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Source: Environmental Health Insights, 14(1)

Published By: SAGE Publishing

URL: https://doi.org/10.1177/1178630220946342

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# Access to Improved Water Sources and Sanitation in Minority Ethnic People in Vietnam and Some Sociodemographic Associations: A 2019 National Survey

Environmental Health Insights
Volume 14: 1–9
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DOI: 10.1177/1178630220946342
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**ABSTRACT**

**BACKGROUND:** Achieving access to clean water and basic sanitation remains as major challenges in Vietnam, especially for vulnerable groups such as minority people, despite all the progress made by the Millennium Development Goal number 7.C.

**OBJECTIVES:** The study aimed to describe the access to improved water sources and sanitation of the ethnic minority people in Vietnam based on a national survey and to identify associated factors.

**METHODS:** A cross-sectional study was conducted in 2019 with a sample size of 1385 ethnic minority households in 12 provinces in Vietnam. Multivariate logistic regression modeling was performed to examine the probability of having access to improved water sources and sanitation and sociodemographic status at a significance level of $P < .05$.

**RESULTS:** The access to improved water sources and sanitation was unequal among the ethnic minority people in Vietnam, with the lowest access rate in the northern midland and mountainous and Central Highland areas and the highest access rate in the Mekong Delta region. Some sociodemographic variables that were likely to increase the ethnic minority people's access to improved water sources and/or sanitation included older age, female household heads, household heads with high educational levels, religious households, and households in not poor status.

**CONCLUSION AND RECOMMENDATIONS:** The study suggested more emphasis on religion for improving the ethnic minority's access to improved water sources and sanitation. Besides, persons of poor and near-poor status and with low educational levels should be of focus in future water and sanitation intervention programs.

**KEYWORDS:** Access, improved water sources, sanitation, ethnic minority people, Vietnam, national survey

**RECEIVED:** May 21, 2020. **ACCEPTED:** June 25, 2020.

**TYPE:** Environmental Health Research and Practice in Vietnam-Original Research

**FUNDING:** The author(s) received no financial support for the research, authorship, and/or publication of this article.

**DECLARATION OF CONFLICTING INTERESTS:** The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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## Introduction

Inadequate access to improved water and sanitation remains a significant challenge threatening public health. Contaminated water, together with poor sanitation and hygiene practices, is closely associated with the transmission of various diseases, including cholera, typhoid, schistosomiasis, and some cancers through exposure to carcinogens.[1] The World Health Organization estimated that lack of access to improved water sources and sanitation may account for 7% of the total disease burden and 19% of child mortality per year worldwide.[2] Hence, water supply and sanitation improvement has been targeted as the main priority of public health measures to ensure the population's health.[1]

Millennium Development Goal 7.C was established to halve the population that had no sustainable access to water and basic sanitation before 2015.[3,4] Although serious efforts were made, 785 million people still lacked in basic drinking water services and, as of 2017, 673 million people lacked basic sanitation services worldwide.[5] Generally, rural communities fall behind the urban areas in providing access to basic water and sanitation facilities. A similar trend has also been seen in Vietnam, and although necessary measures were observed and all indicators reflected significant improvement, a gap remains between the rural and urban sectors. In 2016, it was found that 95.6% and 96.4% of households in urban areas had access to improved water sources and improved sanitation facilities compared with 69.9% and 77% of households in rural areas, respectively.[6] In addition, the burden of sanitation and water-borne diseases was unequally distributed in Vietnam with the highest morbidity rates for diarrhea and parasitic infection–related morbidity in the northern mountainous parts and Central Highland of Vietnam, where most peoples are an ethnic minority.[7] However, in Vietnam, no study has been conducted recently focusing on household trends in access to improved

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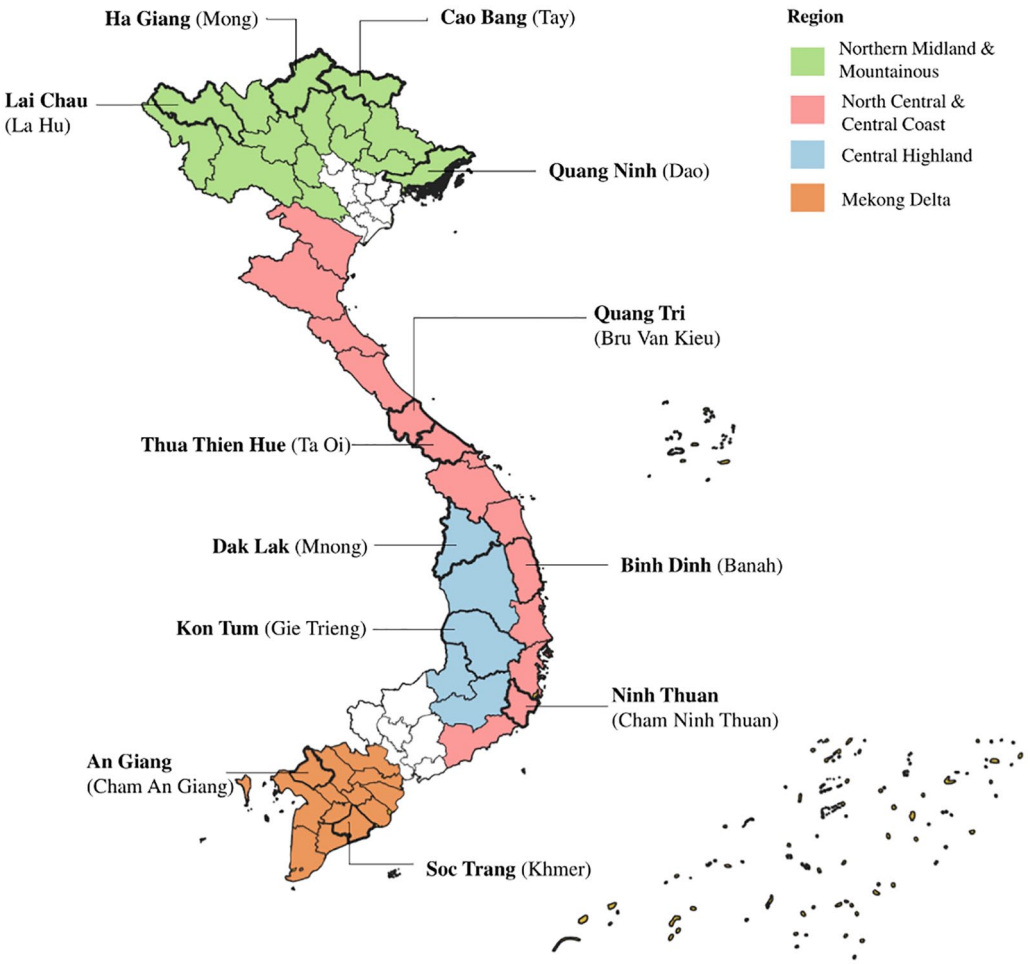



**Figure 1.** Map of Vietnam and the 12 studied provinces.

water and sanitation for this population group. The absence of such a study might lead to inadequate information and limited understanding when developing effective strategies to enhance access to clean water and hygienic sanitation facilities in this area.

This article illustrates the results of a part of a national survey for ethnic minority people and aims to describe the access to improved water sources and sanitation among the ethnic minority people and its associated factors. The outcomes will help to draw a comprehensive picture of water and sanitation facilities for ethnic minorities and to inform policymakers on a safe and sustainably managed water and sanitation promotion program that targets the multiethnic population.

## Methods

### *Study design*

The study applied a cross-sectional design, based on a household survey.

### *Study objects and settings*

The study objects were water sources used for drinking and domestic consumption as well as household toilets at households from 12 provinces located in 4 sociodemographic regions where most ethnic populations inhabited, including (1) northern midland and mountainous region: Lai Chau province (La Hu ethnicity), Ha Giang province (Mong ethnicity), Cao Bang province (Tay ethnicity), and Quang Ninh province (Dao ethnicity); (2) North Central and Central Coast region: Binh Dinh (Bana ethnicity), Quang Tri province (Bru Van Kieu ethnicity), Thua Thien Hue province (Ta Oi ethnicity), and Ninh Thuan province (Cham Ninh Thuan ethnicity); (3) Central Highland region: Kon Tum province (Gie Trieng ethnicity) and Dak Lak province (Mnong ethnicity); and (4) Mekong Delta region: An Giang province (Cham An Giang ethnicity) and Soc Trang province (Khmer ethnicity; Figure 1).

### *Sample size and sampling*

In this study, the total sample size needed for studying water sources and sanitation conditions of 12 ethnicities in 12 provinces was estimated to be approximately 1400 households. In each selected province, based on consultations with local health authorities, 1 to 2 communes with the highest number of target ethnic minority people (eg, La Hu people in Lai Chau province) were selected. From the list of all the households in each selected commune, 84 studied households of ethnic minority

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people were randomly selected. In each selected household, the head of the household or an adult who had the main decisive roles of important issues in the household was invited to participate in the interview to explore the situation of water and sanitation in the household. The exclusion criteria were "separated households but living together in the same house, using the same water sources and toilet." In total, 1397 households participated in the survey, but only 1388 households completed questionnaires with no missing information, resulting in a response rate of 99.4%.

### *Data collection*

Data collection at 12 provinces was conducted from April to September 2019 by local health collaborators who could speak both Vietnamese and local languages through personal household interviews and observations of water sources and toilet types at households. The interviews were conducted at quiet and convenient places of households without other people's presence besides the participants and researchers. The data collectors were also familiar with the culture and people in the studied communes. All data collectors were trained for 2 days in classroom and field settings. Data quality was controlled in the field by supervisors as well as by the investigators of this study. During the data collection process, 100% of the completed questionnaires were screened in the field.

### *Study instrument and measurements*

The structured questionnaire was used to collect information on types of toilets and water sources used for drinking and domestic consumption purposes as well as sociodemographic information of households. In this article, dependent variables were water sources used for drinking and domestic consumption purposes and toilet types (sanitation facilities) of the households. Improved water sources used for drinking and domestic consumption purposes consisted of piped water, tube well/borehole, bottled water, and rainwater. Unprotected well, unprotected springs, and surface water were considered as unimproved water sources. Improved sanitation facilities included piped sewer system, septic tank, pit latrine with slab, and double-vault composting toilet. Unimproved sanitation facilities included pit latrine without slab/open pit, 1 vault toilet, and having no sanitary facilities.[8]

Independent variables including sociodemographic status of the study participants were assessed by ecological regions, locality, age, sex, educational level, marriage status, employment status, religion, ability to speak Kinh language, household size, and the present economic condition of the study respondents. Ecological regions were divided into 4 groups, including northern midland and mountainous region, North Central and Central Coast region, Central Highland region, and Mekong Delta region. The educational level was graded as illiterate, primary school (completion of any school level from the first to the fifth class, or none), secondary school (completion of school level from the sixth to the ninth class), high school, and higher. Employment status was grouped into 2 groups including employed (having a job) and unemployed (jobless). Religions of the study respondents were categorized into 2 groups including "with religion" (Catholic, Christian, Buddhist, etc) or "no religion" (people who did not have any religion). Age and family size were divided into groups (3 age groups including younger than 35 years, from 35 to 54 years, and older than 54 years and 3 groups of family size, namely, less than 5 members, from 5 to 6 members, and more than 6 members) for the descriptive analysis. The original age in years and number of family members were used in the multiple logistics regression. Marital status was categorized into 2 groups (married and live with spouses). The ability to speak the Kinh language also contained 2 groups of yes and no. The economic condition of households or wealth quintiles were classified by the local authorities into 3 groups, which included "Poor," "Near poor," and "Not poor."

### *Statistical methods*

Both descriptive and analytical statistics were performed using SPSS 20.0 (IBM SPSS Statistics). Proportions of water sources and/or toilet types were calculated for all subgroups of demographic characteristics. Multivariate logistic regression analyses with the enter method were performed to examine the associations between access to improved water sources for drinking and other domestic consumption as well as improved toilets, and independent sociodemographic variables (excluding the ecological region). Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were presented at a significance level of $P < .05$.

### *Ethical consideration*

The protocol of this study was approved by the Scientific and Ethical Committee in Biomedical Research, Hanoi University of Public Health (Decision No. 435/2018/YTCC-HD3, dated 01/10/2018). All the study participants who participated in the survey were asked for their consent before collecting data, and all had complete rights to withdraw from the study at any time without any threats or disadvantages.

## Results

### *Access to improved water sources and sanitation of the ethnic minority people in Vietnam*

Table 1 represents the general characteristics of the study participants. Most of them were in their middle age and older (77.1% were older than 35 years). A majority of participants were male (80.6%), married and live with spouse (86.7%), and had not completed high school level (83.7%). Most people (83.3%) had jobs. The majority of the respondents (74.8%)

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**Table 1.** General characteristics of studied household heads (n = 1388).

| VARIABLE | SUBGROUP | WHOLE SAMPLE | |
|---|---|---|---|
| | | N | % |
| Total | | 1388 | 100.0 |
| Age group | >54 | 557 | 40.1 |
| | 36-54 | 514 | 37.0 |
| | ⩽35 | 317 | 22.8 |
| Sex | Female | 269 | 19.4 |
| | Male | 1119 | 80.6 |
| Education | High school and above | 226 | 16.3 |
| | Primary level | 340 | 24.5 |
| | Secondary level | 362 | 26.1 |
| | Illiteracy | 460 | 33.1 |
| Marital status | Married and live with spouse | 1204 | 86.7 |
| | Others | 184 | 13.3 |
| Speak Kinh language | Yes | 1319 | 95.0 |
| | No | 69 | 5.0 |
| Religion | Yes | 350 | 25.2 |
| | No | 1038 | 74.8 |
| Number of family members | <5 | 465 | 33.5 |
| | 5-6 | 647 | 46.6 |
| | >6 | 276 | 19.9 |
| Employment status | Unemployed | 232 | 16.7 |
| | Employed | 1156 | 83.3 |
| Wealth quintiles | Not poor | 966 | 69.6 |
| | Near poor | 163 | 11.7 |
| | Poor | 259 | 18.7 |
| Ecological region | Mekong Delta | 198 | 14.3 |
| | North Central and Central Coast | 508 | 36.6 |
| | Central Highland | 168 | 12.1 |
| | Northern midland and mountains | 514 | 37.0 |
| Locality | Especially difficult areas | 252 | 18.2 |
| | Other | 1136 | 81.8 |

were irreligious. Nearly half of the sample had a medium family size with 5 to 6 members (46.6%). Households with average and nonpoor economic conditions accounted for 69.6% of participants. More than two thirds of the studied minority people resided in the northern midland and mountains (37.0%) and the North Central and Central Coast (36.6%). Approximately one fifth (18.2%) of them lived in especially economically difficult areas.

Figure 2 illustrates the condition of improved water sources, improved sanitation only, and both improved water sources and sanitation in the studied households of the whole sample and by regions. A similarity in the proportion of households with

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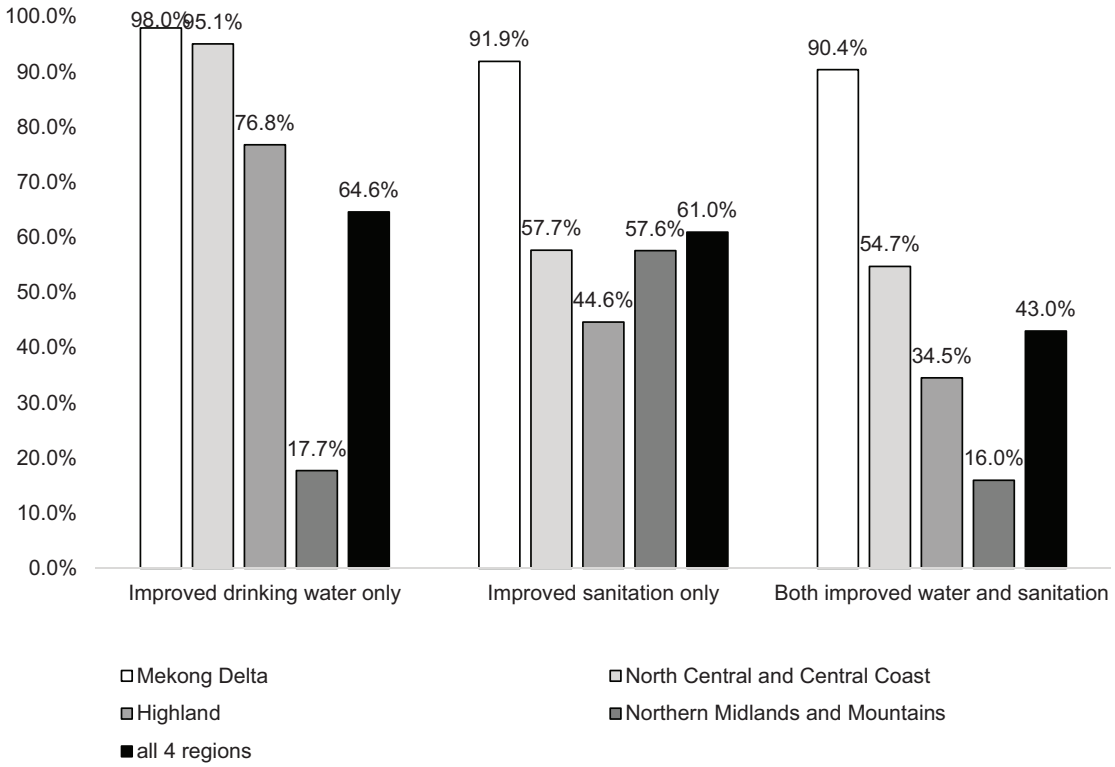



**Figure 2.** The condition of improved water sources, improved sanitation, and both improved water sources and sanitation of the studied households by ecological regions.

access to improved water sources only and improved sanitation only was observed (64.6% and 61.0%, respectively). The number of households having access to both improved water sources and sanitation was relatively high (43.0%). Among regions, significantly unequal accessibility to the condition of water sources and sanitation was found by the study ($P < .001$). In general, the Mekong Delta region had the highest prevalence of improved water sources, improved sanitation only, and both improved water sources and sanitation (98.0%, 91.9%, and 90.4%, respectively), while the northern midland and mountainous region had the lowest prevalence rates (17.7%, 57.6%, and 16.0%, respectively).

### *Factors associated with access to improved water sources and sanitation facilities*

Table 2 shows a significant difference in access to improved water and/or improved sanitation among the minority ethnic households with different demographic characteristics in Vietnam. The age of household owners significantly and positively associated with the likelihood of access to improved water sources only (OR = 1.02, 95% CI: 1.01-1.03, $P < .001$) or improved sanitation only (OR = 1.02, 95% CI: 1.00-1.02, $P < .01$). The number of family members in each household inversely related to access to improved sanitation only, in which households with one more person would be 0.88 times less likely to have access to improved sanitation only ($P < .01$). Households with female owners were only accountable for 19.4% in this study; however, higher percentages of improved water sources were observed among these families compared with households with male owners, especially access to improved water sources (OR = 1.56, 95% CI: 1.05-2.32, $P < .01$).

Regarding other demographic characteristics, education and religion were significantly related to access to all water and sanitation facilities. Higher education generally associated with better access to improved water and sanitation services. Participants with high school level and above were more likely to have access to all services in comparison with those who were illiterate ($P < .01$). People with secondary levels had higher odds to access to improved water or sanitation (OR = 1.53 and 1.47, respectively, $P < .01$), while participants with primary level had better access to sanitation facilities (OR = 1.64, $P < .001$) as compared with illiterate people. Minority people with religion were more likely to have greater access to all improved water sources and sanitation services (OR ranging from 3.38 to 10.19, $P < .001$).

Looking at employment status and economic conditions, less than 20% of households lived in the especially difficult areas or were unemployed by the time of the study; however, they had higher odds in access to the improved water sources and sanitation in a multivariate analysis. However, positive associations between wealth quintiles and access to sanitation only or both improved water and sanitation existed, with an odd of 3.25 ($P < .001$) in the nonpoor and an odd of 2.03 ($P < .01$) in the near-poor in access to both improved water

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**Table 2.** Factors associated with the condition of improved water and toilet among households (multivariate logistic regression, $P < .05$, N = 1388).

| VARIABLE | SUBGROUP | ACCESS TO IMPROVED DRINKING WATER SOURCES ONLY | | | | | ACCESS TO IMPROVED SANITATION ONLY | | | | | ACCESS TO BOTH IMPROVED DRINKING WATER SOURCES AND SANITATION | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N/MEAN | %/SD | OR | 95% CI | | N/MEAN | %/SD | OR | 95% CI | | N/MEAN | %/SD | OR | 95% CI | |
| TOTAL | | 897 | 64.6% | | | | 846 | 61.0% | | | | 597 | 43.0% | | | |
| Age | | 51.8 | 16.5 | 1.02** | 1.01 | 1.03 | 51.4 | 16.1 | 1.01* | 1.00 | 1.02 | 52.3 | 15.9 | 1.01 | 0.99 | 1.01 |
| Number of family members | | 5.2 | 1.7 | 0.95 | 0.89 | 1.02 | 5.1 | 1.8 | 0.88** | 0.81 | 0.94 | 5.2 | 1.6 | 0.93 | 0.87 | 1.00 |
| Sex | Female | 208 | 77.3% | 1.56* | 1.05 | 2.32 | 192 | 71.4% | 1.44 | 0.97 | 2.12 | 147 | 54.6% | 1.36 | 0.94 | 1.95 |
| | Male | 689 | 61.6% | | | | 654 | 58.4% | | | | 450 | 40.2% | | | |
| Education | High school and above | 161 | 71.2% | 2.72** | 1.79 | 4.13 | 183 | 81.0% | 4.95** | 3.18 | 7.72 | 132 | 58.4% | 3.08** | 2.06 | 4.62 |
| | Primary level | 215 | 63.2% | 1.15 | 0.82 | 1.62 | 214 | 62.9% | 1.64** | 1.17 | 2.29 | 152 | 44.7% | 1.32 | 0.94 | 1.86 |
| | Secondary level | 220 | 60.8% | 1.53* | 1.08 | 2.16 | 201 | 55.5% | 1.47* | 1.04 | 2.06 | 126 | 34.8% | 1.12 | 0.79 | 1.61 |
| | Illiteracy | 301 | 65.4% | | | | 248 | 53.9% | | | | 187 | 40.7% | | | |
| Religion | Yes | 320 | 91.4% | 10.19** | 6.70 | 15.48 | 285 | 81.4% | 3.38** | 2.40 | 4.75 | 268 | 76.6% | 7.44** | 5.38 | 10.27 |
| | No | 577 | 55.6% | | | | 561 | 54.0% | | | | 329 | 31.7% | | | |
| Employment status | Unemployed | 186 | 80.2% | 1.80** | 1.21 | 2.68 | 193 | 83.2% | 2.61** | 1.73 | 3.94 | 153 | 65.9% | 2.33** | 1.62 | 3.34 |
| | Employed | 711 | 61.5% | | | | 653 | 56.5% | | | | 444 | 38.4% | | | |
| Locality | Especially difficult areas | 176 | 69.8% | 2.39** | 1.70 | 3.35 | 108 | 42.9% | 1.02 | 0.73 | 1.44 | 77 | 30.6% | 1.68** | 1.17 | 2.41 |
| | Other | 721 | 63.5% | | | | 738 | 65.0% | | | | 520 | 45.8% | | | |
| Wealth quintiles | Not poor | 625 | 64.7% | 0.73 | 0.52 | 1.03 | 680 | 70.4% | 3.83** | 2.70 | 5.43 | 487 | 50.4% | 3.25** | 2.18 | 4.82 |
| | Near poor | 105 | 64.4% | 0.79 | 0.50 | 1.25 | 89 | 54.6% | 2.15** | 1.38 | 3.34 | 62 | 38.0% | 2.03* | 1.23 | 3.33 |
| | Poor | 167 | 64.5% | | | | 77 | 29.7% | | | | 48 | 18.5% | | | |

Marital status and ability to speak Kinh language were not presented in the table because of insignificant association with access to services.
*Significance level at $P < .01$, **Significance level at $P < .001$.

and sanitation, and an odd of 3.83 in the nonpoor and an odd of 2.15 in the near-poor in access to improved sanitation only ($P < .01$), compared with that of the nonpoor households.

## Discussions

The National Target Program phase 2012 to 2015 on Water and Sanitation (NTP3) in Vietnam targeted that, by 2015, the prevalence of rural households having accessed to improved water sources would be 85% and to improved sanitation would be 65%.[9] By 2015, the prevalence of access to both indicators was achieved; however, the prevalence was unequal across different regions in the country, with lower prevalence than the targets in mountainous and disadvantageous areas and higher prevalence rates than the targeted in more advantageous areas such as Red River Delta or Eastern Southern region.[10] A similar trend was also observed in our study, where the lowest access to improved water sources and sanitation belonged to minority ethnic people in the northern midland and mountainous region and the highest prevalence belonged to the Mekong Delta region (Figure 2). According to the statistics of the General Statistics Office of Vietnam in 2019, the northern midland and mountainous region was the most disadvantageous region of the country, and the difference between the highest and lowest income quintile in 2018 in this region was higher than that of the Mekong Delta region and that of the whole country, while the Mekong Delta region was one of the most advantageous of the country.[11] This could be an explanation for the difference in the spatial unequal distribution in access to improved water sources and sanitation in the studied participants across different regions. Similar results were also found in a quarter-century study in sub-Saharan countries by Armah et al,[12] with higher access to improved water sources and sanitation belonged to urban areas, where the economic status was better than that in the rural areas. Other studies in Vietnam also found similar results to this study, with spatial unequal access to improved water, improved sanitation, and both improved water and sanitation in more advantageous regions compared with the more disadvantageous regions.[13,14]

The study results showed that the overall prevalence of ethnic minority households who had access to improved water sources only was 64.6%, to improved sanitation only was 61%, and to both improved water sources and sanitation was 43% (Figure 2). All these figures indicated that even 4 years after the NTP3 ended, the ethnic communities still had lower access to improved water sources and improved sanitation than the 2015 targeted indicators.[9] Similar results were also obtained from the previous national study by Tuyet-Hanh et al,[13] where the Kinh people had higher access to improved water sources, improved sanitation only, and both improved water and sanitation than the non-Kinh people. This imposes significant health risks to this vulnerable group due to poor water and sanitation.[1] This also implies that more investment is needed to increase access to improved water sources and sanitation for these ethnic minority groups. Of these people, more emphasis of the proposed investment should be spent for the minority ethnic people in the northern midland and mountainous region because they lived in the most disadvantageous region[11] and had the lowest access to improved water sources, improved sanitation only, and both improved water sources and sanitation as compared with other regions in the country.

The results of this study indicated that the older the heads of the studied household, the higher the access to improved water sources and improved sanitation only. The finding of the association between increased age and improved sanitation was relevant to that in sub-Saharan countries, but the association between increased age and improved water sources only in this study was inverse to that of Armah et al[12] in sub-Saharan countries. Results found in Ghana also showed that people aged 40 years and above had better access to improved sanitation, which was relevant to our study results.[15] However, several other studies in Vietnam did not analyze the association between the age of the households and the access to improved water and/or improved sanitation.[13,14] This study implied that household heads who were female had better access to improved water sources, and this finding was relevant to other similar studies conducted in Vietnam[13] and the African countries.[12,15,16] This finding highlighted the importance of women in ensuring the family's access to improved water sources, and therefore, they should be involved in improved water promotion programs in different regions and levels, as suggested by Angoua et al[16] in Côte d'Ivoire.

The educational level also showed associations with the access to improved water sources only, improved sanitation only, and both improved water sources and sanitation, with the likelihood of lower access in the households whose heads were illiterate and of primary and secondary educational levels than the households' heads with high school educational level and above. This finding differed from that of a similar study in Côte d'Ivoire, where educational level seemed to have no association with the access of improved water and sanitation.[16] However, this finding was relevant to various studies in Vietnam[13,14] and in other regions of the world, such as in Cambodia[17] or Ghana[15] or sub-Saharan African countries.[12] It could be implied from our studies that ethnic minority people in Vietnam should be paid more attention in the educational process, and they should be able to speak Kinh language (ie, Vietnamese language) so that they can understand the importance of having access to improved water sources and sanitation to decrease their health risks, thus can have better access to the improved water and sanitation.

In this study, households with religious heads had better access to all improved water sources and sanitation than those with nonreligious heads (Table 2). However, this finding was contradictory to what was found in a national survey in Côte d'Ivoire where religion was confirmed to have no association with the access to improved water and sanitation. It could be

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explained that people with religions may have listened to the communication of these issues from the monks, pastors, priests, or vicars during their visits to pagodas, temples, or churches, and therefore, the study recommended that religion should be carefully considered as a component of a health promotion program for increasing community's awareness to the importance of having improved toilets or improved water for drinking and other domestic purposes.[16]

Socioeconomic status contributes to the many aspects of life, including access to improved water sources and sanitation, as revealed by various studies in the area of water and sanitation, with higher access belonged to the wealthier groups and lower access in the poorest, poor, or near-poor groups.[13-17] Similar results were also found by this study, with a likelihood of lower access in poor and near-poor groups than the not poor group (Table 2). Based on this result, it is recommended that water and sanitation programs in Vietnam and other developing countries be focused on communities with lower socioeconomic status or lower wealthy quintile groups.

Although certain interesting results were found by this study, this study still had some limitations. Regarding methodology, although the sample size was relatively large (1388), it was not adequately representative regarding regional scale or ethnic minority groups (54 groups). Future studies should focus on each region; it is also helpful to control the effect of sociospatial difference. We were unable to control the effect of available services on water and sanitation facilities in the analysis because the availability of services varied across regions, with accessible and affordable services being more available in the delta areas. Besides, information on prior intervention/support on water and sanitation access for hard-to-reach areas was not collected in this study. Future studies should address this information. In this study, we were unable to assess the quality of drinking water and sanitation facilities. It is important because the quality of drinking water and hygiene conditions of sanitation facilities hold substantial effects on health. The improvement of such services did not guarantee its safety. We, therefore, used the guidelines from the Ministry of Health for assessing the quality of water sources to categorize them as improved/unimproved water sources, which has been applied by various studies in Vietnam.[13,14] Although containing such limitation, our studies still provided insights for future studies to further investigate the quality of drinking water, especially among ethnic minority groups. In addition, the study did not use an observational checklist to assess the sanitary conditions of the toilets of the study population. The conditions of toilets were assessed based on verbal interviews with heads of the studied households; therefore, it may not comprehensively reflect the sanitary condition of the studied household's sanitation conditions. It is suggested by this study that future studies should pay attention to the analysis of water quality and direct observation of toilets using a standard checklist to have a more precise assessment of the improved water and sanitation coverage. Furthermore, our study only focused on the ethnic minority groups instead of the general Vietnamese population; thus, the findings are not representative of the entire Vietnamese population. However, this was the first study in Vietnam that ever approached the accessibility to improved water sources and sanitation among the ethnic minority people at a national level. Therefore, the findings of this study will inform possible solutions for improving access for this vulnerable group. Finally, although poor access to improved water and sanitation was associated with various health impacts, the study could not correlate the health impacts of the ethnic minority people with their low access to improved water and sanitation. As such, we recommend that future studies should have more focus on this aspect to improve the health status of this vulnerable community.

## Conclusions and Recommendations

Our study found that access to improved water sources and sanitation was unequal in different regions, with the lowest access for the ethnic minority groups in the northern midland and mountainous region and Central Highland region and the highest access in the Mekong Delta region. Several factors associated with lower access to improved water sources and sanitation included living in ecological regions (such as northern midland and mountainous region, Central Highland region, and North Central and Central Coast), lower educational level, nonreligious, and belonging to lower wealthy quintile groups. It is recommended by this study that water and sanitation programs in Vietnam should be more attentive to the ethnic minority groups, especially those living in mountainous and disadvantageous areas such as northern midland and mountainous or Central Highland regions. Religion should be carefully considered as a component of the health promotion program as it is associated with higher access to improved water sources and sanitation. More support should be given to ethnic people in the poor and near-poor groups and low educational levels to improve their access to improved water and sanitation. In addition, the health consequences of the ethnic minority groups with low access to improved water and sanitation should be researched to improve their health status. Future studies should also consider the water quality analysis and direct observation of toilets for a better analysis on the accessibility to improved water and sanitation in Vietnam.

## Acknowledgements

Sincere thanks from our team are sent to the ethnic minority people and the collaborators in 12 studied provinces who contributed to the data collection, and to the Provincial Health Departments of the 12 provinces who unconditionally supported us during the study time. We also acknowledge Ms. Amanda Stephanie Farrell, who is a medical student at Duke University, for her support in the English editing of this article.

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## Author Contributions

All the authors had an equal contribution to the data analysis and writing of the article.

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