Original Article

Prevalence differences in major non-communicable diseases in a low-middle income country: a comparative study between an urban and a rural district in Vietnam

Sopak Supakul ,¹ Hye Yin Park ,² Bao Ngoc Nguyen ,³ Kim Bao Giang ⁴

OPEN ACCESS

Received: Nov 7, 2019

Accepted: Dec 2, 2019

Correspondence to

Sopak Supakul

School of Medicine, Tokyo Medical and Dental University, 1-5-45, Yushima, Bunkyo, Tokyo 113-8519, Japan.

E-mail: 140521ms@tmd.ac.jp

© 2019 Korean Society of Global Health.

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ORCID iDs

Sopak Supakul

<https://orcid.org/0000-0001-5835-2437>

Hye Yin Park

<https://orcid.org/0000-0003-4144-1534>

Bao Ngoc Nguyen

<https://orcid.org/0000-0002-0316-7450>

Kim Bao Giang

<https://orcid.org/0000-0003-2290-0205>

Funding

This project was financially supported by the JW LEE Center for Global Medicine of Seoul National University College of Medicine, Seoul, South Korea.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

¹School of Medicine, Tokyo Medical and Dental University, Tokyo, Japan

²Institute of Environmental Medicine, Seoul National University College of Medicine, Seoul, Korea

³Center for Population Health Sciences, Hanoi University of Public Health, Hanoi, Vietnam

⁴Department of Health Education, Institute for Preventive Medicine and Public Health, Hanoi Medical University, Hanoi, Vietnam

ABSTRACT

Background: Non-communicable diseases (NCDs) are emerging as a serious problem for many low- and middle-income countries, especially in societies with rapidly growing economies. During such economic growth, rapid urbanization may affect population health as much as other economic factors. However, there have been few studies comparing the urban-rural difference in NCDs prevalence in low- and middle-income countries. This study aimed to compare differences in major NCDs prevalence between urban and rural residency after controlling for socioeconomic and behavioral risk factors in Vietnam.

Methods: Residents aged ≥ 15 years from an urban (the district-level town of Thuận An, $n=2,126$) and rural (Quốc Oai, $n=2,970$) district in Vietnam participated in a community-based survey in 2016. Information on NCD history, socioeconomic status, and lifestyle factors was collected on an individual or household basis. Associations between residential area, other risk factors, and NCD prevalence was investigated using multiple logistic regression analysis.

Results: Urban residency was significantly associated with cardiovascular diseases (odds ratio [OR], 1.30; 95% confidence interval [CI], 1.01–1.68) and diabetes (OR, 1.86; 95% CI, 1.01–3.41) for those aged 15–59 years after controlling for other socioeconomic characteristics, and inversely associated with respiratory diseases (OR, 0.66; 95% CI, 0.48–0.90) (rural residency showed more significant prevalence to respiratory diseases). For aged individuals ≥ 60 years old, urban living was similarly positively associated with diabetes (OR, 2.26; 95% CI, 1.25–4.10), and inversely associated with other NCDs (OR, 0.49; 95% CI, 0.36–0.67) (rural residency showed more significant prevalence to other NCDs), in contrast to younger adults.

Conclusions: The study disclosed different prevalence patterns of NCDs for differently aged urban residents in Vietnam. The Vietnamese government is encouraged to develop health care policies that strategically targeted to the different patterns of disease prevalence.

Keywords: Non-communicable diseases; Behavioral risk factors; Urban-rural; Vietnam

Author Contributions

Conceptualization: Supakul S; Data curation:
Nguyen BN; Formal analysis: Supakul S;
Investigation: Supakul S; Methodology:
Supakul S, Park HY; Project administration:
Supakul S; Writing - original draft: Supakul S;
Writing - review & editing: Park HY, Giang KB.

INTRODUCTION

Non-communicable diseases (NCDs), or chronic diseases, kill more than 41 million people each year and have become an important issue that needs to be tackled worldwide. According to the World Health Organization (WHO), NCD mortality is a result of genetic, environmental, and behavioral factors over a long duration.¹ NCDs account for a higher mortality burden in low-income countries (625 per 100,000) and lower-middle-income countries (673 per 100,000) than in high-income countries (397 per 100,000). In 2016, it was reported that the most common cause of death for NCDs are cardiovascular diseases (17.9 million deaths; 44% of all NCD deaths), cancers (9 million deaths; 21.7% of all NCD deaths), chronic respiratory disease, including asthma and chronic obstructive pulmonary disease (COPD) (3.8 million deaths; 9% of all NCD deaths), and diabetes (1.6 million deaths; 3.9% of all NCD deaths). These diseases count for 78.6% of NCD death worldwide² and are expected to account for 8 in every 10 deaths in developing countries.³

Risk factors for NCDs are often categorized as metabolic/physiological risk factors (e.g., raised blood pressure and blood glucose level, obesity), behavioral risk factors (e.g., tobacco use, unhealthy diet, physical inactivity, harmful use of alcohol), and underlying drivers, such as social determinants of health, globalization, population aging, and urbanization.⁴ Rapid and unplanned urbanization in the developing world is a highly influential factor, which has led to a transition in lifestyle characterized by unhealthy nutrition, tobacco use, and reduced physical activity.^{5,6}

The growth of aged populations will also greatly contribute to rising numbers of NCDs. These socio-demographic and epidemiological transitions have resulted in many low-middle-income countries facing a “double burden of disease” (both NCDs and infectious diseases).⁷ Consequently, an increase in NCD prevalence will result in rising healthcare expenditure.

Vietnam is a country in the Western-Pacific region with recent significant economic growth, and thus, is expected to encounter increased NCD prevalence. In 2016, 77% of deaths were due to NCDs (424,000 of 549,000 deaths), most of which were caused by cardiovascular disease, cancer, chronic respiratory diseases, and diabetes.⁸ The government has already taken action by releasing the National Target Program for the Prevention and Control of NCDs in 2002,⁹ and recently has also released a National Strategy targeting cancer, cardiovascular disease, diabetes, COPD, asthma, etc. for 2015 to 2025.^{10,11}

Although there are a number of attempts from both domestic and international partners to strengthen health systems globally including in Vietnam (e.g., movements toward Universal Healthcare and eradication of NCDs),¹² research investigating NCDs prevalence and its relationship with national social and demographic factors (i.e., urban and rural) have not yet been well-studied. Thus, this study aimed to examine the differences in prevalence of some major NCDs between urban and rural districts in Vietnam.

METHODS**Study setting**

The study population was randomly sampled from two districts (one urban and one rural) in Vietnam, where subjects participated in a community-based baseline survey conducted

jointly by 4 universities (Hanoi Medical University, Hanoi University of Public Health, University of Medicine and Pharmacy of Ho Chi Minh City, and Seoul National University).¹³ This cohort is a component of the Vietnam Health System Strengthening Project, which aimed to develop small-scale evidence for sustainable macro-efficient healthcare systems in Vietnam. The cohort was developed to capture the two districts' baseline characteristics and to observe their changing patterns in terms of demographic and socio-economic factors, health status, health service utilization, and health behavioral variables since 2016. Thuan An (Thuận An) in Binh Duong province and Quoc Oai (Quốc Oai) in Hanoi city were selected to represent urban and rural areas, respectively.

Thuận An is located in the southern part of Vietnam close to Ho Chi Minh City. There are 9 wards and 1 commune with a total population of 469,043 people, of whom 65% are migrant workers from other cities in Vietnam. Thuận An, a special industrial zone, was chosen for evaluating urban health matters in relation to its increasing local GDP. On the other hand, Quốc Oai in the northern part of Vietnam is located 35 km to the west of Hanoi, and is composed of 1 township and 20 communes, with a population of 163,000 people.

Sampling and data collection

All clusters and corresponding population members were selected using a probability-proportional-to-size technique.¹⁴ A stratified multistage cluster sampling technique was used to identify households for this study. More detailed methods are described elsewhere.¹⁵ The sample size selected for these surveys was based on the formula suggested by the WHO.¹⁶ Individual interviewees were chosen using the Kish method.¹⁷ In each selected household, the research team interviewed the head of the household using a household questionnaire. Afterwards, the team interviewed 1 or 2 household members using the questionnaire designed for individuals: a randomly selected household member among those aged between 15 and 59; and another aged household member, also randomly selected among those 60 years or older, if any. The number of individuals who responded to the survey was 5,096 in total, composed of 2,126 from the urban area and 2,970 from the rural area. All of them were included in the final analysis. Structured questionnaires and face-to-face interviews were conducted with participants. The questionnaire was divided into two sections for households and individuals.

Variable measurements and instruments

Age (young and old; cut off age 60), sex (male and female), ethnicity (Kinh and Non-Kinh), marital status (married, unmarried, and widowed), religious status (yes or no), educational attainment (no education, under primary, primary, secondary, high school, college, university or higher), working status (worker and nonworker), and health insurance status (yes or no) were used as demographic variables. Body mass index (BMI) was calculated using self-reported heights and weights and categorized on the basis of Asian-specific BMI cut-offs.¹⁸ NCD was accessed via the self-reported question: "In the past 12 months, have you ever been diagnosed by a doctor with one or more of the following chronic diseases (diabetes, cancer, neuropsychiatric diseases, cardiovascular diseases, respiratory diseases, asthma/COPD, liver failure, kidney diseases, digestive diseases, musculoskeletal disorders (MSDs), movement disability, other chronic diseases)?," and chronic diseases were described as "diseases suffered from for a long time (>3 months); diseases progression time is slow; no vaccines to prevent these kinds of diseases."

Variables for evaluating behavioral risk factors (tobacco use and alcohol consumption) were measured with the questions: "Do you currently smoke any tobacco products, such as

cigarettes, cigars or pipes?” and “Have you consumed any alcoholic beverages within the past 30 days?” Moreover, the survey used the questions “Have you ever heard about NCDs?” “Have you ever heard that smoking is a risk factor to NCDs?”, and “Have you ever heard that alcohol abuse is a risk factor for NCDs?” to assess the awareness of NCDs.

Analysis

STATA SE (version 14.0; StataCorp LLC, College Station, TX, USA) was used for the statistical analysis of the data. Descriptive statistical analyses were used to describe the socioeconomic characteristics, health status, including the prevalence of NCDs, behavioral risk factors, and awareness of risk factors. Multivariate logistic regression analyses were performed to detect the influence of factors such as resident area, age, gender, education level, working status, health insurance, and NCDs risk factors on NCDs prevalence. Significance was set at $p < 0.05$.

Ethics and consent

The study was ethically approved at the Institutional Review Board of the Hanoi University of Public Health (certificate no. 003/2016/YTCC-HD3). All participants agreed to written consent form.

RESULTS

An overview of the general characteristics of the study participants is provided in **Table 1**. There were more female participants compared to males of both age groups in both urban

Table 1. General characteristics of the study population stratified by resident area (n=5,096)

Variable	Urban (n=2,126)		Rural (n=2,970)	
	Young (<60 yr)	Old (≥60 yr)	Young (<60 yr)	Old (≥60 yr)
Sex				
Female	1,169 (68.3)	273 (65.9)	1,156 (53.3)	483 (60.2)
Male	543 (31.7)	141 (34.1)	1,012 (46.7)	319 (39.8)
Ethnicity				
Kinh	1,660 (97.0)	410 (99.0)	1,584 (73.1)	655 (81.7)
Non-Kinh	52 (3.0)	4 (1.0)	584 (26.9)	147 (18.3)
Marital Status				
Married/reunion	1,320 (77.1)	225 (54.3)	1,642 (75.7)	468 (58.4)
Single/divorced/separated	271 (15.8)	35 (8.5)	437 (20.2)	38 (4.7)
Widowed	121 (7.1)	154 (37.2)	86 (4.1)	295 (36.9)
Religion				
Yes	566 (33.1)	150 (36.2)	58 (2.7)	18 (2.2)
No	1,146 (66.9)	264 (63.8)	2,110 (97.3)	784 (97.8)
Education				
University or higher	90 (5.3)	7 (1.7)	120 (5.5)	7 (0.9)
College	81 (4.7)	4 (1.0)	228 (10.5)	30 (3.7)
High school	412 (24.1)	60 (14.5)	498 (23.0)	54 (6.7)
Secondary	694 (40.5)	93 (22.4)	889 (41.0)	202 (25.2)
Primary	286 (16.7)	133 (27.3)	316 (14.6)	225 (28.1)
Under primary	127 (7.4)	66 (15.9)	98 (4.5)	199 (24.8)
No education	21 (1.3)	51 (17.2)	19 (0.9)	85 (10.6)
Working Status				
Worker	1,185 (69.2)	113 (27.3)	1,910 (88.1)	605 (75.4)
Nonworker	527 (30.8)	301 (72.7)	258 (11.9)	197 (24.6)
Health Insurance				
Yes	994 (58.1)	321 (77.5)	1,024 (47.2)	582 (72.6)
No	718 (41.9)	93 (22.5)	1,144 (52.8)	220 (27.4)

Values are presented as number of participants (%).

and rural settings and there were more minority ethnic individuals (Non-Kinh) in the rural compared to the urban area (26.9% to 3.0% among young population and 18.3% to 1.0% among old population). Regarding educational attainment, the younger population showed a similar distribution of educational attainment, while the aged population showed a higher level of educational attainment among rural residents. Most of the population in both the young and aged groups in urban and rural areas were covered by health insurance; however, the urban area showed relatively higher coverage by health insurance (61.9%), while more than half of the young population in the rural area (52.8%) did not have health insurance.

Table 2 shows the prevalence of reported NCDs without stratifying for specific age groups. **Table 3** shows the reported NCDs, behavioral risk factors, and awareness of NCDs by study population. Regarding the prevalence of NCDs, cardiovascular diseases, diabetes, neuropsychiatric diseases, liver failure, and kidney diseases were more prevalent in the urban area, while respiratory diseases, cancer, digestive diseases, MSD, and movement disability were more common in the rural area. People in the urban area were more overweight while those in rural areas tended to be underweight. It was also found that the younger individuals in rural areas smoked more than their counterparts in urban areas (19.2% to 14.2%), while the aged smoked more in urban areas. The younger group in the rural area also consumed more alcohol and awareness of NCDs and their risk factors (i.e., smoking and drinking) was found to be higher in the urban area than in the rural area.

Associations between each major NCD and demographic, socioeconomic, and behavioral factors are shown by age group in **Table 4**. Among the younger population, urban residents were significantly more likely to have cardiovascular disease (adjusted odds ratio [aOR], 1.30; 95% confidence interval [CI], 1.01–1.68), diabetes (aOR, 1.86; 95% CI, 1.01–3.41), and less likely to have respiratory diseases (aOR, 0.66; 95% CI, 0.48–0.90). Among the aged population, urban residency was associated with diabetes (aOR, 2.26; 95% CI, 1.25–4.10) and the decrease in likelihood to have other NCDs (aOR, 0.49; 95% CI, 0.36–0.67).

Other socioeconomic covariates had diverse association with different NCDs. High prevalence of cardiovascular, respiratory diseases and other NCDs among the younger population was seen regardless of education level. The aged population also showed a similar lack of association between educational attainment and cardiovascular disease, however, the opposite relationship between educational attainment and diabetes (aOR, 7.95; 95% CI, 1.67–37.83) was observed. Regarding working status, the prevalence of cardiovascular diseases

Table 2. Prevalence of NCDs comparing between urban and rural area (n=5,096)

Reported NCDs	Urban (n=2,126)	Rural (n=2,970)
Cardiovascular diseases	378 (17.8)	398 (13.4)
Diabetes	79 (3.7)	47 (1.6)
Respiratory diseases ^a	109 (5.1)	220 (7.4)
Cancer	3 (0.1)	10 (0.3)
Neuropsychiatric	98 (4.6)	71 (2.4)
Liver failure	104 (4.9)	82 (2.8)
Kidney diseases	77 (3.6)	102 (3.4)
Digestive diseases	224 (10.5)	422 (14.2)
MSD	395 (18.6)	805 (27.1)
Movement disability	16 (0.8)	44 (1.5)
Other chronic diseases	174 (8.2)	217 (7.3)

Values are presented as number of participants (%).

NCD = non-communicable disease; MSD = musculoskeletal disorder.

^aRespiratory diseases included chronic obstructive pulmonary diseases, asthma, and other respiratory diseases.

Prevalence differences in non-communicable diseases in Vietnam

Table 3. Reported NCDs, behavioral risk factors, and acknowledgements of the study population stratified by resident area (n=5,096)

Variable	Urban (n=2,126)		Rural (n=2,970)	
	Young (<60 yr)	Old (≥60 yr)	Young (<60 yr)	Old (≥60 yr)
Reported NCDs				
Cardiovascular diseases	207 (12.1)	171 (41.3)	133 (6.1)	265 (33.0)
Diabetes	40 (2.3)	39 (9.4)	18 (0.8)	29 (3.6)
Respiratory diseases ^a	68 (4.0)	41 (9.9)	134 (6.2)	86 (10.7)
Cancer	3 (0.2)	0 (0.0)	6 (0.3)	4 (0.5)
Neuropsychiatric	69 (4.0)	29 (7.0)	37 (1.7)	34 (4.2)
Liver failure	69 (4.0)	35 (8.5)	51 (2.4)	31 (3.9)
Kidney diseases	46 (2.7)	31 (7.5)	54 (2.5)	48 (6.0)
Digestive diseases	162 (9.5)	62 (15.0)	282 (13.0)	140 (17.5)
MSD	244 (14.3)	151 (36.5)	397 (18.3)	408 (50.9)
Movement disability	7 (0.4)	9 (2.2)	23 (1.1)	21 (2.6)
Other chronic diseases	141 (8.0)	33 (8.0)	109 (5.0)	108 (13.5)
BMI				
Severely underweight	26 (1.5)	6 (1.5)	12 (0.6)	5 (0.6)
Underweight	177 (10.3)	78 (18.8)	293 (13.7)	232 (29.3)
Normal	1,248 (73.0)	258 (62.3)	1,752 (81.8)	525 (66.2)
Overweight	235 (13.7)	63 (15.2)	80 (3.7)	30 (3.8)
Obese	26 (1.5)	9 (2.2)	4 (0.2)	1 (0.1)
Smoking				
Current smoker	243 (14.2)	72 (17.4)	416 (19.2)	98 (12.2)
Nonsmoker	1,469 (85.8)	342 (82.6)	1,752 (80.8)	704 (87.8)
Alcohol consumption				
Current drinker	279 (16.3)	40 (9.7)	649 (29.9)	164 (20.4)
Alcohol abstainer	1,433 (83.7)	374 (90.3)	1,519 (70.1)	638 (79.6)
Acknowledge about NCDs (yes)	1,477 (86.3)	333 (80.4)	1,698 (78.3)	583 (72.7)
Acknowledge about smoking risk (yes)	1,355 (79.2)	289 (69.8)	1,461 (67.4)	484 (60.4)
Acknowledge about drinking risk (yes)	1,296 (75.7)	290 (70.1)	1,462 (67.4)	488 (60.9)

Values are presented as number of participants (%).

NCD = non-communicable disease; MSD = musculoskeletal disorder; BMI = body mass index.

^aRespiratory diseases included chronic obstructive pulmonary diseases, asthma, and other respiratory diseases.

decreased for both age groups among those who were worker, although only the younger population showed a decrease in prevalence of diabetes. Moreover, the younger population who were covered with health insurance reported more cardiovascular diseases and diabetes, while the aged population experienced an association with cardiovascular disease.

Behavioral risk factors also showed various associations across different NCDs. Overweight and obese status was significantly associated with cardiovascular disease in the younger population. Similarly, overweight status was associated with diabetes and other NCDs, while underweight aged individuals were less likely to have diabetes (aOR, 0.46; 95% CI, 0.22–0.96). Although smoking and alcohol consumption were not associated with any NCDs in multiple logistic regression results, the aged population who were current drinkers was less likely to have diabetes (aOR, 0.30; 95% CI, 0.11–0.81).

Different prevalence of NCDs among urban and rural residents was shown (Table 5). For the young population, urban residents were more likely to have cardiovascular diseases, diabetes, and neuropsychiatric diseases, while they were less likely to have digestive diseases, MSDs, and movement disability. The younger population living in the urban area showed less prevalence of respiratory disease, and the aged population in the urban area have lower prevalence of MSDs (aOR, 0.46; 95% CI, 0.34–0.63).

Prevalence differences in non-communicable diseases in Vietnam

Table 4. Association between socio-demographic and behavioral risk factors and each NCD

Major NCDs	Cardiovascular diseases		Diabetes		Respiratory diseases ^a		Other NCDs ^b	
	Young (<60 yr)	Old (≥60 yr)	Young (<60 yr)	Old (≥60 yr)	Young (<60 yr)	Old (≥60 yr)	Young (<60 yr)	Old (≥60 yr)
Resident area								
Rural	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Urban	1.30 (1.01–1.68)	1.03 (0.76–1.40)	1.86 (1.01–3.41)	2.26 (1.25–4.10)	0.66 (0.48–0.90)	1.27 (0.78–2.05)	0.87 (0.75–1.01)	0.49 (0.36–0.67)
Sex								
Male	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Female	1.06 (0.78–1.45)	0.79 (0.58–1.06)	0.66 (0.34–1.31)	0.66 (0.36–1.22)	0.75 (0.52–1.07)	0.72 (0.46–1.13)	1.64 (1.35–1.98)	1.12 (0.83–1.52)
Education								
No education	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Under primary	0.37 (0.16–0.83)	1.11 (0.70–1.75)	0.54 (0.06–5.12)	1.03 (0.33–3.20)	0.56 (0.17–1.85)	1.64 (0.79–3.38)	1.08 (0.54–2.13)	0.91 (0.58–1.43)
Primary	0.32 (0.15–0.68)	1.18 (0.76–1.84)	0.72 (0.09–5.80)	1.15 (0.41–3.28)	0.45 (0.15–1.36)	1.39 (0.68–2.86)	0.73 (0.38–1.39)	0.72 (0.47–1.11)
Secondary	0.28 (0.14–0.59)	1.03 (0.65–1.65)	0.56 (0.07–4.34)	1.62 (0.57–4.65)	0.53 (0.18–1.53)	1.17 (0.55–2.52)	0.63 (0.33–1.18)	0.69 (0.44–1.09)
High school	0.18 (0.09–0.39)	0.93 (0.53–1.64)	0.48 (0.06–3.85)	1.50 (0.46–4.90)	0.44 (0.15–1.30)	0.82 (0.31–2.20)	0.42 (0.22–0.80)	1.22 (0.69–2.16)
College	0.04 (0.01–0.13)	1.33 (0.59–2.99)	-	2.28 (0.48–10.79)	0.23 (0.07–0.80)	2.62 (0.85–8.10)	0.26 (0.13–0.51)	0.45 (0.20–1.00)
University or higher	0.10 (0.04–0.27)	0.38 (0.10–1.46)	0.41 (0.04–4.19)	7.95 (1.67–37.83)	0.42 (0.12–1.42)	0.95 (0.11–8.27)	0.36 (0.18–0.73)	0.26 (0.08–0.87)
Working status								
Nonworker	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Worker	0.63 (0.49–0.82)	0.62 (0.46–0.82)	0.43 (0.24–0.76)	0.82 (0.46–1.48)	1.33 (0.88–2.00)	1.35 (0.85–2.12)	1.16 (0.97–1.40)	0.87 (0.65–1.16)
Health insurance								
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	1.50 (1.18–1.90)	2.58 (1.88–3.53)	2.57 (1.40–4.70)	2.06 (0.99–4.30)	1.04 (0.77–1.40)	1.58 (0.98–2.54)	1.24 (1.07–1.43)	1.21 (0.92–1.59)
BMI								
Normal	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Severely underweight	-	0.23 (0.03–1.87)	-	-	-	-	0.36 (0.12–1.06)	0.51 (0.13–1.94)
Underweight	0.75 (0.50–1.12)	0.81 (0.60–1.08)	0.45 (0.14–1.47)	0.46 (0.22–0.96)	1.35 (0.90–2.00)	1.42 (0.93–2.17)	0.79 (0.63–0.99)	0.84 (0.63–1.12)
Overweight	2.99 (2.19–4.09)	1.51 (0.96–2.39)	2.11 (1.08–4.10)	0.68 (0.28–1.69)	0.83 (0.45–1.53)	0.93 (0.44–1.97)	1.55 (1.21–1.98)	1.38 (0.86–2.20)
Obese	2.74 (1.12–6.68)	1.53 (0.41–5.67)	1.60 (0.21–12.36)	-	0.75 (0.10–5.57)	-	1.66 (0.79–3.49)	2.34 (0.58–9.37)
Smoking								
Nonsmoker	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Current smoker	0.85 (0.55–1.30)	0.85 (0.57–1.27)	1.10 (0.48–2.50)	1.11 (0.50–2.43)	0.83 (0.53–1.30)	0.55 (0.28–1.09)	1.15 (0.91–1.46)	0.79 (0.53–1.16)
Alcohol Consumption								
Alcohol abstainer	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Current drinker	0.72 (0.48–1.08)	0.81 (0.55–1.18)	1.18 (0.53–2.60)	0.30 (0.11–0.81)	0.92 (0.60–1.39)	1.01 (0.56–1.81)	1.12 (0.90–1.40)	0.96 (0.66–1.40)

Values are presented as aOR with 95% CI. The aORs were adjusted by resident area, sex, education level, working status, health insurance, and NCDs risk factors (significant aOR with $p < 0.05$ were represented in bold text).

NCD = non-communicable disease; aOR = adjusted odds ratio; CI = confidence interval; BMI = body mass index; Ref. = references; MSD = musculoskeletal disorder.

^aRespiratory diseases included chronic obstructive pulmonary diseases, asthma, and other respiratory diseases; ^bOther NCDs included cancer, neuropsychiatric diseases, liver failure, kidney diseases, digestive diseases, MSD, movement disability, and other chronic diseases.

Table 5. aORs of urban residents compared to rural residents in NCDs

NCDs	aORs of urban residence to rural (95% CI)			
	No.	Young (<60 yr)	No.	Old (≥60 yr)
Cardiovascular diseases	340	1.30 (1.01–1.68)	436	1.03 (0.76–1.40)
Diabetes	58	1.86 (1.01–3.41)	68	2.26 (1.25–4.10)
Respiratory diseases	202	0.66 (0.48–0.90)	127	1.27 (0.78–2.05)
Cancer	9	0.47 (0.11–2.01)	4	-
Neuropsychiatric	106	1.86 (1.20–2.89)	63	1.79 (0.95–3.37)
Liver failure	120	1.46 (0.97–2.19)	66	1.66 (0.89–3.10)
Kidney diseases	100	0.80 (0.51–1.25)	79	1.33 (0.75–2.38)
Digestive diseases	444	0.72 (0.58–0.90)	202	0.74 (0.50–1.10)
MSD	641	0.58 (0.48–0.70)	559	0.46 (0.34–0.63)
Movement disability	30	0.34 (0.14–0.84)	30	0.63 (0.23–1.69)

aORs were adjusted by resident area, sex, education level, working status, health insurance, and NCDs risk factors (significant aOR with $p < 0.05$ were represented in bold text).

aOR = adjusted odds ratio; CI = confidence interval; NCDs = non-communicable diseases; MSD = musculoskeletal disorder.

DISCUSSION

Our study provided a meaningful comparison of results for major NCDs between urban and rural residency in Vietnam. Among the young population, cardiovascular diseases, diabetes, and neuropsychiatric diseases were associated with urban residency, while respiratory diseases, digestive diseases, MSDs, and movement disability were associated with rural living, after controlling for other socioeconomic factors. Among the aged population, only diabetes showed the same pattern as younger populations. Concerning behavioral risk factors, the proportion of overweight and obese people was also higher in the urban area. People in the rural area had higher alcohol consumption levels than their counterparts in the urban area for both the young and the aged groups. The aged individuals people in the urban area smoked more than those in the rural area, while young urban residents smoked less than their rural counterparts; these findings were relevant to the Global Adult Tobacco Survey from 2015, which showed that residents in urban areas have more access to tobacco in the past while nowadays tobacco more accessible in rural area.

Cardiovascular diseases and diabetes were more prevalent in the urban aged population in this study. The major causes of cardiovascular diseases are often listed as smoking, harmful alcohol consumption, low physical activity, obesity, and diabetes.^{19,20} Our study showed that people living in urban areas of Vietnam are more likely to consume more alcohol, have a higher BMI, and have been diagnosed with diabetes more when compared to those in rural areas. The result is in alignment with the studies of NCD behavioral risk factors between urban and rural dwellers in other lower- and middle-income countries in Asia such as Myanmar,²¹ and Cambodia,²² as well as in other countries from different geographical area such as Africa: the Zulu community, Uganda, and Cameroon,²³⁻²⁵ where rural-urban disparities persist.

Besides the major NCDs discussed above, liver disease and neuropsychiatric diseases are also shown to have a higher prevalence among urban dwellers in our study. Risk factors for liver diseases are alcohol, diabetes, and obesity.^{26,27} Our outcome showed urban dwellers' face a higher prevalence of diabetes, high BMI, and consumption of alcohol. Neuropsychiatric diseases develop by many stressors existing in urban environments such as concentrated disadvantages, residential segregation and other social norms.²⁸ Especially, rapid development and urbanization in Thuận An can potentially cause the high prevalence of these diseases. Our study also showed the same tendency as in other studies.^{29,30}

Higher prevalence of cardiovascular disease and neuropsychiatric diseases is especially found in the younger population in our study. This phenomenon could be explained by occupational risk factors such as working environment, stress from work, and lower physical activity, which are common to working populations.³¹ Considering that the urban area of this study is a rapidly developing industrial zone, more investigation in terms of occupational disease and risk factors might be necessary to uncover potential causes of this aspect.

In addition, diagnosis of cardiovascular disease, diabetes, or liver disease requires careful investigation (e.g., sonography, electrocardiogram, and specific biomarkers) in addition to medical interviews and physical examinations, which are not available in every facility, particularly those in rural areas. While the quality of healthcare provided in urban and rural areas is different, and private hospitals and clinics, which tend to be better equipped often clustered around big cities,³² it is apparent that urban dwellers typically have better access

to quality of healthcare. Moreover, our results revealed a higher insurance coverage rate of the younger population in the urban area, and insurance may be a key factor that can boost early detection and diagnosis of diseases. According to a report from the Ministry of Health, 76.5% of the Vietnamese population was covered by insurance in 2015.³³ However, further investigation of the differences between urban and rural health insurance coverage rates, and its effect on healthcare access, is suggested to reveal potential disparities.

In contrast to the prevalence of NCDs in urban area, rural dwellers of Vietnam showed more prevalence of respiratory disease and MSDs; also, digestive diseases and movement disability among the younger population were also common.

It is well acknowledged that polluted air is associated with a high prevalence of respiratory disease.^{34,35} However, the method of data collection for this study may have had an effect on the result of this marked prevalence in rural areas. To clarify, even though asthma and other respiratory diseases are included in respiratory disease variation, the fact that there may be a considerable number of people reporting COPD diagnosis in our study should be considered. As COPD is well known as a disease that is also caused by smoking,³⁶ our findings also show that rural residents smoke more than their urban counterparts, which supports this pattern of disease prevalence. More specific research will be needed to clarify each respiratory disease and its specific causes, including air pollution in comparison of urban and rural environments in Vietnam.

The cause of high prevalence of MSDs and movement disability in the rural area in both age groups can be speculated in our study. Association between reported diseases and occupation could be addressed, since most people living in a rural area of Vietnam are farmers or laborers; our study showed that 48.11% of people in rural areas are involved in farming and fishing. This speculation is also supported by one study in India, which reported that 60% of farmers had a high prevalence of MSD.³⁷ However, since the term MSDs is very wide, and could possibly include other genetic diseases, more detailed research should be done to clarify this matter.

Another cause leading to higher prevalence of risk behaviors to NCDs among rural dwellers could be interpreted as a result of other socioeconomic factors between 2 areas. Especially, educational attainment was significantly associated with the prevalence of some NCDs. According to a study in Brazil on the association between NCDs risk factors and the education of women of reproductive age,³⁸ it was found that women with a lower educational attainment (below college) had a higher prevalence of NCD risk factors (e.g., physical inactivity, smoking) and NCDs (e.g., self-reported hypertension). Studies on Bangladesh, India, Indonesia, Sri Lanka, and Thailand also show that smoking is more prevalent among a lower educational attainment population.⁴ A higher prevalence of NCD risk factors in the less-educated population could have potentially resulted in emerging disease in this population. The results of this study related to cardiovascular disease and other NCDs also support the impact of educational attainment. A health literacy program for the less-educated population through diverse NCD topics may help people recognize the harm of NCDs and their risk factors, and thus could eventually decrease prevalence to levels similar to those of their more-educated counterparts. As MSD and movement disability showed higher prevalence in the rural area, promoting more health education in these populations is important. Interestingly, in this study diabetes showed an opposite pattern from other NCDs. Higher education attainment was associated with higher diabetes prevalence, while

other NCDs showed a lower prevalence in general. On the other hand, a study in India showed different results, as education attainment did not have any significant association with diabetes prevalence.³⁹ Another study in South Africa showed that diabetes is more concentrated among higher socioeconomic subgroups than among the lower subgroups,⁴⁰ which is consistent with our findings.

Moreover, the urban-rural differences in NCDs were mostly attenuated after being adjusted for NCDs risk factors (obesity, smoking, drinking habits and other socioeconomic factors). This suggests that a higher obesity or overweight proportion in the urban area might have mostly influenced a higher prevalence in cardiovascular diseases as an intermediating mechanism. Diabetes and other NCDs in the younger age group showed similar attenuation patterns, which result from a similar mechanism. In the aged population, current alcohol drinking showed a negative association with diabetes. This counter-intuitive result aligned with another study in Denmark.⁴¹ However, since our study results come from a cross-sectional study, we are unable to demonstrate a causal relationship; therefore, a reverse causation, that healthy people drink alcohol while diabetes patients reduced or quit drinking, cannot be ruled out.

The government of Vietnam has taken NCDs seriously and released a National Strategy for Prevention and Control of NCDs such as cancer, cardiovascular disease, diabetes, COPD, asthma, etc. for the period from 2015 to 2025.¹¹ Many targets have been set especially for leveling up the capacity of early detection, providing efficient treatment, and controlling NCD risk factors (smoking, alcohol consumption, unhealthy consumption, and lack of physical activity). Targets to controlling the number of people with each NCD were also determined (e.g., 50% of people with hypertension, diabetes, COPD, and asthma should be detected, and 50% of those diagnosed with the diseases should be treated accordingly to professional guidelines). However, although clear targets have been set in this plan, it does not consider the necessity of different approaches for urban and rural areas. As prevalence differences for major NCDs exist, as this study has revealed, we strongly encourage the government to consider more specific approaches addressed to urban and rural areas of Vietnam in order to tackle NCDs more precisely and efficiently.

Besides the fact that education attainment is possibly associated with a higher rate of smoking and alcohol consumption among younger group, it is also believed that loosening administrative regulations is one reason for the presence of NCD risk behaviors. According to the Vietnamese Ministry of Health (2010), smoking prevalence among males and females is 47.4% and 1.4%. Furthermore, the smoking rate among students aged 13–15 was 3.8% (2007).⁴² Despite many attempts and initiations from the government to control tobacco use (e.g., establishment of the Tobacco Control Fund) in 2012, which requires pictorial health warnings printed on cigarette packages beginning in May 2013, and the implementation of a high excise tax rate (Special Consumption Tax), violations at point of sales still exist and stronger enforcement is needed.⁴³ Globally, alcohol consumption is suggested to be on the rise due to economic development, especially in Vietnam.⁴⁴ Research by Giang et al.⁴⁵ revealed that the prevalence of problematic consumption was 25.5% in men and 0.7% in women, yet consumption may be underestimated due to the home brewing of alcohol.⁴⁶ Despite a high alcohol consumption prevalence, the existence of specific social norms, limitations in institutional capacity to conduct research and develop interventions targeting alcohol consumption-related problems, along with questionable police authority (unreported driving after drinking in the police data),⁴⁷ alcohol-related problems need to be more formally

recognized. The loosening of government regulations may lead to a higher prevalence of NCDs as reported in this study and elsewhere. The government needs to take serious action to control both smoking and alcohol consumption.

Lastly, Vietnam is well known for being active in strengthening a foundation for Primary Health Care (PHC). After its 2009 effort to implement Universal Healthcare Coverage, in 2015 the government launched the Health Professional Education and Training for Health Systems Reform Project, which focused on developing human resources in primary care setting.⁴⁸ Nevertheless, a study by Duong et al.⁴⁹ on the role of primary healthcare facilities in tackling NCD problems in the rural area of Vietnam revealed need for further improvement, such as, increasing access to NCD medications, building capacity and awareness of the healthcare staff, and increasing patient access which still varies among regions. The strengthening of PHC is also considered to be an important key to lowering NCD prevalence in Vietnam.

This study has several limitations that call for readers to interpret our results with caution. First, there is no available data on metabolic and physiological risk factors in the current survey. Second, most data were self-reported, and collected by interviews in a community-based survey, which has the possibility of measurement error (i.e., interrater reliability, recall bias). Regarding NCDs risk factors, although data on improper diet and physical activity are important, these data could not be collected in this survey. Third, the cross-sectional nature of the data makes this study result limited in developing a causal discourse. Lastly, some of the presentation of the data such as the age-standardized prevalence of NCDs could not be performed due to the lack of information on a precise population structure of 2 areas.

In conclusion, this study provided evidence on the prevalence of major NCDs (cardiovascular disease, diabetes, and respiratory disease) from the perspective of differences between urban and rural areas in Vietnam. The government may need to develop a healthcare system and policies more accurately targeting the different patterns in the urban and rural areas, as shown in this study. Also, these results call for further research regarding causal mechanisms of NCDs in this urban-rural divide (i.e., rapid urbanization) in Vietnam. This research is necessary to increase the healthcare system's responsive to people's changing health needs in Vietnam in the near future.

ACKNOWLEDGMENTS

Authors appreciated kind assistance from Professor Juhwan Oh (Seoul National University, Seoul, South Korea) and Professor Hoang Van Minh (Hanoi University of Public Health, Hanoi, Vietnam) in providing insightful suggestion to the study. Interpretation of data was also assisted by Dr. Deogratius Bintabara (The University of Dodoma, Dodoma, Tanzania). English language editing was generously provided by Assistant Professor Rebecca Carlson (Tokyo Medical and Dental University, Tokyo, Japan). The data of 2 districts of Vietnam were obtained from a collaboration project of 4 universities: Hanoi Medical University, Hanoi University of Public Health, University of Medicine and Pharmacy of Ho Chi Minh City and Seoul National University.

REFERENCES

1. World Health Organization (WHO). WHO fact sheet Noncommunicable diseases. <https://www.who.int/en/news-room/fact-sheets/detail/noncommunicable-diseases>. Updated 2018. Accessed February 10, 2018.
2. World Health Organization (WHO). WHO Global Health Observatory (GHO) data. https://www.who.int/gho/ncd/mortality_morbidity/en/. Updated 2016. Accessed November 25, 2019.
3. World Health Organization (WHO). WHO global action plan for the prevention and control of noncommunicable diseases 2013–2020. https://www.who.int/nmh/events/ncd_action_plan/en/. Updated 2018. Accessed February 20, 2019.
4. World Health Organization (WHO). WHO action plan for the prevention and control of noncommunicable diseases in South-East Asia, 2013–2020. [http://www.searo.who.int/entity/noncommunicable_diseases/documents/sea-ncd-89\(reduced\).pdf](http://www.searo.who.int/entity/noncommunicable_diseases/documents/sea-ncd-89(reduced).pdf). Updated 2013. Accessed April 15, 2018.
5. Allender S, Lacey B, Webster P, Rayner M, Deepa M, Scarborough P, et al. Level of urbanization and noncommunicable disease risk factors in Tamil Nadu, India. *Bull World Health Organ* 2010;88(4):297-304.
[PUBMED](#) | [CROSSREF](#)
6. Yang G, Kong L, Zhao W, Wan X, Zhai Y, Chen LC, et al. Emergence of chronic non-communicable diseases in China. *Lancet* 2008;372(9650):1697-705.
[PUBMED](#) | [CROSSREF](#)
7. Bygbjerg IC. Double burden of noncommunicable and infectious diseases in developing countries. *Science* 2012;337(6101):1499-501.
[PUBMED](#) | [CROSSREF](#)
8. World Health Organization (WHO). World Health Organization - noncommunicable diseases (NCD) country profiles. https://www.who.int/nmh/countries/2018/vnm_en.pdf?ua=1. Updated 2018. Accessed November 25, 2019.
9. World Health Organization (WHO). Vietnam noncommunicable disease Prevention and Control Programme 2002–2010: implementation review. http://www.wpro.who.int/vietnam/topics/chronic_diseases/vietnam_noncommunicable_disease_prevention_and_control_program_2002_2010_imple_review.pdf. Updated 2011. Accessed February 11, 2018.
10. Ministry of Health (VN), General Department of Preventive Medicine. National survey on the risk factors of non-communicable diseases (STEPS) Vietnam 2015. https://www.who.int/ncds/surveillance/steps/VietNam_2015_STEPS_Report.pdf. Updated 2016. Accessed February 11, 2018.
11. Ministry of Health (VN). National strategy for prevention and control of cancer, cardiovascular disease, diabetes, chronic obstructive pulmonary disease, asthma and other non-communicable diseases 2015–2025. https://www.iccp-portal.org/system/files/plans/VNM_B3_Quyet%20dinh%20TTg%20phe%20duyet%20chien%20luoc%20NCD.pdf. Updated 2015. Accessed February 20, 2019.
12. Do N, Oh J, Lee JS. Moving toward universal coverage of health insurance in Vietnam: barriers, facilitating factors, and lessons from Korea. *J Korean Med Sci* 2014;29(7):919-25.
[PUBMED](#) | [CROSSREF](#)
13. Hoang VM, Oh J, Nguyen BN, Dat LM, Lee JK, Tran TG, et al. Study design for the 2016 baseline survey of a Health System Strengthening Project in Quoc Oai District, Hanoi, Vietnam. *J Korean Med Sci* 2019;34(5):e42.
[PUBMED](#) | [CROSSREF](#)
14. World Health Organization (WHO). WHO STEPS surveillance manual: the WHO STEPwise approach to chronic disease risk factor surveillance. https://apps.who.int/iris/bitstream/handle/10665/43376/9241593830_eng.pdf?sequence=1&isAllowed=y. Updated 2005. Accessed February, 2018.
15. Van Minh H, Oh J, Giang KB, Bao Ngoc N, Minh Hoang N, Giang Huong TT, et al. Health service utilization among people with noncommunicable diseases in rural Vietnam. *J Public Health Manag Pract* 2018;24 Suppl 2:S60-6.
[PUBMED](#) | [CROSSREF](#)
16. Cornish R. Statistics: an introduction to sample size calculations. <https://www.lboro.ac.uk/media/wwlboroacuk/content/mlsc/downloads/Samplesize.pdf>. Updated 2006. Accessed November 30, 2017.
17. Levy PS, Lemeshow S. *Sampling of Populations: Methods and Applications*. New York, NY: John Wiley & Sons; 2013.
18. Lee YK, Nam HS, Chuang LH, Kim KY, Yang HK, Kwon IS, et al. South Korean time trade-off values for EQ-5D health states: modeling with observed values for 101 health states. *Value Health* 2009;12(8):1187-93.
[PUBMED](#) | [CROSSREF](#)
19. World Health Organization (WHO). Prevention of cardiovascular diseases: guideline for assessment and management of cardiovascular risk. https://www.who.int/cardiovascular_diseases/guidelines/Full%20text.pdf. Updated 2007. Accessed June 8, 2019.

20. Arnett DK, Blumenthal RS, Albert MA, Buroker AB, Goldberger ZD, Hahn EJ, et al. 2019 ACC/AHA guideline on the primary prevention of cardiovascular disease: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation* 2019;140(11):e563-95.
[PUBMED](#) | [CROSSREF](#)
21. Htet AS, Bjertness MB, Sherpa LY, Kjøllestad MK, Oo WM, Meyer HE, et al. Urban-rural differences in the prevalence of non-communicable diseases risk factors among 25–74 years old citizens in Yangon Region, Myanmar: a cross sectional study. *BMC Public Health* 2016;16(1):1225.
[PUBMED](#) | [CROSSREF](#)
22. Ministry of Health (KH). National strategic plan for the prevention and control of noncommunicable diseases: cardiovascular disease, cancer, chronic respiratory disease and diabetes (2013–2020). https://www.iccp-portal.org/system/files/plans/KHM_B3_NSP-NCD%202013-2020_Final%20approved.pdf. Updated 2013. Accessed June 8, 2019.
23. Gampel B, Slome C, Scotch N, Abramson JH. Urbanization and hypertension among Zulu adults. *J Chronic Dis* 1962;15(1):67-70.
[PUBMED](#) | [CROSSREF](#)
24. Chiwanga FS, Njelekela MA, Diamond MB, Bajunirwe F, Guwatudde D, Nankya-Mutyoba J, et al. Urban and rural prevalence of diabetes and pre-diabetes and risk factors associated with diabetes in Tanzania and Uganda. *Glob Health Action* 2016;9(1):31440.
[PUBMED](#) | [CROSSREF](#)
25. Sobngwi E, Mbanya JC, Unwin NC, Porcher R, Kengne AP, Fezeu L, et al. Exposure over the life course to an urban environment and its relation with obesity, diabetes, and hypertension in rural and urban Cameroon. *Int J Epidemiol* 2004;33(4):769-76.
[PUBMED](#) | [CROSSREF](#)
26. Flores YN, Lang CM, Salmerón J, Bastani R. Risk factors for liver disease and associated knowledge and practices among Mexican adults in the US and Mexico. *J Community Health* 2012;37(2):403-11.
[PUBMED](#) | [CROSSREF](#)
27. National Guideline Centre (UK). Cirrhosis in over 16s: assessment and management. <https://www.ncbi.nlm.nih.gov/books/NBK385224/>. Updated 2016. Accessed June 8, 2019.
28. Galea S, Uddin M, Koenen K. The urban environment and mental disorders: epigenetic links. *Epigenetics* 2011;6(4):400-4.
[PUBMED](#) | [CROSSREF](#)
29. Silver E, Mulvey EP, Swanson JW. Neighborhood structural characteristics and mental disorder: Faris and Dunham revisited. *Soc Sci Med* 2002;55(8):1457-70.
[PUBMED](#) | [CROSSREF](#)
30. Probst JC, Laditka SB, Moore CG, Harun N, Powell MP, Baxley EG. Rural-urban differences in depression prevalence: implications for family medicine. *Fam Med* 2006;38(9):653-60.
[PUBMED](#)
31. Kivimäki M, Kawachi I. Work stress as a risk factor for cardiovascular disease. *Curr Cardiol Rep* 2015;17(9):630.
[PUBMED](#) | [CROSSREF](#)
32. World Bank. The 2015 Vietnam district and commune health facility survey. <https://microdata.worldbank.org/index.php/catalog/2728>. Updated 2015. Accessed June 9, 2019.
33. Ministry of Health (VN). Plan for people's health protection, care and promotion, 2016–2020. [http://www.euhf.vn/upload/Strategic documents/82. MOH 5-year plan \(Eng\).pdf](http://www.euhf.vn/upload/Strategic documents/82. MOH 5-year plan (Eng).pdf). Updated 2016. Accessed June 8, 2019.
34. Portney PR, Mullahy J. Urban air quality and chronic respiratory disease. *Reg Sci Urban Econ* 1990;20(3):407-18.
[CROSSREF](#)
35. Mills CA. Urban air pollution and respiratory diseases. *Am J Epidemiol* 1943;37(2):131-41.
[CROSSREF](#)
36. Laniado-Laborín R. Smoking and chronic obstructive pulmonary disease (COPD). Parallel epidemics of the 21 century. *Int J Environ Res Public Health* 2009;6(1):209-24.
[PUBMED](#) | [CROSSREF](#)
37. Gupta G, Tarique . Prevalence of musculoskeletal disorders in farmers of Kanpur-Rural, India. *J Community Med Health Educ* 2013;3(7):249.
[CROSSREF](#)
38. Mpofu JJ, de Moura L, Farr SL, Malta DC, Iser BM, Ivata Bernal RT, et al. Associations between noncommunicable disease risk factors, race, education, and health insurance status among women of reproductive age in Brazil - 2011. *Prev Med Rep* 2016;3:333-7.
[PUBMED](#) | [CROSSREF](#)

39. Ramachandran A, Mary S, Yamuna A, Murugesan N, Snehalatha C. High prevalence of diabetes and cardiovascular risk factors associated with urbanization in India. *Diabetes Care* 2008;31(5):893-8.
[PUBMED](#) | [CROSSREF](#)
40. Ataguba JE, Akazili J, McIntyre D. Socioeconomic-related health inequality in South Africa: evidence from General Household Surveys. *Int J Equity Health* 2011;10(1):48.
[PUBMED](#) | [CROSSREF](#)
41. Holst C, Becker U, Jørgensen ME, Grønbaek M, Tolstrup JS. Alcohol drinking patterns and risk of diabetes: a cohort study of 70,551 men and women from the general Danish population. *Diabetologia* 2017;60(10):1941-50.
[PUBMED](#) | [CROSSREF](#)
42. Tran DT, Kosik RO, Mandell GA, Chen YA, Su TP, Chiu AW, et al. Tobacco control in Vietnam. *Public Health* 2013;127(2):109-18.
[PUBMED](#) | [CROSSREF](#)
43. Minh HV, Ngan TT, Mai VQ, My NT, Chung le H, Kien VD, et al. Tobacco control policies in Vietnam: review on MPOWER implementation progress and challenges. *Asian Pac J Cancer Prev* 2016;17(S1):1-9.
[PUBMED](#) | [CROSSREF](#)
44. Lincoln M. Alcohol and drinking cultures in Vietnam: a review. *Drug Alcohol Depend* 2016;159:1-8.
[PUBMED](#) | [CROSSREF](#)
45. Giang KB, Allebeck P, Spak F, Van Minh H, Dzong TV. Alcohol use and alcohol consumption-related problems in rural Vietnam: an epidemiological survey using AUDIT. *Subst Use Misuse* 2008;43(3-4):481-95.
[PUBMED](#) | [CROSSREF](#)
46. Health Strategy and Policy Institute (VN). *Evaluation Report on Alcohol Abuse in Vietnam*. Hanoi: Health Strategy and Policy Institute; 2006.
47. Ngoc LB, Thieng NT, Huong NL. The drink driving situation in Vietnam. *Traffic Inj Prev* 2012;13(2):109-14.
[PUBMED](#) | [CROSSREF](#)
48. The Primary Health Care Performance Initiative. Vietnam. <https://improvingphc.org/vietnam>. Updated 2019. Accessed November 21, 2019.
49. Duong DB, Minh HV, Ngo LH, Ellner AL. Readiness, availability and utilization of rural Vietnamese health facilities for community based primary care of non-communicable diseases: a crosssectional survey of 3 provinces in northern Vietnam. *Int J Health Policy Manag* 2019;8(3):150-7.
[PUBMED](#) | [CROSSREF](#)