34.0 per 100,000. In 2018 preventable deaths (home, public, motor-vehicle decreased) but Preventable Occupational deaths at work increased by 1.8%. where poisoning is the leading cause of deaths accounting for a 37% of total deaths in 2018 (NSC Injury Facts, 2018).

The National Safety Council also reports that in 2018, exposure to harmful substances was the 5th leading of workplace fatalities in the United States accounting for 621 deaths which is an increasing trend since 2011 with 419 deaths (National Safety Council Injury Facts, 2018). There were 2.8 million nonfatal workplace **injuries** and illnesses reported by private industry employers in 2018 (U.S. Bureau of Labor Statistics, 2019).

***Risk Perception and Occupational Accidents:***

In 2019, the International Labor Organization estimated that approximately 340 million occupational accidents occur annually throughout the world. In a study of the relationship between risk perception and occupational accidents among foundry workers, the authors state that poor, incorrect or lack of risk perception leads to unsafe behavior and it is a contributing factor to occupational accidents (Jafari et, 2019). Similarly, in 2016, the Republic of Korea in attempt to control their climbing occupational injury, inllness (4.9 cases per 1,000 full-time workers) and fatality rates (rate of 0.96 per 10,000 full-time workers) launched an initiative by their Organization for Economic Cooperation and Development (OECD) standards for researches to evaluate and the possible root causes of such safety performance in order to develop more effective safety programs (Industrial Accidents in Korea, 2016).

Data from 2015 indicates that that fatalities amongst direct hires in Educational (i.e: Higher Education) and Health Services Institutions are higher than fatality rates amongst contractors.  Evidence suggests that hazards associated with roadway incidents, falls, slips, trips, exposure to harmful substances or environments, contact with objects and equipment fires and explosions are contributing factors to fatalities, where women experienced a higher proportion of fatal injuries due to roadway incidents and homicides relative to men. However, men incurred a higher proportion of injuries from falls, slips, and trips and contact with objects and equipment while both men and women experienced similar proportions of fatal injuries from exposure to harmful substances or environments and from fires and explosions (U.S. Bureau of Labor Statistics, 2016).  These type of contributing risk factors previously mentioned as leading to fatal injuries are also commonly found in laboratory settings at educational facilities.

Factors influencing risk perception:

*Figure 1*: Factors Influencing Risk Perception.

The human factor element and associated human behaviors are key in understanding how people react to hazards in different environments and how a culture of safety is developed. Job hazards assessments are integrated in various compliance programs in the United States, but consideration to how employees perceive the risks or stress in their work environment is not required.

Humans perceive and act on risk in two fundamental ways: Instinctively and Intuitively (Slovic P., Peters E., 2006). Risk acceptability is influenced by characteristics such as: familiarity, control, catastrophic potential and uncertainty about the level of risk (Slovic P, Fischhoff B, Litchtenstein S, 1982). However, risk perception disparities across disciplines still exists. In a review of psychological literature on risk perception the author states that the characteristics of risk perception differ across disciplines and there is no general consensus on the “proper” way to measure perception of risk (Decker B.,1995).  Therefore, understanding how workers perceive risk is necessary for effective risk communication and risk management (Portell M., Gill RM., Losilla JM., Vives J., 2014).

***Neglect, Ignoring the Risks:***

Some individuals just choose to ignore or neglect the risk at hand. A thesis research highlights that some risks are ignored simply because they are new and unknown. Neglecting risks, on the other hand, implies that there is a certain degree of knowledge about the risk. Despite this knowledge, the necessary precautions to avoid the risk, or mitigate the consequences, are neglected (Fromm J., 2005).

***Risk Knowledge / Acceptance:***

Another important behavior to understand in risk perception is that some users accept risk based on their **risk knowledge** and organizational hazards in the workplace. Such as in a study of Spanish healthcare workers, where different participants considered their knowledge of the biological, ergonomic, and organizational risk hazards to be higher than the knowledge attributed to the occupational experts (Portell M., Gill RM., Losilla JM., Vives J., 2014).

A case study about risk perception in the face of natural hazards, assumes that high risk leads to higher personal preparedness, however the outcome was affected by the individual’s wiliness to act (Wachinger G, Renn O, Begg C, Kuhlicke C., 2012).

***Laboratories Risk Knowledge / Acceptance:***

A survey published by C& EN’s in 2013 “Views from the Lab” revealed that significant number of laboratories engaged in unsafe practices such as: Researchers work alone, avoid wearing personal protective equipment, and do not receive training on the specific hazards of their work (Kemsley, 2013).The survey was designed by the University of California Center for Laboratory Safety, Nature Publishing Group (NPG) and BioRaft (Software Developing Company) and it was administered by a Coalition of Academic and Commercial organizations. The survey sampled a population of 2,375 laboratory researchers in US and UK. The sample population surveyed consisted of **59%** specialized in biochemistry, biology, medicine or neuroscience in a College, University, Medical School or privately funded research institute, and **11%** were in Government Labs and 8% were in Pharmaceutical or Biotech Private Industries. Results of the survey indicated that people perceived themselves to be safer than they really are, they reported feeling safe at work but nearly half had been injured at least once in a laboratory setting, experiencing injuries such as needlesticks, thermal burns, chemical burns, or minor cuts or bites that required no stitches. Other results indicated neglect to follow Personal Protective Equipment safety requirements and that they were not performing risk assessments before conducting an experiment. Though 83% of researchers thought they received sufficient safety training both to comply with rules and regulations and to minimize the risk of injury to themselves or others, 42% thought that safety training in their organization was focused on compliance requirements rather than on improving lab safety (Kemsley, 2013).

***Behavior Modification:***

When addressing **risk perception**, for people to adopt recommended behaviors, their perceived threat (and its severity) **most outweigh their perceived barriers to action**. This is similarly, to theories and models used in Health Promotion/ Health belief models that use “Causal Assumptions/ Theory of Change” at an individual level. At an interpersonal level, social learning/cognitive theory models look at self-efficacy as one of the most important characteristics that determine behavioral change (US Department of Health and Human Services, 2002).

***Decision and Policy Making:***

Understanding the effect on risk perception on decision and policy making is of relevance when the human factor is involved regardless of the industry.

A study revealed that citizens in an industrialized region where there was known exposure to environmental hazards had a higher risk perception of their hazard exposure and had more confidence in environmental non-governmental organizations (NGOs) than in public authorities. This had an economic impact in food consumption where high perception of environmental risk was associated with lower consumption of fish. An understanding of risk perception may assist community leaders determine strategies for communication and risk management strategies (Coi A., Minichilli F., Bustaffa E., Carone S., Santoro M., Bianchi F., Cori L., 2016).

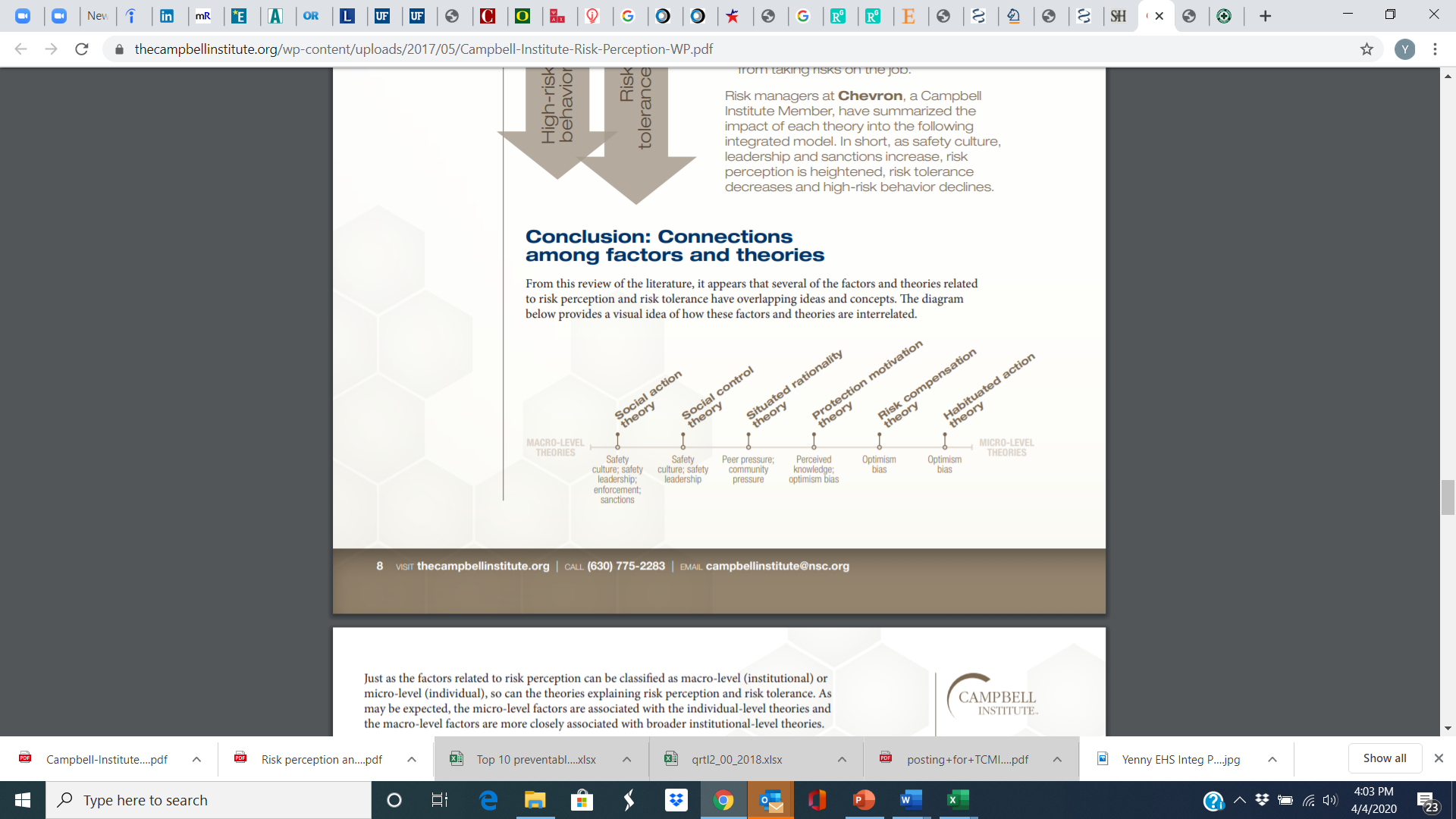
Risk evaluations and risk acceptance levels vary according to the individual or group. For example, the public perception of risk may vary from that of a technical expert who may be basing risk acceptance on well-characterized risk factors. Yet, public perception of risk can have a strong impact on risk mitigation measures in some cases. As recommended by the International Risk Governance Council ([IRGC], 2005). Therefore, risk perceptions of relevant stakeholders should be consider as part of its risk evaluation where the user (public) risk is considered in a separate analysis because risk acceptance is ultimately determined by the user [9]. The individual willingness to invest in risk preparedness or risk mitigation actions is said to have implications on risk governance and communication and on how likely is an individual to take actions regardless of how they perceive risk, the experience and trustworthiness of those conveying the information. This is the case in a study about risk perception in the face of natural hazards, where a risk paradox was said to exist in that it is assumed that high risk leads to higher personal preparedness, however it was seen that the outcome was affected by the individual’s wiliness to take action ([Wachinger G](https://www.ncbi.nlm.nih.gov/pubmed/?term=Wachinger%20G%5BAuthor%5D&cauthor=true&cauthor_uid=23278120), [Renn O](https://www.ncbi.nlm.nih.gov/pubmed/?term=Renn%20O%5BAuthor%5D&cauthor=true&cauthor_uid=23278120), [Begg C](https://www.ncbi.nlm.nih.gov/pubmed/?term=Begg%20C%5BAuthor%5D&cauthor=true&cauthor_uid=23278120), [Kuhlicke C](https://www.ncbi.nlm.nih.gov/pubmed/?term=Kuhlicke%20C%5BAuthor%5D&cauthor=true&cauthor_uid=23278120)., 2012).

***Communication:***

Risk Communication, Risk Acceptance and Perceived Risk are key in communicating risks to stakeholders and laboratory personnel. It is a good reporting and communicating mechanism for incident, accident mitigation. When communicating risks to the public, the risk perceptions of relevant stakeholders should be considered as part of a risk evaluation, because risk acceptance is ultimately determined by the user (Sandia National Laboratories and International Federation of Biosafety Associations, June 2017). Thus, understanding how humans manage and perceive is of significance when integrating human factors into the design of the work environment, when developing policies and when implementing interventions to modify safety behavior. It is also important in the communication and management of risk to be effective.

Risk perception, similarly to theories and models used in health promotion, health belief models that use “Causal assumptions/ Theory of change” at an individual level, for people to adopt recommended behaviors, their perceived threat and its severity most outweigh their perceived barriers to take action. At an interpersonal level, social learning/cognitive theory models look at self-efficacy as one of the most important characteristics that determine behavioral change (US Department of Health and Human Services, 2002).

A review of risk perception literature by the Campbell Institute of Research determines that there are various overlapping theories related to risk perception and risk tolerance (Inouye, J., 2013).



*Figure 2*: Risk Perception Factors and Theories Interrelation.

Similarly, a survey of various manufacturing organizations in Korea evaluated the Influence of Safety Climate, Safety Leadership, Workload, and Accident Experiences on Risk Perception. From the six hundred and twenty employees surveyed, 376 employees provided data that from which researchers determined that workload and accident experiences have a positive influence in risk perception, while safety leadership and safety climate have a negative influence on the cognitive and emotional risk perception. But in summary, they determined that workload, safety leadership, and the safety climate influence perceived risk more than accident experience when referring to the emotional risk perception (Oah, S., Na, R., & Moon, K., 2018).

In contrast with the previous study in Korea, a study of Occupational Risk Perception, Safety Training, and Injury Prevention in and Italian printing industry, the researchers found that the number of injuries sustained was indeed positively related to the perception of risk exposure and negatively related to evaluations about the safety training. The study examined 350 employee’s occupational risk perception in relation to safety training and injuries. This emphasizes the importance of training interventions to increase workers’ adoption of safety procedures and prevention of injuries (Leiter, M. P., Zanaletti, W., & Argentero, P., 2009).

Furthermore, risk communication, risk acceptance and perceived risk are key in communicating risks to stakeholders and laboratory personnel. By understanding the injury, illness and fatality experience of similar institutions, risk factors can be incorporated into the risk assessment process and laboratory personnel can make informed choices about risks related to their roles in the workplace. It also helps establish good reporting mechanisms for any incidents, accidents, mitigation inefficiencies and opens a pathway for communication and future assessments.

Understanding the effect on risk perception on decision and policy making is of relevance when the human factor is involved regardless of the industry. For example a study in Italy regarding how citizens in an industrialized region perceived personal exposure to atmospheric and water pollution, hazardous industries and waste, hazardous material transportation and waste versus in areas characterized by anthropogenic pollution, it was determined that risk perception was higher in geographical areas characterized by anthropogenic pollution and that citizens living in industrial areas appeared to be aware of environmental risks and had more confidence in environmental non-governmental organizations (NGOs) than in public authorities. This had an economic impact in food consumption where high perception of environmental risk was associated with lower consumption of fish ([Coi A](https://www.ncbi.nlm.nih.gov/pubmed/?term=Coi%20A%5BAuthor%5D&cauthor=true&cauthor_uid=27475730), [Minichilli F](https://www.ncbi.nlm.nih.gov/pubmed/?term=Minichilli%20F%5BAuthor%5D&cauthor=true&cauthor_uid=27475730), [Bustaffa E](https://www.ncbi.nlm.nih.gov/pubmed/?term=Bustaffa%20E%5BAuthor%5D&cauthor=true&cauthor_uid=27475730), [Carone S](https://www.ncbi.nlm.nih.gov/pubmed/?term=Carone%20S%5BAuthor%5D&cauthor=true&cauthor_uid=27475730), [Santoro M](https://www.ncbi.nlm.nih.gov/pubmed/?term=Santoro%20M%5BAuthor%5D&cauthor=true&cauthor_uid=27475730), [Bianchi F](https://www.ncbi.nlm.nih.gov/pubmed/?term=Bianchi%20F%5BAuthor%5D&cauthor=true&cauthor_uid=27475730), [Cori L](https://www.ncbi.nlm.nih.gov/pubmed/?term=Cori%20L%5BAuthor%5D&cauthor=true&cauthor_uid=27475730)., 2016).

Therefore, studies such as the current proposal may assist community leaders determine strategies for communication and risk management strategies.

**Specific Aims:**

**Aim 1:** To examine the likelihood that risk perception is higher in laboratory professionals that

have innate experience with previous injuries/fatalities. **Will evaluate:** if the effect of variables such as: Length of service, Age, Gender, Country of Origin, Type of work has on risk perception.

**Aim2:** To examine the likelihood that laboratory professionals in educational (i.e.: Higher

Education) and Health care institutions have a lower incident experience than those in manufacturing. **Will evaluate:** if there is a correlation between occupational injuries, illnesses and fatalities of laboratory professionals in educational and health care institutions and manufacturing.

**Main research question and hypotheses:**

We hypothesize that risk perception is higher in laboratory professionals that innately have a

measure of previous injuries/fatalities. Also, that Laboratory professionals in educational and Health care institutions have a lower risk perception than those in Manufacturing.



Risk Perception

Injuries

*Figure 3*: Graphical Representation of Hypothesis.

**Research Strategy/ Methods**

**Problem:** In research laboratory settings, researcher’s focus is to carry out their research. However, in the process of executing an experiment, occupational safety exposures may occur. How the individual perceives the risk associated with the tasks involved in their research and their lab environment may determine how they will react in the event of an incident or a harmful exposure, that may not only negatively impact their health but also can halt their capabilities to complete their research. There is often a disconnect between perceived risks and actual risks. How professionals perceive risks and their previous experience might differ from the actual risks thus increasing the likelihood of injuries in the workplace.

**Significance / Benefits of the Study:** The study is a secondary data analysis of documented workplace injuries of laboratory workers in Educational and Health Institutions compared to those in Manufacturing. No similar study has been identified.

This study poses minimum to no risk but in turn the expected outcomes will provide public health and safety benefits as it will aim to establish an understanding on whether there is a correlation on how risk is perceived and occupational injuries in laboratory settings. Injuries is a lagging indicator. Lagging indicators are defined by the Cambridge Press as “something that shows what a situation has been like in previous weeks, months, etc., rather than showing what it is like now or will be like in the future” (Cambridge Press, 2020). Though the study uses a lagging indicator, injuries experience is important in profiling the workplace hazards and risks associated with the job, which are used in industry as indicators of how risky an industry is. Injuries is a lagging indicator. Lagging indicators are defined by the Cambridge Press as “something that shows what a situation has been like in previous weeks, months, etc., rather than showing what it is like now or will be like in the future” (Cambridge Press, 2020). Though the study uses a lagging indicator, injuries experience is important in profiling the workplace hazards and risks associated with the job, which are used in industry as indicators of how risky an industry is. Thus, this study will provide opportunities for future studies and increase awareness of the actual work environment risks. It will help to understand how risk perception affects the behaviors of laboratory occupants in Educational and Health Institutions compared to those in Manufacturing in order to propose hazard mitigation interventions that consider the human factors. The importance of understanding what it is believed by the user to be an acceptable level of risk and what is acceptable as an inherent risk of the task. Understanding these perceptions of risks will provide a further insight on potential behaviors that could result in injury and provides an approach that considers the human factor in policymaking, as a determinant of training needs, and in establishing sustainable risk management and hazard controls that in turn will modify behaviors.

**Innovation:** The study is a secondary data analysis of documented workplace injuries and fatalities of laboratory workers compared to those in manufacturing. No other similar studies have been identified. It will examine the “Relationship between Risk Perception and Laboratory Occupational Injuries”**.** The general intent of the study is to understand how risk perception affects the behaviors of the laboratory occupants in order to propose hazard mitigation interventions that consider the human factors. While many studies in risk perception exist, there is limited data on risk perception in laboratories even though harmful exposure is one of the leading causes of fatalities as of 2018 (National Safety Council Fact Sheet, 2018). The study will serve as a launching pad for future analysis to prove other hypothesis outside of the scope of this research in determining if laboratory professionals that have never been injured have a lower safety compliance that those with previous injuries.

**Approach**

**Data availability, copyrights, publications, licensing and data protection:**

The secondary data analysis will be conducted of Occupational Injuries of Laboratory Professionals in the United States. The data is representative of various private sector industries but for the purpose of this study only those occupations related to laboratories and manufacturing (otherwise categorized as production) will be used. Data availability, copyrights, publications, licensing and data protection has been reviewed for this study.

The data collected is publicly available as these industries are subject to reporting their injuries, illnesses and fatalities to their corresponding state once an employee has incurred a recordable case and annually to the US Department of Labor Bureau of Labor Statistics. This study only analyses those injuries deemed to be recordable or resulting in a fatality. A recordable injury is defined by the Occupational Safety and Health Administration (OSHA) recordkeeping standard in the Code of Federal Regulations as a fatality or “Any work-related **injury** or illness that results in loss of consciousness, days away from work, restricted work, or transfer to another job. Any work-related **injury** or illness requiring medical treatment beyond first aid” (OSHA, 29 C.F.R.§1904.7 Subpart C, 2001).

The data will be retrieved using a multi-screen data search for injuries, illnesses and fatalities from 2011 through 2018 from Federal databases from the US Department of Labor (U.S. Bureau of Labor Statistics, 2020). Copyrights, publications, licensing and data protection was also reviewed to ensure the feasibility of data use. The data retrieved from “Data.gov” can be used without cost or a licensing requirement and the Bureau of Labor Statistics requests that they be cited when the data is used.

Furthermore, the data depository “Data.gov” is an official depository from the US Government and it complies with Computer Fraud and Abuse Act of 1986 and the National Information Infrastructure Protection Act. The data integrity of the injured or deceased employee has already been protected by the collecting entity.

**Sampling population and sample size:**

Sample population:

A total of 8 years of Injury, Illness and Fatalities data from the United States Department of labor from 2011 through 2018 in Private Industry in the United States was analyzed. The data is representative of various private sector industries but for the purpose of this study only those occupations related to laboratories and manufacturing will be used.

This study only analyses those injuries deemed to be recordable or resulting in a fatality. A recordable injury is defined by the Occupational Safety and Health Administration (OSHA) recordkeeping standard in the Code of Federal Regulations as a fatality or “Any work-related injury or illness that results in loss of consciousness, days away from work, restricted work, or transfer to another job. Any work-related injury or illness requiring medical treatment beyond first aid” (OSHA, 29 C.F.R.§1904.7 Subpart C, 2001).

Sample size:

Alpha levels will be set at 0.05 (95% confidence level), with a 5% margin of error, therefore

requiring a population size of a minimum if 385.

**Data Analysis:**

This descriptive analysis of the data will examine injury prevalence within 2011 to 2018. Injury prevalence will be defined as the total number of reported injuries in one year by the department of labor. The data provided for each consecutive year will be examined and I will determine if we use it individually or combined as an average, as an overall datapoint. The total number of fatalities per year will used as an additional independent variable that measures risk.  For the purpose of this study risk perception will be determined by the conjunction of the independent variables. The significance of differences observed by exploring associations between independent categorical and/or continuous variables and the outcome of interest will be examined.

Additionally, twenty existing risk perception publications have been reviewed so far to determine previously established correlation between risk perception and injuries.

**Statistical Analysis:**

Pearson’s correlations will be used to determine the relationship between risk exposure and injury. Then a univariate linear regression model will be used to investigate the relationship between injury status and individual potential risk factors. A multivariate linear regression model will also be used to examine the influence of a combination of risk factors for becoming injured. Covariates will be fitted into the model using a forward selection procedure and will retain in the final linear regression model if they reached a statistical threshold of p<0.10 or were of significance. Finally, a logistic regression will be used to investigate the relationship between injury severity and possible risk factors.

All statistical analysis will be conducted using Jupyter and/or R Studio, which is a data analytics tools that is commonly being used to analyze publicly available data. The data will be pulled from the Department of Labor, but it will be stored in the Github depository. The data integrity of the injured or deceased employee has already been protected by the collecting entity.

**Summary of Variables:**

The study will use one **Dependent Variable (Risk Perception)** as the main outcome variable of interest in this study and a total of **7 Independent variables of interest** (6 for Injuries and Illnesses; 1 for Fatalities).

Table 1

*Dependent and Independent Variables*

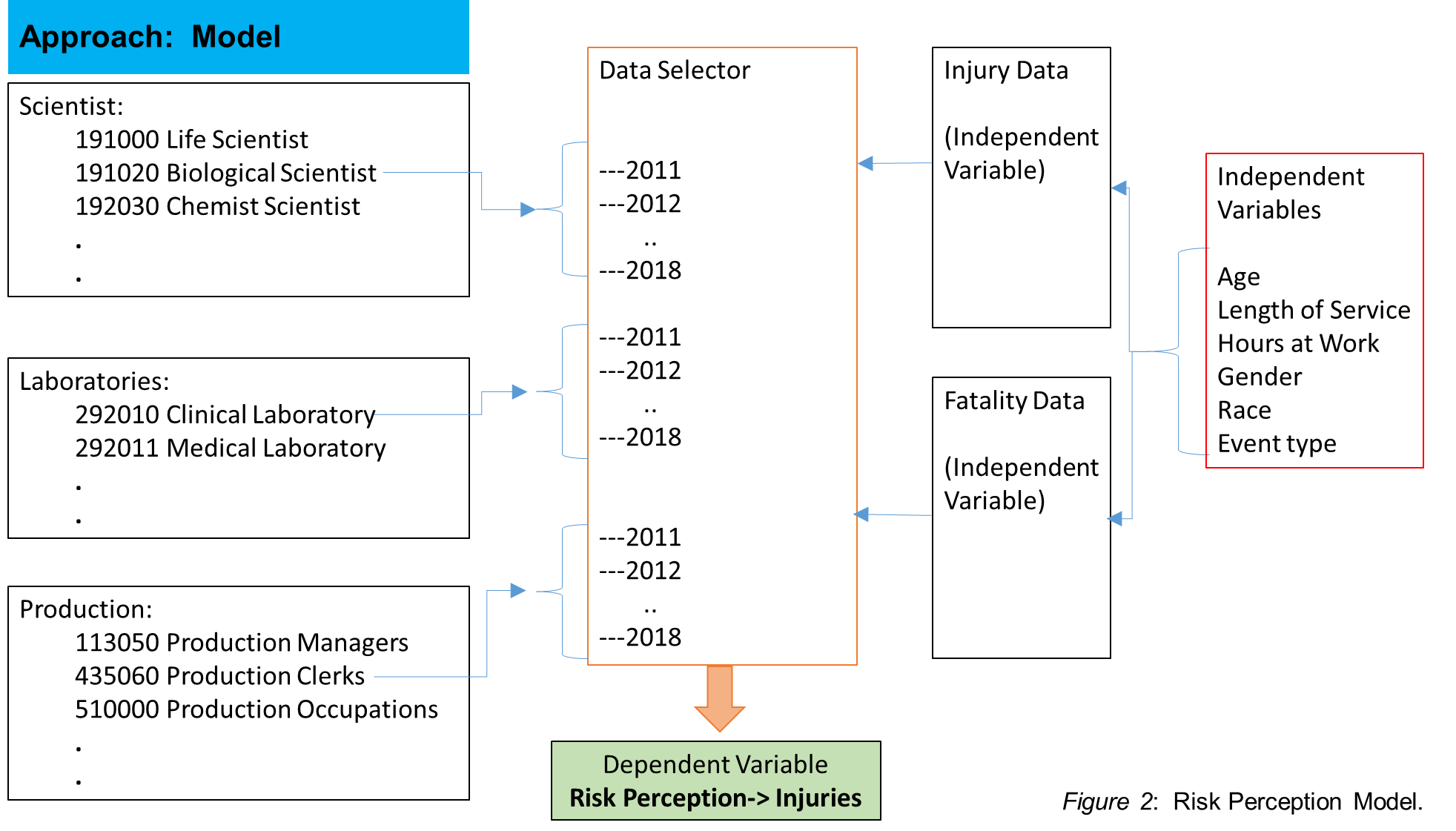
|  |  |
| --- | --- |
| **Dependent Variables** | **Types of Variables** |
| Occupational Recordable Injury and Illness 🡪 Risk Perception | Continuous |
| **Independent Variables** | **Types of Variables** |
| Age, Length of Service, Hours on the Job | Categorical and Continuous |
| Gender, Race, Occupation Type, Event or Exposure | Categorical |
| Fatalities | Continuous |

Table 2

*Description of Independent Variables*

|  |  |  |
| --- | --- | --- |
| **Independent Variables** | **Types of Variables** |  |
| Age | Categorical and Continuous | * 14-15 Yrs.' * 16-19 Yrs.' * 20-24 Yrs.' * 25-34 Yrs.' * 35-44 Yrs.' * 45-54 Yrs.' * 55-64 Yrs.' * 65 Yrs.' + * Not Reported |
| Gender | Categorical | * Male * Female * Not Reported |
| Length of Service | Categorical and Continuous | * < 3 Mos. * 3-11 Mos. * 1-5 Yrs.' * 5 Yrs.' * Not reported |
| Race | Categorical | * Asian * African American/Black (non-Hispanic) * Hispanic/Latino * American Indian/ Alaskan Native * Arab/Middle Eastern/ Arab American * Native Hawaiian or Other Pacific Islander * Not Reported * White * Multi Race * Hispanic and Other |
| Occupation Type | Categorical | * Life Scientists * Biological Scientists * Medical Scientists * Physical Scientists * Chemists & Material Scientists * Chemists * Biological Technicians * Chemical Technicians * Health Technologists & Technicians * Clinical Laboratory Technologists & Technicians * Medical & Clinical Lab Technologists * Medical & Clinical Lab Technicians * Production Occupations (for Manufacturing) |
| Hours on the Job | Categorical and Continuous | * Before shift began (< 1) * < 1hr (0-1) * 1- 2 Hrs. * 2- 4 Hrs. * 4- 6 Hrs. * 6- 8 Hrs. * 8- 10 Hrs. * 10-12 Hrs. * 12-14 Hrs. * 14-16 Hrs. * > 16 Hrs. * Not Reported |
| Event or Exposure | Categorical | * Violence & other injuries by persons or animals * Transportation incidents * Fires & explosions * Fall, slip and Trips * Exposure to harmful substances or environment * Contacts with objects and equipment * Overexertion and bodily reaction |
| Fatalities | Continuous | * Number of Fatalities for each Independent Variable |

Below there is a representation of the Risk Perception model that illustrates the interactions within the variables of the study.



*Figure 4*: Risk Perception Model.

**Limitations:**

The study will be limited to publicly available occupational injury data in the United States. Since the injured population cannot be surveyed for risk perception, risk perception inferences will be made based on previous literature research. There is no OSHA compliance data specific to the laboratory with the documented recordable case. The study will not evaluate the existence of an association between compliance violations and injuries within the laboratory institution reporting the injury, illness or fatality. Therefore, based on the data available we will not be able to determine if there is an association between compliance, previous history of safety violations and the injured employee’s perception of risk. Other human behavior aspects that can affect risk perception are not part of the study. Refer to **Table X** below on how the Literature review impacts that hypothesis.

Table 3

*Current Literature Review Impact on Research Hypothesis*

|  |  |
| --- | --- |
| **Key literature cited that might have an impact on hypothesis** | **How will it impact my hypothesis?** |
| Humans perceive and act on risk in two fundamental ways.  Risk as feelings refers to individuals' instinctive and intuitive reactions to danger (Slovic P., Peters E., 2006). | The distinction on the impact of whether risk perception is instinctive or intuitive will not be examined in this research thus potentially impacting my hypothesis. |
| Studies suggest that risk acceptability is influenced by characteristics such as: familiarity, control, catastrophic potential and uncertainty about the level of risk (Slovic P, Fischhoff B, Litchtenstein S., 1982). | This may affect my hypothesis as the users' past experiences or catastrophic event might make them more likely to have a higher awareness of risk than someone who have not had those experiences. This is not evaluated in the study. Someone who is more with be more aware of their surroundings and perceive risk. Only available public records will be examined. |
| In a study of Spanish healthcare workers, different participants considered their knowledge of the risk related to biological, ergonomic, and organizational hazards to be higher than the knowledge attributed to the occupational experts (Decker B., 1995). | Not being evaluated. |
| Table 3 (*continued)* |  |
| **Key literature cited that might have an impact on hypothesis** | **How will it impact my hypothesis?** |
| In a study about risk perception in the face of natural hazards, where a risk paradox was said to exist in that it is assumed that high risk leads to higher personal preparedness, however it was seen that the outcome was affected by the individual’s wiliness to take action (Wachinger G., Renn O., Begg C., Kuhlicke C., 2012). | Contrary to preparedness for a potential natural disaster like a hurricane, results of my research might be affected by those individuals that might be performing the job for a very long time and are higher risk takers and not see the inherent risks of the job as a threat thus affecting my hypothesis. |
| Evidence suggests that hazards associated with roadway incidents, falls, slips, trips, exposure to harmful substances or environments, contact with objects and equipment fires and explosions are contributing factors to fatalities, where women experienced a higher proportion of fatal injuries due to roadway incidents and homicides relative to men. However, men incurred a higher proportion of injuries from falls, slips, and trips and contact with objects and equipment while both men and women experienced similar proportions of fatal injuries from exposure to harmful substances or environments and from fires and explosions (Wachinger G., Renn O., Begg C., Kuhlicke C., 2012; Coi A, Minichilli F, Bustaffa E, Carone S, Santoro M, Bianchi F, Cori L., 2016). Similar contributing risk factors previously mentioned as leading to fatal injuries are also commonly found in laboratories. | Only reported injuries will be evaluated. Someone who has been involved in a laboratory workplace injury in the past might have a higher perception of risk but if the injury was not reported, there will be no method available to obtain this information. |
| Though past injuries might lead to higher perception of risk, only recordable injuries/illnesses and fatalities will be evaluated. There is no method available to obtain information on repeated injuries. | Only reported injuries in the US will be evaluated. |

**Potential Problems / Pitfalls:**

The researcher has no control on changes made to the interface or data depository from the Department of Labor. Currently the data is stored the data in a very fragmented way, which makes it difficult to access and consolidate for use.

**Risks:**

The study poses minimum to no risk but in turn the expected outcomes will provide public health and safety benefits as it will aim to establish an understanding on whether there is a correlation on how risk is perceived and occupational injuries in laboratory settings compared to those in manufacturing.

**Approvals:**

This study will be ran by the Subject University Office of Research Integrity to collaborate that the research study is exempt from IRB approval via the Exempt Review process as it is a secondary data review and no people identifiers were collected and no identifiers will be included in the dataset for the purpose of the study.

***References***

*Cambridge University Press (2020). Definition of lagging indicator. Cambridge Advanced Learner's Dictionary & Thesaurus.*

*Coi A, Minichilli F, Bustaffa E, Carone S, Santoro M, Bianchi F, Cori L.(2016). Risk perception and access to environmental information in four areas in Italy affected by natural or anthropogenic pollution. Environmental International. 2016 Oct; 95:8-15. doi: 10.1016/j.envint.2016.07.009. Epub 2016 Jul 27.*

*Decker Bill D. (1995). A review of psychological literature on risk perception in terms of chance, harm and context. Michigan State University, Department of Agricultural Economics.*

*Fromm J., (2005). Risk Denial and Neglect: Studies in Risk Perception. Stockholm School of Economics.*

*Inouye, J., (2013). Risk Perception: Theories, Strategies and Next Steps. The Campbell Institute Research.*

*Jahangiri M, Sareban Zadeh K, Bashar O, Saleh Zade H. Investigation risk perception, safety attitude and safety performance in supervisors of construction sites Shiraz-Iran. Iran J Ergon. 2013;1:10 –8*

*Kemsley J (2013). Survey exposes lab safety gaps. C&EN, American Chemical Society, Volume 91 Issue 3 | pp. 30-31. Issue Date: January 21, 2013.*

*Korea occupational safety and health agency (2017). Analysis of Industrial Accident in 2016.*

Leiter, M. P., Zanaletti, W., & Argentero, P. (2009). Occupational risk perception, safety training, and injury prevention: Testing a model in the Italian printing industry. Journal of Occupational Health Psychology, 14(1), 1–10.

*Mohammad F., Fahimeh S., Ebrahim F., Farid J. (2019). Relationship between risk perception and occupational accidents: a study among foundry workers. Jafari et al. Journal of the Egyptian Public Health Association 94:24.*

*National Safety Council (2018, 2017). Injury Facts. Retrieved from: https://injuryfacts.nsc.org.*

*National Safety Council (2003). Course material for Principles of Occupational Safety and Health. Itasca, IL: National Safety Council.*

Oah, S., Na, R., & Moon, K. (2018). The Influence of Safety Climate, Safety Leadership, Workload, and Accident Experiences on Risk Perception: A Study of Korean Manufacturing Workers. *Safety and health at work*, *9*(4), 427–433.

***References (Continued)***

*Occupational Safety and Health Administration (OSHA) (2001). Recording and Reporting Occupational Injuries and Illness, 29 C.F.R.§1904.7 Subpart C.*

*Portell M, Gil RM, Losilla JM, Vives J. (2014). Characterizing occupational risk perception: the case of biological, ergonomic and organizational hazards in Spanish healthcare workers. Span J Psychol. 2014;17:E51. doi: 10.1017/sjp.2014.55.*

*Sandia National Laboratories, in collaboration with the International Federation of Biosafety Associations (2017). Laboratory Biosafety and Biosecurity Risk Assessment Technical Guidance Document. International Biological Threat Reduction.*

*Slovic Paul, Peters Ellen. (2006). Risk Perception and Affect. Sage Journals. Association for Psychological sciences, Vol 15, Issue 6, 2006, pp. 322–325.*

*Slovic P, Fischhoff B, Litchtenstein S (1982). Why study risk perception. Risk Analysis, an international journal. Vol 2, No.2, pp. 83-93.*

*U.S. Bureau of Labor Statistics (2016). Current Population Survey. Census of Fatal Occupational Injuries.*

*U.S. Bureau of Labor Statistics (2020). Copyrights, publications, licensing and data protection***.** https://www.bls.gov/opub

*U.S. Bureau of Labor Statistics (2020). Multi-screen data search for Injuries, Illnesses and Fatalities Data from 2011-2018.* https://www.bls.gov/iif/data.htm

*US Department of Health and Human Services. Physical Activity Evaluation Handbook. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, 2002. Theories and Models used in Health Promotion, Health belief models that use “Causal Assumptions/ Theory of Change”., Appendix 3, pg. 43.*

*Wachinger G, Renn O, Begg C, Kuhlicke C. (2012). The risk perception paradox--implications for governance and communication of natural hazards. Risk Analysis 2013; 33(6):1049-65. doi: 10.1111/j.1539-6924.2012.01942.x. Epub 2012 Dec 24.*

*Figures*

*Figure 1:* Factors Influencing Risk Perception.

*Figure 2*: Risk Perception Factors and Theories Interrelation.

*Figure 3*: Graphical Representation of Hypothesis.

*Figure 4*: Risk Perception Model.

*Tables*

*Table 1*

*Dependent and Independent Variables*

*Table 2*

*Description of Independent Variables*

*Table 3*

*Current Literature Review Impact on Research Hypothesis*

*Biosketch*

