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Gaps in awareness of climate variability and its impacts on society among health professionals and community workers in Vietnam: Implications for COVID-19 and other epidemic response systems

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ABSTRACTS

The study presents a cross-sectional analysis via a web-based survey to assess the awareness and experiences of Vietnamese health professionals and community workers on climate and epidemic changes and their impacts on society. Health professionals, medical students, and community workers were included in the survey. Factor analysis was used to explore the construct validity of measures, and Multivariable Tobit regression models were used to examine associated factors with awareness about climate and epidemic changes and impacts on society. Results showed that the awareness of participants about climate and epidemic changes was moderately-low, while the awareness about the impacts on society were moderately-high. Community workers show higher awareness of climate and epidemic changes compared to health professionals. People working in provincial levels had a lower score (Coef. = -0.64, 95% CI = -1.19 to -0.09) than those working in central level. Compared to Northern participants, those living in Central and Southern regions have lower awareness scores regarding “Changes in weather and epidemics” and “Changes in the environment” compared to Northern people. The higher awareness about climate and epidemic changes were found to be correlated with the higher awareness of “Impacts on health, society and economy” and “Impact on individuals and families”. Community workers scored lower in “Impact on individuals and families” compared to health professionals (Coef.-0.75; 95%CI = -1.34 to -0.16). This study emphasized the vulnerabilities of Vietnamese communities to epidemics and climate change. It suggests the involvements of intersectoral taskforces in the preparedness and responses to climate change and epidemics.

1. Introduction

In the last few decades, climate change has been well-recognized as one of the greatest global threats which has remarkable influences on all nations. Climate change accelerates the increase of the global temperature. In evidence, the Earth’s surface temperature has raised 0.85 ◦C
in the period 1880–2012 [1], and expected to reach 2 °C in 2050 according to the “worst case scenario” [1,2]. The fifth report of the Intergovernmental Panel on Climate Change (IPCC) in 2014 revealed that global warming increased the frequency and severity of extreme weather events such as heat waves, heavy storms, intense rainfall, flood or droughts [1].

Climate change imposes substantial social, health and economic effects on global development [3–6]. In some locals, residents can be beneficial with climate change such as reducing winter-related mortality or increasing agricultural productivity [7]. However, the negative consequences of climate change outweigh its benefits. Climate change elevates the risk of climate-sensitive infectious disease outbreaks (e.g. water-borne diseases, air-borne diseases, or vector-borne diseases), injuries, drowning, heat-related illnesses, and mental disorders, raising a great challenge in ensuring social security and healthcare systems among affected nations [5,8–11]. World major outbreaks such as Spain flu (1918–1920), Influenza H1N1 pandemic in (2009–2010), West African Ebola epidemic (2014–2016) and most recently, COVID-19, are also believed to be related to climate change [12–15]. The World Health Organization (WHO) anticipates that an extra 250,000 deaths per year in 2030 [16]. Moreover, extreme weather and natural disasters damage infrastructures and increase economic losses, which significantly impact on people’s lives and well-being [17–19]. It is estimated that in 2019, extreme weather events caused approximately the loss of 100 billion USD due to their damages [20]. Another prior report indicated that the growth of global economy could be reduced 2%–10% as consequences of climate change [21]. These negative effects are more severe to socially and economically disadvantaged groups, namely, children, poor and elderly people in both developed and developing countries [22–25]. Therefore, strategy planning for the preparation and adaptation to those impacts becomes the priorities in global research and policy agendas [4, 22].

Successful strategies require sufficient participation from the community in reducing the potential climate change-related exposures and developing the adaptive capacity [4]. This involvement, however, depends on the awareness and perception of community in occurrence as well as health and economic impacts of climate change and epidemics [26,27]. Previous studies showed disparities in awareness and perception among different populations [28,29], even in health professionals [30]. For example, a study in China showed that only 26.8% of Chinese healthcare providers understood climate change and 85.4% required more information regarding the health effects of climate change [31]. Meanwhile, another study found that more than 70% of healthcare workers were aware of these impacts [32]. Among the general public, the people in developed countries have minor awareness compared to those in developing countries [30]. This diversity raises the needs of contextualized evidence about the gaps in community’s awareness and experiences towards influences of climate change and infectious disease epidemic, which can be a vital component to develop optimal solutions for the enhancement of climate change preparedness.

Vietnam locates in a tropical monsoon belt of Southeast Asia, and is among the countries which have been significantly influenced by climate change [33,34]. According to the Global Climate Risk Index 2020, Vietnam is the sixth most vulnerable country to the climate variability from 1999 to 2018 [35]. It is estimated that 10–12% of Vietnamese population are affected by the climate change in the sea level increases by 1 m according to the projection scenario [36], not to mention the impacts from worsening natural disasters and extreme weather events (e.g.: wildfires, tornadoes, hurricanes, …) [37]. In the last two decades, there were more than 13,000 lives lost due to natural disasters, and approximately 1% of gross domestic product was damaged as the consequence of climate change [38].

The health and socioeconomic impacts of climate change have been paid attention by the Vietnamese Government in the late 2000s. The 2008 National Target Program in Response to Climate Change, Environmental Protection Law (2014), Law on natural disaster preparedness and response (2013), 2007 National Strategy for Natural Disaster Prevention were issued to promote the resilience of population to the change of climate and epidemics. In 2011, the Vietnamese Government had enacted the National Strategy for Climate Change, informing the strongest commitment of the government to against the climate change [36]. Recently, the Ministry of Health has developed a strategic plan to adapt the climate change in health sector and establish measures to mitigate the adverse outcomes of climate change and epidemics on health and economic development.

Despite the major concern over climate change, there were limited assessments on people’s awareness and experience toward climate change and epidemics in Vietnam, particularly among health professionals. Toan et al. (2014) found that 79.3% of urban residents were aware of climate change and its health impacts [39]. Health professionals and community workers are frontline forces when combating against the negative consequences of climate and epidemic changes. Sufficient awareness and perceptions of these populations about climate and epidemic changes, as well as their impacts on society are particularly important for preparing a robust response system. This study assessed the awareness of Vietnamese health professionals and community workers in the changes of climate and epidemics, and their impacts on society. Results of this study would offer useful evidence for policy makers to identify the awareness gaps and develop climate change policies.

2. Methods

2.1. Study setting and participants

A web-based cross-sectional study was carried out from January to February 2020 in Vietnam. A total of 643 participants (including a medical professional, medical students and community workers) were enrolled in this survey. They met following selection criteria: (1) aged 18 years old or above; (2) being health professionals, medical students or community workers; 3) has been living in Vietnam for at least 6 months; (3) agreeing to involve in the survey by accepting the online informed consent; (4) being capable of reading and answering the online questionnaire. They were recruited via snowball sampling method. We first invited representatives of the Vietnam Young Physicians Associations and The Vietnam Youth Federation to participate in the study. Afterward, they were asked to invite other colleagues in 46/63 provinces in Vietnam including Hà Noi, Ho Chi Minh city, Hai Phong, Can Tho, Đăk Nông, Thua Thien Hue, Ben Tre, etc. These colleagues continued to perform the survey and invite other people until the chain-referral process was stopped. This approach helps to cover all three regions of Northern, Central and Southern Vietnam. The institutional review board of Vietnam Youth Research Institute has reviewed and approved this study (No. 404 QĐ/TWĐTN-VNCTN).

2.2. Measurements

A 20-min structured questionnaire was developed and uploaded to an online platform by the research team. We used the Survey Monkey platform (https://www.surveymonkey.com/, San Mateo, CA, USA) to collect participants’ data. Given that our study aimed to recruit people from different provinces of Vietnam, this approach was demonstrated with its low-cost, less time-consuming without direct contact, which helped to avoid the risk of COVID-19 and other infectious disease transmission.

To develop the questionnaire, we first conducted a review to identify the candidate items that could be able to capture the awareness of climate change and its impacts. Then, we conducted a focus group discussion with the involvement of health professionals, community service workers and researchers to improve the instrument. Finally, after having
the instrument, this questionnaire was online piloted with ten participants in order to ensure the quality of questionnaire regarding logical order, text, language and presentation. Data of these participants were not included in the final dataset. Following information was included in the questionnaire:

Socio-demographic characteristics: the collected information includes age, gender (male/female), living area (rural/urban), name of province (which could be used to identify the region including Northern, Central and Southern Regions), marital status (single/living with spouse/others), and administration level of their workplace (Central/Provincial/Under provincial/College and University).

Awareness of climate, epidemic and environmental change: The participants are requested to rate their agreements about ten statements below regarding the climate, epidemic and environmental change in their local. The agreement level ranged from 0 “Totally disagree” to 10 “Totally agree”:

1. Environment is more polluted.
2. More people suffer from chronic diseases.
3. There are more extreme weather events.
4. Mosquito densities increase.
5. Infectious disease epidemics re-emerge.
6. Temperature changes abnormally.
7. Rainfall decreases compared to before.
8. New infectious disease epidemics emerge.
9. Special phenomena of rain, lightning and thunder appeared.
10. Diseases appeared in many new residential areas.

Awareness of impacts of climate and environmental change on society: The participants are requested to rate their agreements in the 11-point Likert scale from 0 “Totally disagree” to 10 “Totally agree” for nine statements below:

1. Increasing risk of drought, flood
2. Change conditions of cultivation and fishing
3. Increased risk of disease
4. Increased burden of medical care with hospitals
5. Negative impact on the health of local communities
6. Negative impact on your health
7. Negative impact on the health of family members
8. Change the distribution and mode of transmission of diseases
9. Reduce people’s income and employment opportunities

2.3. Data analysis

Stata 15.0 (Stata Corp LP, College Station, TX) was used to analyze the data. Exploratory factor analysis (EFA) was utilized to explore the construct validity of items regarding awareness of climate change and its impacts. Parallel analysis was conducted to identify the optimal number of factors. An orthogonal varimax rotation with Kaiser normalization was applied in exploring the scale of items to improve the interpretability of the results. The cut-off point for factor loading was set at 0.5. We measured the internal consistency of each factor by Cronbach’s alpha [40]. Statistical significance was detected if the p-value was less than 0.05.

For the first ten items about the awareness of climate, epidemic and environmental change, we explored three factors, including “Changes in climate factors and epidemics” (4 items), “Changes in the environment” (3 items) and “Changes related to extreme weather events” (3 items). The Cronbach’s alpha values of these factors were 0.91, 0.86 and 0.82, respectively. The highest agreement among the participants could be seen in “Environment is more polluted” (19.0%), followed by “More people suffer from chronic diseases” (13.3%) and “There are extreme weather events” (10.2%) (Table 1).

For the next nine items regarding the awareness of climate and environmental change’s impacts, two factors were identified, namely, “Impacts on health, society and economy” (6 items) and “Impact on individuals and families” (3 items), with the respective Cronbach’s alpha being 0.95 and 0.87. There were 30.7% of participants totally agreed the effects of climate change results in an increasing risk of drought and flood, followed by change conditions of cultivation and fishing (27.7%), and increased risk of disease (25.1%). (Table 2).

The overall score of each factor is calculated by summing scores of all items in the factor and then dividing to the number of items in this factor. The score of each factor ranges from 0 to 10, where higher score indicates a higher level of awareness of participants regarding this factor. Descriptive statistics including Kruskal-Wallis test, Fisher-exact test or Chi-square test were performed to examine the difference regarding social demographic characteristics and awareness of climate change and its impacts among medical professional, medical students (or prospective medical professional) and community workers. Multivariate Tobit regression models were utilized to examine associated factors with the score of each factor. To obtain a reduced model, stepwise forward selection strategies were utilized with a log-likelihood ratio test at a p-value of 0.2. Statistical significance was defined at a p-value of less than 0.05 [41]. For three factors regarding awareness of climate, epidemic

| Items                                      | n | % strongly agree | Changes in climate factors and epidemics | Changes in the environment | Changes related to extreme weather events |
|--------------------------------------------|---|------------------|-----------------------------------------|---------------------------|----------------------------------------|
| Infectious disease epidemics re-emerge     | 47| 7.3              | 0.70                                    |                           |                                        |
| Special phenomena of rain, lightning and thunder appeared | 26| 4.1              | 0.80                                    |                           |                                        |
| Diseases appeared in many new residential areas | 32| 5.0              | 0.81                                    |                           |                                        |
| New infectious disease epidemics emerge    | 53| 8.3              | 0.65                                    |                           |                                        |
| Mosquito densities increase                | 85| 13.3             | 0.81                                    |                           |                                        |
| More people suffer from chronic diseases   | 122| 19.0             | 0.86                                    |                           |                                        |
| Environment is more polluted               | 41| 6.4              | 0.75                                    |                           |                                        |
| Rainfall decreases compared to before      | 65| 10.2             | 0.78                                    |                           |                                        |
| There are extreme weather events           | 44| 6.9              | 0.78                                    |                           |                                        |
| Temperature changes abnormally             |   |                  |                                         |                           |                                        |

| Cronbach’s alpha                           |   |                  |                                         |                           |                                        |
|Mean                                        | 4.7 | 6.4              | 6.0                                    |                           |                                        |
|SD                                          | 2.6 | 2.4              | 2.2                                    |                           |                                        |
and environmental change, the dependent variables in the model are the scores of three factors “Changes in weather and epidemics”, “Changes in the environment” and “Changes related to extreme weather events”, whereas independent variables are socio-demographic characteristics (age, gender, occupation, marital status, living area, region and administrative levels of workplace). Meanwhile, for two factors representing the awareness of climate and environmental change’s impacts, the dependent variables are the score of two factors “Impacts on health, society and economy” and “Impact on individuals and families”. The independent variables of these models include socio-demographic characteristics and scores of three factors about awareness of climate, epidemic and environmental change.

3. Results and discussion

This study presents a rapid assessment on the awareness of climate change and epidemics among people who are expected to be at frontline when combating the impacts of climate change, including health professionals, medical students and community service workers. Table 3 depicts that 79.6% of the respondents were medical students. The mean age of respondents was 22.8 (SD = 5.4) years old. The majority of samples were female (68.0%), lived in urban areas (86.1%) and were single (84.2%). Among health professionals and community workers, most of them worked at provincial level (57.8% and 47.5%, respectively).

3.1. Awareness of climate, epidemic and environmental change

Table 4 shows the difference in the awareness of climate change, epidemic and environmental change by occupations. The mean score of “Changes in the environment” domain was higher than that of “Change of in the climate factors and epidemics” and “Changes related to extreme weather events” (mean = 6.4, 4.7 and 6.0, respectively). It means that only a minor proportion of our samples agreed with the proposed alterations of weather, climate and environment in their locals. Nonetheless, Vietnam is among the most affected nations by climate change in the last two decades, and that will be worsen in the coming years [35]. Previous reports indicated that climate change across Vietnam is significant [42]. In addition, seasonal epidemics such as dengue fever, malaria or seasonal flu tend to appear more frequently. Even so, with the moderate-low level of awareness, we supposed that this could be because these changes were gradual over the years; hence, participants might adapt and feel that there had been not significant changes in weather events.

Overall, community workers were found to have higher score in all three domains compared to medical professionals and medical students.

Table 2
Factor loading for items regarding awareness of impacts of climate, epidemic and environmental change on society.

| Items | n % totally agree | Impacts on health, society and economy | Impact on individuals and families |
|-------|------------------|---------------------------------------|----------------------------------|
| Increasing risk of drought, flood | 191 30.7 | 0.62 | |
| Increased burden of medical care with hospitals | 156 25.0 | 0.65 | |
| Change conditions of cultivation and fishing | 172 27.7 | 0.75 | |
| Negative impact on the health of local communities | 154 24.8 | 0.80 | |
| Increased risk of disease | 155 25.1 | 0.83 | |
| Change the distribution and mode of transmission of diseases | 114 18.2 | 0.83 | |

Cronbach’s alpha

| | Mean | SD |
|-------|------|----|
| Gender | 0.95 | 0.87 |
| Living area | 7.9 | 7.6 |
| Region | 1.6 | 1.7 |

Table 3
Socioeconomic characteristics of respondents.

| Characteristics | Health professional | Medical students | Community workers | Total | p-value |
|----------------|---------------------|------------------|-------------------|-------|---------|
|                | n %                 | n %             | n %              | n %  |         |
| Gender         |                     |                 |                   |       |         |
| Male           | 20 44.4             | 135 26.4        | 50 59.5          | 205 32.0 | <0.01 |
| Female         | 25 55.6             | 377 73.6        | 34 40.5          | 436 68.0 |       |
| Living area    |                     |                 |                   |       |         |
| Urban          | 37 82.2             | 435 86.3        | 73 86.9          | 545 86.1 | 0.73   |
| Rural          | 8 17.8              | 69 13.7         | 11 13.1          | 88 13.9 |         |
| Region         |                     |                 |                   |       |         |
| Northern       | 27 62.8             | 133 26.4        | 35 45.5          | 195 31.3 | <0.01 |
| Central        | 9 20.9              | 24 4.8          | 15 19.5          | 48 7.7   |         |
| South          | 7 16.3              | 347 68.9        | 27 35.1          | 381 61.1 |         |
| Marital status |                     |                 |                   |       |         |
| Single         | 12 26.7             | 501 98.2        | 26 30.6          | 539 84.2 | <0.01 |
| Others         | 33 73.3             | 9 1.8           | 59 69.4          | 101 15.8 |         |
| Administration level of workplace | | | | | <0.01 |
| Central        | 6 13.3              | 58 11.5         | 21 26.3          | 85 13.5 | <0.01 |
| Provincial     | 26 57.8             | 59 11.7         | 38 47.5          | 123 19.5 |         |
| Under provincial | 11 24.4          | 5 1.0           | 21 26.3          | 37 5.9   |         |
| College/University | 2 4.4              | 383 75.8        | 0 0.0            | 385 61.1 |         |
| Participated in community activities | | | | | <0.01 |
| Yes            | 38 84.4             | 212 41.5        | 86 100.0         | 336 52.3 | <0.01 |
| No             | 7 15.6              | 299 58.5        | 0 0.0            | 306 47.7 |         |

| | Mean | SD | Mean | SD | Mean | SD | p-value |
|-------|------|----|------|----|------|----|---------|
| Age   | 32.0 | 6.4| 20.5 | 1.5| 32.0 | 4.6| <0.01   |
medical students often work and study in hospitals, thus they rarely had attention of our sample, particularly health professionals and medical working in central level. Compared to Northern participants, those had a lower score (Coef. = -0.64, 95%CI = -1.19 to -0.09) than those working in central level. Compared to Northern participants, those living in Central and Southern regions have lower awareness scores regarding “Changes in weather and epidemics” and “Changes in the environment”. The reasons might not be clear, which requires further explanatory studies to understand this issue. We assumed that our participants in these region might misunderstand that the increase of extreme weathers could be regular environmental issues; thus, their concerns about these problems might not be sufficient [39]. However, it should be noted that Central and Southern regions are two regions which are considered the most vulnerable settings to climate change [43]. Therefore, more intensive trainings should be warranted to raise the knowledge and awareness among health professionals and medical students, especially in Central and Southern regions, in order to prepare for future challenges.

3.2. Awareness of impacts of climate, epidemic and environmental change on society

Table 6 depicts that participants have moderately high agreement in the overall impacts on health, society and economy and impact on individuals and families. The mean score of two domains “Impacts on health, society and economy” and “Impact on individuals and families” are 7.9 (SD = 1.6) and 7.6 (SD = 1.7), respectively. No difference is observed among medical professional, medical students and community workers regarding the impacts of climate change (p > 0.05). This is in line with previous studies in Vietnam and other countries, which indicates high awareness of health professionals about the connections between climate change and health [30-32,39].

Table 7 indicates that the higher awareness about climate and epidemic changes were found to be correlated with the higher awareness
of climate change and epidemics in Vietnam through awareness and experience of health professionals, medical students and community service workers. It emphasizes the vulnerabilities of Vietnamese communities to not only new diseases like COVID-19, but also the combination of local epidemics and climate changes. It suggests the involvements of intersectoral taskforces in the preparedness and responses to climate change and epidemics.

Several implications are drawn from this study. Firstly, more educational campaigns should be undertaken to increase people’s awareness of climate change, epidemic and their impacts on health and socioeconomic development. This is critically important for the preparation of emerging epidemics such as the current COVID-19 pandemic. Raising the awareness can improve the epidemic preparedness and thus help to timely respond the epidemic without delay. Secondly, media should be facilitated to increase the coverage of climate change and epidemic information, particularly about impacts on individuals and families, to elevate people’s awareness of climate change and its impact.

The strength of this study consists of sample size in different settings in Vietnam, which was the advantage of online survey. However, several limitations still exist. Firstly, the result would not be representative to the whole health professionals, medical students and community service workers in Vietnam, thus it should be carefully interpreted to other provinces. Secondly, the cross-sectional study design limited the ability to infer causal relationships. Thirdly, data collected by self-reporting may lead to the social desirability bias. Finally, the awareness and experience in mitigation measures to reduce impacts of climate change and epidemics were not considered in this study. Nonetheless, this study provides useful information for policy makers to develop the effective adaptation strategies to alleviate the burden of climate change and epidemics.

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