Risk factors for Non-Communicable Diseases among adults in Vietnam: Findings from the Vietnam STEPS Survey 2015

Tran Quoc Bao, Hoang Van Minh, Vu Hoang Lan, Bui Phuong Linh, Kim Bao Giang, Pham Quyhn Ng, Nguyen Tuan Lam, Lai Duc Truong, Truong Dinh Bac, Tran Dac Phu, Tran Thi Thanh Huong, Tran Van Thuan, Hung N. Luu, Wei Zheng, Xiao-Ou Shu, Tran Thu Ngan, Martha J. Shrubsole

1General Department of Preventive Medicine, Ministry of Health, Hanoi, Vietnam
2Department of Health Economics, Hanoi University of Public Health, Hanoi, Vietnam
3Hanoi Medical University, Hanoi, Vietnam
4Vietnam Country Representative Office, the World Health Organization, Hanoi, Vietnam
5Vietnam National Institute for Cancer Control, National Cancer Hospital, Hanoi, Vietnam
6Division of Epidemiology, Department of Medicine, Vanderbilt Epidemiology Center, Vanderbilt-Ingram Cancer Center, Vanderbilt University School of Medicine, Nashville, TN, USA
7University of Pittsburgh, Pittsburgh, PA, USA

ABSTRACT

Background: The burden of mortality from non-communicable diseases (NCDs) continues to rise, particularly in low- and middle-income countries, including Vietnam. The modifiable lifestyle factors that may help reduce this burden need to be thoroughly evaluated. Thus, in 2015, we conducted a National Non-Communicable Disease Risk Factor Survey among Vietnamese adults to evaluate the distribution of five major risk factors for NCDs, including smoking, alcohol use, overweight, hypertension, and diabetes.

Methods: The standardized World Health Organization STEPwise approach was used across all 63 provinces/cities of Vietnam and involved 3,758 participants aged 18–69 years.

Results: Over half of the men were current smokers (50.6%), although smoking was less common among women (1.5%). Likewise, most men were current drinkers (77.2%) while women who were current drinkers accounted for only 11.1%. Overweight and hypertension were present, respectively, in 15.6% and 18.9% of participants. Nearly all men had at least one risk factor (91.8%) and over half of the men had 2 or more risk factors (57.8%) (compared with only 36.9% and 9%, respectively, in women).

Conclusion: Having one or more risk factors was more likely among individuals who were male, older, or less educated. The findings from this study should serve as the basis of policy and prevention strategies for improving the health behaviours of Vietnamese people.

Keywords: Prevalence; Risk factors; Non-communicable diseases; Vietnam

INTRODUCTION

Non-communicable diseases (NCDs), including cardiovascular disease (CVD), cancer, diabetes, and chronic respiratory diseases are the leading causes of death and disability
worldwide, accounting for 68% of the 56 million global deaths in 2012.\(^1\) Mortality rates due to NCDs continue to rise, especially in low- and middle-income countries (LMICs), including Vietnam. It is anticipated that by 2030, mortality from NCDs will increase by eight times in LMICs compared to developed countries.\(^1,2\)

Like other developing countries, Vietnam is undergoing a rapid epidemiological transition, resulting in an increase in the burden of chronic diseases.\(^3\) Chronic diseases have been shown to be major causes of morbidity and mortality in hospitals for the whole country. In 2010, NCDs accounted for 318,425 deaths (72% of total deaths), 6.7 million years of life lost (56% of total YLLs), and 14 million disability adjusted life years lost (66% of DALYs lost).\(^2,4\) Of these NCDs, hypertension leads to an estimated 91,000 deaths per year in Vietnam, representing 21% of total mortality. A study by the Vietnam National Heart Institute found that 25% of adults had hypertension, but less than half were aware of their condition and only 11% had achieved targeted control. Vietnam is also among countries that have the highest growth rate of diabetes patients worldwide. The prevalence of diabetes mellitus in Vietnam in 2012 was 5.7% among people aged 35 years old and over (versus only 2.7% in 2001). The country is forecast to have between seven and eight million people suffering from diabetes by 2025.\(^6\) Moreover, a significant number of the Vietnamese population also lives with undiagnosed diabetes, estimated to be up to two million.\(^7\)

Globally, some of the increased burden from NCDs is attributed to a shorter life expectancy: the adoption of unhealthy diets (e.g., high in fat, cholesterol and sugar, and low in fiber and polyunsaturated fatty acids), an increase in sedentary lifestyles, and increased overweight and obesity.\(^8,9\) Vietnam is facing increasing trends of overweight, obesity, and sedentary lifestyles. In the 2005–2015 period, the country’s prevalence of overweight and obesity increased from 15.3% to 21.3% in urban areas and from 5.3% to 12.6% in rural areas.\(^10,11\) A 5-year cohort study in Ho Chi Minh City—the biggest city in Vietnam—conducted among 759 secondary students (aged 11–16 years) reported that students’ time spent on sedentary activity increased from 512 to 600 minutes per day.\(^12\)

However, the prevalence of these risk factors and its associations with sociodemographics have not been previously well-evaluated on a national scale. According to the World Health Organization (WHO), the key to controlling NCDs is primary intervention, based on comprehensive population-wide programs. The basics of primary intervention of NCDs in general is the identification of the modifiable behavioural risk factors and their prevention and control. Therefore, using the 2015 National NCD Risk Factor Survey, which applies the standardized WHO STEPwise approach to risk factor surveillance (WHO STEPS) for NCDs,\(^7,13\) we aimed to examine the distribution of major risk factors for NCDs among adults in Vietnam.

**METHODS**

**Survey design**

The Vietnam STEPS is a cross-sectional survey applying the methods and tools of WHO STEPS, which offers a simple, standardized method for collecting, analysing and disseminating data in WHO member countries.\(^13\) The Vietnam STEPS consists of 3 steps: collecting demographic information and behavioral risk factors in an interviewer-administered survey (STEP 1); collecting physical measurements such as height, weight, waist circumference and blood pressure (STEP 2); and obtaining blood samples to test for...
fasting blood glucose/cholesterol (STEP 3). The Vietnam STEPS was conducted across all 63 provinces/cities of Vietnam between June and October 2015. The Ethical Review Board for Biomedical Research at the Hanoi University of Public Health provided ethical approval for the Vietnam STEPS survey.

Survey participants were Vietnamese, aged 18–69 years, who were residing in Vietnam at the time of the survey. Exclusion criteria included: 1) those who were not residing permanently in Vietnam and 2) people who were unable to participate in the interview due to physical and/or mental health issues. The survey was approved by all participating institutions. All participants provided verbal and/or written informed consent.

Sample size and sampling
A sample size of 4,320 people, aged 18–69 years, was determined based on the sample calculator used in the WHO STEPS approach. Samples were stratified by gender and age groups (i.e., 18–29, 30–49 and 50–69 years of age), using a 2-stage random systematic sampling method. The sampling frame for the survey was developed by the General Statistics Office (GSO) of Vietnam, based on the master sampling frame from the Population and Housing Census of 2009, and updated with data from the 2014 Vietnam Inter-censal Population and Housing Survey. In the first sampling stage, the primary sampling unit (PSU) of each household was identified. In the second stage, 10% of households in each enumeration area (EA) were selected. Thus, using this sampling method, 15 households were selected from an urban EA, and 14 households were selected from a rural EA. The total number of households for STEPS 2015 was 4,651. One eligible participant was then randomly selected from each of the selected households for the STEPS interview. The selection of this individual was automatically done after eligible household members were entered into a personal digital assistant (PDA) program. In total, 3,856 eligible persons were selected for STEP 1 from 4,651 households (In all STEPS survey designs, sampling is non-replacement; thus, the number of selected persons were less than selected households). Weights were calculated for each STEP component before being used for population adjustment. The detail of weight calculations has been published elsewhere.

Survey and data collection
For the STEP 1 interview, the survey used the standardized WHO questionnaire (STEPS Instrument CORE_EXP V3.1). The English standardized questionnaire was translated into Vietnamese by a bilingual researcher. It was then back-translated to English by another bilingual researcher. This back-translated version was compared with the English standardized version to find any discrepancy (if any) and to ensure the English-Vietnamese translation was done properly. The final translated version was pre-tested before use. A set of show cards (pictures) of alcoholic beverages, vegetables and fruits was also developed to provide standard units for interviewers to measure and convert the intake of these items. For physical and biochemical measurements in STEPS 2 and 3, interviewers used standard devices provided by WHO, such as digital automatic blood pressure monitors, standard electronic scales, stadiometers and constant tension tape measures for measuring height, weight and waist circumference, and devices for testing fasting blood glucose and total cholesterol. Questionnaires and tools/devices were pre-tested in the field before their implementation within the full-scale survey.

Questionnaires and measurements were administered by trained interviewers. All interviewers were staff members of the General Statistics Office (GSO) or the Provincial
Preventive Medicine Centres, who received a one-week training course by trainers from WHO, GSO and the General Department of Preventive Medicine, Ministry of Health. Training contents included: 1) the use of questionnaires; 2) techniques for finding physical measurements and giving blood tests; and 3) sample selection procedures in the field.

Each province had one data collection team that included five interviewers (who were employed by, and had experience in data collection for, the Global Adults Tobacco Survey—GATS—which was also conducted in 2015). They were in charge of interviewing households. Three local staff members were in charge of conducting STEPS 2 and 3 (physical measurement and blood tests) at the commune health station (CHS). In each EA, data collection from a participant was carried out over two days. On the first day, interviewers visited households to collect STEP 1 data. On the second day, participants were invited to the local CHS to participate in physical measurements and capillary blood tests. Data collection for STEPS 2 and 3 was conducted in the early morning to ensure an overnight fasting state of all participants (who were asked to not eat anything after their dinner on the day prior to the data collection).

STEP 1 interview data were captured on handheld computer tablets (Samsung Galaxy Tabs 3, 7.0) and keyed directly into a computer-assisted electronic interviewing system at the field site. Data collected from surveys were sent to the data management team weekly via the internet and were checked for completeness and validity by IT personnel from the GSO. For STEPS 2 and 3 measurement data, all completed questionnaires were sent to the data management team for data entry. Data were cleaned and double-entered by trained staff for data entry.

Variables and definitions
In this paper, we report five main risk factors for NCDs, including: 1) current smoking, if respondents answered “Yes” (either daily or less than daily) to the question, “Do you currently smoke tobacco on a daily basis, less than daily, or not at all?”; 2) current alcohol use, if respondents answered “Yes” to the question, “Have you consumed any alcohol within the past 30 days?”; 3) overweight, defined by a measured BMI ≥25 kg/m²; 4) hypertension, defined by a systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg, or they are currently taking medication for raised blood pressure; and 5) raised blood glucose/diabetes, defined by a measured fasting blood glucose (venous plasma value) ≥7 mmol/L and/or they are currently taking medication for diabetes. The results of capillary blood measurements collected in STEPS were adjusted to the equivalent results of venous blood tests.

From these 5 risk factor variables, a new variable, “number of risk factors”, was created to assess the joint prevalence of risk factors. This variable has four categories: “no risk factor”, “1 risk factor”, “2 risk factors” and “3 or more risk factors”. Some of the mentioned risk factors can be interlinked with each other (e.g., overweight/obesity with diabetes). However, to be able to assess the association between demographic characteristics and the number of risk factors each person has, all of the risk factors were included in the current analysis.

The following demographic variables of survey participants were evaluated: 1) gender (i.e., male/female); 2) age (i.e., 18–29, 30–49 and 50–69); 3) educational level (i.e., less than primary education, primary school, middle school, high school and university/college and higher); 4) current primary occupation (i.e., farmer, government staff, others, including housewives, small traders, temporary workers, housekeepers, handicraft makers and
jobless); 5) type of residential area (urban/rural); and 6) economic status of the household, which was measured based on an asset-based wealth index, constructed using principal component analysis (PCA) and divided into quintiles: poor, near poor, average, better off and wealthiest (as described elsewhere).

Data analysis
To calculate the national representative prevalence of NCD risk factor figures, the sampling weight was used. Both descriptive and analytical statistics were performed. Prevalence estimates were derived and stratified by sociodemographic variables. Ordered logistic regression models were used to evaluate the association between number of risk factors a person has and the sociodemographic characteristics of respondents. In this model, all sociodemographic variables were included in order to evaluate the independent contribution of each. An alpha level of 0.05 was used. Data were analysed using EPI Info 3.54 and Stata 13 software.

RESULTS
Of the 3,856 selected participants, 3,758 completed STEP 1 (response rate of 97.4%), 3,036 had valid BMI and blood pressure measurements (response rate of 78.7%) for STEP 2, and 2,816 had valid blood glucose values (response rate of 73.0%) for STEP 3 (Table 1).

Table 1. Sociodemographic characteristics of the study respondents, STEPS Vietnam 2015

| Characteristics          | STEP 1    |          |          | STEP 2    |          |          | STEP 3    |          |          |
|--------------------------|-----------|----------|----------|-----------|----------|----------|-----------|----------|----------|
|                          | Men (%)   | Women (%)| Total (%)| Men (%)   | Women (%)| Total (%)| Men (%)   | Women (%)| Total (%)|
| Age group                |           |          |          |           |          |          |           |          |          |
| 18–29                    | 316 (18.9)| 375 (18.0)| 691 (18.4)| 220 (16.7)| 251 (14.6)| 471 (15.5)| 191 (15.8)| 238 (14.8)| 429 (15.2)|
| 30–49                    | 795 (47.4)| 1,025 (49.2)| 1,820 (48.4)| 610 (46.4)| 686 (50.4)| 1,476 (48.7)| 559 (46.4)| 819 (50.9)| 1,378 (48.9)|
| 50–69                    | 565 (33.7)| 682 (32.8)| 1,247 (33.2)| 485 (36.9)| 602 (35.0)| 1,087 (35.8)| 456 (37.8)| 553 (34.4)| 1,009 (35.8)|
| Education                |           |          |          |           |          |          |           |          |          |
| Less than primary education | 251 (15.0)| 424 (20.4)| 675 (18.0)| 203 (15.4)| 373 (21.7)| 576 (19.0)| 185 (15.3)| 349 (21.7)| 534 (19.0)|
| Primary school           | 327 (19.5)| 476 (22.9)| 803 (21.4)| 270 (20.5)| 407 (23.7)| 677 (22.3)| 257 (21.3)| 377 (23.4)| 634 (22.5)|
| Secondary school         | 473 (28.2)| 531 (25.5)| 1,004 (26.7)| 383 (29.1)| 461 (26.8)| 844 (27.8)| 351 (29.1)| 432 (26.8)| 783 (27.8)|
| High school              | 327 (19.5)| 302 (14.5)| 629 (16.7)| 257 (21.3)| 377 (23.4)| 634 (22.5)| 254 (21.3)| 377 (23.4)| 634 (22.5)|
| University/college       | 298 (17.8)| 349 (16.8)| 647 (17.2)| 251 (20.5)| 396 (22.7)| 647 (21.5)| 251 (20.5)| 396 (22.7)| 647 (21.5)|
| Primary occupation       |           |          |          |           |          |          |           |          |          |
| Government employees     | 176 (10.5)| 186 (8.9)| 362 (9.6)| 119 (9.1)| 151 (8.8)| 270 (8.9)| 109 (9.0)| 141 (8.8)| 250 (8.9)|
| Non-government employees | 203 (12.1)| 227 (10.9)| 430 (11.4)| 139 (10.6)| 141 (8.2)| 280 (9.2)| 123 (10.2)| 131 (8.1)| 254 (9.0)|
| Informal sector workers  | 1,062 (63.4)| 1,147 (55.1)| 2,209 (58.8)| 873 (66.4)| 1,020 (59.3)| 1,893 (62.4)| 801 (66.4)| 945 (58.7)| 1,746 (62.0)|
| Student                  | 38 (2.3)| 50 (2.4)| 88 (2.3)| 21 (1.6)| 28 (1.6)| 49 (1.6)| 18 (1.5)| 25 (1.5)| 43 (1.5)|
| Unstable jobs            | 197 (11.8)| 472 (22.7)| 669 (17.8)| 163 (12.4)| 381 (21.2)| 544 (17.9)| 155 (12.9)| 368 (22.9)| 523 (18.6)|
| Ethnicity                |           |          |          |           |          |          |           |          |          |
| Kinh                     | 1,383 (82.5)| 1,737 (83.4)| 3,120 (83.0)| 1,067 (81.1)| 1,418 (82.4)| 2,485 (81.9)| 982 (81.4)| 1,331 (82.7)| 2,313 (82.1)|
| Others                   | 293 (17.5)| 345 (16.6)| 638 (17.0)| 248 (18.9)| 303 (17.6)| 551 (18.2)| 224 (18.6)| 279 (17.3)| 503 (17.9)|
| Wealth index quintile    |           |          |          |           |          |          |           |          |          |
| 1st quintile (Poorest)    | 318 (19.0)| 448 (21.5)| 766 (20.4)| 274 (20.8)| 386 (22.4)| 660 (21.7)| 247 (20.5)| 365 (22.7)| 612 (21.7)|
| 2nd quintile             | 409 (24.4)| 535 (25.7)| 944 (25.1)| 343 (26.1)| 463 (26.9)| 806 (26.6)| 322 (26.7)| 442 (27.5)| 764 (27.1)|
| 3rd quintile             | 274 (16.4)| 306 (14.7)| 580 (15.4)| 220 (16.7)| 260 (15.1)| 480 (15.8)| 210 (17.4)| 240 (14.8)| 450 (16.0)|
| 4th quintile             | 320 (19.1)| 384 (18.4)| 704 (18.7)| 249 (18.9)| 316 (18.4)| 565 (18.6)| 224 (18.6)| 291 (18.1)| 515 (18.3)|
| 5th quintile (Richest)    | 355 (21.2)| 409 (19.6)| 764 (20.3)| 229 (17.4)| 296 (17.2)| 525 (17.3)| 203 (16.8)| 272 (16.9)| 475 (16.9)|
| Living area              |           |          |          |           |          |          |           |          |          |
| Urban                    | 799 (47.7)| 1,035 (49.7)| 1,834 (48.8)| 571 (43.4)| 789 (45.9)| 1,360 (44.8)| 525 (43.5)| 733 (45.5)| 1,258 (44.7)|
| Rural                    | 877 (52.3)| 1,047 (50.3)| 1,924 (51.2)| 744 (56.6)| 932 (54.2)| 1,676 (55.2)| 681 (56.5)| 877 (54.5)| 1,558 (55.3)|
| Total                    | 1,676 (100.0)| 2,082 (100.0)| 3,758 (100.0)| 1,315 (100.0)| 1,721 (100.0)| 3,036 (100.0)| 1,206 (100.0)| 1,610 (100.0)| 2,816 (100.0)|

STEPS = STEPwise approach to risk factor surveillance.
The overall prevalence of current smoking was 25.8%. The prevalence was substantially higher among men than women (50.6% vs. 1.5%, respectively). Current smoking was also more prevalent among people aged 30–49 years compared to other age groups. Current smoking was also more prevalent among people with lower educational attainment, informal sector workers, ethnic minorities, individuals with a lower wealth index, and individuals who lived in rural areas.

The prevalence of current alcohol use was 43.8% and was much higher among men than women (77.2% vs. 11.1%, respectively). The prevalence of alcohol use was also highest among people aged 30–49 years, people with a university/college education, government employees, ethnic minorities (among women), individuals with a higher income and residents of urban areas (among women) (Table 2).

The prevalence of overweight was similar between men and women but was slightly higher among women (14.9% in men and 16.4% in women). Overall and within sex strata,

| Characteristics | Smoking (%) | Alcohol use (%) | Overweight (%) | Hypertension (%) | Diabetes (%) |
|-----------------|-------------|-----------------|----------------|------------------|--------------|
| Gender          |             |                 |                |                  |              |
| Men             | 50.6        | 1.5             | 25.8           | 77.2             | 11.1         |
| Women           | 13.5        | 14.0            | 5.6            | 16.2             | 22.8         |
| Total           | 22.8        | 17.6            | 6.7            | 20.3             | 43.6         |
| Age group       |             |                 |                |                  |              |
| 18–29           | 38.4        | 1.1             | 20.0           | 75.3             | 10.3         |
| 30–49           | 59.1        | 1.4             | 30.3           | 81.8             | 14.5         |
| 50–69           | 51.8        | 2.1             | 25.4           | 71.6             | 6.3          |
| Education       |             |                 |                |                  |              |
| Less than primary education | 62.8 | 5.3             | 29.7           | 79.9             | 11.2         |
| Primary school  | 61.6        | 0.6             | 28.7           | 73.4             | 10.9         |
| Secondary school| 51.7        | 0.6             | 26.9           | 78.2             | 8.6          |
| High school     | 41.3        | 1.1             | 24.1           | 71.2             | 8.5          |
| University/college | 37.8 | 0.0             | 18.4           | 85.5             | 17.4         |
| Occupation      |             |                 |                |                  |              |
| Government employees | 37.1 | 0.0             | 19.8           | 88.8             | 18.7         |
| Non-government employees | 44.5 | 0.1             | 21.5           | 81.7             | 14.4         |
| Informal sector workers | 57.1 | 2.3             | 32.1           | 78.6             | 10.5         |
| Student         | 8.2         | 0.0             | 4.3            | 44.0             | 11.9         |
| Unstable jobs   | 43.0        | 1.1             | 13.2           | 60.3             | 7.4          |
| Ethnicity       |             |                 |                |                  |              |
| Kinh            | 50.3        | 0.7             | 24.8           | 77.5             | 10.1         |
| Others          | 51.6        | 5.5             | 30.2           | 76.2             | 16.0         |
| Wealth index quintile |             |                 |                |                  |              |
| 1st quintile (Poorest) | 58.5 | 5.1             | 31.8           | 73.2             | 9.2          |
| 2nd quintile    | 57.4        | 0.6             | 28.1           | 76.9             | 5.5          |
| 3rd quintile    | 51.0        | 0.1             | 26.8           | 77.5             | 10.3         |
| 4th quintile    | 46.5        | 0.2             | 22.7           | 80.0             | 11.0         |
| 5th quintile (Richest) | 37.7 | 1.2             | 19.1           | 78.8             | 20.6         |
| Living area     |             |                 |                |                  |              |
| Urban           | 45.5        | 1.2             | 22.4           | 75.7             | 15.4         |
| Rural           | 53.2        | 1.6             | 27.6           | 78.0             | 8.7          |
| Total           | 50.6        | 1.5             | 25.8           | 77.2             | 11.1         |

Definitions:
1. Current smoking: Respondents answered “yes” to the question “Do you currently smoke tobacco on a daily basis, or less than daily?”
2. Current alcohol use: Respondents said “Yes” to the question “Have you consumed any alcohol within the past 30 days?”
3. Overweight: Defined as a person with BMI ≥25
4. Hypertension: Defined as an average systolic blood pressure ≥140 mmHg, and/or average diastolic blood pressure ≥90 mmHg, and/or currently on medication for raised blood pressure
5. Diabetes: A person with fasting blood glucose (plasma venous value) ≥7 mmol or currently on medication for diabetes

NCD = non-communicable disease; STEPS = STEPwise approach to risk factor surveillance.
overweight was more common among older individuals (≥30 years), Kinh participants (Kinh is the major ethnicity in Vietnam, accounting for 86.2% of the whole population), and rural dwellers. Among men and women, the patterns of increased prevalence of overweight differed by educational status. Among men, the higher prevalence was observed among individuals with lower educational attainment (primary school) or with higher educational attainment (university/college), whereas among women, the highest prevalence was observed only among those with the lowest educational attainment.

The prevalence of hypertension was 18.9% (23.1% among men and 14.9% among women). Hypertension was more common among older participants. Specifically, the oldest age group had the highest prevalence. In participants aged 50–69, nearly half the men, and about one-third of the women, had hypertension. The prevalence of hypertension was also higher among people with lower educational attainment, people having unstable jobs, Kinh participants, the wealthiest men, and women belonging to the 2nd and 3rd wealth index quintiles.

The prevalence of diabetes was 4.1% (4.5% among men and 3.6% among women). Similar to hypertension, the highest prevalence was observed among those aged between 50–69 years. The prevalence of diabetes tended to be higher among people with less than a primary education, people having unstable jobs, Kinh participants, people belonging to the 3rd wealth index quintile, and urban residents (Table 2).

Table 3 shows summary NCD risk factor scores among people aged 18–69 years old in Vietnam. The proportion of people with none, 1, 2, and 3 or more NCD risk factors were 38.6%, 30.6%, 23.2%, and 7.5%, respectively. The proportion of people with two or three or more NCD risk factors were higher among men, older people, individuals with less education and informal sector workers.

The associations between the number of NCD risk factors and sociodemographic characteristics are also presented in Table 3. The overall model shows that the odds of having a one unit increase in the number of NCD risk factors were statistically significantly higher among men (odds ratio [OR] was 19.18, 95% confidence interval [CI], 16.36–22.49), older people (ORs were from 1.91 [95% CI, 1.57–2.31] to 3.01 [95% CI, 2.44–3.71]), and those with less education (ORs were from 0.71 [95% CI, 0.61–0.84], 0.72 [95% CI, 0.58–0.88], and 0.7 [95% CI, 0.55–0.89]). Among women, apart from an older age and less education, being a member of an ethnic minority was associated with having a higher risk, with a one unit increase in the number of NCD risk factors. Women belonging to the lowest 2 wealth index levels were less likely to have multiple NCD risk factors as compared to women of the richest quintile. Among men, higher educational attainment was associated with lower odds of having numerous risk factors. Individuals with the lowest economic status tended to have the highest odds of multiple NCD risk factors.

**DISCUSSION**

The 2015 Vietnam STEPS survey provides data for planning health services as well as monitoring and evaluating related interventions, which facilitate the implementation of the National NCD strategy for 2015–2025. In the current context of global health development, it would be interesting to share information on the distribution of major risk factors for NCDs
Table 3. Number of NCD risk factors by sociodemographic characteristics of the study respondents, STEPS Vietnam 2015

| Characteristic                | Prevalence of number of NCD risk factors | Association with number of NCD risk factors |
|------------------------------|------------------------------------------|-------------------------------------------|
|                              | No risk factor (%) | 1 risk factor (%) | 2 risk factors (%) | 3 or more risk factors (%) | Overall (%) | Men (%) | Women (%) |
| Overall                      | 38.6          | 30.6          | 23.2          | 7.5                        | 19.18 (16.36–22.49) |
| Gender                       |               |               |               |                            |               |         |           |
| Men                          | 8.2           | 34.0          | 42.6          | 15.2                       | 1.00 (ref)    | 1.00 (ref)| 1.00 (ref) |
| Women                        | 63.1          | 27.9          | 7.6           | 1.4                        | 1.00 (ref)    |         |           |
| Age group                    |               |               |               |                            |               |         |           |
| 18–29                        | 50.1          | 31.0          | 17.1          | 1.9                        | 1.00 (ref)    | 1.00 (ref)| 1.00 (ref) |
| 30–49                        | 39.2          | 30.0          | 24.4          | 6.4                        | 1.00 (ref)    | 1.00 (ref)| 1.00 (ref) |
| 50–69                        | 31.4          | 31.4          | 24.9          | 12.4                       | 3.01 (2.44–3.71) | 2.59 (1.95–3.45) | 3.98 (2.86–5.53) |
| Education                    |               |               |               |                            |               |         |           |
| Less than primary education  | 34.8          | 31.9          | 24.6          | 8.7                        | 1.00 (ref)    | 1.00 (ref)| 1.00 (ref) |
| Primary school               | 40.2          | 27.0          | 24.4          | 8.3                        | 0.70 (0.55–0.89) | 0.71 (0.51–0.90) | 0.74 (0.53–0.90) |
| Secondary school             | 39.0          | 29.4          | 24.8          | 6.8                        | 0.71 (0.61–0.84) | 0.72 (0.57–0.92) | 0.73 (0.58–0.91) |
| High school                  | 39.6          | 31.8          | 20.4          | 8.3                        | 0.72 (0.58–0.88) | 0.81 (0.61–1.09) | 0.81 (0.44–0.84) |
| University/college            | 39.0          | 34.6          | 20.7          | 5.7                        | 0.70 (0.55–0.89) | 0.71 (0.51–0.90) | 0.74 (0.53–0.90) |
| Occupation                   |               |               |               |                            |               |         |           |
| Government employees         | 36.5          | 35.6          | 19.9          | 8.0                        | 1.00 (ref)    | 1.00 (ref)| 1.00 (ref) |
| Non-government employees     | 42.3          | 32.3          | 20.9          | 4.4                        | 0.88 (0.66–1.17) | 0.81 (0.56–1.19) | 1.04 (0.66–1.65) |
| Informal sector workers      | 35.9          | 30.0          | 26.1          | 8.0                        | 1.08 (0.84–1.40) | 0.95 (0.68–1.34) | 1.29 (0.87–1.93) |
| Student                      | 63.6          | 27.3          | 8.0           | 1.1                        | 1.12 (0.84–1.49) | 0.77 (0.51–1.17) | 1.47 (0.97–2.23) |
| Other jobs                   | 43.1          | 29.3          | 19.0          | 8.7                        | 1.12 (0.84–1.49) | 0.77 (0.51–1.17) | 1.47 (0.97–2.23) |
| Ethnicity                    |               |               |               |                            |               |         |           |
| Kinh                        | 38.9          | 30.5          | 22.7          | 7.8                        | 1.00 (ref)    | 1.00 (ref)| 1.00 (ref) |
| Others                       | 37.0          | 31.0          | 25.7          | 6.3                        | 1.11 (0.92–1.34) | 0.84 (0.64–1.09) | 1.46 (1.12–1.90) |
| Wealth index quintile        |               |               |               |                            |               |         |           |
| 1st quintile (Poorest)       | 40.7          | 28.9          | 23.6          | 6.8                        | 0.84 (0.66–1.08) | 1.41 (0.98–2.03) | 0.52 (0.37–0.74) |
| 2nd quintile                 | 40.2          | 26.2          | 26.8          | 6.9                        | 0.88 (0.71–1.10) | 1.37 (1.01–1.87) | 0.57 (0.42–0.78) |
| 3rd quintile                 | 35.9          | 31.2          | 24.1          | 8.8                        | 0.98 (0.78–1.24) | 1.30 (0.94–1.80) | 0.74 (0.54–1.03) |
| 4th quintile                 | 39.4          | 32.5          | 20.3          | 7.8                        | 0.87 (0.71–1.08) | 1.15 (0.86–1.55) | 0.67 (0.50–1.01) |
| 5th quintile (Richest)       | 36.0          | 35.7          | 20.4          | 7.9                        | 1.00 (ref)    | 1.00 (ref)| 1.00 (ref) |
| Living area                  |               |               |               |                            |               |         |           |
| Urban                        | 38.4          | 32.1          | 22.1          | 7.4                        | 1.00 (ref)    | 1.00 (ref)| 1.00 (ref) |
| Rural                        | 38.8          | 29.3          | 24.3          | 7.6                        | 0.92 (0.80–1.06) | 0.98 (0.81–1.20) | 0.86 (0.70–1.05) |

NCD = non-communicable disease; STEPS = STEPwise approach to risk factor surveillance; OR = odds ratio; CI = confidence interval.

*OR (95% CI) derived from a single ordered logistic regression model for number of NCD risk factors with mutual adjustment for all sociodemographic factors in the table; *Education reference category is primary school or less than primary education; *Occupation category includes both students and other jobs; *Denotes statistically significant association for a one unit increase in the number of NCD risk factors.

among Vietnamese with the rest of the world. The evidence generated from this study also helps to shed light on models of epidemiological transition in low-end-middle income countries.

Previous studies provided evidence that cigarette smoking has been associated with poor health outcomes for a variety of chronic diseases such as asthma, and lung and other cancers.1.16 Thus, understanding which segments of the national population are most likely to use cigarettes can provide an opportunity for health promotion and tobacco smoking cessation strategies, including those that are targeted to the highest consumers of cigarettes. Based on the findings from this study, smoking is particularly high among men, older men, and men who live in rural areas. These findings are in agreement with previous reports in Vietnam and around the world.19,22 The prevalence of smoking among men is high (50% among men compared with 1% in women). Indeed, the male smoking prevalence in Vietnam is among the highest across the region (prevalence of smoking among men is reported to be between 30% and 50% in the other nine countries in South and Southeast Asia).20 There was no significant reduction in overall smoking prevalence in 2015 compared to the numbers recorded in the national health survey in 2009–2010 (25.8% vs. 28.2%, respectively).21 This
indicates that tobacco control efforts in Vietnam, such as augmenting tobacco taxes and regulations encouraging smoking-free environments, have not yet been effective in making substantial improvements in smoking prevalence, particularly among individuals of low socioeconomic status.

Heavy alcohol consumption is a risk factor for stroke, heart diseases, liver diseases, cancer, and mental and social problems. We were unable to evaluate participants’ frequency and amount of alcohol consumption, which would further elucidate the potential burden of alcohol consumption on NCDs in Vietnam. Nonetheless, among the risk factors for NCDs evaluated in this study, alcohol use had the highest prevalence, especially among men. Over 70% of men across multiple subgroups had consumed alcohol at least once in the 30 days prior to the interviews, while only 11% of women consumed alcohol. In comparison to other countries in the Asia Pacific region, Vietnam had a higher prevalence of alcohol use among men (77% in Vietnamese vs. 60% in other Asia Pacific regions) and a substantially lower prevalence of alcohol use among women (11% vs. 30%). Among women, alcohol use was associated with two different measures of socioeconomic status—urban living and higher economic status—factors which did not vary for alcohol consumption among men. This indicates that prevention strategies for NCDs that include reducing alcohol consumption may need to be developed separately for women and men.

Overweight was present in 15.6% of the population, which demonstrated a slight absolute increase of 3.6% points in comparison to the national STEPS survey in 2009. Prevalence of overweight increased with age but was not affected by sex. However, prevalence patterns between different groups of education levels and occupations differed between men and women. We were unable to measure physical activity, sedentary behavior, and diet, which are all factors that may affect the prevalence of overweight and should also be incorporated into prevention strategies.

Hypertension and diabetes, which are chronic diseases, are also risk factors for other NCDs such as stroke, heart failure, and chronic kidney disease. The doubling of diabetes prevalence from about 2% in 1990 to 4.1% in 2015 is noteworthy. Similar to other developing countries, some of the changes may be due to increased globalization, urbanization, and an aging population. The prevalence of hypertension has fluctuated slightly around 19% over the past 10 years (over 40% of adults aged 50–69).

Individuals may possess more than one risk factor for NCDs. Thus, in order to evaluate the combined contributions of risk factors, we evaluated a summary measure across all risk factors for this study. Most women had no risk factors, and very few women had more than one risk factor. However, nearly all men had at least one risk factor, and over half of the men had two or more risk factors. Previous studies provided evidence that combined the effect of risk factors associated with the likelihood of the simultaneous presence of two or more chronic conditions in the same person. Given the very high prevalence of multiple risk factors among men and the combined effects of these factors, policy and prevention strategies which simultaneously address multiple risk factors should be developed.

This study has several strengths as well as some limitations which we attempted to address. The study was conducted with a rigorous and standardized study design to ensure adequate statistical power for subgroups analysis. Data were collected using a validated questionnaire that has been used across multiple populations. The questionnaire was translated into
Vietnamese and pre-tested prior to its implementation in this study. The major limitation of this study is the lack of detailed information on diet, smoking duration, and/or alcohol consumption amount. Though using the dry chemistry method (finger blood test was used to measure blood glucose, total cholesterol and high-density lipoprotein) is the standard for WHO STEPS, we acknowledge that the accuracy of the test may be greatly affected by who administered it. Thus, to ensure and enhance the quality of the test, blood tests were only operated by a separate team of CHS’s healthcare personnel rather than the normal interviewer team (where team members were not required to be health professionals).

In summary, the study revealed that nearly all men had at least one risk factor for NCDs. Several risk factors were also common among women, or women within subgroups, defined by socioeconomic status. All of the risk factors evaluated are modifiable either by behavior changes or treatment. Thus, the findings from this study should serve as the basis of policy and prevention strategies for improving the health of Vietnamese people. Additional studies are needed to assess risk factors and their temporal trends, as well as to test prevention strategies.

ACKNOWLEDGMENTS

We thank the World Health Organization Office in Vietnam for providing both technical and financial support to this survey.

REFERENCES

1. World Health Organization. Global Status Report on Noncommunicable Diseases 2014. Attaining the Nine Global Noncommunicable Diseases Targets; a Shared Responsibility. Geneva, Switzerland: World Health Organization; 2014.
2. Institute for Health Metrics and Evaluation. Vietnam Global Burden of Disease Study 2010 Results 1990–2010. Seattle, WA: Institute for Health Metrics and Evaluation; 2013.
3. Son PT, Quang NN, Viet NL, Khai PG, Wall S, Weinahall L, et al. Prevalence, awareness, treatment and control of hypertension in Vietnam-results from a national survey. J Hum Hypertens 2012;26(4):268-80.
4. Vietnam Ministry of Health, Health Partnership Group. Jointed Annual Health Review 2014: Strengthening Prevention and Control of Non-Communicable Disease. Hanoi: Medical Publishing House; 2014.
5. World Vietnam Ministry of Health. Health Statistics Yearbook 2015. Hanoi: Medical Publishing House; 2017.
6. National Endocrinology Hospital. National Survey on Diabetes in Vietnam. Hanoi, Vietnam: National Endocrinology Hospital; 2012.
7. International Diabetes Federation. IDF Diabetes Atlas. 6th ed. Brussels, Belgium: International Diabetes Federation; 2014.
8. Popkin BM. Global nutrition dynamics: the world is shifting rapidly toward a diet linked with noncommunicable diseases. Am J Clin Nutr 2006;84(2):289-98.
9. GBD 2013 Mortality and Causes of Death Collaborators. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2015;385(9963):117-71.
10. Khan NC, Mai Le B, Do Thi PH, Minh ND, Tuyen LD, Tue HH, et al. Situation of Overweight and Obesity among Adults 25–64 Years Old in Vietnam and Some Related Factors: the 2005 National Survey. Hanoi: National Institute of Nutrition; 2005.
11. Ministry of Health. National Survey on the Risk Factors of Non-Communicable Diseases (STEPS) Vietnam, 2015. Hanoi, Vietnam: General Department of Preventive Medicine; 2016.
12. Trang NH, Hong TK, Dibley MJ. Cohort profile: Ho Chi Minh City Youth Cohort—changes in diet, physical activity, sedentary behaviour and relationship with overweight/obesity in adolescents. BMJ Open 2012;2(1):e000362.

PUBMED | CROSSREF

13. World Health Organization. WHO STEPS Surveillance Manual. Geneva, Switzerland: World Health Organization; 2017.

14. Ministry of Health. National Survey on the Risk Factors of Non-Communicable Diseases (STEPS) Vietnam 2015. Hanoi, Vietnam: General Department of Preventive Medicine; 2016.

15. Vyas S, Kumaranayake L. Constructing socio-economic status indices: how to use principal components analysis. Health Policy Plan 2006;21(6):459-68.

PUBMED | CROSSREF

16. Decision to Approve the National Strategy for Prevention and Control of Cancer, Cardiovascular Disease, Diabetes, Chronic Obstructive Pulmonary Disease, Asthma and Other Non-Communicable Diseases, Period 2015–2025. Hanoi: Prime Minister; 2015.

17. U.S. Department of Health and Human Services. How Tobacco Smoke Causes Disease: What It Means to You. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2010.

18. U.S. Department of Health and Human Services. The Health Consequences of Smoking—50 Years of Progress: a Report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2014.

19. Eberhardt MS, Pamuk ER. The importance of place of residence: examining health in rural and nonrural areas. Am J Public Health 2004;94(10):1682-6.

PUBMED | CROSSREF

20. Sreeramareddy CT, Pradhan PM, Mir IA, Sin S. Smoking and smokeless tobacco use in nine South and Southeast Asian countries: prevalence estimates and social determinants from Demographic and Health Surveys. Popul Health Metr 2014;12(1):22.

PUBMED | CROSSREF

21. Nguyen NP, Tran BX, Hwang LY, Markham CM, Swartz MD, Phan HT, et al. Prevalence of cigarette smoking and associated factors in a large sample of HIV-positive patients receiving antiretroviral therapy in Vietnam. PLoS One 2015;10(2):e0118185.

PUBMED | CROSSREF

22. World Health Organization. Factsheet on tobacco. https://www.who.int/news-room/fact-sheets/detail/tobacco. Updated 2019. Accessed March 22, 2020.

23. Harper C. Vietnam Noncommunicable Disease Prevention and Control Programme 2002–2010: Implementation Review. Geneva, Switzerland: World Health Organization; 2011.

24. World Health Organization. Global Status Report on Alcohol and Health. Geneva, Switzerland: World Health Organization; 2014.

25. Centers for Disease Control and Prevention. Fact sheets - alcohol use and your health. https://www.cdc.gov/alcohol/fact-sheets/alcohol-use.htm. Updated 2018. Accessed March 22, 2020.

26. Kessaram T, McKenzie J, Girin N, Roth A, Vivili P, Williams G, et al. Alcohol use in the Pacific region: results from the STEPwise approach to surveillance, Global School-Based Student Health Survey and Youth Risk Behavior Surveillance System. Drug Alcohol Rev 2016;35(4):412-23.

PUBMED | CROSSREF

27. Center for Disease Control and Prevention. Effects of high blood pressure. https://www.cdc.gov/bloodpressure/effects.htm. Updated 2014. Accessed March 22, 2020.

28. National Center for Chronic Disease Prevention and Health Promotion. At a Glance 2016. Diabetes: Working to Reverse the US Epidemic. Atlanta, GA: National Center for Chronic Disease Prevention and Health Promotion; 2016.

29. Quoc PS, Charles MA, Cuong NH, Lieu LH, Tuan NA, Thomas M, et al. Blood glucose distribution and prevalence of diabetes in Hanoi (Vietnam). Am J Epidemiol 1994;139(7):713-22.

PUBMED | CROSSREF

30. Godfrey R, Julien M. Urbanisation and health. Clin Med (Lond) 2005;5(2):137-41.

PUBMED | CROSSREF

31. World Health Organization. Urbanisation and health. Bull World Health Organ 2010;88(4):241-320.

32. Allender S, Wickramasinghe K, Goldacre M, Matthews D, Katulanda P. Quantifying urbanization as a risk factor for noncommunicable disease. J Urban Health 2011;88(5):906-18.

PUBMED | CROSSREF
33. Kontis V, Mathers CD, Bonita R, Stevens GA, Rehm J, Shield KD, et al. Regional contributions of six preventable risk factors to achieving the 25 × 25 non-communicable disease mortality reduction target: a modelling study. *Lancet Glob Health* 2015;3(12):e746-57.

34. Agrawal G, Patel SK, Agarwal AK. Lifestyle health risk factors and multiple non-communicable diseases among the adult population in India: a cross-sectional study. *J Public Health (Bangkok)* 2016;24(4):317-24.