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Extreme Cold Event Perception and Preparedness of Western Michigan University Students

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by

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Preparing for disasters at universities differs throughout the country but taking preventative measures is the first step in reducing loss of life and recovery measures. This research examined differences among undergraduate students regarding perceptions when it comes to extreme cold events at Western Michigan University (WMU). The main focus of the thesis was to determine if there is a lack of awareness and/or preparation measures of extreme cold events. Data were collected online using a specially designed questionnaire through Qualtrics. Survey questions were coded and analyzed using SPSS software using standard univariate descriptive statistics and/or multivariate statistical tests deemed appropriate. Results indicated that a majority of respondents have experienced more than four extreme cold events and do not see extreme winter weather to be an issue. Results also demonstrated that perceptions of WMU undergraduate students regarding extreme cold events have no significant differences regarding class standing and gender. However, a great number of respondents do not have any formal emergency training and do not take proper vehicle and home preparation measures when it comes to extreme cold events.

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Connor J. Landeck

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CHAPTER I

INTRODUCTION

Michigan is vulnerable to a range of natural, technological and human related disasters (Michigan Hazard Analysis 2019). Disasters such as floods, tornadoes, winter storms, severe thunderstorms and other events cause injuries, loss of life, economic impacts and property damage. Colleges and universities are regulated by law to have emergency management plans for a variety of different disasters that may occur. These are in place because having coordination when these disasters occurs helps reduce damages while protecting students, faculty and staff as much as possible. Preparation for disasters differs by university simply because different places experience different hazards (such as blizzards at the University of Buffalo or tornadoes at the University of Alabama). Taking preventative measures is the first step in reducing stress, loss of life and damage. Emergency managers on campus are in charge of implementing this plan should an event occur, however, everyone should have at least a basic knowledge of what to do in the most frequent situations. Unfortunately, many in the campus community, especially students, may lack of awareness and knowledge, formal training emergency provisions if an event does occur.

One type of disaster event, extreme winter weather, can occur on campus in any northern state regularly, or a southeastern state campus if the jet stream drags cold air to this region. Heavy ice or snow accumulation can lead to fatal motor vehicle accidents (Clements 2017). About 70 percent of all winter related deaths occur in motor vehicle accidents caused by hazardous driving conditions. The preventive steps necessary to reduce winter storm mortality begin with building basic preparedness measures such as emergency preparedness kits (Clements 2017).

In an attempt to assist institutes of higher education be more prepared in the face of a disaster, the Guide for Developing High-Quality Emergency Operations Plans for Institutions of Higher Education (2014) was developed by the Federal Emergency Management Agency (FEMA). This guide provides recommendations for creating emergency procedures for those charged with this task, including new approaches on how institutions of higher education can plan to mitigate negative effects from certain disasters.

Although universities have emergency management plans for each type of incident or natural disaster, much of this information goes unnoticed by staff and students for a variety of reasons. Whether these reasons are a lack of education about these events or lack of training for these extreme events, many students might not receive, understand or comply with information regarding disaster preparedness (Kapucu 2013) When it comes to preparation and liability, universities may have the proper documentation necessary for disaster management protocol but not the proper training for real life situations. This is lack of training is detrimental to the mitigation process. Educational institutions have different disaster response and recovery efforts between them. This was demonstrated by Kapucu (2013), which suggested programs that conducted exercises and training, developed all hazards preparedness plans, and strengthen partnerships within the community had a more successful disaster response program.

Having students educated on what to do during disaster scenarios such as extreme winter weather and blizzards is important if an actual event occurs because injuries, loss of life and general confusion can be minimized. If university training and education is conducted frequently, a student is more likely to have the confidence to respond appropriately in effectively dealing with the event.

Purpose

The purpose of this research was to determine if Western Michigan University (WMU) undergraduate students are ill-prepared for extreme winter weather and how they feel WMU does in terms of communication and safety in terms of extreme winter weather. In order to examine this purpose, a specially-designed questionnaire was used. This research could help Western Michigan University and other universities understand what aspects students need to be educated on regarding extreme winter weather perception and preparedness. This research will also help students understand what they are not doing to protect themselves in their home and vehicle regarding emergency equipment needed.

For this research, the task was to examine how perceptions and knowledge of extreme winter weather varied among undergraduate students, determine how prepared students are for these events, and generate suggestions as to how to better prepare students for future events. Class standings will be a main focus throughout this work to examine if students who have been at Western Michigan University longer are more prepared for extreme cold events. If this research spreads awareness to only a few students, preparations for the university will be better than before.

Hypotheses

The hypotheses guiding this research are:

- Students, in general, do have a general understanding of what constitutes an extreme winter weather event at WMU;
- There is a significant difference in perceptions among class standing of what constitutes an extreme winter weather event;

- There is a significant difference in vehicle preparation for an extreme winter weather event among class standing;
- There is a significant difference in home preparation for an extreme winter weather event among class standing;
- There is a significant difference in students' perceptions of WMU's communication during an extreme winter weather event among class standing;
- There is a significant difference in students' perceptions of safety during an extreme winter weather event at WMU among class standing.

The format of this thesis will be as follows. Chapter I discusses the introduction, purpose and hypothesis of this study. Chapter II discusses past research that is relevant to this thesis. Chapter III outlines the methodologies involved within this work. Chapter IV reports the results and discussion portion of the data presented and Chapter V presents the conclusion and summary of the data presented.

CHAPTER II

LITERATURE REVIEW

Introduction

This literature review addresses three main questions corresponding to the idea of disaster management protocol assessment and student and employee perceptions regarding the risks associated with extreme winter weather that challenges Western Michigan University (WMU). The first section summarizes the major elements of FEMA's Guide for Developing High Quality Emergency Operation plans for Institutions of Higher Education (hereafter, FEMA's Guide). The second section focuses on previous studies related to overall disaster perception assessment and emergency preparedness techniques. The final section addresses the preventative measures that can be taken in order to reduce damage from natural disasters.

Major Elements of FEMA's Guide

Across all universities, disaster management protocols are both requested and essential to deal effectively with natural disasters, to reduce overall damage, and assure the normal provision of academic services. Although a majority have such a plan, community colleges and universities should be encouraged to include disaster management training in their curricula (National Research Council 1991) and have their organizational chart available to everyone on campus.

Figure 1 is the response plan organization chart showing the chain of command throughout WMU when an event might occur. Demonstrating how WMU's disaster management protocol compares to FEMA's Guide demonstrates the standard that schools should be implementing in regard to their disaster management plans.

Many weather-related emergencies occur with little or no warning. Therefore, it is critical for institutions of higher education to plan ahead to help ensure the safety of all members of the campus community (FEMA 2013). Many institutions have decentralized organizational structures and many academic programs differ in the way decision-making responsibilities are allocated (FEMA 2013). Throughout FEMA's Guide, the importance of preparing university officials and first responders to implement emergency operation plans is emphasized. FEMA's Guide has been organized into four sections: 1) a summary of the principles of emergency planning; 2) the process for developing emergency operation plans (EOP) within the community; 3) a discussion of different types of EOPs and; 4) the support of emergency management of IHEs.

The Presidential Policy Directive (PPD)-8, signed by President Barack Obama in 2011, describes the nation's approach to preparedness (FEMA 2011). Using policies from the PPD-8,

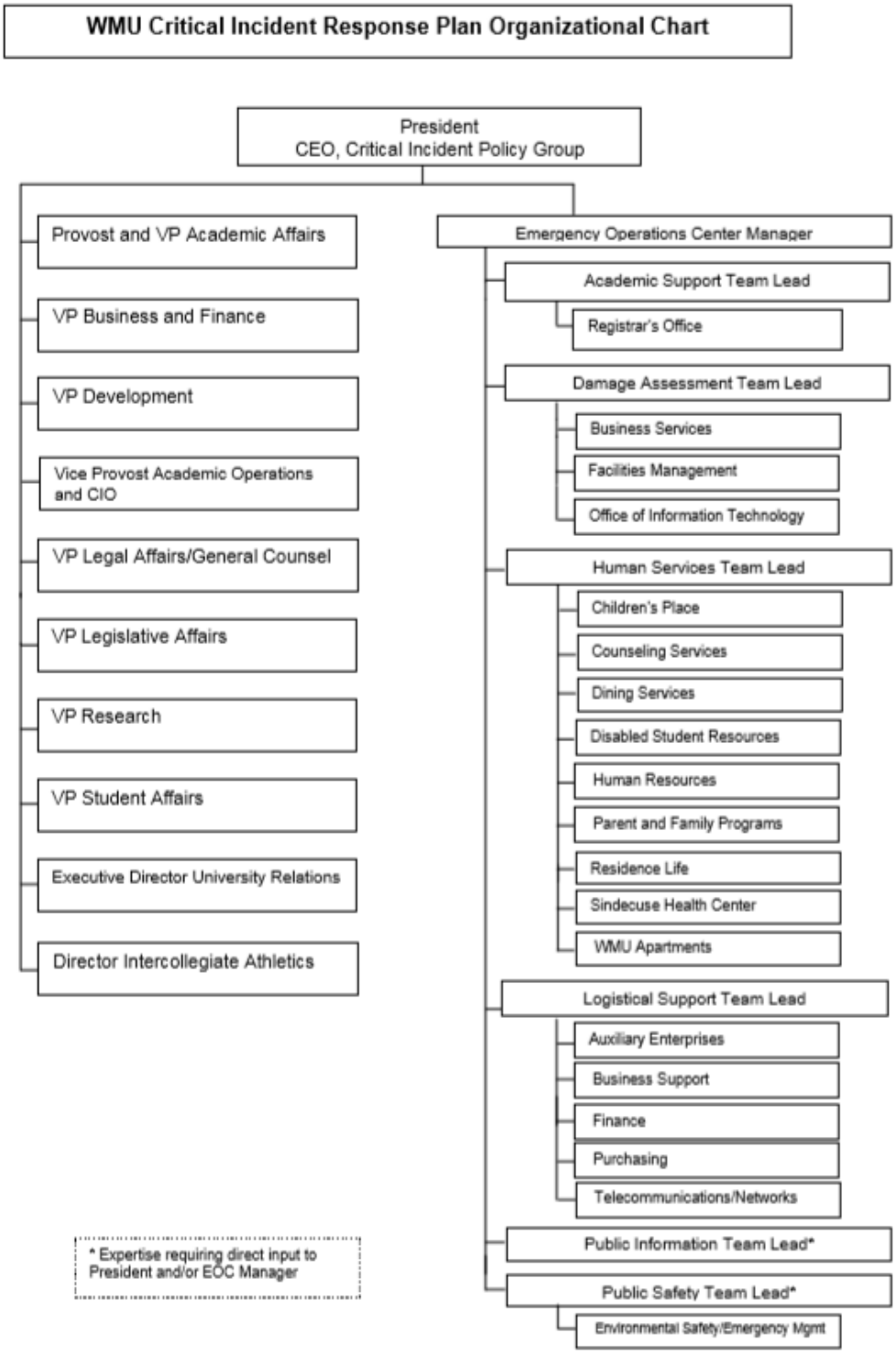


Figure 1: Western Michigan Organization Chart for Emergency Planning. Source: *WMU (2016)*

five mission areas were described to define preparedness for natural disasters: prevention, protection, mitigation, response, and recovery. With regard to institutes of higher education,

standard concepts and principles have been developed by the National Incident Command System (NIMS) (FEMA 2008). NIMS, was created to establish an Incident Command System (ICS) protocol to provide effective communications, common terminology and operation best practices regarding emergency situations for any agency.

A Guide for Developing a High-Quality Emergency Operation Plan (EOP) for Higher Education

There are many planning principles that are key to developing a comprehensive higher education EOP that addresses threats and hazards. WMU's upper administration initiates and supports planning efforts to help ensure engagement from the entire campus community. Effective planning is built around all institutions and an ongoing assessment according to FEMA regulations is always needed. Another principle guideline followed is to consider all threats and hazards relevant to the higher education institution. The entire higher education community includes instructors, staff and students and through these guidelines, planning is imperative for the functional needs of these groups. Considering all settings and times that an incident might occur and how the individual prepares is a standard guideline set throughout FEMA protocol (FEMA 2013).

There are many steps involving the planning process and how institutes of higher education (IHE) should consider the impact of their decisions regarding ongoing activities such as training, equipment and resources. Forming a collaborative team, understanding the situation, determining goals, plan development, plan preparation and implementation are all steps in the planning process for disasters on campus (FEMA 2013). There are many departments in IHE's such as health services planning, environmental health and safety, information technology, public information, public safety and transportation that have specific contributions to the

planning team overall. Assessments of initial plans regarding protocols for disaster are essential for quick response times and effective coordination when a disaster occurs within a university (FEMA 2013).

Planning Roles

Each department listed above has separate contributions to the planning team that are essential for incidents regarding the before, during and after stages of a disaster. The responsibilities of the separate departments previously listed are crucial for implementing communication within the university and awareness throughout the student body (FEMA 2013).

Regarding the health services planning team, providing physicians and medications is an essential part in the process for disaster response. Health services is also responsible for developing procedures to determine if there are adequate supplies and equipment to triage during an emergency. Developing procedures for mobilizing personnel on campus and at external sites is also an important step for this team. Health services is also directly responsible for making procedures regarding mutual aid agreements and ensuring departments over an area respond thoroughly and accordingly. Even though these are the most important contributions they make, coordinating with local and state health partners ensure the quality of correct mitigation actions (FEMA 2013).

Environmental health and safety concerns play a crucial role in university procedures regarding hazard assessments. FEMA updates Standard Operation Procedures (SOPs) with regard to universities to create consistency when an action is performed. Ensuring these procedures are current and revised as necessary helps limit the chance of error and gives students a guide to follow when a disaster occurs. One of the main challenges for a university is the

timely process of releasing public information and awareness when a disaster occurs. The environment health and safety department coordinates with public safety officers to increase public awareness and resources for extreme winter weather events.

Although the information technology department does not have much involvement dealing with the physicality of disasters, the department plays a huge role in ensuring that communications throughout an institution are consistent and frequent. Information technology is directly responsible for developing systems of communication which are accessible to students regarding websites, cell phone, email and other social media platforms to spread emergency information. This department is also directly responsible for identifying the need for and sources for emergency communication as well. Ensuring student communication throughout the university is essential but making sure first responders and emergency management have adequate communication throughout the process helps ensure smooth coordination of disaster response. Before an emergency occurs, having developed plans to continue academic programs that use technology helps recovery and assures continuation of education during times of natural disasters (FEMA 2013).

According to the FEMA's guidelines for a Public Information Department (FEMA 2013), coordinating beforehand with all departments to provide accurate messaging to students, staff, faculty and the media is essential to the planning process within universities. Developing agreements with the media before an emergency is a crucial part in the process of dealing with an emergency. As soon as an emergency or disaster occurs, the media plays a role in distributing information as soon as possible. This could bring stress to the first responders regarding media being involved while disaster response occurs. Designating a campus spokesperson to deal with

the media is an essential step because it will keep the media away from first responders and emergency management team that need to focus solely on doing their job.

Public safety operation planning is one of the most important steps related to the development process regarding mitigation measures. One of the more important steps that goes unnoticed regarding this planning team is to ensure testing systems are current and up to code. Effective warning systems for students and faculty can save time during the evacuation process and provide people with time to prepare, if possible. Developing a process for managing incidents at the field level using the Incident Command System is a contribution which heavily affects the process of recovery. This ensures effective communication through branches of command and among emergency responders. With regards to individuals with different language needs, including effective communication methods for international students along with people with disabilities helps the process go smoothly (FEMA 2013).

When blizzards or snowstorms occur, many students may not have the proper transportation to evacuate (FEMA 2013). The Transportation Planning Department develops procedures for mobilizing campus-wide transportation for an emergency because many students attending WMU do not have vehicles and rely heavily on the school's bus system.

There are many other departments related to the planning process (Human Resources, Legal Counsel, Residential Life, Student Affairs), but the collaboration of these departments previously stated help ensures proper communication with WMU and should not place a burden on a single person when a disaster occurs. These planning teams should be small enough to ensure close communication within them but large enough to be representative of the community overall. This is essential in ensuring proper communication is being held within a small group while dealing with a majority of people. Forming a common framework and defining assigned

roles help decrease the possibility of something going wrong during disasters. These planning teams are essential to my thesis in regard to demonstrate how WMU compares to standard FEMA protocol with planning and communication when an extreme winter weather event occurs.

Disaster Perception and Assessment through Communities and Universities

Since the 1970s there have been more than 9800 natural disasters worldwide, affecting more than 5.8 billion people, causing more than $1.7 trillion in estimated damages, and the numbers are steadily increasing (Kellenberg 2011). The annual average number of disasters worldwide over the 10-year period from 2006 to 2015 was 376 causing almost 70,000 deaths (Gajanayake 2020). Disaster assessment is a process to identify potential hazards that might occur and steps to gather information related to disasters and potential disaster responses. Identifying correct preventative measures ensures reduction of damages and loss of life.

It is essential to obtain an understanding of prior research regarding perception and assessment on natural disasters regarding extreme winter weather. Understanding perceptions of disasters throughout the world will help identify knowledge gaps within the topic and demonstrate what needs to be address about the lack of perception and preparedness of extreme weather events.

This subsection has two overall goals: 1) to demonstrate previous work on disaster perceptions related to the lack of awareness for people in many different types of communities; and 2) to examine disaster assessments to demonstrate the previous measures taken in order to reduce loss of life and damages due to natural disasters. Studies related to disaster perception and disaster assessment examine previous research related to the methodologies behind them.

Disaster Perceptions

How individuals perceive risk is an important factor in determining how they will respond to warnings of an impending natural hazard. There are several characteristics that fall within the field of perception such as: 1) individual experiences; 2) an individual's attempt to construct meaningful relationships among the pieces of information that are received; 3) an individual tending to select information that is relative only to personal experiences; 4) an individual's attempt to construct new information to fit an expected view of reality and; 5) an individual perceiving disasters differently in the same situation (Burn 1999).

Increasingly, universities are turning to preparedness of disasters in relation to previous experiences. The more a university has experienced a certain disaster, the better they can prepare for the next one. Tkachuck (2018) suggests that the relationship between university preparedness and actual preparedness is conditional on values of previous disaster experiences. The more people within universities that experience natural disasters, the more confidence people have in their university regarding mitigation techniques. Their actual preparedness did not increase for a number of reasons, but this study demonstrates how perception of disaster and preparedness of them result from previous experiences. Tkachuck (2018) found students' confidence in the university is related to the number of disasters student's experience.

Distributing a survey to 1,167 US colleges and universities from January 2010 to August 2011, a Basiaga and Olympia (2014) study demonstrated that 96 percent of US institutions have emergency and disaster plans, yet 10 percent do not practice the plan and 20 percent of them do not submit after action reports. Although most of the institutions participating in the study reported having an emergency plan, areas of improvement were identified such as disaster

response plans coordination, proper documentation when a disaster occurs, and many institutions lacked implementation throughout them. This is relevant to the previous work discussed because it demonstrates that universities might not be taking the proper measurements necessary if an extreme winter weather event could occur.

Another study also supports the conclusion that perception is directly correlated to preparedness is one conducted at Western Washington University. Researchers found that having students watch a preparedness video brought more knowledge about certain disasters and how to prepare for them as compared to students who did not watch it (Sattler 2014). Two-hundred twenty-two participants were surveyed involving a portion of students watching a video and completing a questionnaire whereas others were assigned to no emergency preparedness video and then had to complete the questionnaire as well. Questions were asked to participants such as "Do you know how to find updated emergency information on the university website?" and "Do you know what to do if an earthquake happens when you are in a campus building?" on a 5-point Likert-type scale. Student t-tests examined both groups and demonstrated a significantly higher mean with participants who viewed the video ($\overline{X} = 4.04$) versus students who did not watch the video ($\overline{X} = 2.62$). Participants who also viewed the video demonstrated to have more confidence in university emergency management and response. The video also increased feelings of self-efficacy and personal responsibility for emergency preparedness and response (Sattler 2014). This research is beneficial to understand that spreading awareness of information such as an emergency preparedness video exposes student to emergency preparedness protocol and promotes feelings of trust within the university.

A study conducted by researchers at the University of Waterloo in Ontario found the majority of students felt they were the most important actors in well-being during the first 72

hours after an emergency has occurred. However, most felt they were not prepared to deal independently with a disaster for the 72-hour period (Tanner 2015). In this study, 72.5 percent of the people surveyed (n = 58) had no emergency preparedness kit or specific emergency preparedness supplies on hand. Although many of the student felt they were responsible enough when a disaster occurred (69.2 %), this study demonstrated a lack of preparedness among students which can negatively affect the outcomes after an emergency situation. One fact worth mentioning from this study is that only 27.5 percent of the people surveyed had a battery-operated wind-up radio (Tanner 2015). This piece of information is important to show that many people do not have another form of communication when electronic devices no longer work.

Many people have different preparedness levels and that is demonstrated throughout the past research mentioned. Information on risk perception was collected in the Ebro Delta Coast, located on the northeast coast of Spain, with the help of on-site interviews. Respondents that were prone to flood areas were identified according to the use of the land (rice production-RP, water distribution cooperative- WD, salt manufacturer-SM, restaurants at Marquesa beach- RM, tourism organizations -TO, town council-TC and the coastal engineering -CE). Data involving the level of risk perception demonstrated that private stakeholders were generally less worried than public stakeholders (Raaijmakers 2008). The reasoning for this was because private stakeholders were unaware of what to do in case of an event (such as a flood) versus public stakeholders (authorities) which were involved in the development of land use plans. Many stakeholders showed a difference in levels for preparedness and most have little to no preparedness regarding the flood risk. This study demonstrated that citizens in Spain have quite a bit of worry regarding floods but are very ill-prepared regarding said disaster.

An example of a disaster management tool for extreme events includes the use of a disaster simulation. Simulations improve the disaster and crisis management capacity of an organization or society overall. Disaster simulations are beneficial for preparing people for disasters because simulations may show a type of crisis that falls outside the typical imagination. Having students and practitioners complete a 3-hour disaster simulation within the area of New York City, demonstrated that people became crisis converts (Boin et al. 2004). A crucial reasoning for the utilization of this simulation is the lack of awareness that a crisis can occur anywhere, anytime. Knowing this and being prepared for a disaster will help reduce the loss of life and damages that will occur by being more prepared.

Quality of life is always essential in understanding disaster preparedness and perception. Not only do citizens who live a better lifestyle have more understanding of disasters, they have the money and capabilities to prepare adequately for them (Hong 2020). Hong (2020) demonstrated how quality of life impacts an individual's disaster preparedness behavior while also considering the effects of self-efficacy and trust in government. A one-way analysis of variance (ANOVA) was applied to test the differences in quality of life, trust in government, self-efficacy, and preparedness behavior by socio-demographic variables. The study hypotheses were verified by using regression analysis based on 1682 samples. Results indicated that quality of life had a positive effect on preparedness behavior yet was directly impacted by government trust (Hong 2020). The positive effect on quality of life and preparedness behavior was only observable when government trust was enhanced. Understanding the influence of quality of life on preparedness behavior can greatly support research related to perceptions and understanding of disasters.

In the aftermath of a catastrophic event, an effective response will directly depend on the adaptive behavior of citizens, front line workers and middle managers (Boin 2007). Strategies for enhancing social resilience start with preparing first responders, business continuity planning, working with communities, joint training and other forms of training. First responders must be trained to act independently and effectively in dire circumstances. First responders should also be trained enough to asses when plans need to be implemented, modified, or rendered useless under certain conditions. Business continuity planning helps organizations think about setting up an emergency operation center (EOC), an off-site location to conduct operations and have information technology back up and mobile gathering units. Joint training revolves around having a continuous and comprehensive coordinating force to ensure effective planning across functional boundaries. Other training methods include political and organizational leaders having the need to develop resilient behavior in times of crisis, create expert networks, information assessment, organizing outside forces and initiating long term reconstruction (Boin 2007).

Disaster Risk Assessment

Quantitative risk assessment is a key part of the process, involving the evaluation of the significance of risk (Smith 2009). The main practical process is risk management which aims to mitigate threats of the known hazards while reducing damages. Achieving optimum safety involves controversial value judgements such as the way in which different impacts are compared to each other. (Smith 2009).

Hazard analysis is one of the key components to assessing natural disasters and understanding the technical definitions of a certain disaster. Extreme winter weather hazards include snowstorms, blizzards, extreme cold, and ice and sleet storms. Approximately 81 percent

of those storms occur during the months of January, February, March and April when conditions are most conducive for the development of ice and sleet (Michigan Hazard Analysis 2011). Frequency distribution of ice and sleet storms are greatest within five months of the year (December, January, February, March, April) and the rest of the year virtually no storms occur (Table 1). Data shown in Table 1 is essential for alerting communities of the time frame of extreme weather events and assessing when extreme winter events are more likely to occur.

Table 1. *Number of Occurrences of Ice and Sleet Storms Throughout Michigan. Source: Michigan Hazard Analysis (2011)*

Frequency Distribution of Ice and Sleet Storms in Michigan: 1970 – July 2007

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
17	10	14	6	0	0	0	0	0	0	3	9	59
29%	17%	24%	10%	0%	0%	0%	0%	0%	0%	5%	15%	100%

Source: National Weather Service; Storm Data, National Climatic Data Center (percentages are rounded off)

Disasters are not only natural but also a socio-natural phenomenon (Salas 2005). Disasters are regarded as a result of materialism of existing risks in which not only triggers (natural disasters) but also vulnerability conditions increase their impact and occurrence when managed inappropriately (Salas 2005). Communities need to have some form of risk assessment plan to mitigate damages done when a disaster occurs frequently. Risk cannot be completely eliminated, but it can be assessed and managed in order to reduce the impacts of a disaster (Smith 2009). Although damages occur, disasters can be seen as an opportunity to reveal a situation of existing vulnerability and to substantially improve areas that need to be improved.

Previous work brings together a group of indicators that measure risk management performance and effectiveness. The risk management index (RMI) is designed to quantify four

public policies each of which is described by six indicators (Figure 2;Carreno 2007). These four policies are identification of risk, risk reduction, disaster management, and governance and financial protection. Each of these policies have six indicators including individual perception, social representation, object assessment, prevention, mitigation and response and recovery. Examining methods or indicators will help evaluate overall vulnerability and disaster risk issues. The design of RMI involved establishing a scale of achievement levels or determining the distance between current conditions. RMI is one of the first systematic and consistent indexes developed to measure risk management performance (Carreno 2007). The following equation is used to measure those conditions overall:

$$RMI = (RMIri + RMIrr + RMIdm + RMIfp)/4. \quad \text{Eqn. 1}$$

RMIri is a measure of individual perceptions. RMIrr is a measurement of involving prevention and mitigation measures. RMIdm involves measures of response and recovery. RMIfp measures the degree of institutionalization and risk transfer. This type of work sets quantitative benchmarking during different periods and helps establish performance targets for improving management effectiveness.

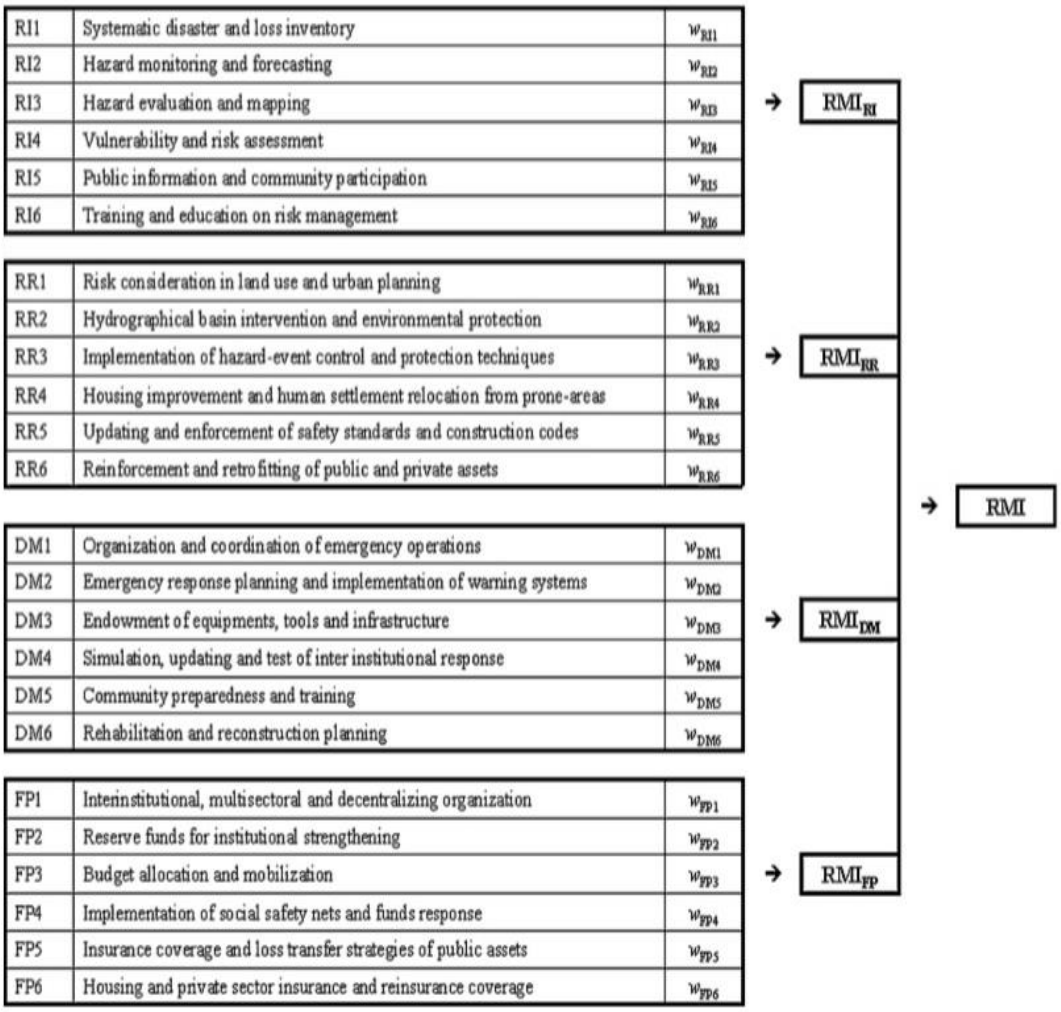


Figure 2: Six Indicators Used for RMI Modeling. Source: Carreno (2007)

Four practical operations of RMI (After action reviews, Recognition-Primed Decision Making, the edge of chaos, and the bowtie model) were examined to recognize the centrality of information flow among participating agents that include technical systems and human actors (Comfort 2005). After action reviews determine what went right, wrong and how to improve performance next time. Recognition-primed was a decision-making process that was formulating alternatives of disaster responses in light of likely consequences. The edge of chaos shows that typical organizations that move towards the chaotic end of disaster response typically have more

order than those who are not as prepared when a disaster occurs. The last method is the bowtie model showing a processing unit where data are integrated, analyzed, and interpreted to make improvements (Comfort 2005). The bowtie model (Figure 3) examines how new ideas are examined throughout emergency operation centers.

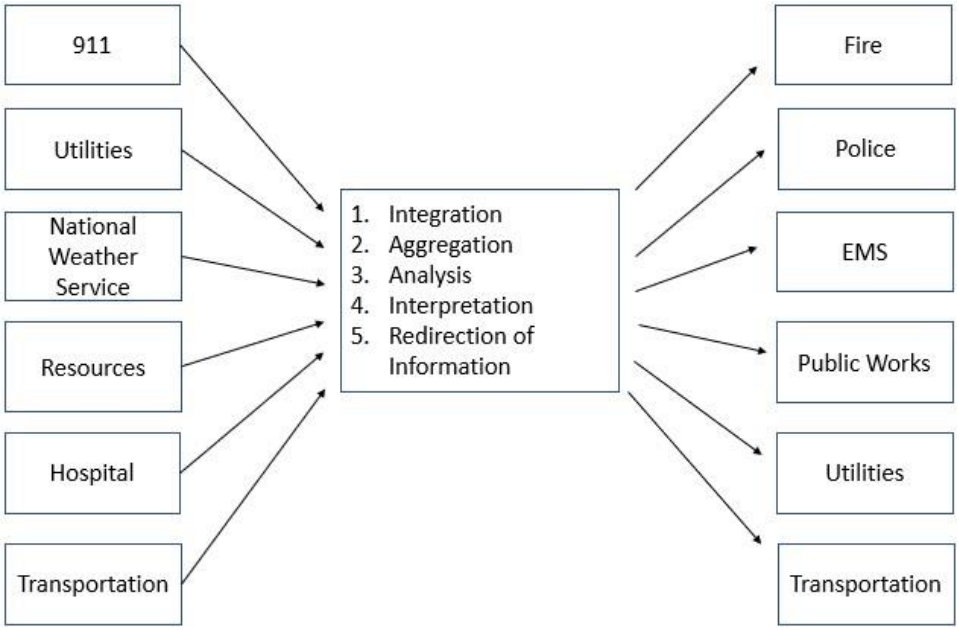


Figure 3: Bowtie Model throughout EOCs. Source: Comfort (2005)

Other research exists at a state level correlated with state hazard mitigation plans regarding infrastructures and critical facilities. According to FEMA guidance, state assessments "may include state-owned or operated buildings, infrastructure and critical facilities" (State Mitigation Plan Review Guide 2015, pp.15). Critical facilities, in turn, are described as those "structures that the state determines must continue to operate before, during and after an emergency" (State Mitigation Plan Review Guide 2015, pp 15). Assessing the vulnerability of two types of data within the state of Pennsylvania demonstrates inventory of state-owned facilities, estimated loss profits and visualized all geolocated buildings within the state. Figure 4

demonstrates how visualizing the distribution of buildings will help assess disastrous situations more smoothly. Visualizing these maps will help citizens be able to locate where structures are located that are considered critical facilities within the vulnerability assessment.

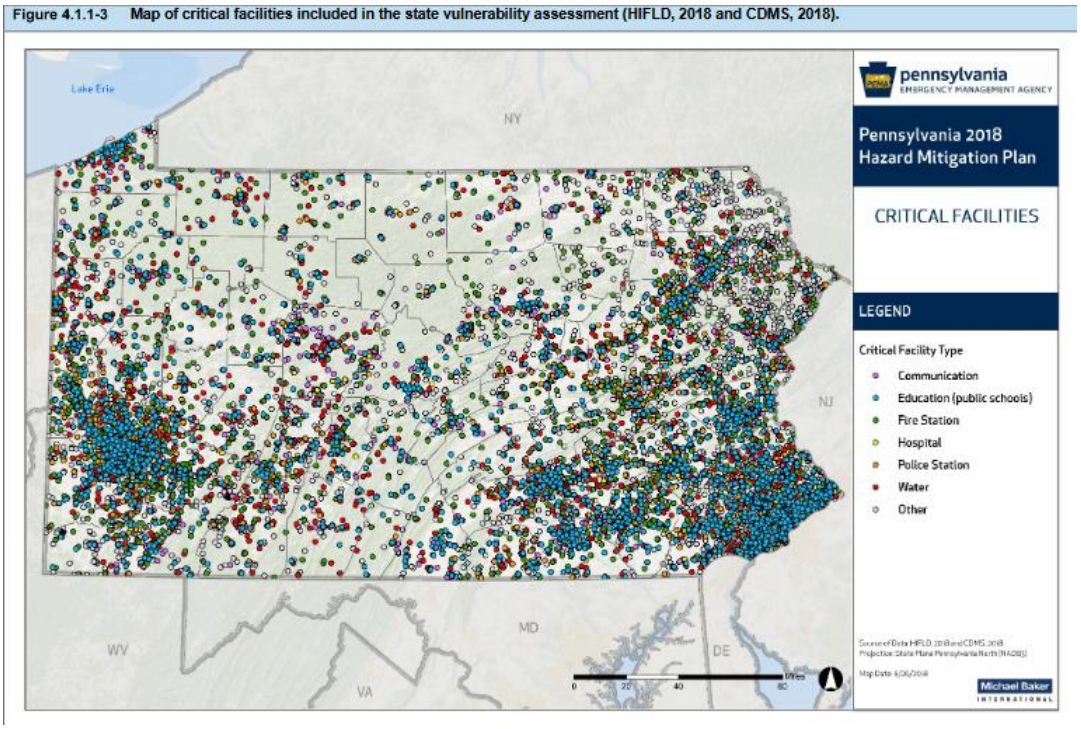


Figure 4: State Owned or Critical Facilitates by Type. Source: Baker International 2018

Past events are beneficial to understanding how devastating extreme winter weather events have been to certain communities. Extreme winter weather events have devastating effects on the costs of damages to repair infrastructure, the loss of lives and the recovery process as a whole. For instance, the 2011 Groundhog Day Blizzard brought 14 inches of snow from Oklahoma City to Chicago and Boston (Heise 2013). Ultimately, the blizzard caused 36 fatalities and $18 billion in damages. Another recent example is the Blizzard of February 2010 (Heise 2013). While no lives were lost, this disaster caused severe damage throughout the Pittsburgh

metro region, resulting in over $5 million in damages and recovery cost. Although blizzards might not be as destructive as in the past, many people might lack awareness when one occurs which could causes further damages and underscores the need for preventative techniques. When it comes to students' perceptions and preparedness of extreme winter weather events, examining past research methods is beneficial for understanding where some improvements could be taken within WMU's emergency management protocols. Describing planning roles within FEMA's protocols helped demonstrate where roles are implemented when disasters occur such as an extreme cold event. Methods used for this thesis are discussed in the next chapter describing what program was used, how data collection was performed and how a general analysis of the survey distributed was performed with the questions distributed.

CHAPTER III

METHODS

In places where severe winter weather occurs and is common, a snowstorm can become a disaster (Smith 1992). Administrators, faculty and staff at WMU must take preventative measures to ensure the safety of the students regarding extreme cold conditions. Previous research demonstrating that university students' increased awareness has proven to mitigate the effects of disasters. This chapter will describe the research methods and data used to gain information about hazard perceptions among WMU undergraduate students regarding extreme winter weather events.

Study Area

This study focuses on the main campus of Western Michigan University (WMU), which is located in Kalamazoo (Kalamazoo County), Michigan, USA. The campus is located approximately 50 miles from the eastern shoreline of Lake Michigan and experiences harsher snowfall than regions not neighboring water due to lake-effect snow. WMU has 22,562 students that are enrolled as of 2020 (Figure 5). WMU attracts a diverse, culturally rich student body and 82 percent of students attending are Michigan residents. This means that 18 percent of students are not from Michigan, so they have not fully understood the magnitude of extreme winter weather that can occur in Michigan.

From January 16-29, 2016, most of the lake-effect snow affected northwest lower and northern upper Michigan with this event leaving 12-18 inches of snow (Pollman 2016). On February 19, 2016, strong winds in excess of 70 mph downed many trees and limbs and left nearly 200,000 homes and businesses without power. The strong winds continued to cause

damage and power outages into February 20. By time the wind subsided, there was nearly $50 million in damage. Damages will only continue to increase in upcoming years and studying nearby regions will prepare students for preventative measures they need to take during these disastrous times.

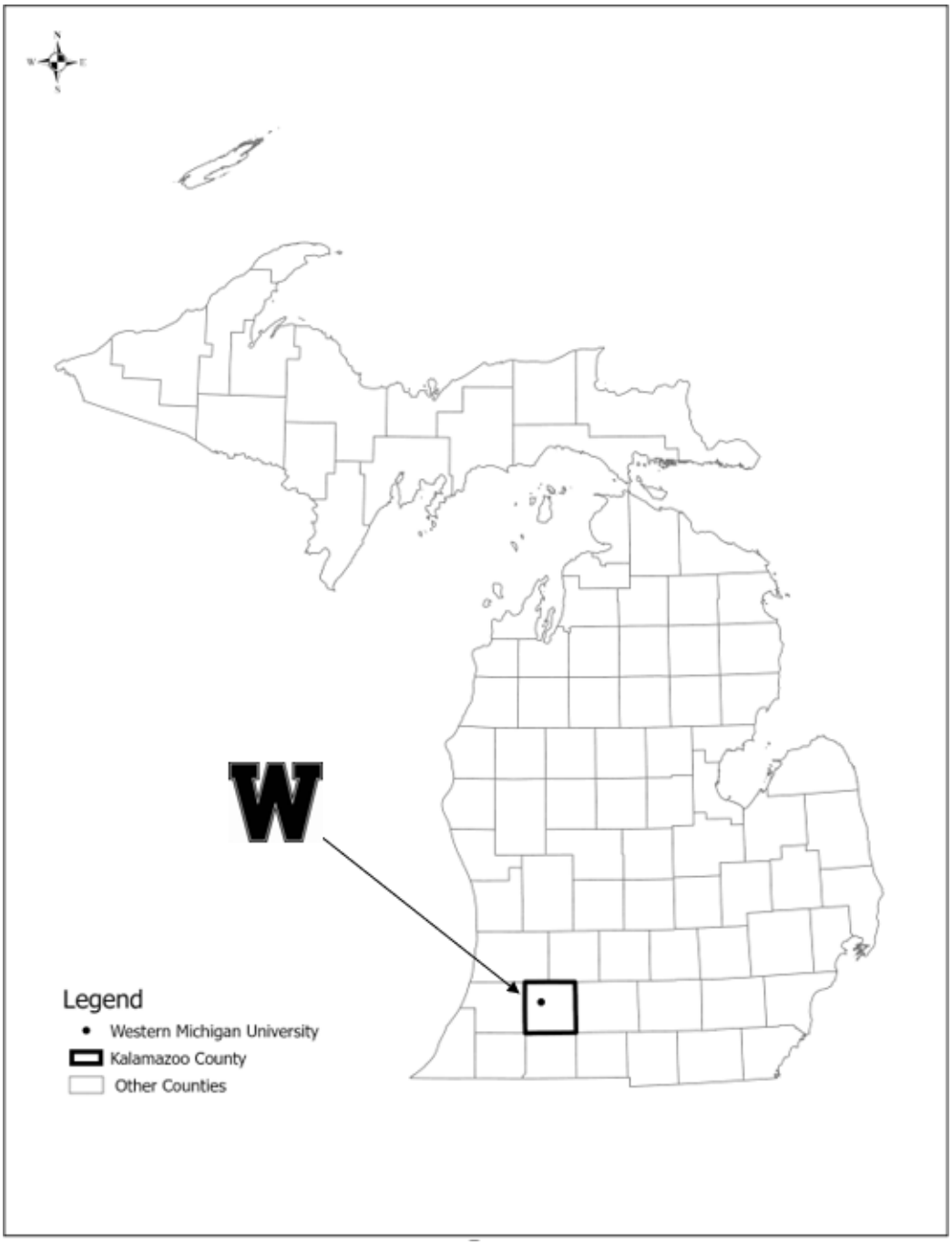


Figure 5: Labeling Western Michigan University within Kalamazoo County, Michigan.

Survey Instrument

A specially- designed questionnaire (Appendix A), approved by WMU's Human Institutional Review Board (HSIRB), was designed and used to learn more about student perceptions of extreme winter weather event awareness and preventative measures. To ensure anonymity, no identifying information was asked. Responses were in the form of fill-in-the blank, open ended, and a 5-point Likert-type scale. Qualitative questions were asked to see if students knew the difference between a blizzard watch and a blizzard warning, describing the last extreme cold event they experienced and how they received information regarding weather on campus. A list of effectiveness questions, confidence of performance questions and how much of a problem do you consider extreme cold events nearby was asked as well. These were asked using a 1-5 Likert style scale where 1= "Not effective" to 5 = "excellent communication or performance". Students were then asked to check off what preventative measures they take at home and in their vehicle when it comes to extreme cold events. Demographic questions are also asked in the beginning of the survey regarding gender, age, and how long they have lived in Michigan. Regarding formal training questions, they were asked on a YES/NO basis.

Data Collection

The web-based questionnaire was distributed through email and respondents completed the survey in Qualtrics beginning on March 31, 2020, through April 24th, 2020. An email blast (Appendix B) went out to a selected group of 5,000 WMU undergraduate students with the link to the survey. The survey contained the consent form (Appendix D) and the actual questionnaire. The selected group of WMU students was randomly generated by the University based on the criteria set forth in the HSIRB approved proposal (Appendix C), which helped to eliminate bias

based on a number of characteristics such as participating in a particular class or having a particular major. Surveying a large number of students ensured data samples were large enough to obtain accurate results and conduct statistical significance testing.

Statistical Analyses

Similar to work done by Kanclerz and DeChano-Cook (2013), survey questions were coded and analyzed using SPSS software using standard univariate descriptive statistics and/or multivariate statistical tests deemed appropriate. Standard univariate descriptive statistics were tests of count, median and mean of the questions asked. Multivariate tests that were conducted for the remaining questions were the Kruskal-Wallis test and the Chi Square test. These tests were conducted to demonstrate whether students have different perceptions of extreme cold events based on class standing and gender. As discussed in the hypotheses section, these tests typically had a null hypothesis that all students throughout WMU had similar perceptions regarding extreme cold events and blizzards. The alternative was that students throughout WMU had different perceptions regarding extreme cold events and blizzards based on class standing and/or variable demographic characteristics. The null hypothesis will be rejected when the significance level is less than or equal to alpha (0.05).

CHAPTER IV

RESULTS AND DISCUSSION

Demographics

A total number of 336 responses were collected through Qualtrics March 5 - April 24, 2020. Sixty-seven participants that took part in the survey were removed due to not finishing the survey or lack of information overall. A total of 269 WMU undergraduate students were used throughout this research. Ninety-one percent of the total respondents were shown to be between the age group of 18-25 (Figure 6). Sixty-five percent of respondents were female while 32 percent of males took the survey (Figure 7). More than half (61.34 percent) of respondents were juniors and seniors while the remaining respondents were freshman and sophomores (Figure 8).

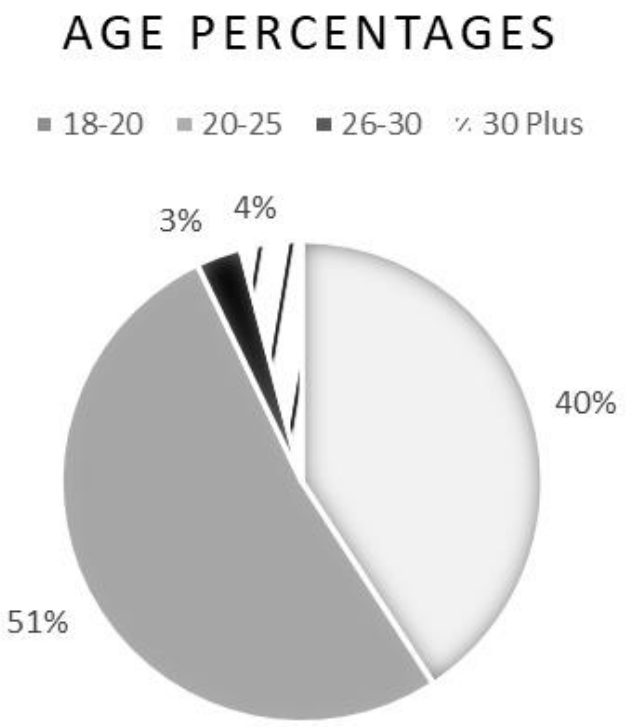


Figure 6: Age Percentages of WMU Undergraduate Respondents.

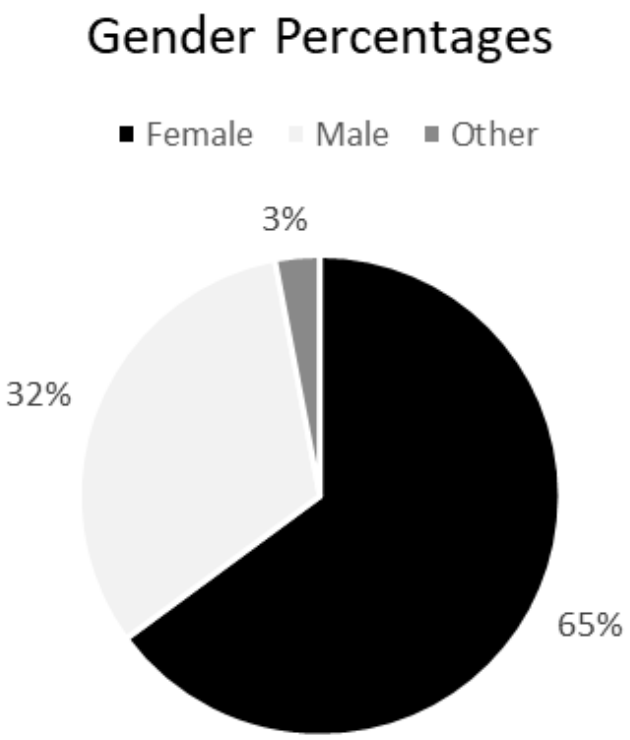


Figure 7: Gender Percentages of WMU Undergraduate Respondents.

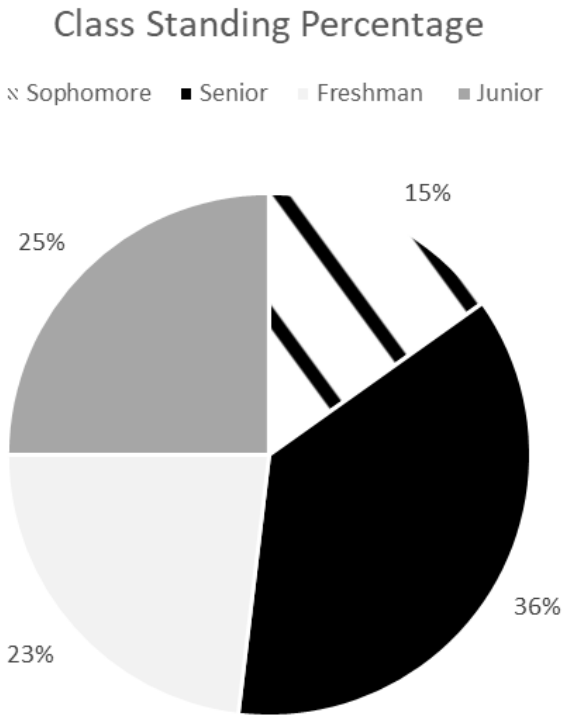


Figure 8: Class Standing Percentages of WMU Undergraduate Respondents.

Seventy-five percent of respondents reported living within Michigan for 10 or more years. This demonstrates that around 25 percent of the respondents have resided in Michigan for less than 10 years total. When it came to how many extreme cold events respondents have personally experienced, 80.67 percent said they have experienced four or more events within their lifetime (Table 2). Nearly 51 percent of female respondents have experienced four or more extreme cold events. Because a large number of respondents have lived in Michigan for more than 10 years, and 80 percent of respondents have experienced four or more events, it would seem likely that many respondents would know how to prepare for an extreme cold event. This analysis comes later in this section.

Table 2. *Percentage of Extreme Cold Events Experienced by Survey Respondents*

	Percentage of Extreme Cold Events Experienced				
	1	2	3	4+	Total
Female	4.46	6.32	2.6	50.56	64.68
Male	0.74	1.49	1.49	28.25	31.97
Other	0	0.37	0	1.86	2.23
Total	5.2	8.18	4.09	80.67	

Blizzard Warning vs Watch

When it comes to the standard definition of a blizzard watch versus a blizzard warning, a warning will usually be issued in advance with the possibility of a storm (within 24 hours) while a warning will be issued when a blizzard becomes imminent (US Department of Commerce 2015). Asking the question "What is the difference between a Blizzard Watch and a Blizzard Warning", 69 percent of respondents knew the difference between the two warning systems. Although this seems like a good portion, 31percent of the respondents did not know the

difference between a blizzard watch and warning. One percent of students answered “I do not know” while others confused a warning vs watch. This demonstrates that awareness can be spread to students for understanding the differences on warning systems which are time related. While 69 percent knowing the difference between a watch and a warning is good, education is still a good idea so that in the future a higher percentage will know the difference.

A Kruskal-Wallis test was conducted to demonstrate the significance level between class standing and their understanding of a blizzard watch vs blizzard warning. These results showed a significance level of 0.428, meaning there was no difference in class standing and their understanding of what a blizzard watch versus a blizzard warning. The reasoning why there is no difference is because the significance level is greater than alpha (0.05) meaning you fail to reject a significant difference between the two variables.

Perception Studies Based on Class Standing

In regard to perceptions of extreme cold events, a question was asked stating “On a scale from 1 to 5, with 1 not being a problem and 5 being a major problem, how much do blizzards or extreme cold events affects you daily life?” After gathering data, approximately 62 percent of the respondents answered within the 2-3 Likert style range (mean score = 2.78). Figure 9 demonstrates that students do not see blizzards or extreme cold events to be a huge impact throughout their daily living. Nearly 25 percent of respondents answered 4-5 on the Likert style range indicating that they do not perceive extreme cold events to be an issue. This may be because of experience with living in Michigan. Cold weather happens every winter and many students may be used to it and have learned how to go about their daily activities even when it is cold.

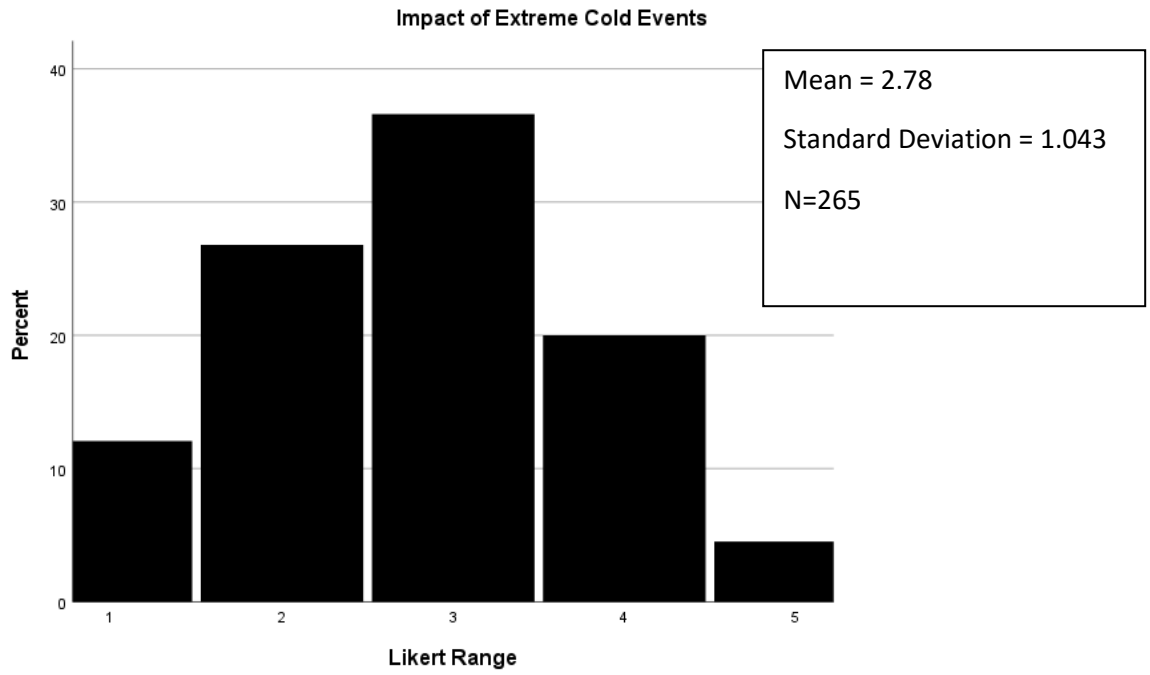


Figure 9: Histogram of Extreme Cold Events and Affecting Daily Life.

Table 3 highlights that there are no differences in perceptions among class standings and cold affecting daily life. The mean score between class standings fluctuated from 2.58-3.06 and had a significance level of 0.848 which demonstrated there is not a drastic difference between groups. Based on question 15_1 which was “On a scale from 1-5, 1 being poor and 5 being excellent, rate the performance of staff from WMU on: Plowing pathways when needed”(Performance on Plowing) the mean score range of class standing was 2.55-2.92 and a significance level of 0.329 which also demonstrated no perception differences among class standings. When it came to Question 15_2 which was “On a scale from 1-5, 1 being poor and 5 being excellent, rate the performance of staff from WMU on: Adequately closing school when need be” (Performance on closing school) the mean score range between classes was 2.53-2.79 and a significance level 0f 0.557 demonstrating no significant difference on perceptions on

classes as well. Question 15_3 which was “On a scale from 1-5, 1 being poor and 5 being excellent, rate the performance of staff from WMU on: Salting and or sanding roads and walkways to prevent icing”(Performance on Salting) the range of means scores between class standing was 2.40-3.00 and a significance level of 0.427 demonstrating no significant difference on perceptions between class standings.

Table 3. *Means Between Likert Style Questions and Class Standings*

	Cold Affecting Daily Life	WMU’s Performance on Plowing	WMU’s Performance on closing school	WMU’s Performance on Salting/Sanding
Freshman (1)	3.06	2.92	2.53	2.78
Sophomore (2)	2.66	2.55	2.79	2.76
Junior (3)	2.58	2.61	2.77	2.40
Senior (4)	3.06	2.86	2.79	3.00

A Kruskal-Wallis test showed the significance levels between class standings and the perception questions asked within this survey. Table 4 shows the significance numbers all being over the alpha (0.05). Since the significance level is over 0.05, it can be concluded that all class standings have the same perceptions on extreme cold events and performance of WMU.

Table 4. *Class Standing and Perception Questions*

Class Standing and Perceptions				
Questions	Q14_1	Q15_1	Q15_2	Q15_3
Significance level	0.845	0.329	0.557	0.427

Perception Studies Based on Gender

Running a Chi-Square test between gender and perceptions demonstrated whether there is a significant difference among gender and the perceptions they have. Examining gender with the "Affect Daily Life" question showed that there was no significant difference ($p=0.606$). For the question related to "Performance of Plowing", gender did not play a significant role in perception (i.e. males and females expressed the same perception) ($p=0.858$). Investigating gender and the "Performance on closing school" question resulted in a significance number of 0.364 indicating that there is no significant difference between genders with this question as well. A Chi-Square test was also conducted on gender and "Performance on salting road" to see if there was a difference between genders. The significance number came out to be 0.670 which indicated there is no significant differences between gender and the perception questions asked throughout the survey.

The results of a Kruskal-Wallis test that was conducted between gender the perception of WMU's communication effectiveness. Students were asked the following question: "Overall, on a scale from 1-5, 1 being not confident and 5 being highly confident, how confident are you in WMUs staff on communication and safety regarding winter snowstorms and blizzards?" Results show a significance level of 0.487 concluding there is no difference between groups of genders and their confidence on WMU's communication.

Comparing means between genders and their confidence in WMU communication (Table 5) also demonstrated how confident respondents are in WMU's communication efforts regarding extreme cold events. The mean for each group was 3.62 (females), 3.61(males), and 3.00 (other). This concluded that each group or gender shows no significant difference between them and their confidence on WMU's communication efficiency.

Table 5. *Means of Genders on Confidence with WMUs Communication Efforts*

Group (Genders)	Mean
Female	3.62
Male	3.61
Other	3.00

A Kruskal-Wallis test was conducted to compare the difference between gender groups and their understanding when it comes to a blizzard watch vs a blizzard warning. A significance level of 0.295 resulted from the test demonstrating there is no significant difference between genders and their understanding of the difference between a blizzard watch versus a blizzard warning.

Communication of WMU

Students were relatively confident in WMU's communication regarding extreme cold events. When asked "On a scale from 1 to 5, 1 being not confident and 5 being highly confident, how confident are you in WMUs staff on communication and safety regarding winter snowstorms and blizzards?" 27.5 percent of respondents answered 3 within the Likert style scale. Fifty-six percent of respondents answered within the 4-5 range on WMU's communication

effectiveness. This demonstrated that students believe WMU's communication efforts on winter storm events are effective and they are confident with the university.

Asking respondents "Where do you obtain your local campus information regarding weather?" was beneficial to understanding how WMU can better target students when extreme cold events occur. When asked this question, a majority of the respondents gather their weather information from campus text alerts (77 percent) and email was also an important mode of communication. This demonstrated that WMU is effective at distributing weather information to students which is an important tool to disaster management and response. Shown below (Table 6) are the percentages of where students received their information about weather:

Table 6. *WMUs Communication on Weather Information*

	Percentage
Email	52
Campus text alerts (WMU alert)	77
Radio or TV	8
WMU home page	18
Weather app	46

Mapping

Once the survey was distributed and collected, latitudes and longitudes of where students took the survey were given. Data for this were collected anonymously and were put on a separate spreadsheet so this was not with the rest of the survey information. Mapping the latitude and longitude provided a map which is representative of the data collected. Outliers were removed within the map that were not within the United States. This is beneficial to show because the survey was distributed when the COVID-19 quarantine was in effect and demonstrated where

students were when they completed the survey. Many students were in areas surrounding Chicago, Kalamazoo or the Detroit. Ninety-three percent of students that completed the survey are represented within the map. Many students that took the survey should have experience with extreme cold events based on the map provided. This map is important to understand that many people may have experience with extreme cold events yet lack awareness in preventative measures they could be taking.

Vehicle Preparations

When students are asked "Do you regularly (1+ times per week) drive an owned or borrowed vehicle (car, truck, etc.)?" a majority of respondents (63 percent) own or borrow a vehicle. This showed that nearly 37 percent of respondents do not own or currently have a vehicle. When it comes to transportation regarding WMU, some of these respondents might rely heavily on the public transportation system. Roads, bridges and transit systems are critical to emergency response. Extensive damage to transportation systems can leave a campus and its community paralyzed (FEMA 2003). If these extreme cold events occur, some of these students might not be able to get onto campus or be able to find transportation if school is still open. This is an important aspect for WMU's emergency team to consider and have alternatives in place for such an event.

Vehicle preparation is important to better prepare oneself for certain extreme cold events. Following FEMA's information, a list of equipment has been shown to help when keeping things within your vehicle. Some of these would be blankets, first aid kit, flashlights, emergency flares, ice scraper, jumper cables, food supplies, etc. When asking this question on the survey, the format was asked to see which of the following do students keep in their car in case they are

stranded by a blizzard or a snowstorm. Less than 50 percent of respondents carried a majority of these items within their car: blankets (40%), first aid kit (27%), flashlights (27%), emergency flares (9%), jumper cables (48%) and food supplies (11%) were all below the threshold of 50 percent (Table 8). The only thing that more than 50 percent of respondents had in their car was an ice scraper. “Other” included: water, snow shovel, cat litter, lighters and a toolkit.

The results of Table 7 demonstrate that respondents are ill-equipped when it comes to vehicle preparations. Preparing information on vehicle preparations that can be easily distributed to WMU students would be beneficial for the students. Examples of this would be a brochure (Appendix E) that could be mass distributed to students on campus or an emergency preparedness video similar to the Sattler (2004) study.

Table 7. *Vehicle Preparation*

Equipment	**Percentage**
Blankets	40
First Aid Kit	27
Flashlights	27
Emergency Flares	9
Ice Scraper	73
Jumper Cables	48
Food Supplies	11
Other	7

Using FEMA Standard guidelines, a question on the questionnaire was asked saying “When stranded in your vehicle what preventive measures do you take to ensure your safety during a snowstorm?” Respondents were able to check as many as were pertinent to them. Table 8 shows that a majority of people did not remain hydrated (33%), run your car for only a few minutes at a time (33%) or maintain their body heat by not moving too much (24%). These are

preventative measures to ensure you will not get hypothermia or increase your safety when stranded within a vehicle. Nearly 67 percent of students use hazard lights and 53 percent of students remain in their vehicle until the storm passes. Some examples of answers students included in the other section were to: Call someone and make sure they know your situation, using flares for extra visibility, using a shovel to dig yourself out and a portion of students said they have never been stranded before, so they have not had to practice protocol. These are preventative measures that help ensure the safety of citizens or students overall.

Table 8. *Preventive Measures for a Vehicle*

Totals	**Percentage**
Use Hazard Lights	67
Run your car for only a few minutes at a time	33
Remain Hydrated	33
Maintain your body heat by moving but not too much	24
Remain in your vehicle until the storm passes	53

Home Preparations

When it comes to home preparation, there are many preventive measures students should take to ensure their safety when stuck inside due to a snowstorm. Table 9 shows percentages of respondents' answers when asked the question of "Check any of the preventative measures taken beforehand to ensure your safety during a snowstorm." Many of the responses had less than 50 percent selected within the group of students responding. Percentages of preventative measures will not equal 100 percent due to allowing them to select multiple answers. Some of the preventative measures are keeping fire extinguishers on hand, insulating water pipes, allowing faucets to trickle, winterizing your home, having battery operated carbon monoxide detectors and having at least one gallon of water per person for at least three days. Other preventative measures

students have taken beforehand that were not within the list were: having generators for power outages, having candles, and having a battery-operated AM/ FM radio. Some of the other preventive measures were practiced more than the others (extra clothing, having blankets or sleeping bags, having rock salt and keeping pathways clear between storms) previously mentioned which is beneficial to disaster response if a situation would arise again.

Table 9. *Home Preparations for Extreme Cold Events*

Preventative Measures	**Percentage**
Keep fire extinguishers on hand and make sure you know how to use them	24
Insulated water pipes	33
Allow faucets to trickle during cold weather to avoid freezing	42
Winterize your home by weather stripping doors and windows and covering windows with plastic	35
Have battery operated carbon monoxide detectors	40
Have a 3-day supply of non-perishable food within your home	61
Have at least 1 gallon of water per person per day for at least 3 days	34
Extra clothing	77
blankets and sleeping bags in case you lose power	77
Rock salt to melt ice or other snow removal equipment	60
Keep pathways and driveways clear between storms to avoid buildup of snow	67

Formal Training

Formal training is imperative to disaster management and response. Students should have some formal training such as CPR/AED or Community Emergency Response Team (CERT) knowledge to better help mitigate certain situation if a disastrous event occurs. When asked

"Have you had any type of formal training regarding response measures to natural disasters?" a majority of the respondents do not have formal training whatsoever. Eighteen percent of respondents said they have some type of formal training regarding natural disasters. Some of these types of formal training regarding natural disasters include: Military disaster response training, State Police Incident training, Mass Casualty Medical Training and various survival classes. This demonstrates that approximately 82 percent of people do not have any training.

When asked "Do you have your CPR/AED certification?" 37.5 percent of respondents said they do have CPR/AED certifications. Although this is encouraging, more students should at least have CPR certifications. Formal training is imperative to reduce the loss of life and damages if a situation were to occur. The reasoning why this is important for this study is first aid training within schools has benefits for adolescents to increase health and safety knowledge relating to injury or cardiac arrest (Reveruzzi 2020). When a person is injured, actions taken by a bystander are crucial, and timely first aid can reduce harm.

Summary

Results demonstrated throughout this research indicate that there were no differences in class standing and gender on the perception of extreme cold events and performances of WMU regarding extreme cold events. Students' perception of extreme cold events demonstrated no difference and students seem to be neutral on how it affects their life yet if an event occurs, students seem to be ill-prepared. When it came to specific questions such as vehicle preparations, many respondents did not have the proper equipment in their car if an extreme cold event were to occur. Demonstrating that students do not take some preventive measures whether it be in home or vehicle preparations is beneficial to demonstrate the lack of preparations within a certain

community. If a situation was to arise and students were stuck in their vehicles because of an event, the analysis of this work shows they would not have taken the proper precautions necessary.

The results of this study showed that respondents were confident within their universities or communities road maintenance and communication. This aligned with the previous study of Heise 2013 where a majority of residents were satisfied with the community on the issue of road maintenance. On a scale from one to five (One being poor performance while 5 being excellent), they demonstrated a rating of 3.51 for salting roads and 3.77 for reopening roads. Heise demonstrates a higher confidence range while this study demonstrates a Likert style range of 2.4-3.00. This could be related to how frequently the Great Plains region experiences more blizzards as compared to Michigan.

Similar to the University of Waterloo study (Tanner 2015), many of the respondents surveyed in this study did not have emergency preparedness supplies on hand. While 72 percent of the people surveyed in the Sattler study did not have an emergency preparedness kit, a majority of respondents in this study did not have emergency equipment as well. Less than 50 percent of respondents carried a majority of these items within their car (Blankets, first aid kit, flashlights, emergency flares, etc.). This demonstrates students might be ill prepared when it comes to emergency equipment regardless of location.

Suggestions for Improvements at WMU

Throughout this study, it is demonstrated that educational programs need to be implemented to spread awareness on preventative measures of extreme winter weather events. Similar to the preparedness videos shown in the Sattler 2014 study, videos might be beneficial

for an educational method to spread awareness to Western Michigan University. Spreading awareness to the students on preventative measures such as being properly equipped within vehicles or homes is the first step to have WMU better prepared. Better preparing students on specific measures such as these will help make WMU a more disaster resilient university as a whole. One way of doing this could be to distribute the brochure provided in Appendix E to all students on campus. Another thing that WMU could do to become more disaster resilient would be hazard identification. Identify hazards that present risk to students and to the campus is the first step in identifying where help is needed. Once this has been done, developing an awareness plan document for students would be the next phase.

Planning is an integral part of many higher educational institutions (FEMA 2003). Once this awareness plan has been written, implementing the plan is where the focus shifts. An integrative approach to implanting this awareness plan would be a beneficial way to ensuring students understand the material or objectives that are being conveyed. Coordinating with emergency management officials on preventative measures and emergency equipment students should have is the first step which will help reduce the consequences of many extreme events. Whether a mandatory training exercise or awareness seminar is the best option, getting the attention of students and spreading awareness of emergency equipment needed for situations is the where work needs to be done throughout Western Michigan University.

CHAPTER V

CONCLUSION

Research has indicated that there is not a significant difference between genders and class standings regarding extreme winter event perceptions. These results demonstrated that although respondents believe extreme winter events to be not that big of an issue, they neglect taking preventive measures regarding these certain events. They understand the risk of blizzards, snowstorms, freezing rain, etc. but they do not have emergency equipment or would not practice certain precautionary steps if an event were to happen. A beneficial takeaway from this research is to understand that steps to understanding winter hazards involves following through with precautionary steps to reduce the risk of damages throughout the event.

Throughout this work, many different approaches could have been used to have a better understanding of perceptions of extreme weather events of WMU students. After gathering the data from the respondents, some of the respondents had to be omitted from the survey due to the format which was set up in Qualtrics. A portion of the respondents either left options blank on questions throughout the survey or did not complete the survey all together. Having less open-ended questions throughout the survey would have helped with the problem of having unanswered questions and would have increased the number of respondents used in the data analysis in this work. This is one of the reasons where methods of the survey could have been different in this research.

Another limitation or had to do with COVID-19 quarantine being in effect. Many of the possible respondents might have not had the capability to internet access where they would have if they were on campus. These data were not representative of WMUs undergraduate population because it resulted in a 1.5 percent total of the overall undergraduate population that was

involved within this questionnaire. Although following WMUs standard protocol is required, a mass email larger than 5000 undergraduate students would have yielded a higher response rate.

This research is beneficial for future research in regard to universities becoming more disaster resilient. Demonstrating that students understand the risk but do not take the preventative measures necessary helps other universities understand that this might be a problem in other states as well. Universities that might experience more risk to natural disasters or events might want to adopt the approach of educating students on the standpoint of having emergency equipment within homes or vehicles. The more frequent these events occur, the more imperative it is that students have the necessary equipment for response to whatever events occur within the region.

Another reason this study will be beneficial to other universities is to understand that many students do not have formal training regarding natural disasters or emergency events. Depending on how severe and how frequent natural disasters occur within certain universities, formal training helps reduce the loss of life and reduces the amount of time for a recovery period. This is why examining how many students, faculty or staff have training will help better understand how well certain universities are prepared.

Although this work has been examined on the basis of student respondents, students should not be the only people being educated on the preventative measures needed for extreme winter events. Faculty, staff and local citizens should be educated on how to prepare for extreme winter events which will help increased community resiliency. Continued education and awareness throughout universities or communities will help citizens be more prepared if a disastrous event strikes.

Appendix A

Extreme Cold Event Survey

Survey

1. Gender (Please choose one): ____ Male _____ Female _____Other

2. Age? _____

3. Are you from the United States?

3. Hometown?

4. State? _____ If not from U.S., what country? _____

5. How long have you currently resided in Michigan?

6. Year at WMU (Please choose one):

- _____ Freshman
- _____ Sophomore
- _____ Junior
- _____ Senior

Extreme cold events are defined as: Temperatures at or below freezing for an extended period of time (at least two hours).

7. Based on your definition, how many extreme cold events have you personally experienced?

- _____ 1
- _____ 2
- _____ 3
- _____ 4+

8. Describe the last snowstorm or blizzard you remember experiencing?

9. What is the difference between a Blizzard Watch and a Blizzard Warning?

10. On a scale from 1-5, with 5 being a major problem, how much do blizzards or extreme cold events affect your daily life?

1 2 3 4 5

11. On a scale from 1-5, 5 being excellent, rate the performance of staff from Western on:

Plowing pathways when needed	1	2	3	4	5
Adequately closing school when need be	1	2	3	4	5
Salting roads early to prevent icing	1	2	3	4	5

12. Where do you obtain your local campus information regarding weather?

- _____Email
- _____Campus text alerts (WMU alert)
- _____Radio or TV
- _____WMU home Page
- _____Weather app
- _____ Other, Specify

- 13. Do you regularly (1+ times per week) drive an owned or borrowed vehicle (car, truck, etc.)?

- 14. Which of the following do you keep in your car in case you are stranded by a blizzard/snowstorm? (Check all that apply)

  _____ Blankets

  _____ Coats, hats or gloves

_____ First aid kit

_____ Flashlights

_____ Emergency flags/flares

_____ Ice scraper

_____ Jumper cables

_____ Food Supplies (Water and non-perishable food)

_____ Other, Specify:

- 15. When stranded in your vehicle, what preventative measures do you take to ensure your safety during a snowstorm?

  _____Use Hazard Lights

  _____Run your car for only a few minutes at a time

  _____Remain Hydrated

  _____Maintain your body heat by not moving too much

  _____Remain in your vehicle until the storm passes

  _____ List other options

- 16. List the preventative measures taken beforehand to ensure your safety during a snowstorm. (Check all that apply)

  _____ Keep fire extinguishers on hand and make sure you know how to use them

  _____ Insulated water pipes

  _____ Allow faucets to trickle during cold weather to avoid freezing

  _____ Winterize your home by weather stripping doors and windows and covering windows with plastic

  _____Have battery operated carbon monoxide detectors

_____ Have a 3-day supply of non-perishable food within your home

_____ Have at least 1 gallon of water per person per day for at least 3 days

_____ Extra clothing, blankets and sleeping bags in case you lose power

_____Rock salt to melt ice or other snow removal equipment

_____ Keep pathways and driveways clear between storms and avid buildup of snow

_____ Other:

- 17. Overall, on a scale from 1-5, 5 being excellent, how confident are you in WMU's staff on communication and safety regarding winter snowstorms and blizzards?

  1 2 3 4 5
- 18. Do you have your CPR/AED certification? ___ Yes ____ No
- 19. Have you had any type of formal training regarding response measures to natural disasters? _____ Yes _____ No
- 20: Please describe the type of formal training you have obtained regarding natural disasters?
- *Thank you for your time and participation in this important research project.*

Appendix B

Mass Email Format

Email Sent to the Student Body and Faculty

Hi all,

My name is Connor Landeck and I am a master's student in the Geography program here at WMU. I am writing to invite you to participate in a research study investigating student and faculty perceptions and preparation measures regarding extreme winter events. Please see below for details:

Extreme Cold Event Survey
Research Participation Opportunity

The purpose of this study is to gather information about the experiences of WMU student and faculty regarding preparation measures and perceptions of extreme cold events and to better understand the needs to educate the community.
What to do: Complete an online survey which will take approximately 15 minutes to complete.
Eligibility: Any current WMU student of faculty member that wants to participate in the survey.
Benefits of participation: Participants who complete the survey will have the opportunity to enter a raffle for one of the four $30 Amazon gift cards.

If interested in learning more about participating, please follow this link: LINK PROVIDED LATER

Best regards,
Connor Landeck
MS Student, Geography
Western Michigan University

Appendix C

HSIRB Approval Letter

WESTERN MICHIGAN UNIVERSITY

Human Subjects Institutional Review Board

Date: March 23, 2020

To: Lisa DeChano-Cook, Principal Investigator
Connor Landeck, Student Investigator for thesis

From: Amy Naugle, Ph.D., Chair

Re: IRB Project Number 20-02-56

This letter will serve as confirmation that your research project titled "Extreme Cold Event Perception and Preparedness of Western Michigan University Undergraduate Students" has been **approved** under the **exempt** category of review by the Western Michigan University Institutional Review Board (IRB). The conditions and duration of this approval are specified in the policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note: This research may **only** be conducted exactly in the form it was approved. You must seek specific board approval for any changes to this project (e.g., ***add an investigator, increase number of subjects beyond the number stated in your application, etc.***). Failure to obtain approval for changes will result in a protocol deviation.

In addition, if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the IRB for consultation.

The Board wishes you success in the pursuit of your research goals.

A status report is required on or prior to (no more than 30 days) March 22, 2021 and each year thereafter until closing of the study. The IRB will send a request.

When this study closes, submit the required Final Report found at https://wmich.edu/research/forms.

Note: All research data must be kept in a secure location on the WMU campus for at least three (3) years after the study closes.

251 W. Walwood Hall, Kalamazoo, MI 49008-5456
PHONE: (269) 387-8293, FAX: (269) 387-8276

Appendix D

Informed Consent Letter

Western Michigan University

Department of Geography

Principal Investigator: Lisa DeChano-Cook
Student Investigator: Connor Landeck

You are invited to participate in this research project titled "Extreme Cold event Perception and preparedness of Western Michigan university Student."

STUDY SUMMARY: This consent form is part of an informed consent process for a research study and it will provide information that will help you decide whether you want to take part in this study. Participation in this study is completely voluntary. You may choose to not answer any question. The purpose of the research is to: Make WMU a more disaster resilient university and will serve as Connor Landeck's thesis for the requirements of the MA in Geography. If you take part in the research, you will be asked to complete a survey regarding perception and preparedness of extreme cold events. Your replies will be completely anonymous, so do not put your name anywhere on the survey. Your time in the study will take 15 minutes to complete the survey. Possible risk and costs to you for taking part in the study may be no financial costs but a cost of time to complete the survey and potential benefits of taking part may be gaining an understanding of preparation measures you need to take in order to be safer when an extreme cold event occurs. Your alternative to taking part in the research study is not to take part in it.

The de-identified (anonymous) information collected for this research may be used by or distributed to investigators for other research without obtaining informed consent from you.

Should you have any questions prior to or during the study, you can contact Lisa DeChano-Cook at (269) 387-3536 or lisa.dechano@wmich.edu or the Connor Landeck at (269) 325-1664 or Connor.j.landeck@wmich.edu. You may also contact the Chair, Institutional Review Board at 269-387-8293 or the Vice President for Research at 269-387-8298.

This consent has been approved by the Western Michigan University Human Subjects Institutional Review Board (HSIRB) on "(study approval date).

Participating in this survey online indicates your consent for use of the answers you supply.

Add buttons to click:

I agree to participate in this research study	(Survey following upon clicking)
I do not agree to participate in this research study	(Browser closes)

Appendix E

Brochure

Watches, Advisories and Warnings

Winter Storm – Conditions favorable for a winter storm which is threat to life/property

Blizzard Watch – Conditions favorable for a blizzard (< ¼ mile of visibility; 35+ mph winds)

Winter Weather Advisory – issued any one or more is expected:

- Snow of 3-5 inches in 12 hours
- Sleet < ½ inch
- Freezing rain with sleet/snow
- Blowing snow

Freezing Rain Advisory – ice accumulation of < ¼ inch

Winter Storm Warning – heavy snow of 6 inches in 12 hours or 8 inches in 24 hours, or sleet of ½ inch or more

Ice Storm Warning – ice accumulation of ¼ inch of more

Blizzard Warning – blizzard conditions for at least 3 hours

Definitions are from the National Weather Service.

For more on WMU's Winter Weather Closure Policy

https://wmich.edu/policies/closure

To find out of campus is open:

WMU Homepage
https://wmich.edu

WMU Alert System

Area radio and television stations

WMU Emergency Information Phone Line
(269) 387-1001

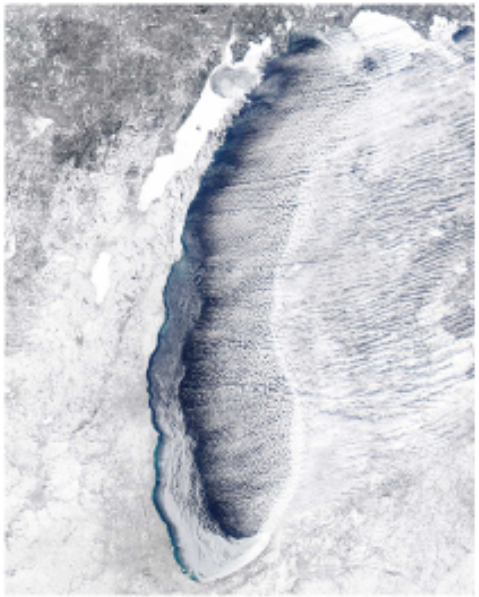
WESTERN MICHIGAN UNIVERSITY

Emergency Management

https://wmich.edu/emergencymanagement

WESTERN MICHIGAN UNIVERSITY

Extreme Cold Weather Preparation



About Extreme Cold Weather

Extreme cold weather (including winter storms) creates a higher risk of car accidents, hypothermia, frostbite, carbon monoxide poisoning, and heart attacks from overexertion. Winter storms including blizzards can bring extreme cold, freezing rain, snow, ice and high winds.

A winter storm can:

- Last a few hours or several days.
- Cut off heat, power and communication services.
- Put older adults, children and sick individuals at greater risk.

Extreme Cold Weather Preparation

Things to do or have on hand at home:

- Insulate pipes
- Allow faucets to drip so pipes do not freeze
- Weather strip window and doors
- Keep pathways/driveway clear
- Fire extinguisher
- Batter operated carbon monoxide detector and radio
- 3-day supply of non-perishable food
- 1 gallon of water per person for at least 3 days
- Extra clothing, blankets, sleeping bags for loss of power
- Snow removal equipment (rock salt, shovel)

Things to do or have on hand in your car:

- Blankets, mittens, socks, hats
- Ice scraper and snow brush
- Flashlight and extra batteries (or hand-crank flashlight)
- Jumper cables
- First-aid kits
- Bottled water
- Road flare or reflective warning triangles

Dress for Conditions

- Cover your head, ears, and hands (hat, gloves/mittens, scarf)
- Layer clothing using 3-4 light layers
  - Outer layer – loose fitting, windproof, water-resistant
- Wear socks and sensible shoes (insulated walking shoes/boots with rubber soles)

After It Warms Up

- Check your pipes for any that may have burst
- Salt your sidewalks and shovel away any snow that you can
- Call your neighbors, especially if they are seniors, disabled, or living along
- Refill your supplies so you will be ready for the next time.

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