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ORIGINAL RESEARCH

Nursing Students' Perceptions about the Effects of Climate Change on Health: A Descriptive Exploratory Study

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Abstract

Background: Climate change is recognized as an important health concern that the health sector and nurses must prepare for. Adequate preparation and understanding of its effects on health must be exemplified by nurses and nursing students. Previous studies showed that nurses and nursing students have good knowledge of climate change and its effects on health. However, none of these studies were conducted in the Philippines.
Purpose: This study explored the perceptions of nursing students about the effects of climate change on health.
Methods: The researchers utilized a descriptive qualitative research design. The study was conducted among level three Bachelor of Science in Nursing students selected through purposive sampling using the following criteria: a) students who were enrolled with a full load of units in the BSN course, and b) those who have not taken Disaster Nursing course in the previous semesters. A total of 35 participants were included in the study. Data collection was done through an interview using a researcher-made interview guide. Data analysis was done through content analysis.
Results: Two major themes were identified, which describe the perceptions of the nursing students about the effects of climate change on health. The findings revealed that the respondents have an adequate understanding of what climate change is and the factors that cause it. The respondents also mentioned that climate change negatively affects the physiological health of humans. Specifically, climate change increases the risk for non-communicable disease such as cardiovascular and respiratory diseases. It also alters certain characteristics of communicable diseases such as prevalence, seasonal pattern, and geographic distribution.
Conclusion: The findings revealed that student nurses know what climate change is and are aware that it negatively affects health. However, their perceptions of the effects of climate change on health are limited to its physiologic effects, specifically on non-communicable and infectious disease, as this reflects their understanding of how environmental factors affect disease pathogenesis or development.

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1. Introduction

Climate change is any long-term, measurable change in climate, which includes global warming and results from either natural or man-made events (National Aeronautics and Space Administration, 2015). Climate change has been found to negatively affect health both directly and indirectly (Butler, 2018; Dupraz & Burnand, 2021; Weilnhammer et al., 2021). Studies describe the variations in the climate that directly affect health as extreme weather events, which include heat waves, torrential rains that lead to flooding, droughts, storms and cyclones, and wildfires (Butler, 2018; Harper et al., 2015; Sun et al., 2022; Weilnhammer et al., 2021). The health effects linked with extreme weather events include: 1) thermal stress, which increase the mortality of vulnerable individuals especially the elderly; 2) floods which cause traumatic injuries, exposure to toxic substances, and possible death; 3) increased incidence of communicable diseases such as diarrheal diseases, vector-borne diseases, and respiratory infections; 4) airborne

allergies from polluted air ; 5) malnutrition resulting from changes in crop yields; 6) mental stress and behavior problems; and 7) complications from chronic pathologic conditions (Opoku et al., 2021; Sun et al., 2022; Weilnhammer et al., 2021).

The World Health Organization [WHO] (2021) stated that climate change threatens to cause the emergence of new diseases and increases the occurrence of prevailing diseases in humans. WHO (2021) also reported the prevalence of malnutrition as a result of poor quality and quantity of crop production and flooding. Indirect effects of climate change include a decrease in the quality and supply of potable water, food insecurity, social disruption, and population displacement (Butler, 2018; Crowley & Health and Public Policy Committee of the American College of Physicians [HPPC/ACP], 2016; Weilnhammer et al., 2021). Climate change is cited as one of the environmental risk factors to disability-adjusted life year (DALY), which is a measure of disease burden or the number of years lost to a disease (WHO, 2021). Due to the many adverse effects of climate change on human health, it is regarded as one of the most important health threats in the contemporary time and must be addressed also as a health problem and not merely an environmental issue (Butler, 2018; Hathaway & Maibach, 2018; Weilnhammer et al., 2021). This, therefore, means that health professionals have an active role in mitigating or preventing the negative effects of climate change on health (Anåker et al., 2015; Dupraz & Burnand, 2021).

The effects of climate change on health are felt worldwide but may differ across populations and geographical locations (Cianconi et al., 2020; Rocque et al., 2021). Moreover, there are a multitude of factors that can determine the extent of the effects of climate change on human health. Vulnerable groups that are at a higher risk are the elderly, children, pregnant women, those with underlying conditions, those with low socioeconomic status, outdoor workers, people living in certain geographical locations, and certain cultural-traditional groups (Ebi et al., 2021; Harper et al., 2015; Kreslake et al., 2016; McIver et al., 2016; Rocque et al., 2021). This implies a need for in-depth knowledge, understanding, and commitment, especially among allied health professionals, to effectively address climate change as an important health threat (Crowley & HPPC/ACP, 2016; Dupraz & Burnand, 2021; Hathaway & Maibach, 2018).

Knowledge and understanding of climate change and its effects on health are affected primarily by a person's educational status. People of higher educational status tend to have a better understanding of climate change and its effects (Lujala et al., 2015; Ofori et al., 2023; Siña et al., 2016). Physicians, nurses, and other allied health professionals possess a good understanding of how environmental factors affect health and well-being. This implies that allied health professionals must also have a very good grasp of the effects of climate change on health and the factors that affect an individual's vulnerability to such effects (Dupraz & Burnand, 2021; Opoku et al., 2021). Studies also found that physicians, nurses, and most allied health professionals have good knowledge about the effects of climate change on health (Anåker et al., 2015; La Torre et al., 2020; Hathaway & Maibach, 2018). However, these healthcare professionals also verbalized a desire to have a better knowledge and understanding of the effects of climate change on health, which suggests a need for enhancing education and training regarding this to better prepare for and mitigate these effects (Crowley & HPPC/ACP, 2016; Dupraz & Burnand, 2021; Hathaway & Maibach, 2018). Moreover, in-depth knowledge could be a strong factor in determining the successful implementation of appropriate interventions to combat the effects of climate change on health among target populations (Opoku et al., 2021). In spite of adequate awareness and knowledge, many misconceptions and misunderstandings have also been manifested by allied health professionals (Liao et al., 2019). Moreover, nurses do not consider climate change as a priority issue or health threat (Anåker et al., 2015).

Allied health students were found to have moderate to good level of knowledge and awareness about what climate change is and its negative effects on human health (Felicilda-Reynaldo et al., 2018; La Torre et al., 2020; Liao et al., 2019; Opoku et al., 2021; Yang et al., 2018). Nursing students were also found to be knowledgeable about climate change and that it negatively affects human health (Felicilda-Reynaldo et al., 2018; La Torre et al., 2020; Yang et al., 2018). However, nursing students have a lower level of knowledge and awareness of the effects of climate change on health compared to medical students (Liao et al., 2019). All of these studies about nursing students' perceptions on the effects of climate change on health were conducted outside the Philippines. Moreover, research on students' knowledge, awareness, and perceptions about climate change and its effects on health were limited to medical students (Domantay et al., 2021)

and secondary students (Caranto & Pitpitunge, 2015). None have been conducted that focused on nursing students.

As future health professionals, it is necessary that nursing students understand and are prepared to face the threat of climate change on health. Nurses must also be responsibly involved in and support efforts for climate change mitigation and adaptation because of its many negative effects on human health (Anåker et al., 2015). Moreover, determining how students understand climate change and its effects on health is important in identifying the proper approach in providing information to this target population, especially in the locale of the study where no studies assessing the knowledge or perceptions of nursing students about the effects of climate change have been conducted. Therefore, this study aimed to explore the perceptions of nursing students about the effects of climate change on health.

2. Methods

2.1. Research design

The researchers utilized a descriptive qualitative design employing semi-structured interview for data collection. This design was chosen to have a more in-depth assessment of the student's understanding, as well as identify any misconceptions that they may have about the effects of climate change on health (Merriam & Tisdell, 2015).

2.2. Setting and participants

The study was conducted in three different universities with nursing schools in Tuguegarao City, Cagayan, Philippines. These universities are the only schools in the city offering Bachelor of Science in Nursing (BSN) program. A total of 35 respondents were included and were among the level three BSN students. Purposive sampling was used to select the respondents using the following inclusion criteria: a) students who were enrolled with a full load of units in the BSN course, and b) those who have not taken Disaster Nursing course in the previous semesters. Level 3 students were selected because they already have theoretical knowledge on major nursing concepts, such as community health and medical-surgical nursing. However, these students have not yet taken Disaster Nursing subject, wherein any interventions can be provided based on the results of the study.

Polit and Beck (2018) discuss that in a qualitative research, the occurrence of data saturation may prompt the researchers to stop the data collection process. Moreover, the use of purposive sampling also emphasizes the need for data saturation, wherein respondents are continuously included until no new information is collected (Etikan, 2016). In this study, data saturation occurred on the 28th respondent. However, the researchers added more respondents to ensure that data saturation was indeed reached.

2.3. Data collection

The researchers sought necessary approvals from the different universities included in the study before starting data collection. The researchers also coordinated with focal persons from each university in order to schedule data collection. Informed consent of the respondents were sought after discussing the nature and procedure of the research. An audio-recorded one-on-one interview was conducted using a semi-structured interview guide. The interview guide was developed by both researchers consisting of three main open-ended questions, "Tell me what comes to your mind when you hear the term climate change?", "What do you perceive are the effects of climate change on health?", and "How do you think climate change affects health?". Probing questions were also asked to follow up on the verbalizations of the respondents to the main questions, such as "Can you elaborate or give examples of these changes in the weather you consider as climate change?", "What type/s of changes in the weather affect/s cardiovascular diseases, and do these changes affect cardiovascular diseases?". The interview guide questions were evaluated by a total of three experts, one on research methods, one on environmental sciences, and one on health sciences, for their relevance to the research objectives. Researchers modified the wording of some questions based on the recommendations. The data collection was conducted from February to April 2021, which depended on the availability and convenience of the respondents. During actual data collection, the researchers asked permission from each respondent for the audio-recording of the interview session. The interviews were conducted by

the researchers in a private area that was provided by the focal person from each university. Each respondent was interviewed once, which lasted between 25-35 minutes.

2.4. Data analysis

Qualitative content analysis of the respondents' verbalizations was conducted using the conventional form of content analysis, as described by Assarroudi et al. (2018). JPS performed the data analysis, while EMSG conducted member-checking at each step of the analysis process. The analysis followed several steps outlined below. Firstly, all verbalizations were transcribed into textual format to facilitate data analysis; after which, the transcribed texts were thoroughly read and re-read to identify the underlying meanings. Next, the impressions of these meanings were noted, and the text was further broken down into smaller units that captured the essence of the entire verbalization. Subsequently, these meaning units were condensed, and labels or codes were assigned to represent each unit. Finally, the coded units were sorted into categories, which were then clustered to form different themes. An illustrative sample of the verbalizations, meaning units, codes, categories, and themes is provided in Table 1.

Table 1. Sample codes, categories, and themes generated in the study

Verbalizations	Units/ Codes	Categories	Theme
P104: Climate change refers to the changes in weather and temperature P201: Climate change is a unusual weather condition that we're experiencing	Changes in normal weather pattern (Understanding)	Consistent with definition of climate change	Nursing students' understanding of climate change
P108: Climate change is when there is a big difference in normal climate patterns over a long amount of time. P205: It is change in a region with particular weather pattern or conditions, a change in the average course or condition of the weather at a place usually over a period of years	Change in weather over time (Understanding)	Consistent with definition of climate change	
P102: Different factors that contribute to the change in our climate are: factories, increase in number of vehicles, burning of plastic, deforestation, smoking P107: The contributors of climate change are greenhouse gases, aerosols in the atmosphere, major change in land use, deforestation and other human activities such as burning of fossil fuels and change in agricultural practices	Caused by human activities (Understanding)	Consistent with definition of climate change	

2.5. Rigor/*trustworthiness*

In ensuring the rigor or trustworthiness of the data and findings of analysis, the researchers applied Lincoln and Guba's Framework of Quality Criteria [as cited in Polit & Beck (2018)]: (a) credibility or the truth-value, by making sure that the information are the actual verbalizations of the respondents; (b) dependability or the consistency, by gathering the same set of relevant information across all respondents; (c) confirmability or the neutrality, through avoiding researchers' bias by ensuring that there is objectivity of the information and that the findings were actually shaped by the respondents' lived experiences; (d) transferability, by ensuring that the results can be applied to other settings and groups of nursing students who experienced the same phenomenon on client change on health; and (e) authenticity, by presenting fairly the realities of

the experiences and perceptions of the respondents. To emphasize more about confirmability, member-checking was performed by the researchers among 18 respondents to present to each of them the initial results of the analysis. During the process, the researchers emphasized that the results are aggregated and not just based on individual perceptions. The respondents affirmed; hence, there was no need to revise.

2.6. Ethical considerations

Informed consent was obtained from the respondents prior to data collection. Institutional research review and clearance were also obtained before data collection. Respondents were informed of the recording of the interview, and all recordings and transcripts of the interviews were destroyed after data analysis was completed. Respondents' names were not gathered to ensure anonymity. Respondents were assigned four character alphanumeric codes, the first character is the letter P which stands for participant/ respondent, first number denotes the school and last two numbers denote the number by which the respondent was interviewed. So P101 for example, is the first respondent to be interviewed in the first school or university. For to ensure confidentiality. Transcripts were stored in a password-protected file, which can be accessed only by the researchers. Ethics review and approval was obtained from the University Research Ethics Board of University of Saint Louis, Tuguegarao City, Philippines, with reference number 2020:001.

3. Results

3.1. Characteristics of the participants

The majority of the respondents are female, and a large percentage of the respondents are 20 years old, with an average age of 20.1 years (Table 2).

Table 2. Characteristics of the respondents

Characteristics	Mean	f	%
Gender			
Female		7	23.33
Male		23	76.67
Age (years)	20.1		
19		9	30.00
20		13	43.33
21		5	16.67
22		3	10.00

3.2. Analytical findings

Two major themes were derived from the verbalizations provided by the respondents, which described their understanding of climate change and its effects on health. These themes are: a) Nursing students' understanding of climate change; and b) Climate change negatively affects the physiological health of humans. The second theme also consists of two sub-themes, namely: a) Climate change precipitates risk for respiratory and cardiovascular disease; and b) Climate change as a modifying factor of communicable disease.

3.2.1 Theme 1: Nursing students' understanding of climate change

All the respondents described climate change as a change in the normal or usually experienced weather patterns. For example, one respondent mentioned that *climate change is an unusual weather condition that we're experiencing (P201)*. Majority of the respondents also mentioned that climate change is characterized by marked increases in environmental temperature, changes in wind patterns, increases in the amount of rainfall, and faster wind velocity, which occurs over a prolonged period of time. This was described by the respondents as follows: *"climate change is when there is a big difference in normal climate patterns over a long amount of time (P108)"*, and *"a change in the average course or condition of the weather at a place usually over a period of years as exhibited by temperature, wind velocity and precipitation (P205)"*. Moreover, the majority of the respondents mentioned that human activities are the major causative factor for climate change. This is mentioned by the respondents as follows:

"people's act such smoking, burning, technologies' effect such smoke coming from motors and vehicles, CFC from refrigerator and other equipment (P101)", and *"the contributors of climate change are greenhouse gases, aerosols in the atmosphere, major change in land use, deforestation and other human activities such as burning of fossil fuels and change in agricultural practices (P107)"*. The perceptions of the respondents on climate change describe its actual definition. This indicates that the nursing students have a good grasp or understanding of climate change and its causative or contributory factors.

3.2.2 Theme 2: Climate change negatively affects physiological health of humans

All the respondents are aware of and have experienced some of the effects of climate change on health. They believe that climate change affects health negatively and that it poses a risk to human health, as stated by one respondent that *"the first major health impact of climate change is the rise in rates of mortality and diseases caused by extreme weather events (P111)"*. Moreover, the previous statement highlights that the effects of climate change on health are a result of extreme weather events, as verbalized by the following respondents: *"the different effects of climate change to us humans are drought which causes scarcity of food and water, unusual weather, death of animals due to inability to adapt, wildfire, diseases to humans, hurricanes (P102)",* and *"climate change will affect people and the environment in many ways. Some of these, like stronger hurricanes and severe heat waves could be life threatening (P109)"*. Despite the consensus among the respondents of the negative effects of climate change on health, most of the respondents merely mentioned negative effects on the physiologic health of humans. However, it is important to note that a few respondents also mentioned the effect of climate change on animals, as one respondent mentioned, *"my dog once had a heat stroke because there was no current, the extreme heat really took a toll on him causing him to have a heat stroke (P206)"*, and in agriculture and economy, as verbalized by one respondent *"extremes in droughts and flooding will affect fresh water which can mean less agriculture, food and income (P306)*". The effect of climate change on the physiologic health of humans is further summarized into two sub-themes as follows:

3.2.1.1 Subtheme 1: Climate change precipitates risk for respiratory and cardiovascular disease

Majority of the respondents mentioned that climate change effects on non-communicable diseases are the most commonly experienced or observed. The respondents also verbalized that climate change increases the risk for morbidity and mortality of certain population groups for non-communicable diseases, especially of the cardiovascular and respiratory systems, as mentioned in the statement: *"climate change contributes directly to deaths from cardiovascular and respiratory diseases, particularly among elderly people (P107)"*. They explained that unpredictable changes in weather patterns cause unnecessary stress in the body and increase the risk of developing these diseases, as mentioned in this statement: *"maybe the effect of this to our health is not good in the sense that you are prone to diseases (P203)"*. The respondents also ascribed the increase in respiratory disease morbidity and mortality to sudden changes in weather and a constant increase in the quantity of air pollutants. According to the respondents, sudden, unpredictable changes in environmental temperature and the presence of air pollution due to climate change can increase a person's risk of developing certain respiratory diseases like asthma or Chronic Obstructive Respiratory Disease (COPD). This is mentioned by one respondent as follows: *"as I cited that pollution is the greatest problem that contribute to climate change the effects of this is maybe it may precipitate to lung diseases (P303)"*.

Similarly, the respondents believe that cardiovascular disease morbidity and mortality due to climate change result from an increase in environmental temperature or heat waves. According to the respondents, excessive environmental heat can aggravate symptoms of cardiovascular disease like chest pain and fatigue and may cause certain conditions like heat stroke, especially among the elderly, as mentioned in the following statement: *"the changes of earth's temperature may be brought by the increase number of cardiovascular diseases, respiratory diseases (P103)"*. The respondents further asserted that climate change weakens the adaptive capacities of humans, increasing their susceptibility to the diseases mentioned above, as expressed in the following statement: *"the effect of climate change on human health are your immune system will become weak (P205)"*. The most vulnerable groups mentioned are the elderly and children because they have poor adaptive mechanisms to climate change events, which was mentioned in

the following statement: *"climate change can exacerbate health effects or diseases specially in vulnerable populations such as children, elderly and those with asthma or cardiovascular disease (P306)"*. It is evident from the verbalizations of the respondents that they have an adequate understanding of how extreme weather events caused by climate change affect certain non-communicable diseases, particularly respiratory and cardiovascular diseases.

3.2.1.2 Subtheme 2: Climate change as a modifying factor of communicable disease

Majority of the respondents also verbalized that climate change causes changes in the characteristics of certain infectious diseases like water-borne infections (e.g., diarrheal diseases and leptospirosis), food-borne infections, and vector-borne infections (e.g., dengue fever), as expressed by the statements: *"the health effects changes in the prevalence and geographical distribution of foodborne and waterborne illnesses and other infectious diseases (P308)",* and *"if weather suddenly changes from hot to cold, sometimes it can cause diarrhea, fever and other infection (P202)"*. These changes include increase in prevalence of infectious diseases, change in geographic distribution of food-borne and waterborne infections, and as mentioned in the statements: "*the health effects include changes in the prevalence and geographical distribution of foodborne and waterborne illnesses and other infectious diseases and threats (P108)",* and *"the changes in weather may increase number of diarrhea diseases (P303)"*. Moreover, the respondents also verbalized that changes in the seasonal pattern of certain infectious diseases have occurred, as expressed by the following statement, *"the most common effect of climate change is acquiring some infections that are more common during rainy or cold seasons even when it is summertime due to change of weather like dengue or diarrhea (P102)"*. The respondents also mentioned that, similar with non-communicable diseases, vulnerability to infectious diseases also increases due to climate change, especially among vulnerable populations, as mentioned in the statement, *"geriatric people or young children are sometimes more affected because the shifting of weather makes them more prone to infections (P206)"*. From the statements of the respondents, it can be determined that the respondents have a good understanding of the effects of climate change on some communicable diseases and the mechanisms by which these effects occur.

4. Discussion

This study explored the perceptions of nursing students about the effects of climate change on health. The perceptions of the nursing students are described in two major themes: a) Nursing students' understanding of climate change; and b) Climate change negatively affects physiological health of humans.

4.1 Nursing students' understanding of climate change

The results showed that the nursing students have a good grasp or understanding of what climate is and its main causative factor. This finding is consistent with previous studies conducted abroad among nurses and other healthcare professionals (Anåker et al., 2015; Hathaway & Maibach, 2018; La Torre et al., 2020). Similarly, it corresponds with previous studies conducted among nursing students abroad, indicating adequate knowledge and understanding of climate change (Felicilda- Reynaldo et al., 2018; La Torre et al., 2020; Yang et al., 2018). Moreover, the outcome resonates with previous studies conducted in the Philippines among medical students and secondary students (Caranto & Pitpitunge, 2015; Domantay et al., 2021). This finding may indicate the adequacy of basic education related to climate change among Filipino students. The Philippine basic education includes Disaster Risk Reduction and Management (DRRM) subjects among elementary and secondary students. In this subject, DRRM education is integrated into subjects such as natural sciences, social studies, and Earth and Life Science at different grade levels, focusing on hazard awareness, disaster management principles, and community-based practices (Cabilao-Valencia et al., 2019). Therefore, a good foundation, as early as elementary level, is essential in developing a good understanding of climate change and its causative factors. The respondents' adequate grasp of climate change may also be attributable to their educational level. Knowledge of climate change and its effects on health is affected primarily by a person's educational status (Lujala et al., 2015; Ofori et al., 2023; Siña et al., 2016). It can be noted that all the participants are at the college level. Moreover, previous experience of the environmental effects of climate change also justifies the adequacy of awareness manifested by the students, as

majority of the respondents verbalized having direct or indirect experiences of the environmental effects of climate change. Personal experience of the effects of climate change, either direct or indirect, is a strong determinant of awareness and knowledge (Debela et al., 2015). Adequate knowledge and understanding of climate change is associated with better awareness of personal risks related to climate change and its effects (Siña et al., 2016; Zaman, 2021). Moreover, healthcare professionals such as nurses must possess adequate understanding of climate change in order to be prepared to face the threat to health (Crowley & HPPC/ACP, 2016; Dupraz & Burnand, 2021; Hathaway & Maibach, 2018; Opoku et al., 2021) and foster responsible involvement in and support efforts for climate change mitigation and adaptation (Anåker et al., 2015; Crowley & HPPC/ACP, 2016; Dupraz & Burnand, 2021).

4.2 Climate change negatively affects physiological health of humans

The findings of this study reveal that nursing students believe that climate change negatively affects health and poses a risk to human health. This is consistent with the findings of previous studies conducted in other countries (Felicilda-Reynaldo et al., 2018; La Torre et al., 2020; Yang et al., 2018). However, studies have also identified that although healthcare professionals have adequate understanding of climate change, there is always a need to gain better understanding of how climate change affects health and that these can be areas for professional development among healthcare workers (Crowley & HPPC/ACP, 2016; Dupraz & Burnand, 2021; Hathaway & Maibach, 2018). Moreover, the inclusion of climate change concepts in the curriculum of healthcare professionals is highly encouraged to ensure adequate understanding of climate change and its effects on health (Crowley & HPPC/ACP, 2016). The nursing students' verbalizations further identified that climate change affects the physiologic dimension of human health. This is consistent with the findings of studies conducted among nursing students, which also identified physiologic health effects of climate change. These studies mentioned that health system disruptions, food security and shortage, and mental health effects are the least identified effects of climate change on health by nursing students (Felicilda-Reynaldo et al., 2018; La Torre et al., 2020; Yang et al., 2018). As such, there is a need for a better coverage of concepts relating to the effects of climate change on health in the BSN curriculum (Felicilda-Reynaldo et al., 2018). This finding contrasts with a study conducted among healthcare professionals stating that climate change effects go beyond physiologic health (Opoku et al., 2021). Climate change also affects mental and psychological health, which leads to mood and behavioral disorders, occupational health disturbances, and social and economic disruptions that affect food security and nutrition (Butler, 2018; Crowley & HPPC/ACP, 2016; Ebi et al., 2021; Opoku et al., 2021; Weilnhammer et al., 2021). Moreover, climate change also causes significant disruptions on local and international health systems (Ebi et al., 2021). The effects of climate change on health are, therefore, multi-dimensional, and as such, a comprehensive and more holistic knowledge of these effects is needed in order to fully understand how climate change affects health. It is also important that healthcare professionals not only fully understand what climate change is but also have a comprehensive understanding of its effect on health in order to effectively implement measures to mitigate or address these effects (Dupraz & Burnand, 2021; Opoku et al., 2021).

4.2.1 Climate change precipitates risk for cardiovascular and respiratory disease

The results of the study further showed that the respondents believe that climate change effects on non-communicable diseases are the most commonly experienced or observed. These include respiratory and cardiovascular diseases such as stroke, hypertension, heat stroke, asthma, and COPD. This is consistent with the studies conducted among nursing students, which stated that climate change affects diseases, especially those that are related to heat, cold, and air quality (Felicilda-Reynaldo et al., 2018; La Torre et al., 2020; Yang et al., 2018). Research findings have also confirmed that climate change affects the prevalence and occurrence of non-communicable diseases (Kreslake et al., 2016; Alcayna et al., 2016; Maxwell & Blashki, 2016). However, studies have found a difference in the effects of climate change according to geographical location, which is important in predicting these effects in order to implement effective mitigation and adaptation activities (Liao et al., 2019). In tropical and subtropical countries like the Philippines, the most commonly documented effects of climate change on health are physical injuries related to extreme weather events like flooding and typhoons (Kreslake et al., 2016; McIver et al., 2016) and

consequences of the latter, which include increases in the prevalence of water-borne, food-borne, and vector-borne infections.

The respondents also mentioned that climate change increases the risk for morbidity and mortality of certain population groups for non-communicable diseases, especially of the cardiovascular and respiratory systems. This is consistent with the findings of previous studies (Crowley & HPPC/ACP, 2016; Ebi et al., 2021; Opoku et al., 2021). This increase in respiratory disease morbidity and mortality is due to sudden changes in weather and a constant increase in the quantity of air pollutants. Moreover, the presence of air pollution due to climate change can increase a person's risk of developing certain respiratory diseases. Studies found that acute respiratory problems associated with chronic respiratory diseases like asthma result from extreme heat and are exacerbated by the presence of air pollutants (Yang et al., 2018; Yusa et al., 2015). Drought and increasing temperature and precipitation favor the concentration of air contaminants that can trigger acute episodes of obstructive airway diseases (Yusa et al., 2015). Moreover, increased environmental temperatures place additional stress on the respiratory system, especially for those with chronic respiratory disorders (Ebi et al., 2021; Seposo et al., 2015; Yang et al., 2018). So, although certain climate change events trigger exacerbations of chronic respiratory problems, they do not directly contribute to the development of these diseases.

Similarly, the results showed that the respondents believe cardiovascular disease morbidity and mortality due to climate change result from an increase in environmental temperature or heat waves, which can aggravate symptoms of cardiovascular disease like chest pain and fatigue and may cause certain conditions like heat stroke, especially among the elderly. This is also consistent with the findings of previous studies (Felicilda-Reynaldo et al., 2018; La Torre et al., 2020; Yang et al., 2018). Cardiovascular system effects of climate change arise from the occurrence of more intense heat waves (Crowley & HPPC/ACP, 2016; Ebi et al., 2021; Opoku et al., 2021). However, extreme cold can also affect morbidity and mortality from cardiovascular diseases as it triggers the emergence of symptoms of these diseases (Gumabay et al., 2018).

The respondents further asserted that climate change affects the immune system of an individual, which increases vulnerability to disease. However, previous studies conducted among nursing students or healthcare professionals have not focused on this finding. Other studies found that the elderly and children are among those with high vulnerability to the effects of climate change on health, especially for respiratory and cardiovascular diseases (Cianconi et al., 2020; Ebi et al., 2021; Kreslake et al., 2016). This is because an individual's ability to adapt to the changes in the weather declines with advancing age (Seposo et al., 2015). However, a variety of factors increase an individual's susceptibility to the effects of climate change on health, which physiologic factors such as age, sex, pregnancy, underlying conditions; socio-behavioral factors such as low socioeconomic status, outdoor work, cultural-traditional groups; environmental factors such as certain geographical locations, and health system factors such as access and availability of health resources (Cianconi et al., 2020; Ebi et al., 2021; Harper et al., 2015; Kreslake et al., 2016; McIver et al., 2016). It can be observed that the understanding of the nursing students of the effects of climate change on non-communicable diseases is greatly determined by their understanding of the effects of environmental conditions on the disease process of non-communicable diseases. This further implies a good grasp on the interplay between environmental risk factors that contribute to the development of non-communicable diseases. However, there is limited understanding on other risk factors that contribute to non-communicable disease susceptibility in relation to climate change.

4.2.2 Climate change as a modifying factor of communicable disease

The results also showed that respondents believe climate change causes changes in the characteristics of certain infectious diseases like water-borne infections (e.g., diarrheal diseases and leptospirosis), food-borne infections, and vector-borne infections (e.g., dengue fever) such as increase in prevalence of infectious diseases, changes in the seasonal pattern and geographic distribution of certain diseases like dengue, and increase in the spread of and vulnerability to certain infections. This is also consistent with the findings of previous research conducted among nursing students (Felicilda-Reynaldo et al., 2018; La Torre et al., 2020; Yang et al., 2018). Majority of scientific data identified the increase in the prevalence of infectious diseases to be the most significant effect of climate change on health in the Philippines and in other countries

(Cianconi et al., 2021). Increased prevalence of infectious diseases may be attributed to changes in vector population and behavior, expansion of geographical range of infectious diseases, and changes in water, food safety, and security (Ajuang et al., 2016; Felicilda-Reynaldo et al., 2018; McMichael, 2015; Maxwell & Blashki, 2016;).

The respondents also attributed these changes to infectious disease characteristics to shifting of climate or weather patterns and increase in the incidence and intensity of extreme weather events like typhoons and flooding, which favor the proliferation of vectors and reservoirs of infectious agents. This is also consistent with the findings of previous research conducted among nursing students (Felicilda-Reynaldo et al., 2018; La Torre et al., 2020; Yang et al., 2018). Moreover, research findings confirm that torrential rain, which causes flooding, increase in ambient temperature, and water insecurity are the major contributors to the effects of climate change on infectious diseases (Seposo et al., 2015; Yusa et al., 2015).

The findings of this study also identified that, similar with non-communicable diseases, vulnerability to infectious diseases also increases due to climate change, especially among vulnerable populations. As discussed in the previous section, vulnerability to the effects of climate change on health may increase due to a variety of factors (Cianconi et al., 2020; Ebi et al., 2021; Harper et al., 2015; Kreslake et al., 2016; McIver et al., 2016). This is also applicable to communicable diseases (Cianconi et al., 2020). The perceptions of nursing students on the effects of climate change on communicable diseases present an adequate understanding on how environmental factors and events such as flooding and temperature changes contribute to changes in the patterns of these diseases. This may stem from the students' background on the ecological model of infectious disease occurrence and transmission. However, there are limitations in considering multiple factors that contribute to the vulnerability of individuals to infectious diseases in relation to climate change.

5. Implications and limitations

As this is the first study of this nature conducted in the Philippines, this study provides insight on the perceptions of nursing students in the country about climate change and its effects on human health. This study can then serve as a guide for other nursing researchers to further enrich the knowledge based on this topic. Moreover, initial improvements on the nursing curriculum can be made in the locale of the study based on the findings. As the nursing curriculum in the country has recently implemented the inclusion of Disaster Nursing subject within the nursing curriculum, this can be an avenue for the discussion of concepts related to climate change and its effects on health among nursing students.

This study has various limitations that necessitate further exploration. The effects of climate change can vary from one geographical location to another. Other allied health professionals also play a key role in mitigating the effects of climate change on health; therefore, an assessment of their perceptions must also be performed. As future health professionals, an in-depth and holistic understanding of the effects of climate change on health is needed by these students to effectively implement measures to prevent, mitigate, and address this global health threat in the future. Lastly, this study did not focus on how students deal with or address the effects of climate change on health, which is also essential for nurses and other healthcare professionals. This, too, can be further explored.

6. Conclusion

The findings of the study reveal that nursing students have an adequate understanding of climate change and are aware that it negatively affects health. However, their perceptions of the effects of climate change on health are limited to its effects on non-communicable, specifically cardiovascular and respiratory diseases and infectious diseases, as this reflects their understanding of how environmental factors affect disease pathogenesis or development. However, these effects cited are limited to physiologic health. As health is a multi-dimensional concept, climate change also affects other dimensions of human health. The students also failed to acknowledge certain factors that greatly determine the effects of climate change on health, such as geographical, socioeconomic, and health system factors. Moreover, the students have limited knowledge on the effects of climate change on physical safety, nutrition, and mental health, which are also very important health issues that must be addressed. The findings, therefore, suggest that these students need a more holistic understanding of the effects of climate change on health to

better prepare them for addressing these issues in their future practice. This study further recommends a need for an in-depth instruction of student nurses about the effects of climate change on health. Therefore, the possibility of incorporating such subject matter in nursing education must be explored. Exploration of the perceptions of nursing students about climate change and its effects on health can also be done in other parts of the country to determine consistencies or variations. This can help add to the knowledge base of the country about this topic. Moreover, a quantitative study can also be implemented to include a larger population to better the findings. Lastly, to better understand the preparedness of nursing students in addressing climate change and its effects, assessment of knowledge, attitudes and/or practices of students on mitigation and preparedness activities related to climate change should also be performed.

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Author contribution

JPS and EMSG contributed to the conceptualization of the study, preparation of tools and instruments, data collection and processing, and manuscript preparation and revision. All authors have read and approved the final manuscript.

Conflict of interest

The authors do not have any form of conflict of interest in the conduct of this study.

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