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The Ferocity of Recently Occurring Heat Waves Across the Globe and Its Potential Impact on Global Manufacturing.

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Abstract: Extreme heat waves, which can last for days and be accompanied by high humidity, are a relatively new area of climate change research with important societal and economic repercussions. The severity of a natural hazard and the degree to which people are susceptible determine the risk associated with an effect of climate change. All throughout the world, recent heat waves have been examined for their severity in this research. Previous research failed to successfully compare heat wave intensity across continents and throughout time. Many catastrophic heat wave incidents have posed serious threats to public health in recent decades. Since both the frequency and intensity of heat waves are predicted to increase, it is crucial to evaluate the relationship between heat waves and health markers that could be employed in early warning systems to direct public health response. Forecasts for future climate change indicate an increase of over 4 degrees Celsius in annual average temperatures. As the average temperature of the Earth has increased, so too have the frequency, duration, and intensity of heat waves in various parts of the world. There have been increasing reports of heat-related deaths as average temperatures and heat wave intensity have risen. The study's goal was to learn about the global impacts of recent heat waves. We did a cross-sectional analysis using data from 200 participants. Important results were gleaned from the survey. If these results hold up, they might be useful in putting up plans to deal with global warming as part of a larger climate change effort.

Keywords: Heat waves, ferocity, global, human health, manufacturing organisation.

Introduction

Hotter and more frequent hot days are being experienced all throughout the world, while cooler days are becoming less common.(C2es, n.d.) The study of climate change has been thrust to the forefront of the social and political sciences thanks to the media's increased focus on the topic in recent years. Our understanding of the Earth's climate system has advanced greatly because to the quantity of data provided by the scientific community on the future climate, as well as the consequences and hazards of predicted global warming. The topic of climate change's prominence in today's public and political discourse is well-deserved.(denning, 2021a)

Because of global warming, extreme weather events like heat waves, droughts, floods, cyclones, and wildfires have increased in frequency. Researchers looking into climate change now consider heat waves to be a "hot" topic because of the recent spate of intense heat waves. A popular research from 2004 in Science predicts "more severe, more frequent, and longer lasting heat waves in the twenty-first century."(Meehl& Tebaldi, 2004) In meteorology, a heat wave is defined as an extended stretch of exceptionally hot weather, typically accompanied by high levels of humidity. In light of the fact that heat waves manifest differently depending on location, we can only define them in relation to the local climate and seasonal norms.(Marx, Haunschild, & Bornmann, 2021)

Heat waves will not only become more often in a future warmer environment with rising mean temperatures, but their length and severity are also quite likely to grow.(Fountain, 2021) Many climatic indices have been used in recent years to measure the length and intensity of heat waves by comparing midnight minimums with daytime maximums.(Li, Gu, Bi, Yang, & Liu, 2015a) It has been discovered, however, that none of these indicators is particularly robust when used to evaluate heat wave severities in different locations and over different periods of time. Most heat wave indices (relating to

human health, wildlife, agriculture, bushfire-wildfire control, transportation, electricity, and power) are created with a particular effect group or industry in mind. As a result, they may not be as useful in other contexts, with other people, or at other times.(Russo et al., 2014)

Both the frequency and severity of climate-related natural catastrophes have skyrocketed in recent decades. An extended period of excessively high temperatures that is greater than the average or maximum values observed during the same time period in the past is referred to as a heat wave. When heat waves get dangerous enough to put people's lives in jeopardy, that's when we start to take notice. When it comes to determining whether or not a heat wave will occur, local factors (such as population acclimatization, age, or health preconditions) and other meteorological variables (such as wind speed and direction) matter more than any of the hundreds of indices used to make such a determination (such as humidity and wind speed).(F & R., 2018)

Impact of heat waves in 21st century

Midway through the summer, we've already witnessed fatal floods in China and Germany as well as heat waves that would make Death Valley appear pleasant in the Pacific Northwest and Canada. Recent weather disasters have shocked many people, despite scientists' predictions that such disasters will become more common and severe as a result of slow but steady shifts in the global climate. There are a few key points to remember about how climate change contributes to this kind of catastrophic weather.(Overland & Wang, 2021)

To begin, the "normal" has changed because of the excessive amounts of carbon dioxide and other greenhouse gases that humans have released into the sky. For instance, a recent research released on July 26, 2021, demonstrates that the frequency with which record-breaking, long-lasting heat waves occur is rising, and that this increase is related to the pace at which the planet is warming. Second, global warming cannot be blamed for all instances of severe weather.(denning, 2021)

Global warming has been extensively discussed over the last several decades because of the serious threat it presents to human health and social stability.(Pascal et al., 2021) Climate change, according to a growing body of scientific opinion, will cause more frequent and severe weather occurrences (such as heat waves). For instance, in 2011 the United States was hit by about fourteen weather and climate-related disasters that had devastating effects on the economy and human life. Around 15,292 new high temperature records were set in the United States in March 2011 due to heat waves and other weather-related disasters. (Shafiei Shiva, Chandler, & Kunkel, 2019) Although though their physical, social, environmental, and economic implications are poorly understood, heat waves can have significant detrimental effects on people's health in many temperate countries.(Heo, Bell, & Lee, 2019) Adelaide, like many other Australian towns, is no stranger to summertime heat waves. Much of south-eastern Australia was hit by a severe heat wave in late January and early February of 2009, and the memory of that event is still vivid for many people today.(Zhang et al., 2017) Early 2009 heat wave had significant social, economic, and environmental effects. An estimated 500 people in South Australia and Victoria died from heat-related causes. In South Australia, a heat wave is declared when the thermometer reads 35 degrees Centigrade or higher for three days in a row, or 40 degrees Centigrade or higher for a total of five straight days. Even before the historic heat wave of early 2009, Adelaide had endured significant heat waves in both 2008 and 2010. Heat waves in 2008 and 2009 were unprecedented in their length (15 and 13 days, respectively), and the 2009 heat wave was also exceptional in its severity, with six days in a row recording temperatures over 40 degrees Celsius and a peak of 45.7 degrees Celsius on a single day.(Saniotis et al., 2013) Five days in a row in Adelaide reached above 35 degrees Celsius, with four days reaching over 40 degrees Celsius, during the 2010 heat wave. Adelaide has average monthly highs of 27.0 °C29.5 °C from December to March, the height of summer and early autumn. As the climate changes, heat waves in Adelaide are expected to become more common and more severe. Australian and international authorities have acknowledged the dangers posed by heat waves. According to epidemiological research, a variety of anatomical, physiological, and environmental characteristics make some demographic groups more susceptible to heat waves.(Black, Karoly, & King, 2015)

Many people, especially the most vulnerable, experience emotional and psychological anguish as a result of climate change. People are worried about the effects of climate change, according to research. But, studies demonstrate that people are able to distinguish between how climate change will affect their own lives and how it would affect society as a whole. Others worry more about the societal effects of climate change, maybe because they think that the hazards connected with these effects are larger for individuals who are geographically or temporally remote from them. Some people are more concerned about their own health, wealth, comfort, and safety. Even if the science of climate change is complex and up for debate, it is crucial to remember that the public has questioned the connection between heat waves and global warming.(Baldwin, Dessy, Vecchi, & Oppenheimer, 2019)

In addition, people's preexisting knowledge, information they get from numerous sources, and daily interaction within the community may impact their attitudes and views on climate-related threats like heat wave. There is a rising need to learn how the general population feels about environmental problems. Several studies have looked at how the general public views climate change, and they've all come to the same conclusion: people's opinions on the subject shift with time.(Zuo et al., 2015) Some people don't think they're susceptible to heat waves, according to other research that looked at how people feel about heat waves. Australia has a lot of heat waves, but there hasn't been much research done on how people feel about them in the context of climate change.(Akompab et al., 2013)

Heatwaves, or sustained periods of high temperature, may have serious consequences for civilization, including an increase in heat-related fatalities.(Nori-Sarma et al., 2019) Although though heatwaves produce a disproportionately high number of deaths and property damage, they are often overlooked as a natural disaster threat. More than 166 thousand people died from heatwaves between 1998 and 2017. More than 70 thousand of these deaths occurred during the 2003 heatwave in Europe.(Tomczyk, Bednorz, & Półrolniczak, 2019)

Because of climate change, more individuals will have to endure uncomfortable temperatures. Global extreme temperature occurrences are reportedly becoming more frequent, longer, and stronger. A rise of almost 125 million persons who experienced heatwaves between 2000 and 2016 is attributed to climate change.

Although the urban heat island (UHI) effect may amplify the negative impacts of heat in urban areas, extreme heat may still have a significant impact on the lives and well-being of those living in less populated areas, both during and after the event.(Ward, Lauf, Kleinschmit, & Endlicher, 2016)

Power shortages or even blackouts may occur when heatwaves put a strain on water, electricity, and transportation systems in addition to health and emergency services. The loss of crops or cattle due to abnormally high temperatures may also threaten people's access to food and their ability to make a living.(who, n.d.) Review of literature

(Im, Pal, & Eltahir, 2017) According to prior research, the wet-bulb temperature at which humans can possibly survive is 35 degrees Celsius. Under the "business as usual" scenario of future greenhouse gas emissions, we predict that by the end of the twenty-first century, wet-bulb temperature extremes across South Asia will have reached and, in some locations, surpassed this key threshold. Several highresolution simulations of climate change provide the basis for this assessment. Due to their large population concentrations and thriving agricultural operations, the areas around the Ganges and Indus rivers are especially susceptible to the effects of possibly catastrophic heat waves.

(Van Oldenborgh et al., 2018)The highest measured maximum temperature in India was 51.0 °C at Phalodi on 19 May 2016. Experts predicted that, like the rest of the globe, India would experience more frequent and severe heat waves as a result of global warming. The increase in greenhouse gas emissions cannot be explained by decadal variability, as it has been offset by other factors. These factors include rising air pollution that blocks sunlight and increased irrigation that promotes evaporative cooling. Existing climate models cannot assign heat waves in this region because they do not accurately capture these processes. Air pollution reduces health consequences, while excessive humidity worsens them. (Li, Gu, Bi, Yang, & Liu, 2015b) The health of humans has been put at serious risk by a number of heat wave catastrophes during the previous few decades. It is crucial to evaluate the connection between heat waves and the metabolic parameters that may be utilised in early warning mechanisms to coordinate the public health response because both the intensity and frequent of heat waves are expected to rise in the future. The majority of research indicates that heat waves may have a deleterious effect on morbidity, but only in the short term. Heat waves exacerbated the need for medical attention for those with preexisting conditions, particularly the elderly, children, and men. Societal variables, such as lower socioeconomic level, have been linked to increased heat sensitivity.

(F & R., 2018) As average temperatures have risen and heat waves have become more common and severe, so have reports of deaths caused by extreme heat. The Centre for Research on the Epidemiology of Disasters (CRED) found that between 1996 and 2015, heat waves were a contributing factor in five of the twenty worst catastrophes recorded. The origins of heat waves, how dangerous temperature thresholds are determined, existing trends, and future predictions in light of climate change are all examined in this chapter. Preventative measures are recommended after an association between heat wave episodes and an increase in fatality rates was found.

(Akompab et al., 2013) In recent years, Adelaide, a city in South Australia, has seen unprecedented heat waves, endangering the nation's health. Researchers conducted a cross-sectional survey of 267 residents of the area over the summer of 2012. More than half of those surveyed (50.3%) agreed that people in Adelaide had already felt the consequences of recent heat waves. These findings might influence how heat waves are portrayed and addressed in Adelaide in relation to climate change.

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Objectives

1. To examine the perception and attitude towards heat waves in the context of climate change in the world.
2. To assess the severity of recent heat waves that have been experienced world wide
3. To ascertain how heat waves affect international industrial companies.

Research Methodology

There were 200 respondents in the sample, making this a cross-sectional study. For this study, closed-ended questionnaires are used to gather data. After reviewing the existing research on the effects of heat waves, a questionnaire was developed. Due to remoteness, we mailed questionnaires worldwide with the help of Google Forms to get the responses. The population for the study comprises of the respondents from the globe to collect information about the impact of heat waves. For this study we used SPSS tool to perform the research analyses.

Analysis and results

Table 1: Age

Age of the Respondent		
	“Frequency”	“Percent”
“21-25 years”	26	13.0
“26-30 years”	74	37.0
“31-35 years”	35	17.5
“36-40 years”	38	19.0
“40+ years”	27	13.5
“Total”	200	100.0

The Age of the Respondent is covered in the preceding table. The frequency is 26 and the percentage is 13.0 for people aged 21 to 25. Frequency is 74 and percentage is 37.0 in 26–30 years. The frequency is 35 and the percentage is 17.5 in the 31–35 year range. The frequency is 38 and the percentage is 19.0 in 36–40 years. The frequency is 27 and the percentage is 13.5 in people over 40. Graph 1: Age

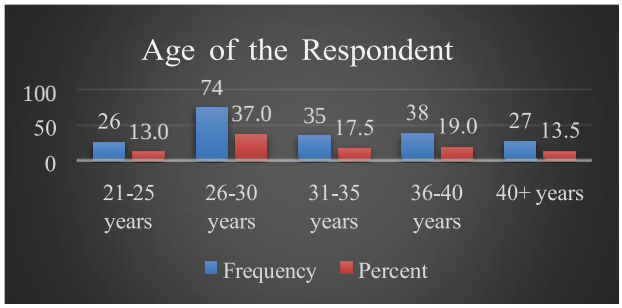

Table 2: Gender

Gender of the Respondent		
	“Frequency”	“Percent”
“Male”	“113”	“56.5”
‘Female”	“87”	“43.5”
“Total”	“200”	“100.0”

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The above table discuss about the Gender of the Respondent. The frequency is 113 and the proportion is 56.5 for men. Frequency is 87 and percentage is 43.5 for females. Graph 2: Gender

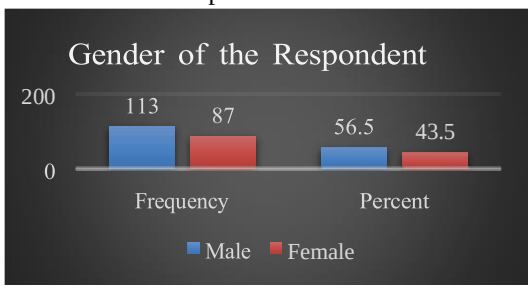

Table 3: Impact of heat waves on global manufacturing organizations

Have global manufacturing organizations been affected by the brutality of the recent worldwide heat waves?		
	“Frequency”	“Percent”
“Yes”	“108”	“54.0”
“No”	“92”	“46.0”
“Total”	“200”	“100.0”

The above table discuss about the global manufacturing organizations affected by the brutality of the recent worldwide heat waves. The frequency and percentage for yes are 108 and 54.0, respectively, whereas the frequency and percentage for no are 92 and 46.0.

Graph 3: Impact of heat waves on global manufacturing organizations

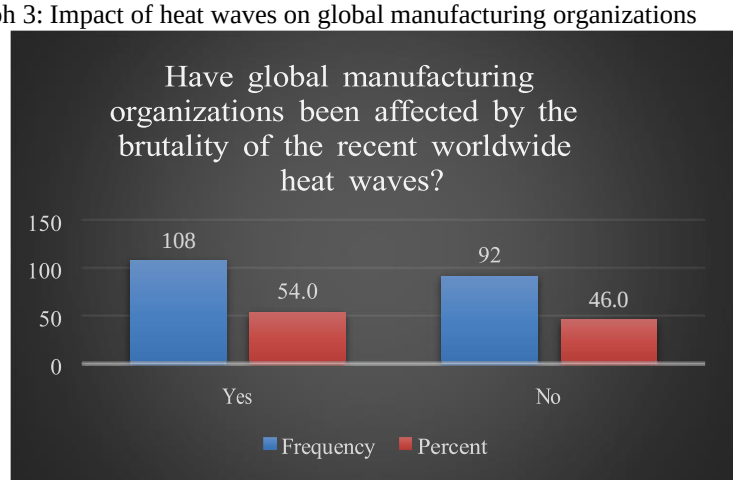

Table 4: heat-related illness

Did any of your family member suffered heat-related illness due to heat wave?		
	“Frequency”	“Percent”
“Yes”	140	70.0
“No”	60	30.0
“Total”	200	100.0

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The status of family members who contracted a heat-related ailment as a result of the heat wave is discussed in the table above. The frequency is 140 and the percentage is 70.0 for "yes." The frequency and proportion in no are both 60 and 30.0.

Graph 4: heat-related illness

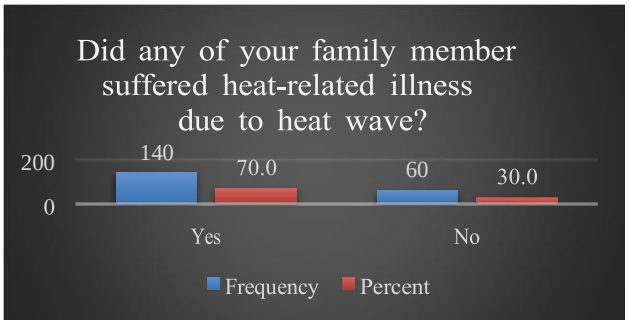

Table 5: Impact of heat waves on public health

Did your family faced or are facing any public health impacts of heat wave?		
	Frequency	Percent
Yes	125	62.5
No	75	37.5
Total	200	100.0

The above table discuss about the status of family faced or are facing any public health impacts of heat wave. The frequency is 125 and the percentage is 62.5 for "yes." The percentage is 37.5, while the frequency is 75.

Graph 5: Impact of heat waves on public health

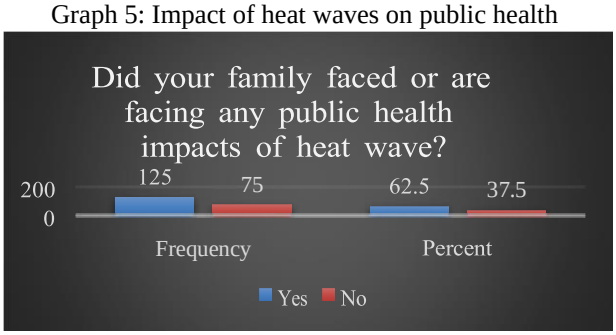

Table 6: Impact of heat waves on mental health

Did any of your family member suffered mental health effects of heat wave?		
	“Frequency”	“Percent”
“Yes”	111	55.5
“No”	89	44.5
“Total”	200	100.0

The above table discuss about the status of family member suffered mental health effects of heat wave.

In yes the frequency is 111 and percentage is 55.5. In no frequency is 89 and percentage is 44.5. Graph 6: Impact of heat waves on mental health

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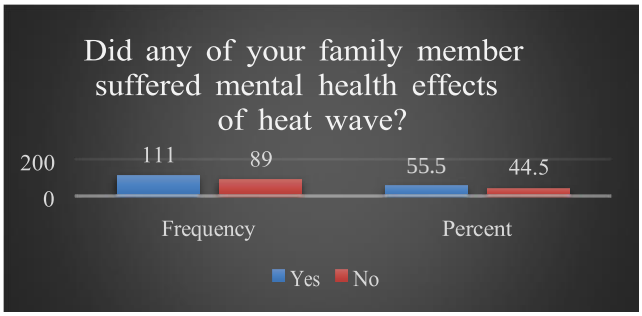

Table 7: Measures of protection

Are you familiar with some measures you can take to protect yourself from a heat wave?		
	“Frequency”	“Percent”
Yes	“150”	“75.0”
No	“50”	“25.0”
“Total”	“200”	“100.0”

The above table discuss about the status of some measures you can take to protect yourself from a heat wave. In yes the frequency is 150 and percentage is 75.0. In no frequency is 50 and percentage is 25.0.

Graph 7: Measures of protection

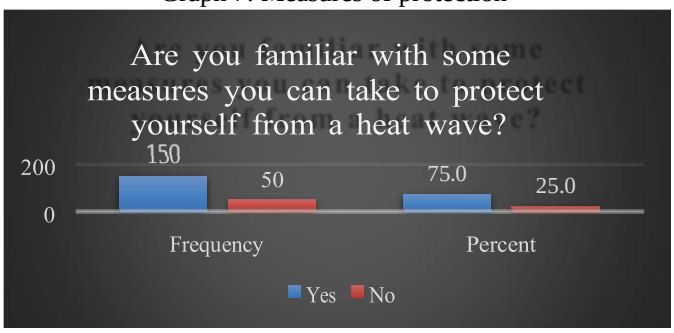

Table 8: Last heat wave took place in your city

Do you know when the last heat wave took place in your city?		
	“Frequency”	‘Percent”
“Yes”	“128”	“64.0”
“No”	“72”	“36.0”
“Total”	“200”	“100.0”

The state of the most recent heat wave that occurred in your city is discussed in the above table. The frequency is 128 and the percentage is 64.0 for "yes." 72 is the frequency in no, and 36.0 is the percentage

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Graph 8: last heat wave took place in your city

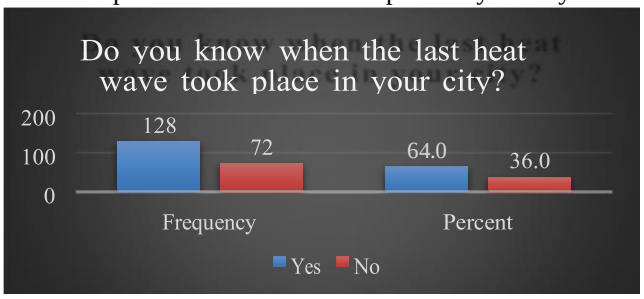

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Table 9: Symptoms of heat waves

"Can you name some of the symptoms people may experience due to a heat wave?"		
	"Frequency"	"Percent"
"Yes"	"141"	"70.5"
"No"	"59"	"29.5"
"Total"	"200"	"100.0"

The symptoms that people may suffer as a result of a heat wave are discussed in the above table. The frequency is 141 and the percentage is 70.5 for "yes." The proportion is 29.5 and the frequency is 59.

Graph 9: Symptoms of heat waves

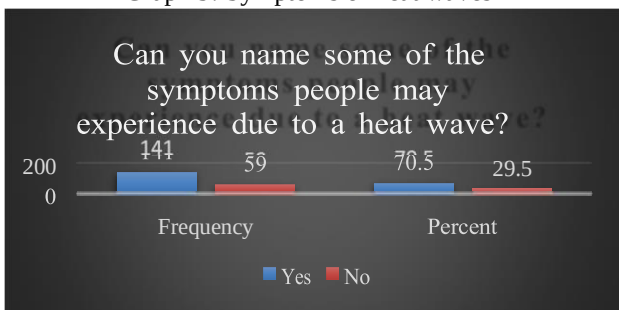

Table 10: Impact of heat wave/extreme temperatures

Do you feel worried about the effects of heat wave/extreme temperatures?		
	"Frequency"	"Percent"
"Yes"	107	53.5
"No"	93	46.5
"Total"	200	100.0

The above table discuss about the status of worried about the effects of heat wave/extreme temperatures. The percentage of yes is 53.5 and the frequency is 107. The proportion is 46.5 and the frequency is 93 in no.

Graph 10: Impact of heat wave/extreme temperatures

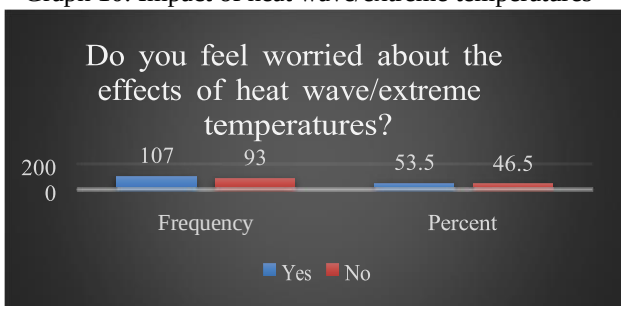

Table 11: Effect of heat waves on development

Do you agree with that heat waves effects social and health development of the people?		
	"Frequency"	"Percent"

“Strongly Agree”	63	31.5
“Agree”	31	15.5
“Neutral”	38	19.0
“Disagree”	40	20.0
“Strongly disagree”	28	14.0
“Total”	200	100.0

The state of heat waves' effects on peoples' social and physical development is discussed in the table above. The frequency and percentage of strongly agreeing are 63 and 31.5 respectively. The percentage is 15.5, while the frequency is 31. 38 is the frequency and 19.0 is the percentage in neutral. The percentage of disagree is 20 and the frequency is 40. The frequency is 28 and the percentage is 14.0 for strongly disagreeing.

Graph 11: Effect of heat waves on development

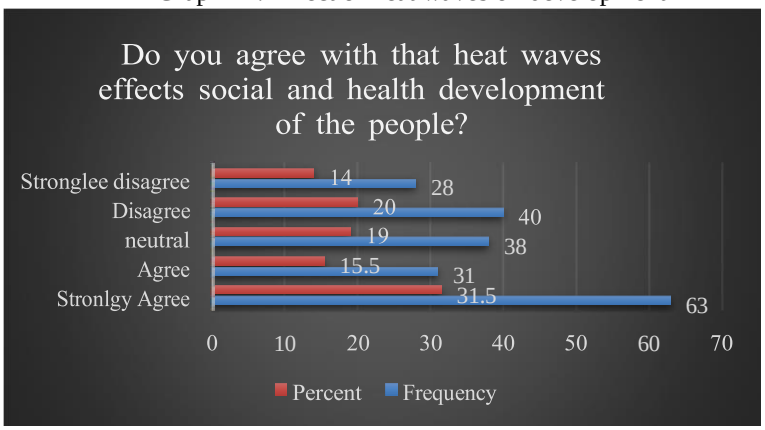

Table 12: Effect of heat waves on natural hazards

“Do you agree with that Heat waves are among the most dangerous of natural hazards?”		
	“Frequency”	“Percent”
“Strongly Agree”	66	33.0
“Agree”	28	14.0
“Neutral”	39	19.5
“Disagree”	40	20.0
“Strongly disagree”	27	13.5
“Total”	200	100.0

The state of heat waves, one of nature's most dangerous threats, is discussed in the chart above. The frequency is 66 and the percentage is 33.0 in a solid agreement. The proportion is 14.0 and the frequency is 28. 39 is the frequency and 19.5 is the proportion in neutral. The percentage of disagree is 20 and the frequency is 40. The frequency is 27 and the percentage is 13.5 in strongly disagreeing.

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Graph 12: Effect of heat waves on natural hazards

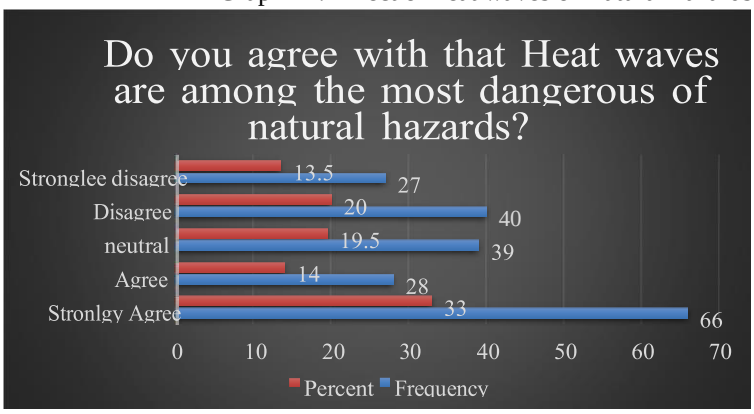

Table 13: Effect of heat waves on increased Energy Demands

"Do you agree with that the Impact of Heat Waves increased Energy Demands?"		
	"Frequency"	"Percent"
"Strongly Agree"	68	34.0
"Agree"	28	14.0
"Neutral"	38	19.0
"Disagree"	40	20.0
"Strongly disagree"	26	13.0
"Total"	200	100.0

The state of the impact of heat waves' increasing energy demands is discussed in the table above. The frequency is 68 and the percentage is 34.0 in cases of great agreement. The proportion is 14.0 and the frequency is 28. 38 is the frequency and 19.0 is the percentage in neutral. The percentage of disagree is 20 and the frequency is 40. The frequency is 26 and the percentage is 13.1 in strongly disagree. Graph 13: Effect of heat waves on increased Energy Demands

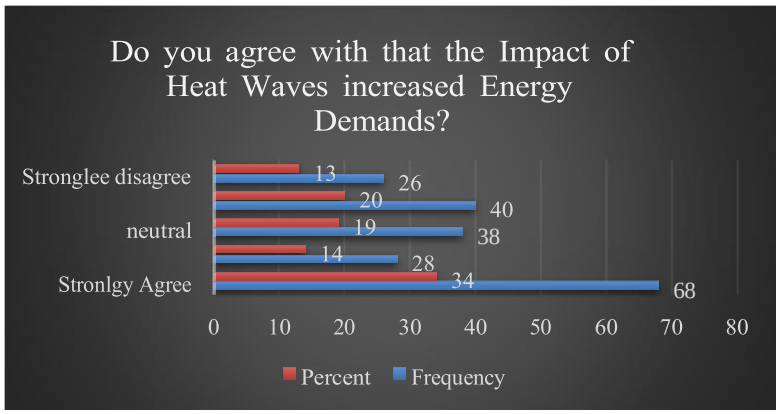

Table 14: Expect information about next heat wave

From whom do you expect information about what to do during the next heat wave?		
	Frequency	Percent
I don't know	20	10.0

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Police/fire brigade	28	14.0
Health authority	50	25.0
Environmental agency	35	17.5
Meteorological agency	15	7.5
Health care professionals	52	26.0
Total	200	100.0

The information on what to do during the upcoming heat wave is discussed in the table above. The frequency is 20 and the percentage is 10.0 in I don't know. The frequency is 28 and the percentage is 14.0 in the police/fire brigade. The frequency and proportion in Health Authority are 50 and 25, respectively. The frequency and percentage in Environmental Agency are 35 and 17.5 respectively. In the Meteorological Agency, the proportion is 7.5 and the frequency is 15. Professionals in healthcare have a frequency of 52 and a percentage of 26.0.

Graph 14: Expect information about next heat wave

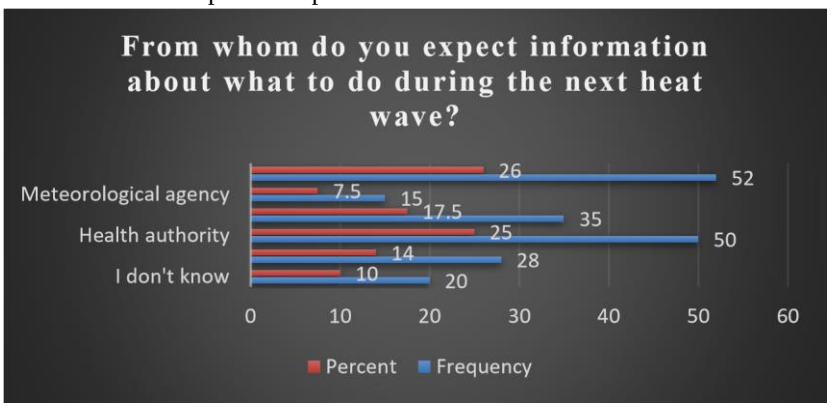


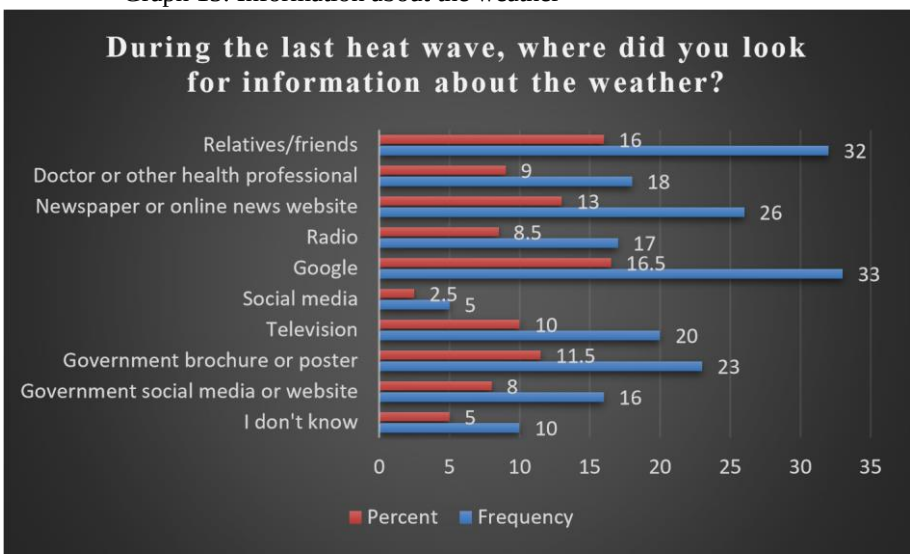
Table 15: Information about the weather

During the last heat wave, where did you look for information about the weather?		
	Frequency	Percent
I don't know	10	5.0
Government social media or website	16	8.0
Government brochure or poster	23	11.5
Television	20	10.0
Social media	5	2.5
Google	33	16.5
Radio	17	8.5
Newspaper or online news website	26	13.0
Doctor or other health professional	18	9.0
Relatives/friends	32	16.0
Total	200	100.0

The information on what to do during the upcoming heat wave is discussed in the table above. The frequency is 10 and the percentage is 5.0 in I don't know. In Government social media or website the frequency is 16 and percentage is 8.0. The

frequency and percentage in a government brochure or poster are 23 and 11.5 respectively. 20 is the frequency and 10 is the proportion in television. In social media, the percentage is 2.5 and the frequency is 5. Google reports a frequency of 33 and a percentage of 16.5 percent. In radio, the proportion is 8.5 and the frequency is 17. In Newspaper or online news website the frequency is 26 and percentage is 13.0. In Doctor or other health professional the frequency is 18 and percentage is 9.0. In Relatives/friends the frequency is 32 and percentage is 16.0.

Graph 15: Information about the weather



Conclusion

This study's objective was to evaluate the intensity of recent global heat waves. In general, respondents indicated that they were aware of heat waves and worried about their impacts. Regarding several of the themes covered in the study, sentiments did differ. It was found that during a heat wave, respondents mostly got their information from government pamphlets or posters, television, Google web services, newspapers or online news websites, and family and friends. Organizations engaged in global manufacturing are significantly impacted by heat waves. Families of emergency personnel have experienced severe effects from heat waves all across the world. Most of the people are feeling sick due to the heat waves all over the world. People's health is being negatively impacted by the heat wave. Our study shows that heat waves affect people's social and health development. The majority of people in the globe concur that heat waves are the most dangerous natural hazard. People around the world are preparing to implement measures to prevent future heat waves.

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