PREVALENCE OF DIABETES AND ASSOCIATED FACTORS AMONG VIETNAMESES ADULTS IN 2015: AN UPDATE FROM NATIONAL STEPS SURVEY

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Vietnam

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Prevalence of diabetes and associated factors among Vietnamese adults in 2015: An update from national STEPS survey

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By:

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Declaration:

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Signature:……

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List of Abbreviations

CDC	Centers for Diseases Control and Prevention
GATS	Global Adult Tobacco Survey
GDP	Gross Domestic Product
MOH	Ministry of Health
NCDs	Noncommunicable diseases
PPMC	Provincial Preventive Medicine Center
STEPS	STEPwise approach to Surveillance
THE	Total Health Expenditure
WHO	World Health Organizaiton

Abstract

Tran Anh Tu - Vietnam

Background: In recent decades, as Vietnam had become a low-middle income country with the rapid growth of socio-economic status, with other non-communicable diseases (NCDs), the prevalence of diabetes was rising quickly. To effectively prevent and control diabetes, it was necessary to update the prevalence as well as to explore associated factors that might lead people to risk of the disease. This study was based on a national survey on NCDs to identify the most updated prevalence of diabetes among Vietnamese adults and its associated factors.

Method: Based on secondary data collected from NCDs STEPS survey conducted at national level, a cross-sectional study was designed with a sample of 3068 participants. The diabetes participants were identified based on previous diagnosis combined with fasting blood glucose test.

Results: In 2015, the prevalence of diabetes among Vietnamese adults was 5.5%. Besides, in total 170 participants with diabetes in the study, only 37.6% were diagnosed by doctors beforehand, and only 50% of diagnosed participants were provided insulin treatment. Older age, unemployment, urban living standard and sedentary lifestyle were found to be associated with high diabetes prevalence.

Conclusion: The prevalence of diabetes in Vietnam was lower than other countries but saw a considerable and rapid increase for the last five years. This result indicated the demand for investing more supports and resources into the health care system to improve capacities of diagnosis and treatment of diabetes in communities in Vietnam.

Keywords: *diabetes, Vietnam, low-middle income country, STEPS survey*

Thesis word count: 11,195

Introduction

As an epidemiologist working in the Department of Epidemiology at National Institute of Hygiene and Epidemiology since 2013, the burden and epidemiological characteristics of both noncommunicable diseases and communicable diseases are always in my concerns. Although I am working on infectious diseases, the information of noncommunicable diseases is still necessary to be updated. As in 2015, Vietnam conducted a national survey on non-communicable diseases and the related factors, it was an opportunity for me to learn more based on the data collected.

Despite there were several non-communicable diseases investigated in that survey, diabetes was my most major concern because recently, there was sparse updated information of this disease. Besides, the complications caused by diabetes were severe, which could raise the burden of diabetes if there was no proper intervention. However, to have appropriate measure to control diabetes at community level, it is essential to have updated findings of the current situation and the related factors based on the population. Therefore, to support the policy makers to make effective and efficient decision for diabetes prevention and control program, I decided to conduct this thesis. My thesis included six chapters.

Chapter 1 describes the demographic information of Vietnam as well as the health care system in Vietnam. It also includes the problem statement, justification, and objectives of the study.

Chapter 2 explains the method of data collection, measurement, and analyses to achieve the objectives of the study.

Chapter 3 illustrates the results of the data after analyses following the objectives.

Chapter 4 discusses the results with literature reviews.

Chapter 5 makes conclusion on the most important findings.

Chapter 6 provides recommendations for policy makers and implementers to increase to effectiveness and efficiency of the diabetes prevention and control program.

Chapter 1: Background

1.1. Background information

1.1.1. Demographic

Vietnam is a tropical country located in South East Asia. There are three administrative regions in Vietnam, including the North, the Middle and the South (1). According to the 2015 census, the total population in 2015 was 91.71 million with 49.3% male and 50.7% female. More people live in rural areas (66.1%) than those lives in urban areas (33.9%). The general life expectancy was 73.3 years. It was higher in female with 76.1 years, compared to male with 70.7 years. The fertility rate was in replacement level with 2.1 children/woman and on decreasing trend. The population was currently young with approximately 50% of people in labour age (over 15 years old) but recently, it has been ageing. In particular, proportion of children from 0 to 14 years old is decreasing while the proportions of other age groups, especially over 60 years old, are increasing (2).

Vietnam has a large ethnic diversity with 54 ethnic groups, in which, the most popular ethnic group is Kinh, with over 85% of the population. The others have small proportions, from 1% to 2% (3).

1.1.2. Education and Socioeconomic status

Economy

Vietnam has seen a stable development over the past ten years and becomes a low-middle income country since 2010. Following World Bank, the economic growth rate in Vietnam from 2000 to 2015 fluctuated around 5% to 6% annually (4). In 2015, the GDP per capita was reported 2,109 USD, ranking 7th in 10 ASEAN countries (5). Parallel with the economic development, there has been a high urbanization rate, which was averagely 2.0% during 2010-2015, one of the fastest increase in the region (6).

In socio-economic aspect, Vietnam was divided into six economic zones, including Red River Delta, North Midlands and mountain areas, North Central and Central coastal areas, Central Highlands, South East and Mekong River Delta. This way of division was commonly used by the General Statistics Office to sample households in national census and survey.

Education

Although Vietnam was a low-income country for a long time, there was an effective education system, which led to impressive results. The illiteracy rate was less than 10% among population and more than 98% children at primary school age attend schools. At higher level, in 2015, more than 90% of students graduated from high school and more than

80% graduated from universities or colleges. In education indices, there was no significant difference of between male and female (7).

Occupation

In the past, most of the jobs in Vietnam were manual and required high labour resource. Recently, thanks to high technologies and automatic machine, there have been more people working in the office or providing services. In particular, during the time from 2010-2015, the number of people working in agriculture, forestry and fishing decreased from 49.5% to 44% while those working in trading, administrative, researching and services activities increased from 16.8% to 19.9% (2).

1.1.3. Culture

Vietnam has a conservative culture of a typically Asian and agricultural country, especially in gender issue. Recently, although gender equality has been concerned and improved significantly in society, men are still considered in higher priority than women. Both boys and girls can attend school, but boys were more preferred to be given birth. Both men and women can work and earn money, but men are generally supposed to be the person who earns major household income while women are expected to do housework and take care of children at home. Men can drink and smoke freely while women should not.

In culinary style, rice is the main food in daily Vietnamese meals. Vegetables and fruits were highly consumed because they are easy to produce and very cheap in the market. However, as living standard rising nowadays, Vietnamese people consume more meat and fast food which are imported from other countries.

In religious aspect, most of Vietnamese are non-religious. However, society and village leaders play important roles in establishment of norms and values in the communities.

1.1.4. Healthcare system

Healthcare Service

Most of healthcare services in Vietnam are provided and managed by the government at four levels: national, provincial, district and commune. In preventive sector, almost all services are provided by the public preventive medicine centre. Meanwhile, in curative sector, there were only less than 10% of the total beds belonging to private sector (8). Therefore, different to conventional six building blocks designed by WHO, the health services delivery block in Vietnam is separated and determined by the other five blocks which were managed in concentration by the public sector as shown in Figure 1.

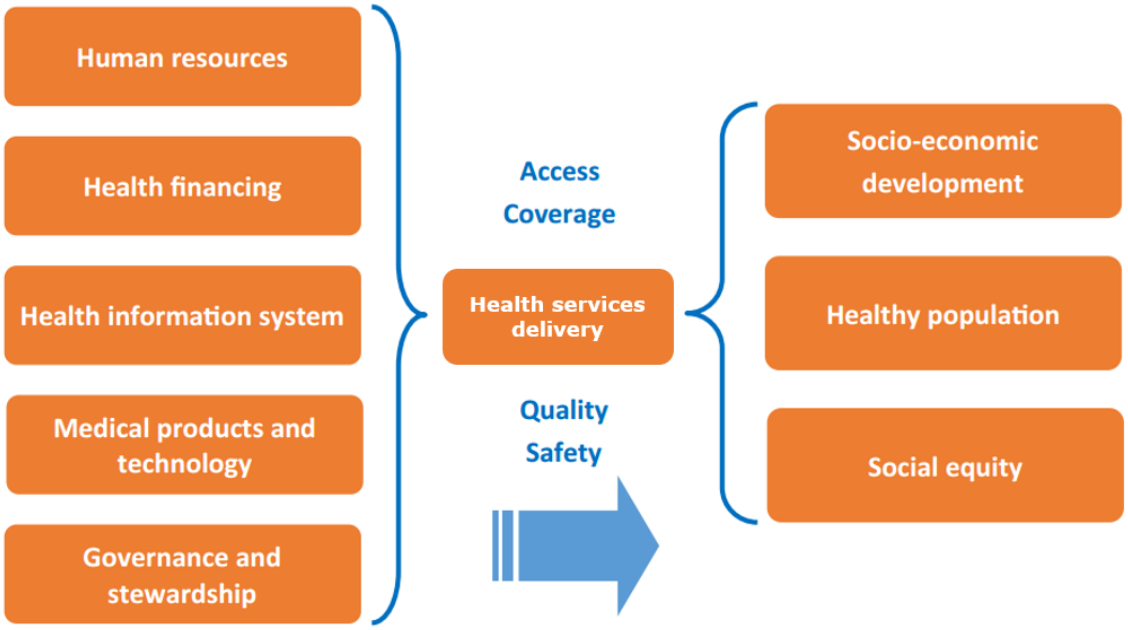

Figure 1. Modified six building blocks in Vietnam health care system based on WHO

Inequity in health care services has remained in Vietnam. The quantity and quality of health services are mostly provided in large cities and urban areas. Meanwhile, in mountainous and remote areas, the services are poor as they lack facilities, infrastructures and human resources (9).

Beside conventional healthcare services, traditional healthcare services are also popular in Vietnam. In 2014, it was estimated 80% of the total hospitals having traditional department. There was about 22.9% of consultation by traditional method at commune level (8).

Regarding communicable diseases, there are two components of healthcare services, including preventive medicine and public health; and medicine, traditional medicine and rehabilitation services.

a. Preventive medicine and public health

The capacity of surveillance system in both communicable and non-communicable diseases has been increased recently, which satisfied about 70% of basic requirements of the International Health Regulations in 2015 (10). To support the surveillance system, the laboratories were upgraded widely at all levels across the country, which could implement confirmed test of most of seasonally infectious diseases, including measles, hand foot mouth disease, dengue fever, at provincial level. Vaccination is provided for free at the commune health station for 12 common infectious diseases in Expanded Program on Immunization (EPI). For HIV/AIDS, free testing and counselling have remained.

As for noncommunicable diseases (NCDs), the strategies of prevention and control has been continually brought into the national target programs (NTPs) since 1998. In particular, two projects of hypertension and diabetes prevention and control were implemented vertically

from national to commune level in 2008 and covered all provinces in the whole country by the end of 2014. However, currently, the services provided by those projects were not effective because of limited supports from other related stakeholders and lack of integration with other programs (11).

b. Medicine, traditional medicine and rehabilitation services

Since 2000, the number of beds per 10,000 population has increased significantly, from 23.36 to 31.93 per 10,000, in which, public sector was from 17.51 to 25.41 per 10,000 (See Figure 2) (8).

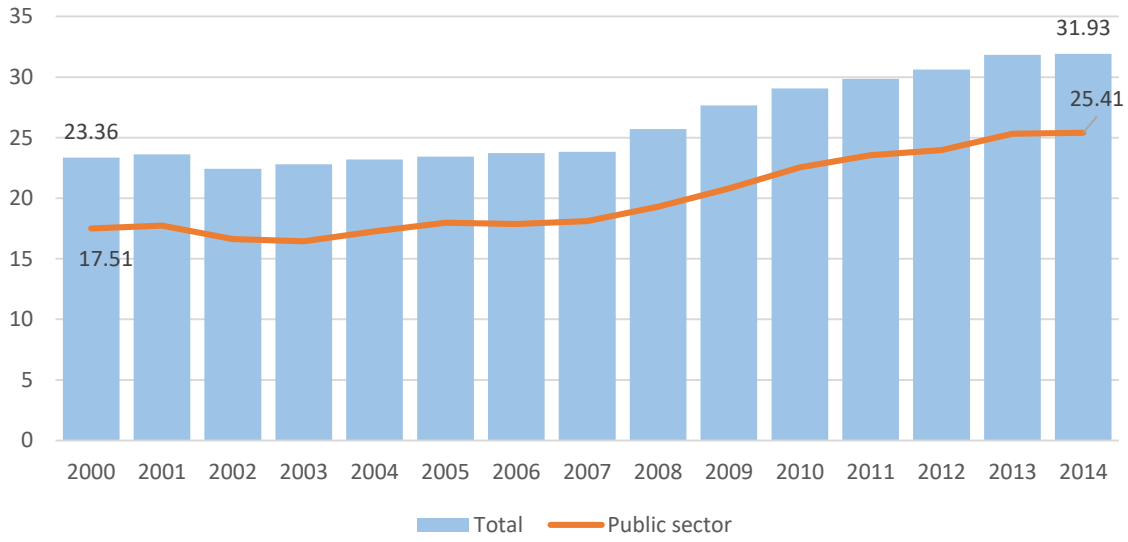

Figure 2. Number of beds per 10,000 population in total and in public sector (8)

Commune health stations cover 99% of the total population, which can provide primary care services including emergency health care, reproductive health care, and provision of medicines. However, for noncommunicable diseases, especially diabetes, most of commune health stations are still not be able to provide test-based diagnosis and diseases management.

Traditional medicine is available at about 70% of commune health centre and more than 80% of the centres having herb garden for traditional drugs. Rehabilitation centres are available in all 63 provinces as well as in all provincial and national hospitals. At district level, rehabilitation services are integrated with clinical department.

Human resources for health

Following with facilities, the number of health care workers in Vietnam has been increasing rapidly in all professions. From 2010 to 2014, the number of doctors per 10,000 population increased from 7.2 to 7.8 doctors, while the number of nurse per 10,000 population increased from 9.4 to 10.8 nurses. There was also a rise in a number of pharmacists, from 1.76 to 2.41 pharmacists per 10,000 population. However, the distribution of health care workers was not equitable. Most of public health workers, doctors and high degree nurses worked at district

level and higher while at commune level with high demand of primary health care, most of staffs were assistant doctors and element nurses (8) (See Table 1).

Table 1. Health personnel by provincial, district and commune level in Vietnam, 2014 (8)

	Total staffs	*Medical PhD.*	*Medical master of science*	*Medical doctor*	*Public health PhD.*	*Master of public health*	*Bachelor of public health*	*Assistant doctor*	*High degree technician*	*Med. technician*	*Element med. technician*	*High degree nurses*	*2nd-degree nurse*	*Elementary nurse*
TOTAL	**309,546**	**288**	**4,011**	**50,071**	**25**	**141**	**1,365**	**54,249**	**2,352**	**10,969**	**383**	**8,256**	**71,568**	**4,185**
Commune level	70,967	0	7	8,409	0	2	133	27,980	3	247	24	258	11,256	2,000
District level	108,994	10	461	18,770	16	32	606	17,751	698	4,489	177	2,440	24,687	1,159
Provincial level	129,585	278	3,543	22,892	9	107	626	8,518	1,651	6,233	182	5,558	35,625	1,026

This was the result of limited policies on planning human resources regarding recruitment, deployment and remuneration. The quality of healthcare workers was not totally standardized, which was higher in large cities and higher level. Although there was an 18-month practical training curriculum in hospitals for doctors, it was not compulsory in the regulation.

Health financing

The total health expenditure (THE) increased from 7.7% to 8.2% during period 2010-2014. In 2014, most of total health budget came from the government/tax (39.1%) and health insurance (33.6%). The foreign aid and loans only accounted for 1.2%. Although more than 65% of people had insurance card in 2012, the contribution of health insurance remained low which was about 25%. Meanwhile, at that time, the out of pocket payment rate was reported high, at 48.8% (8).

Regarding noncommunicable diseases, the budget for prevention and control accounted for 3.5% of total health expenditure, of which, 12.5% belonged to preventive activities. However, it was decreased following time. For example, the budget for NCDs prevention and control in 2014 was cut by 66% compared to 2013 and only met 23% of the budget which was built for planned programs. Most of services covered by the insurance focused on health examination and treatment while diseases screening activities were not included. Besides, because of limited capacity at the commune health stations, most NCDs diagnostic tests and essential medicines for diseases such as hypertension and diabetes were only provided at district levels or higher. This caused obstacles for patients to utilize the benefits of insurance, especially in rural and remote areas.

Health information

Generally, health data is reported routinely from lower level to higher level. Based on the indicators, essential health information is collected by the Ministry of Health and published annually under Health Statistics Yearbook in dual languages including Vietnamese and English. Recently, the information system has been strengthened regarding both quantity and quality. Thanks to the internet and high technologies applied to health information system, most of the data was collected quickly and managed in digital. For example, among preventive health care centres, a nationwide online software was created for infectious diseases data management, in which, the data could automatically flow from district level to national level. In hospital, more than 60% of district and provincial hospitals used patients data software. The quality of data was also improved by collecting not only the diseases but also the information of risk factors. However, there was still limitation in Vietnam health information system. The data remained inconsistent in different healthcare facilities because of inaccurate and delayed reports. Therefore, the data were limited to be used in policy making as they were unreliable and not analysed for the reports (12).

Until now, noncommunicable diseases data surveillance system has not been established. Most of information related to non-communicable diseases were reported from research or collected unsystematically from the hospitals (13).

Essential medicines

Medicines have been made more available and higher quality in health care system in Vietnam. Although imported drugs still dominate, domestic drugs have been produced and used more. Especially, Vietnam could produce ten over 12 vaccines in the EPI (14). However, because of limited capacity of domestic pharmaceutical companies, price of most drugs, such as diabetes or hypertension, remains high, even in the public sector. For medical equipment, only simple devices could be made in Vietnam. The others were mostly imported from foreign countries.

In non-communicable diseases, the list of essential medicines and list of medicines covered by the insurance has been regulated by the Ministry of Health. These lists were established based on current WHO guidelines for essential medicines and several criteria, including effectiveness and safety, availability and production capacity, current pattern of diseases and healthcare capacity, and price. There was also guidelines for drug prescription and usage in each NCD, for example hypertension in 2010, and diabetes in 2011 (15,16). However, at commune level, some specialist drugs were not available such as insulin in controlling diabetes type 2, which made patients difficult to access medicine for NCD management. Additionally, commune health station also lacked necessary equipment for NCDs diagnosis such as blood glucose test strips or urine protein test strips (17).

Leadership and Governance

Healthcare policies and strategies in Vietnam have been developed by the Ministry of Health with long term vision, targeting universal health coverage. Many regulations were brought into laws such as Laws of infectious diseases prevention and control, Laws of health insurance. Besides, legal documents and guiding circulars were also issued to direct practical activities. All documents were established with involvement of both public and private sectors, as well as international organizations such as WHO, UNICEF, FAO. However, there were limitations in developing and applying policies. Because of lack of health information and research findings, little evidence was based on making policies. Besides, there were different capacities between healthcare facilities across the country, it was difficult to apply the same policies and always needed adjustment. Meanwhile, feedback of policies from stakeholders was delayed and not in details, which is slow down the improvement process (13).

Vietnam has established some policies to control risk factors of NCDs. Based on that, national programs of NCDs prevention and control for each disease were developed. However, compared to the burden, the concern of NCDs from the government and policy makers were not adequate. For example, the budget of health for NCDs prevention and control was made declined in recent years despite the high-cost effectiveness. Besides, most of NCDs prevention and control programs were not integrated as they were designed vertically and implemented separately by specific hospitals (18) (See Figure 3).

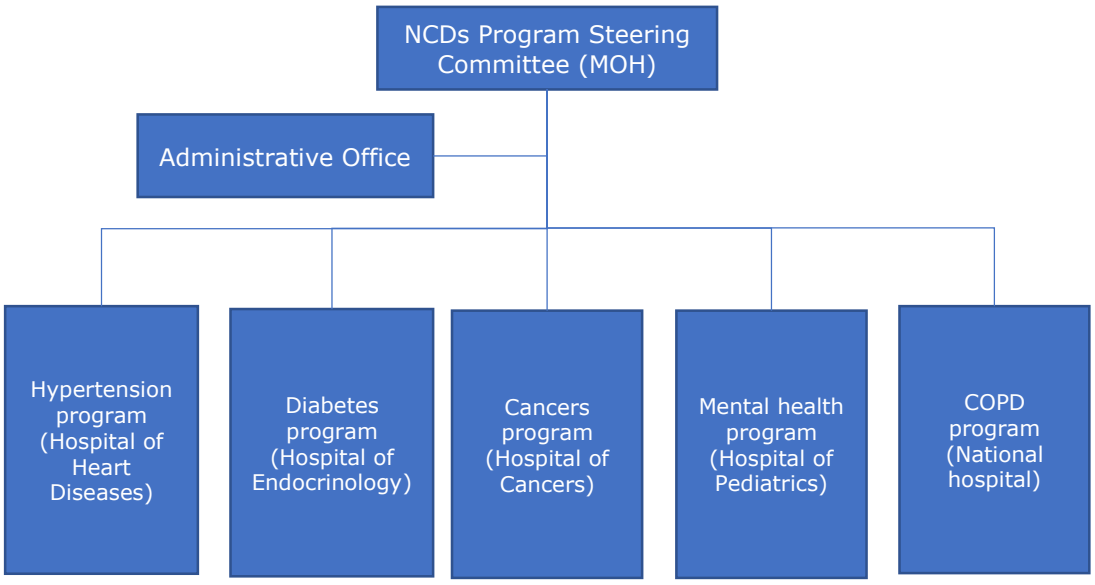

Figure 3. Framework of NCDs prevention and control programs (18)

1.1.5. Burden of disease

As a tropical country, in Vietnam, communicable diseases have been considered as the main burden of diseases for many decades. However, in recent years, thanks to wide vaccination coverage and outbreak prevention and control effort, the incidence of

communicable diseases decreased significantly. In particular, in 1976, the proportion of deaths caused by communicable diseases in Vietnam was over 50% of the total mortality. After 38 years, in 2014, this number was reduced to 11.2%. Inversely, it was seen a rapid increase in both prevalence and mortality of noncommunicable diseases. From 1976 to 2014, the mortality caused by non-communicable diseases rose from 44.7% to 72.6%, in which, cardiovascular diseases and cancers were two major causes, with 33% and 18%, respectively (8). As endemic communicable diseases remain, Vietnam was considered in the situation of double burden of diseases.

1.2. Problem statement, Justification, Research questions and Objectives

1.2.1. Problem statement

In recent decade, diabetes mellitus has been rising as one of the most serious public health issues at global level, for which, it requires urgent interventions. Following the most updated data provided by WHO, by the end of 2014, there were 422 million adults worldwide who had reported with diabetes mellitus (defined in surveys as those having a fasting plasma glucose value of greater than or equal to 7.0 mmol/L or on medication for diabetes/raised blood glucose). Also, it was estimated 1.8 million people died because of diabetes. This death number accounted for 3.6% total number of deaths caused by all diseases, which jumped to the 6th rank in the top 10 causes of death worldwide while it was not on the list in 2000 (19,20). Also compared to the number of 285 million people in 2010, it was seen a rapid increase of diabetes in global population in recent years. Moreover, this actual reported number of diabetes people in 2014 were nearly equal the estimated number in 2030 which was predicted by previous studies in 2004 and 2010 (21,22).

However, burden of diabetes did not develop and distributed equally over the world. From 1980 to 2014, while prevalence of diabetes in high-income countries gradually increased from 5 to 7 percent, the number in low and middle-income countries witnessed a double from around 4 percent to 8 percent (20). Especially, in those countries who had a growing economy status, the average proportion of diabetes among population was up to 10% such as China (9.4%), India (7.8%), and Thailand (9.6%) (23). This phenomenon was explained by the fact that lifestyles and diets had changed along with higher socioeconomic status, which resulted in high prevalence of risk factors of diabetes in the populations, including obesity, high blood glucose and physical inactivity (24).

Since 2010, Vietnam has become a low middle-income country with quick socioeconomic development. As the consequences similar to other developing countries, in 3 years from 2010 to 2012, the prevalence of diabetes among Vietnamese adults doubled from 2.7% to 5.4%. In particular, in 2012, more than 13,000 Vietnamese people were killed by diabetes. As the results, diabetes in Vietnam was one of the top 10 leading diseases causing deaths (25,26). Additionally, high proportion of people in Vietnam is under risk factors of diabetes.

It was estimated that one fifth of the total population in Vietnam was overweight (20.4%), high blood pressure (23%), physical inactivity (23.6%) and smoking (23%) (23,27).

Therefore, since 2008, the Ministry of Health has implemented a national program for diabetes prevention and control. However, at the time, there had not been any national investigation on noncommunicable diseases and the risk factors, the current prevalence of diabetes and its specific risks in the Vietnam context were still in question.

1.2.2. Justification

As mentioned above, national program for diabetes prevention and control was approved in 2008 and officially implemented in 2010. In the program, early detection and management of diabetes in community were targeted to be enhanced. To reach those targets, to research into the prevalence diabetes and the pattern of associated factors are essential.

Since 1990, in Vietnam, many studies had been conducted to learn about the noncommunicable diseases in general, as well as diabetes in particular. However, due to financial and technical resources, most studies were implemented within local scales, especially in large cities such as Hanoi in 1990 (28) and Ho Chi Minh City in 2005 (29). As those data were mostly out of date, updated data of diabetes could only be derived from different sources of hospitals and preventive medicine centres. In those health facilities, the data were collected incompletely, which consisted only the number of new cases and death cases while epidemiological characteristics of the patients were often missing. Therefore, with those databases, it was difficult to identify associated factors in the current context in Vietnam. Moreover, as Vietnam was under quick developing process in socioeconomic status, prevalence of diabetes, as well as its model of cause-effect, could be changed unexpectedly. Therefore, a national survey on non-communicable diseases, specifically on diabetes, would be able to provide the most updated information to timely adjust targets and establish intervention framework of the national program for diabetes.

STEPS survey, so called STEPwise approach to non-communicable disease risk factor surveillance, was an instrument designed and published by WHO to support countries in obtaining updated prevalence of non-communicable diseases as well as establishing risk factors that cause the burden of diseases (30). There were 105 countries across all six WHO Regions which had conducted this survey and already published the results of their STEPS survey. Although Vietnam had once implemented STEPS survey in 2005, it was only at the sub-national level, which located in Ho Chi Minh City centre and two rural districts in Hanoi and Can Tho Province (31). Clearly, to improve the program of diabetes prevention and control at the national level, it was necessary to identify the current burden of diabetes and research for the pattern of the risk factors.

In 2015, under endorsement and support from WHO and local authorities across the country, the Vietnam Ministry of Health conducted a national STEPS survey on the risk factors

of non-communicable diseases to prepare for evidence based information for the implementation of the action plan and evaluate the targets of National Strategy for the period 2015-2025. As part of that purpose, our study was conducted using secondary data which were collected from the survey to answer two questions. The first question was about the current prevalence of diabetes in Vietnamese community at the national level and the second question was about the major risk factors which mostly affected the burden of diabetes.

1.2.3. Overall objective

To describe the prevalence of diabetes and the associated factors among Vietnamese adults from 18 to 69 years old in 2015 to recommend policy makers for strategies to improve the programs of diabetes prevention and control in Vietnam.

1.2.4. Specific objectives

Specific objective 1

To identify the prevalence of diabetes among Vietnamese adults from 18 to 69 years old in 2015.

Specific objective 2

To describe associated factors of diabetes among Vietnamese adults from 18 to 69 years old in 2015.

Specific objective 3

To disseminate the results of the study and to recommend policy makers for strategies to improve the programs of diabetes prevention and control in Vietnam.

Chapter 2: Methodology

2.1. Design and setting

2.1.1. Study design

This study was designed as a secondary data analysis of a sample from *a national survey on the risk factors of non-communicable diseases (NCDs) in Vietnam (STEPS survey)*, conducted by the General Department of Preventive Medicine (GDPM). GDPM was a specialized department of Vietnam Ministry of Health, with functions in field of preventive medicine nationwide (http://vncdc.gov.vn/en).

2.1.2. Study setting

The STEPS survey was conducted in 2015 as a population-based cross sectional study, to update situation of common NCDs and their risk factors. This survey covered across all 63 provinces and cities in Vietnam.

2.2. Subjects

Subjects in the STEPS survey were people who would be recruited from registered households in the communities. Eligible participants were adults from 18 to 69 years old with mental and physical capabilities of participating in the survey. Ineligible criteria were temporary residence and current inpatients in health facilities.

2.3. Sample size and sampling

2.3.1. Sample size

Based on the STEPS sample size and sampling guidelines provided by WHO, the population was divided into groups based on age and sex. In age, there were 3 groups: from 18 to 29 years old, from 30 to 49 years old, and from 50 to 69 years old. Afterward, each group of age would be divided into male and female subgroups. Totally, six groups were established. The sample size of each group was calculated with following formulas:

$$n = Z^2 \frac{p(1-p)}{e^2} \times DE$$

With level of confidence measure (Z) equal 1.96, margin of error (e) equal 0.05, baseline levels of the key indicators (p) equal 0.5 (to reach the largest sample size as possible) and design effect (DE) equal 1.5, there would be 576 participants in each group. Therefore, with 80% of expected response rate for all 6 groups, it was calculated that total number of participants in the survey were 4320.

2.3.2. Sampling

In the STEPS sampling, there were totally three stages, including enumeration areas (EAs) sampling, households (HH) sampling and individual sampling. To optimize resources because of the same study design and setting, the STEPS sampling was done as part of the sampling in previous survey of tobacco among people over 15 years old (GATS) conducted by the Ministry of Health in 2010.

EAs sampling

Based on the Population Census conducted by General Statistics Office in 2014, there was a master sample frame of 25,500 EAs which represent all 170,000 EAs in the whole country. This master sample frame was divided into six strata by two stratification variables which were urbanization (urban; rural) and district group (district/town/city of province; plain and coastal district; mountainous/island district). To satisfy the GATS sample size, there were 657 EAs selected in stratification, which was based on probability proportional to size (PPS) approach, from the master sample frame for the GATS survey. Afterward, to have 4320 participants for STEPS survey, there would need to systematically select 315 EAs from 657 EAs in GATS survey.

HHs sampling

Based on GATS study, 10% of total households in each EAs would be randomly selected. Therefore, with 315 EAs in STEPS survey, there would be 4651 households.

Individual sampling

One person from each selected household by Kish Grid selection method. Eligible and ineligible criteria were used to finally determine whether that selected individual would be recruited into study.

2.4. Data collection

2.4.1. STEPS survey

In STEPS survey, an electronic questionnaire was used to collect data of the participants through PDA (personal digital assistant device). The questionnaire was designed based on the questionnaire CORE_EXP V3.0 provided in STEPS approach by WHO. There were some modifications compared to the original version to meet the context in Vietnam (*Annex 1*). All the content of the questionnaire was translated from English to Vietnamese.

Finger blood test was used for fasting blood glucose measurements; the equipment was standardized under recommendation by WHO.

2.4.2. Secondary data

All information collected from questionnaire and measurement were input by the management team under supervision of GDPM. The raw data were cleaned and then stored in STATA format (.dta). Under permission of GDPM, the STATA database in format was used to analyse in this study.

2.5. Measurement

2.5.1. Diabetes

A participant who was diagnosed diabetes if he/she reported history of diabetes or currently in treatment of diabetes or his/her fasting blood glucose test result was equal or higher than 7.0 mmol/L.

2.5.2. Demographic information

Age

Based on the sample calculation approach, in our study, all participants were divided into three age groups: (1) 18-29 years old, (2) 30-49 years old, (3) 50-69 years old.

Sex

Our study analysed population with two sexes: male and female

Ethnicity

Because most of Vietnamese people belong to Kinh ethnic group and the other ethnic groups only account for less than 2 percent each, there were two main groups in our study: Kinh group and the other minor ethnicity group.

Education levels

Based on the number of formal educational years, there were four levels of education including: no formal education (0 years), from 1-5 years (primary school), from 6-12 years (secondary and high school), over 12 years (university/college and higher degree).

Household income

Based on methodology of constructing wealth indices by WHO in GATS survey, furniture and facilities used in each household were investigated (*Annex 2*) (32). As the results, the income was categorized into five quintiles:

- Poorest
- Second
- Middle
- Fourth
- Richest

Occupations

Occupations of participants were defined as a job by which they earn most of their income or on which they spend most of their time for working. In our study, there were five groups including white collar workers, blue collar workers, farmers, house services/care, and unemployment. The definition and jobs specification was described in *Annex 3*.

Marital status

Marital status was classified as unmarried and married, in which, married included those who were already in married as well as separated, divorced and widowed.

Region

Based on sampling process for socioeconomic status, there were two regions where people were living, including urban and rural.

2.5.3. Lifestyles measurement

The lifestyles measurement and classification were based on STEPS survey analysis manual issued by WHO (30)

Physical activity level

Based on METs measurement of physical activity guided by WHO, there were two categories of physical activity level:

- **Meet the physical activity level recommended by WHO:** practising physical activities during work, travelling and play sports with 600 METs-minute per day and over.
- **Did not meet the physical activity level recommended by WHO:** practising physical activities during work, travelling and play sports with less than 600 METs-minute per day.

Sedentary lifestyles

Sedentary lifestyles were defined as the self-reported time the participants spent on sitting daily. Based on length of sedentary time, there were two groups to be analysed:

- Less than 4 hours per day
- Four hours and over per day

Alcohol consumption

To evaluate the effect of alcohol on blood glucose level, in our study, the levels of alcohol consumption were divided into four groups, including:

- Never drink in the last 12 months
- Never drink in the last 30 days

- Recommended by WHO: less than five standard unit of alcohol and less than four standard units of alcohol for men and women, respectively. Each standard unit of alcohol was estimated as 10 gram of ethanol.
- Over recommended by WHO: From 5 standard unit of alcohol for men or from 4 standard units of alcohol for women.

Fruit and vegetable consumption

Based on WHO recommendation, by calculating a number of servings of fruit and vegetable consumed by each participant daily (each serving equivalent to 80 gram of the combination of fruit and vegetable), we defined the consumption into two levels, including:

- Less than five servings
- Five servings and over

2.6. Data management and analysis

The database was cleaned and analysed by software STATA version 13.0. Statistical techniques used to analyse include:

- **Data description:** proportion, means, SD.
- **Statistical test:** T-test, chi square test to identify significant difference between mean, proportion. If p value is equal or less than 0.05, the difference is determined significant.
- **Logistic regression:** to identify relationship between factors and outcome in both univariate and multivariate models.

2.7. Ethical consideration

Ethical proposal of STEPS survey was approved by the Research Ethics Committee of the Hanoi School of Public Health. Usage of data for analysis in this study was permitted by the General Department of Preventive Medicine and STEPS Vietnam Research Team. The data was ensured to be used only for the objectives of this study and must not be shared for any other purpose.

2.8. Quality assurance

The secondary data was cleaned and labelled based on the codebook before analysis. New variables were created following the measurement definition mentioned above to make it suitable for the specific objectives of this study. The analysed results were discussed with STEPS Vietnam Research Team for validation checking.

Chapter 3: Results

3.1. Participants

Table 2. Demographic description of participant

Demographic information (N=3068)		n	%
Sex	Male	1,318	43.0
	Female	1,750	57.0
Agegroup	From 18-29	486	15.8
	From 30-49	1,495	48.7
	From 50-69	1,087	35.5
Age range= 18 – 69 (years old), **Mean**=43.7, **SD**=13.1			
Ethnicity	Kinh	2509	81.8
	Other minor groups	559	18.2
Marital status	Unmarried	302	9.8
	Married	2,766	90.2
Education years	No formal education	174	5.7
	Under 5 years	608	19.8
	6-12 years	1,864	60.7
	Over 12 years	422	13.8
Occupation	White collar worker	215	7.0
	Blue collar worker	1,767	57.6
	Farmer	391	12.7
	House care/services	399	13.0
	Unemployment	296	9.7
Region	Urban	1,373	44.8
	Rural	1,695	55.2
Household wealth	Poorest	669	21.8
	Second	816	26.6

Demographic information (N=3068)		n	%
	Middle	483	15.7
	Fourth	569	18.6
	Richest	531	17.3

Of the 3758 participants approached, 3,068 answered the questionnaire (STEP 1) and completed blood test for fasting blood glucose (STEP 2 and 3), providing a response rate of 81.6%. All rejections happened during stage of taking blood sample. However, it was not researched for the reason of rejections.

The mean age of the respondents was 43.7 years (SD = 13.1, range = 18 – 69). Nearly half of the participants were in middle age, from 30-49 years old, with 48.7%. Meanwhile, there were only about 15.8% of the participant who was younger than 30 and the others were people older than 50 years old. There was more female than male participants, 57% for the former and 43% for the latter. Kinh ethnic group dominated in the studied population with 81.8% while all other ethnic minorities only accounted for 18.2%. Most of participants already married while only less than 10% were still in single status.

As for socioeconomic status, the majority of participants had from 6 to 12 educational years, which equivalent to graduation of secondary to high school, with 60.7%. Only more than 5% had no formal education. The others were under five years (primary school) and over 12 years (university and higher) with 19.8% and 13.8% of each, respectively. In occupation distribution, for manual workers, 57.6% of the total respondents were working in non-agriculture manual labourer while 12.7% were working as farmers. For non-manual workers, office staffs and services workers accounted for 7% and 13%, respectively. The others were unemployed and retired, with 9.7%. Regarding economic status, with 55.2% compared to 44.8%, more participants were living in rural than urban areas. There was an equivalent in classification of household income from the poorest to the richest, which was more or less than 20%.

3.2. Diabetes prevalence

3.2.1. Prevalence of diabetes and prediabetes

Table 3. Prevalence of diabetes among participants

Table 3 (N=3068)		n	%	Cum. (%)
Diabetes diagnosis based on test results	Diabetes	134	4.4	4.4
	Pre-Diabetes	177	5.8	10.2
	Non-Diabetes	2757	89.8	100.0
Verified diabetes	Diabetes	170	5.5	5.5
	Non-Diabetes	2,898	94.5	100.0

Table 3 describes the prevalence of diabetes status in the studied population. Following WHO, based on fasting blood glucose test results, of the total participants, there were 4.4% with diabetes (blood glucose higher than 7.0 mmol/L) and 5.8% with prediabetes (blood glucose from 6.0 to 7.0 mmol/L). The others who had blood glucose less than 6.0 mmol/L were considered nondiabetes.

However, in our study, to verify the diabetes status of each participant, we combined blood test results with self-report information related to history of diabetes diagnosis and treatment such as on insulin or traditional drugs usage. As a result, there were finally 5.5% of the participants who were in verified diabetes status. The others were considered non-diabetes, with 94.5%.

3.2.2. Diabetes management and recommendations

Table 4. Diagnosis and treatment for diabetes among diabetes participants by sex

Table 4	Male		Female		Total	
	n	%	n	%	n	%
Among 170 diabetes participants (N=170, N_{male}=78, N_{female}=92)						
Diagnosed by doctors	25	32.1	39	42.4	64	37.6
Undiagnosed	53	67.9	53	57.6	106	62.4
Among 64 diabetes participants diagnosed by doctors (N=64, N_{male}=25, N_{female}=39)						
Diagnosed but not on insulin treatment	13	52.0	19	48.7	32	50.0
Diagnosed but not on treatment program	5	20.0	6	15.4	11	17.2
**p<0.05, **p<0.01, ***p<0.001*						

Table 4 showed the rate of participants with diabetes who were diagnosed and treated for diabetes in the past. Over 50% the diabetes participants were undiagnosed beforehand, with 62.4%. Although in the result, more males were not diagnosed than females, the difference was not statistically significant. Among the other 64 diabetes participants who were already diagnosed, half of them were not given insulin treatment and only less than 20% were not in treatment program. The difference between males and females were not significant in both cases.

Table 5. Level of diabetes management program among diabetes participants

Table 5		n	%
Level of health facility among participants joined diabetes management program (N=53)	Commune	3	5.7
	District	20	37.7
	Provincial	19	35.8
	National	8	15.1
	Private	3	5.7

Among 53 diabetes participants who were under diabetes treatment program, there were over 80% of those participants who were told about diabetes condition had joined. However, most of them were managed at provincial level (35.8%) and district level (37.7%). The others were managed at national level (15.1%), commune level (5.7%) and private sector (5.7%).

3.3. Health determinants of diabetes

3.3.1. Socio-demographic determinants

Table 6. Verified diabetes among participants by demographic determinants

Table 6		Diabetes (N=170)		Non-Diabetes (N=2,898)		Total (N=3,068)	
		n	%	n	%	n	%
Sex	*Male*	78	5.9	1,240	9.1	1,318	100
χ^2=0.6	*Female*	92	5.3	1,658	94.7	1,750	100
Age group* **	*18-29*	7	1.4	479	98.6	486	100
χ^2=46.6	*30-49*	64	4.3	1,431	95.7	1,495	100
	50-69	99	9.1	988	90.9	1,087	100
Ethnic*	*Kinh*	149	5.9	2,360	94.1	2,509	100
χ^2=4.2	*Other minor groups*	21	3.8	538	96.2	559	100

Table 6		Diabetes (N=170)		Non-Diabetes (N=2,898)		Total (N=3,068)	
		n	%	n	%	n	%
Marital status* $\chi^2=4.2$	*Unmarried*	9	3.0	293	97.2	302	100
	Married	161	5.8	2,605	94.2	2766	100
Education years** $\chi^2=11.2$	*No formal education*	5	2.9	169	97.1	174	100
	Under 5 years	46	7.6	562	92.4	608	100
	6-12 years	89	4.8	1,775	95.2	1,864	100
	Over 12 years	30	7.1	392	92.9	422	100
Occupation*** $\chi^2=45.3$	*White collar worker*	8	3.7	207	96.3	215	100
	Blue collar worker	80	4.5	1,687	95.5	1,767	100
	Farmer	14	3.6	377	96.4	391	100
	House services	28	7.0	371	93.0	399	100
	Unemployment	40	13.5	256	86.5	296	100
Region*** $\chi^2=13.2$	*Urban*	99	7.2	1,274	92.8	1,373	100
	Rural	71	4.2	1,624	95.8	1,695	100
Household income* $\chi^2=11.9$	*Poorest*	30	4.5	639	95.5	669	100
	Second	35	4.3	781	95.7	816	100
	Middle	30	6.2	453	93.8	483	100
	Fourth	31	5.5	538	94.5	569	100
	Richest	44	8.3	487	91.7	531	100

*$p<0.05$, **$p<0.01$, ***$p<0.001$

Table 6 described the demographic determinants of participants currently with and without diabetes condition. Except for "sex" variable, for the other variables, there were all significant differences between diabetes and nondiabetes groups. In particular, diabetes prevalence was higher among older age groups (χ^2=46.6,$p<0.001$); Kinh ethnic people had higher proportion of diabetes than people of other minority groups (χ^2=4.2, $p<0.05$). Besides, diabetes prevalence was found higher among married people compared with unmarried ones (χ^2=4.2, $p<0.05$). For education, people who had a large number of education years had higher rate of diabetes compared with those who had no formal education (χ^2=11.2, $p<0.01$). Famers

and white-collar workers were those groups which had lowest proportion of diabetes compared with the other occupational groups (χ^2=45.3, p<0.001). Meanwhile, more proportion of people who live in urban regions had diabetes than those living in rural (χ^2=13.2, p<0.001). Lastly, the higher household income comes with the higher prevalence of diabetes (χ^2=11.9, p<0.05).

3.3.2. Individual lifestyles determinants

Drinking

Table 7. Alcohol consumption among diabetes and nondiabetes participants

Table 7		Diabetes (N=169)		Non-Diabetes (N=2,878)		Total (N=3,047)	
		n	%	n	%	n	%
Alcohol consumption* χ^2=8.5	*Never in recent 12 months*	76	6.8	1,049	93.2	1,125	100
	Never in recent 30 days	33	4.5	708	95.5	741	100
	Recommended by WHO	50	4.7	1,016	95.3	1,066	100
	Over recommended by WHO	10	8.7	105	91.3	115	100

**p<0.05, **p<0.01, ***p<0.001*

It can be seen from the Table 7 that there was a significant association between diabetes condition and alcohol consumption (χ^2=8.5, p<0.05). Specifically, proportion of diabetes among participants who stopped consuming alcohol in recent 30 days or followed recommendation by WHO was lower than those who never consumed alcohol in recent 12 months or consumed more than the amount recommended by WHO.

Physical activity and sedentary lifestyle

Table 8. Physical activity level and sedentary time among participants

Table 8		Diabetes (N=170)		Non-Diabetes (N=2,898)		Total (N=3,068)	
		n	%	n	%	n	%
Physical activity level daily χ^2=0.01	*600 MET-mins and over*	124	5.5	2,121	94.5	2,245	100
	Less than 600 MET-mins	46	5.6	777	94.4	823	100
Sedentary time daily* χ^2=10.3	*Less than 4 hours*	77	4.4	1,676	95.6	1,753	100
	4 hours and over	93	7.1	1,222	92.9	1,315	100

**p<0.05, **p<0.01, ***p<0.001*

Table 8 presented the physical activity and sedentary lifestyles among diabetes and nondiabetes participants. It was found that physical activity level daily was not significantly associated with diabetes condition (χ^2=0.01, p>0.05). The proportions of diabetes among people who had more than and less than 600 MET-mins were not much different, with 5.5% and 5.6%, respectively. Meanwhile, there was a significant difference in sedentary time daily between diabetes and nondiabetes groups (χ^2=10.3, p<0.001). Respondents with more than 4 hours sitting daily had higher prevalence of diabetes than those who had less than 4 hours, with 7.1% compared with 4.4%, respectively.

Fruit and vegetable diet

Table 9. Fruit and vegetable consumption among participants

Table 9		Diabetes (N=170)		Non-Diabetes (N=2,898)		Total (N=3,068)	
		n	%	n	%	n	%
Fruit and vegetable consumption per day χ^2=0.2	*Less than 5 servings*	79	5.4	1,396	94.6	1,475	100
	5 servings or over	91	5.7	1,502	94.3	1,593	100

**p<0.05, **p<0.01, ***p<0.001*

In Table 9, no significant association between fruit and vegetable consumption daily and diabetes condition was found. In particular, no difference in diabetes prevalence was found between people ate more than and less than five servings (χ^2=0.2, p>0.05).

3.3.3. Logistic regression model

As can be seen, there were a number of variables which were found significantly associated with diabetes condition. Because those variables could be potentially correlated, multiple logistic regression was used to explore the independent effects.

Table 10 presented both unadjusted and adjusted results comparing the diabetes participants and nondiabetes participants derived from univariate and multivariate logistics regression analysis. In summary, after adjusting, there were several changes in the relationships between diabetes condition and the selected factors. Based on chi square test for significant difference in our study and the other results found in previous studies, sex was excluded from our model because it was not considered an associated factor of diabetes.

In univariate analysis, most of variables were significantly associated with diabetes, except for vegetable and fruit diet, and physical activity. However, in multivariate, only a few variables remained the significant associations, including age, occupation, regional, and sedentary time daily.

For age, similar to univariate analysis, in the multivariate analysis, the younger group from 18-29 years old were less likely to have diabetes condition than older age groups which were 30-49 years old (OR=3.4, CI=1.4-8.4), and 50-69 years old (OR=5.8, CI=2.3-14.5). For occupation, it was only found that those participants who were unemployed were 3.2 times (OR=3.2, CI=1.3-7.8) more likely to have diabetes condition than those who work as white collar workers. The likelihood of having diabetes was also found more than 1.5 times among participants living in urban areas compared those living in rural areas (OR=1.5, CI=1.0-2.1). Regarding lifestyle factors, only sedentary time daily was found significantly associated with diabetes. Participants who spent over 4 hours per day would be more likely to have diabetes than those with less than 4 hours (OR=1.5, CI=1.1-2.1).

The other variables such as ethnicity, marital status, educational years, and household income, which were found significant association with diabetes in univariate analysis, were not in multivariate analysis.

Table 10. Associated factors of diabetes condition among participants

Table 10	n	%	Univariate			Multivariate		
			OR	95%CI	p	Adjusted OR	95%CI	p
Age								
From 18-29	486	15.8	1			1		
From 30-49	1,495	48.7	3.1	1.3-6.7	<0.01	3.4	1.4-8.4	<0.01
From 50-69	1,087	35.5	6.8	3.2-14.9	<0.001	5.8	2.3-14.5	<0.001
Ethnicity								
Other minor groups	559	18.2	1			1		
Kinh	2,509	81.8	1.6	1.0-2.6	0.04	1.1	0.7-1.9	0.6
Marital status								
Unmarried	302	9.8	1			1		
Married	2,766	90.2	2.0	1.0-4.0	0.04	1.0	0.5-2.3	0.9
Education years								
No formal education	174	5.7	1			1		
1-5 years	608	19.8	2.7	1.1-7.1	0.02	2.5	0.9-6.6	0.06
6-12 years	1,864	60.7	1.7	0.7-4.2	0.25	1.5	0.6-4.0	0.39
Over 12 years	422	13.8	2.6	1.0-6.8	0.04	2.1	0.7-6.1	0.17

Table 10	n	%	Univariate			Multivariate		
			OR	95%CI	p	Adjusted OR	95%CI	p
Occupation								
White collar worker	215	7.0	1			1		
Blue collar worker	1,767	57.8	1.2	0.6-2.6	0.59	1.7	0.7-4.1	0.22
Farmer	391	12.7	1.0	0.4-2.3	0.93	1.2	0.5-3.3	0.68
House care/services	399	13.0	2.0	0.9-4.4	0.10	1.9	0.8-4.7	0.15
Unemployment	296	9.7	4.0	1.8-8.9	<0.001	3.2	1.3-7.8	0.01
Region								
Rural	1,695	55.2	1			1		
Urban	1,373	44.8	1.7	1.3-2.4	<0.001	1.5	1.0-2.1	0.03
Household income								
Poorest	669	21.8	1			1		
Second	816	26.6	1.0	0.6-1.6	0.86	0.9	0.5-1.5	0.65
Middle	483	15.7	1.4	0.8-2.4	0.19	1.2	0.7-2.1	0.53
Fourth	569	18.6	1.2	0.7-2.1	0.43	1.1	0.6-2.0	0.78
Richest	531	17.3	2.9	1.2-3.1	<0.01	1.5	0.9-2.8	0.14

Table 10	n	%	Univariate			Multivariate		
			OR	95%CI	p	Adjusted OR	95%CI	p
Alcohol consumption								
Recommended by WHO	1,066	35.0	1			1		
Never in recent 30 days	741	23.3	1.0	0.6-1.5	0.81	0.9	0.6-1.5	0.70
Never in recent 12 months	1,125	36.9	1.5	1.0-2.1	0.04	1.4	0.9-2.0	0.13
Over recommended by WHO	115	3.8	1.9	0.9-3.9	0.06	1.9	0.9-3.9	0.09
Fruit and vegetable diet								
Less than 5 servings	1,475	48.1	1			1		
5 servings and over	1,593	51.9	1.1	0.8-1.5	0.67	1.0	0.8-1.4	0.82
WHO recommended PA								
Yes	2,245	73.2	1			1		
No	823	26.8	1.0	0.7-1.4	0.94	0.9	0.5	0.48
Sedentary time daily								
Less than 4 hours	1,753	57.1	1			1		
4 hours and over	1,315	42.9	1.7	1.2-2.3	<0.01	1.5	1.1-2.1	0.01

Chapter 4. Discussion

4.1. Validity of diabetes prevalence based on in STEPS survey

The first research question of this study was to what is the prevalence of diabetes among adults from 18 to 69 years old in the Vietnam in 2015 and how it compares to other regions. To answer that question, it required that the diagnostic criteria of diabetes in our study must meet the criteria used in other previous studies, especially at national level. As using the secondary data collected from the national STEPS survey on non-communicable diseases implemented in 2015, diabetes was identified based on the results of the fasting blood glucose test which were taken from the participants. Any test result which was higher than 7 mmol/L would indicate a case of diabetes. Our case definition was similar to many international guidelines on diabetes prevention and control. In 2006, WHO published a reference on "Definition and diagnosis of diabetes mellitus and intermediate hyperglycemia", in which, suitable diagnostic test for diabetes was fasting plasma glucose with over 7 mmol/L (33). The same diagnostic criteria were found in an article published by American Diabetes Association in 2010 (34). Under literature reviews, many countries, from low-middle income such as Thailand, India, Sub Saharan Africa, to high income such as China, Sweden, America, had used this approach to identify the prevalence of diabetes (35–40). In Vietnam, the Ministry of Health had already issued guidelines with same diagnostic standard for both diabetes and pre-diabetes in 2011, which was officially used widely in all health facilities across the country (15).

The survey in our study is the second survey using STEPS approach to research about non-communicable diseases in Vietnam. The previous one was conducted in 2005, however, the scale was smaller. In particular, the 2005 STEPS survey was only sampled in only three provinces which were Ho Chi Minh city, Can Tho city, and Ba Vi district (41–43). Therefore, compared to previous studies based on the survey in 2005, by sampling the whole national population, our study was believed more representative with higher confidence.

4.2. Demographic characteristics of studied population

All information and laboratory test results collected from 3068 respondents who followed all three steps in the STEPS survey were included in the secondary database. As there were total 3758 participants who were reached in the survey, 81.6% of respondents were analysed. As in the formulas to calculate the sample size, it was allowed to have at maximum 20% of participants lost-followed up. Therefore, the size of sample used in this study was still acceptable.

The demographic characteristics of our studied population fairly fit with the whole population in Vietnam. In particular, there was more female than male, with 57% compared with 43%, respectively. In addition, most of the participants were from 30 to 49 years old while the younger (18-29) or the older (50-69) groups accounted for small percentages. This was reasonable because Vietnamese population was typically young, with nearly 60% of the labours from 25 to 49 years old (2). There were also more participants living in rural than urban as Vietnam was a developing country. In short, to some extent, the studied population might be representative of the whole population in the country.

4.3. Prevalence of diabetes

On 3068 adults from 18 to 69 years old selected in the study, in 2015, the prevalence of diabetes in Vietnam was 5.5%. In comparison with previous studies, the prevalence of diabetes in 2015 was higher than past years. For example, in 2010, the prevalence of diabetes among Vietnamese adults was estimated only 2.7%, which was equalled half of the number in 2015 (25). Meanwhile, the proportion of diabetes in community in 2012 was found nearly close to our finding, with 5.4% compared to 5.5% (26). These comparisons might suggest a quick increase of diabetes in the last five years because of lifestyles changing with higher socioeconomic status. However, the increase appeared to gradually slow down as the results of the national program on prevention and control of diabetes starting from 2011 (15).

Because most of STEPS reports on diabetes in many countries were out of date, to compare with international statistics, the International Diabetes Federation (IDF) Atlas 2015 was used. Besides, the diabetes prevalence in Vietnam we found this study was equivalent to the result reported in the IDF report, which was about 5.6% (44).

As in the IDF Atlas, the diabetes prevalence in Vietnam still was much lower than the average prevalence estimated in the whole Western Pacific Region, where Vietnam belonged to, with 5.5% of the former compared to 9.3% of the latter). In particular, the proportion of diabetes among adult population in Vietnam was lower than most of neighbourhood countries such as Singapore with 12.8%, Thailand with 8%, and the Philippines with 6.1%. Meanwhile, some of the countries with lower diabetes prevalence were Cambodia with 2.6% and Lao with 2.9% (44). These findings might be explained by the differences in socio-economic status between Vietnam and the other countries. Specifically, the GDP of Vietnam was lower than those countries where the diabetes prevalence was higher and vice versa (following International Monetary Fund) (45). Hence, it can be seen the effect of macro economy on diabetes prevalence at national level and it was also more obvious when comparing with other countries in other regions. For example,

compared with the prevalence of diabetes in some high-income countries such as Netherlands with 7.9%, Germany with 10.6% or the United States with 12.8%, Vietnam was far lower (44). Inversely, compared to low-income African countries, especially in the Sub Saharan Africa Region including Senegal, Ghana or Kenya, where the economy was lower than in Vietnam, those numbers were only around from 1% to less than 3% (46).

As the discussion above, it can be seen that Vietnam had a low diabetes prevalence compared to many countries with higher income. However, on the other hand, the speed of increase in diabetes in Vietnam might be a concern. During five years from 2010 to 2015, there was nearly a double of diabetes proportion in community. Meanwhile, based on previous statistics in the last five years on the compared countries as mentioned above, there was only a small increase in diabetes prevalence. Specifically, the ratio of diabetes in 2015 and 2010 in Netherlands, Germany, and United States was respectively 7.9/7.3, 10.6/8.0 and 12.8/10.9, which was far less than the double in Vietnam. Even though Thailand was a developing country, there was nearly no change in diabetes in this country, with approximately 8%.

In summary, the diabetes prevalence in community in Vietnam still at a low level but it was growing considerably quick.

4.4. Diagnosis and management of diabetes in population

Based on the answer of the respondents, in our study, it was found that more than half of diabetes participants were not diagnosed beforehand, in which, male was more than female. Compared to some developed countries such as England (in 2003) and United States (2003-2006), the rate of diabetes undiagnosis in Vietnam was nearly double. Meanwhile, in Mexico (2006) or Thailand (2004), the situations were quite the same as Vietnam (47). This comparison indicated obvious difference in capacity of primary health care on diabetes between high income and low-middle income countries. Because early detection of diabetes in community required much of resources in term of both human and equipment at commune level, which was considered as the gate keeper, which was usually insufficient in developing countries such as Vietnam, the high rate of undiagnosed diabetes people was inevitable.

In contrast to the high rate of undiagnosed diabetes people in Vietnam, among those who were diagnosed, it was seen a low rate of untreatment. In particular, only 17.2% of diagnosed participants were not in diabetes treatment program. However, this number was still high when comparing with other countries such as Thailand, Colombia or Mexico in 10 years ago, with less than 12% (47). Besides, most of the diagnosed participants were managed at the local levels where equipment and medication specialized in diabetes were insufficient in Vietnam. For example, although the patients could be managed for

diabetes at commune level, they would not be given insulin because insulin was only available in hospitals at higher levels (17). The fact was that This explained why, in this study, only half of the participants who were diagnosed for diabetes were not given insulin. Therefore, diabetes management in Vietnam needed to be improved in all three levels of prevention.

4.5. Distribution of diabetes in population

In general, except for sex, there were statistically significant differences in demographic groups, including age, ethnicity, marital status, education, occupation, living region and household income.

4.5.1. Age and sex

Sex

Similar to other previous study conducted in Vietnam, there was no difference between male and female in diabetes status. Results of the STEPS survey in 2005 showed that in all three provinces (Ho Chi Minh City, Can Tho and Ba Vi), the prevalence of diabetes among men and women were the same (41,48). International studies in India (2011), Thailand (2009), United States (2011-2014) also found no difference in diabetes between men and women (35,38,39).

Age

As the results, the proportion of diabetes in older group was significantly higher than in the younger group. While only 1.4% of participants from 18 to 29 years old had diabetes, there were more than three times and six times higher among those over 30 years old and those over 50 years old, respectively. This trend was common in many previous studies worldwide. For example, in a study in Thailand from 2005-2013 by K.Papier et al., there was 7% of diabetes among people over 50 years old compared with only 2% of people less than 40 years old (49). Same results were reported in India, Qatar, and Australia (39,50,51). Especially, it was also found in literature that diabetes would increase following the ageing of population. Hence, compared to 2005, in 2050, as the number of people over 65 years old was expected to increase, it was predicted that the prevalence of diabetes would be four times higher (52). It might be caused by the differences in risk behaviours between young and old people which would be discussed later in this section.

4.5.2. Sociocultural distribution

Ethnic

In our study, the prevalence of diabetes among participants of Kinh group was higher than those from ethnic minorities. This might be explained by the fact that people of ethnic minorities often lived in rural or mountainous areas, which were less affected by the urbanization. Therefore, there was little change in their lifestyles, which prevent them from diabetes condition.

Education

There were differences in diabetes prevalence among people with a various number of education years. High prevalence of diabetes was found among people have less than five years (primary school) or people have more than 12 years (university and higher level). Those who had no formal education had the lowest prevalence of diabetes. This finding contradicted the results stated in some previous studies that lower education level came with higher prevalence of diabetes (53,54). This might be due to typical characteristic of Vietnamese society. In general, people with high level of education tended to work in the office, which caused sedentary lifestyle. Besides, they might also have higher income, which allowed them to eat more fast food, which was expensive in Vietnam. In contrast, those who had few years of education tended to live in the rural or mountainous areas because of lacking educational facilities, which might prevent them from effect of urbanisation and changes in lifestyles as mentioned in the ethnic section.

Marital status

Group of married participants had higher prevalence of diabetes than the unmarried group, with 5.8% compared with 3.0%. Our finding was opposite to research on men in the United States. In that study, unmarried men had higher risk of diabetes than married men, which was explained by mental issues caused by marriage (55). Meanwhile, in a study in Iran, there was no significant difference in diabetes between married and unmarried population (56). We believed the relationship between marital status and diabetes condition might be varied by the differences in norms and values on people before and after marriage in different countries.

4.5.3. Socioeconomic distribution

Living condition and household income

In our study, there was significantly a higher prevalence of diabetes among people with higher income and live in urban areas. These results were consistent with findings in previous studies found in developing countries. In a STEPS survey in India (2011), the prevalence of diabetes in urban area was 7.0% while that number in rural was only 5.8%

(39). Similar results were found in national study in Thailand (2009) (35). Another study by S. Lear et al. also found the significant relationship between household income and diabetes (57). Meanwhile, in such developed country as the United States, there was higher burden of diabetes in rural than urban areas. This was explained by the disparity of socioeconomic status, low in rural and high in urban. Although that disparity was found the same in Vietnam as well as other developing countries, the problems causing high diabetes burden in developing and developed countries were different. On the one hand, in developed countries, mostly rich people living in urban areas could afford healthy food, which was generally expensive. Meanwhile, people living in rural areas consumed high amount of fast food, a well-known risk factor of diabetes, as it was cheaper and had higher calories. Moreover, the accessibility to health facilities and health insurance in the rural United States was limited (58). On the other hand, in developing countries, especially Asia region, as the consequences of urbanization, lifestyles and diet of urban people changed, which causes them at high risk of diabetes (49,59). In short, Vietnam had a typical distribution of diabetes by living regions of a developing country, where diabetes rose considerably in urbanized areas.

Occupation

In our study, there were various proportions of diabetes among different groups of jobs. Noticeably, the highest prevalence was found among people who were unemployed or retired with 13.5%, which was followed by group of housewife, childcare with 7%. These two groups had a common characteristic which was staying at home for high amount of time daily. This might lead to low quantity of physical activity and sedentariness – one of the main risk factors of diabetes. This reason was also mentioned to explain the high prevalence of diabetes among nurses compared with other health care workers in a study in Brazil (60). However, in our results, the prevalence of diabetes among white collar workers, who were defined as people working in the office, was lower than those who had manual jobs as farmers and blue-collar workers although it was obvious that former group had higher amount of sedentary time compared to the later. This contradicts point might be explained by a study on the incidence of diabetes among occupational classes in Sweden which found the same pattern as ours. It was claimed that there was an association between diabetes and the stressful issues that the low occupational class had to suffer from, such as financial stress or burden caused by life events (61). Moreover, a cohort study of women in the United States found that night shift work, which was popular among manual workers in Vietnam, can increase the risk of diabetes type 2 (62).

4.5.4. Individual lifestyles

Alcohol consumption

To assess the effects of alcohol consumption on diabetes, we have four groups with different habits. In the results, those who reported the moderate consumption or started stopping drinking for recent 30 days had the much lower prevalence of diabetes compared to the other groups, including high consumption and never drinking for recent one year. It suggested a U-shaped indicated in a meta-analysis study that moderate alcohol consumption was a protective effect of diabetes type 2 (63). Our finding was consistent with results a systematic review based previous studies on the relationship between alcohol consumption and diabetes. Meanwhile, in our study, moderate drink was defined as women with less than four drinks and men with less than five drinks, which was equivalent to those studies. Similar to our comparison between those with moderate drinking habit and those without drinking, in several studies among men in that review, it was found that people drank averagely from one to three standard drinks daily could reduce up to 56% their risks of diabetes compared to nondrinkers (64,65). The systematic review also gave a hypothesis that ethanol in alcohol at appropriate level might reduce the glucose in the blood because there was "a decrease in plasma glucose concentration after alcohol consumption" (66,67). However, too high consumption of ethanol could have inverse effects on diabetes development, as suggestion of a study in Swedish population (68).

Vegetables and fruits diet

In our study, there was no statistically significant difference in diabetes among people with different diets of vegetables and fruits. Both low and high consumption of vegetables and fruits had more or less than 5.5% of diabetes prevalence. However, in a systematic review by P. Carter published in 2010, it resulted that people with high consumption of vegetables, especially green leafy vegetables, could be less likely to develop type 2 diabetes (69). In a study among Chinese women, it was emphasized that only high consumption of vegetables but not fruits could reduce the risk of diabetes type 2 (70). Another systematic review by Y. Wu in 2014 recommended three servings of vegetables and two servings of fruits for diabetes prevention, which was the same as WHO recommendation used as the cut-off in our study (71). The non-statistical significant difference found in study might be explained by the fact that many Vietnamese dishes contained vegetables and fruits. When the respondents were asked for the estimation of vegetables and fruits consumption, they might skip those dishes in which vegetables and fruits were used minor ingredients. Therefore, our results of vegetables and fruits consumption could be underestimated. Besides, this is unadjusted results as there were many modified factors influencing the risk of diabetes, which was not analysed.

Physical activity and sedentary lifestyles

Physical activity was calculated to METs based on various activities of the participants, including working, travelling, and doing exercises. Based on WHO, the recommended level was 600 METs and higher. As the results, we did not find the significant effect of physical activity level on the risk of diabetes among participants. Meanwhile, there was a significant difference in diabetes prevalence between people with more and less than 4 hours of sedentary daily. Following that, the former had 1.7 times higher risk of diabetes compared to the later (OR=1.7, 95%CI=1.2-2.3). The results of physical activity were surprised because physical activity level, in systematic reviews on many previous studies, was considered as an effective protective factors of diabetes (72,73). This might be due to bias caused by the research method. In the STEPS survey, it was quite difficult to the participants to report exactly of how long and what type of each physical activity. Moreover, as a cross-sectional study, it could not detect when the participants start their habits of those reported activities before and after they had diabetes. As our findings, there were more than 60% of participants with diabetes had not been diagnosed. Therefore, it was necessary to conduct further a cohort study to estimate the real effect of physical activities on diabetes among Vietnamese people. Meanwhile, as the duration of sedentary seemed easier to be reported, which explained the consistency in our study about sedentary lifestyles on diabetes to other studies (74,75).

4.6. Associated factors in logistic regression model

In univariate regression analysis, there were correlations between diabetes and many factors related to demographic and individual lifestyles factors. However, in multivariate model, there were only several factors associated with diabetes, including age, occupation, living areas and sedentary time daily.

In particular, after adjustment for other factors, the odd of finding diabetes among people who were from 30-49 and 50-69 were respectively 3.1 times (CI=1.3-6.7) and 6.8 times (CI=3.2-14.9) the odd of finding diabetes among people under 29 years old. This result indicated a strong association between age and diabetes development. Diabetes was more common among the elderly than the younger. Besides, people who were unemployed had risk of diabetes nearly three times higher than those who were working in the office (OR=3.2, CI=1.3-7.8). This might be due to most of unemployed participants in our study were retired, who tended to change lifestyles, including diets and physical habits, comparing to when they were working. There could be negative effect of mental disorder, such as stressful life events, on diabetes development among unemployed people.

Our logistic model analysis also found that participants who lived in urban areas had 1.5 times the odds of having diabetes compared to those living in rural areas (OR=1.5, CI=1.0-2.1). This could obviously explain by the association between urbanization and diabetes, which was indicated in many previous studies on diabetes in developing countries (76,77).

The last associated factor we found was sedentary time daily. In both univariate and multivariate analysis, there was significant association. In the adjusted model, people who had more than 4 hours of sedentary time daily tended to have diabetes 1.5 times higher than the others with less sedentary time (OR=1.5, CI=1.1-2.1). Although low physical activity level was not significantly associated with diabetes in the multivariate model, this result partly support the negative effect of less physical active lifestyles on diabetes. This indication was consistent to the previous warning on risk of diabetes related to physical activity in other studies (73,78). This was very important point because to reduce sedentary time was very easy. It does not cost much of money and very convenient as people could simply standing, walking or doing light exercise during the day. Therefore, physical active practice would be very efficient in diabetes prevention and control in communities.

There was also one interesting point in our findings was that people who never drank in the last 12 months were 1.5 times more likely to had diabetes than those who drank in range of the recommendation provided by WHO (OR=1.5, CI=1.0-2.1). Meanwhile, we did not find a significant association between drinking too much and diabetes. Despite in the multivariate model, the association between never drinking in the last 12 months and diabetes was no longer significant, it suggested an idea of using alcohol properly in diabetes prevention and control, rather than simply stopping drinking.

In summary, although there were many factors were significantly associated with diabetes among the population in univariate model but they were fewer in multivariate model. This might be caused by the coefficiencies between the variables that were out of control in our study design. Hence, in addition to intervene on the significant related factors with diabetes found in the multivariate model, the significant difference in diabetes between groups of people distributed by the other variables should also be noticed.

4.7. Strengths and Limitations

In our study, because the analyses were conducted on population-based data, which was representative of a whole country, the findings might show a completed situation of diabetes in Vietnam. Besides, the data was updated in 2015, which could provide timely information to the policy makers to respond to the situation. One more advantage in our study was that the survey was designed specifically for NCDs which included diabetes and

the data consisted broad range of information related to risk factors of the respondents, which was expected to illustrate a comprehensive picture of diabetes among Vietnamese population.

However, there were several limitations which needed to be noticed in our study. Because we analysed based on secondary data, it was impossible to control missing data and lost followed-up participants. As the results, nearly 20 percent of the respondents were eliminated from the data because of missing blood test results. The questionnaire in our study was designed with too many questions, which might also cause larger recall bias among the respondents, especially in questions related to lifestyles such as alcohol consumption, diet and physical activity. One more important drawback in our study was the design. As the survey was based cross-sectional study, it could not identify the sequences of causes and effects. For example, the questions did not provide the time starting the behaviours or the onset of the diseases. The last thing that we need to improve in further study was the definition of the case, as in this study, only fasting blood glucose was used to determine diabetes condition.

However, despite those, following the main objective, this study still met the expectation when it provided the prevalence of diabetes among Vietnamese population and partly described some of the associated factors related to diabetes.

Chapter 5. Conclusion

Compared to the past years, the number of Vietnamese adults with diabetes had witnessed a considerable increase. In comparison with other countries, especially high-income countries, the prevalence of diabetes in Vietnam was far lower. However, speed of the increase in diabetes prevalence was much higher than those countries. This phenomenon was associated closely with the fact that the economy in Vietnam had been developing quickly recently, which transformed the country, from low-income level, to low-middle income level. As the economy kept growing, Vietnam was evaluated as one of the fastest developing countries in term of socio-economy. Therefore, despite the low prevalence, the rapidly rising number of diabetes people in Vietnam should be in concern.

However, despite there was a dramatical increase in the general socioeconomic status, the health care system had not been supported to meet the burden of diabetes. Moreover, the budget for noncommunicable diseases prevention and control, including diabetes, was even reduced. Meanwhile, currently, there was insufficiency of health resources in health care facilities, especially, at commune level, which was considered as the gate keeper in Vietnam health care system. As the consequences, lack of health care workers, equipment and medicine in community might take the chances of being diagnosed and treated away from many people with diabetes.

Although the survey was not designed to identify risk factors of diabetes among adult population in Vietnam, in this study, some factors were suggested to be associated with the high prevalence of disease. For individual factors, old people were more likely to have diabetes than the younger. Meanwhile, related to socioeconomic status, the number of people living in urban areas with higher income had diabetes was higher than those who lived in rural areas with lower income. Some of lifestyle factors, such as longer time sitting, were also found significantly associated with diabetes. Besides, alcohol consumption at proper dose, to some extent, showed the protective effect on the high blood glucose and diabetes among Vietnamese people.

In summary, the prevalence of diabetes among Vietnamese adults was still in control but increasing sharply. Meanwhile the health care system needed to be improved to provide adequate resources for diagnosis and treatment to people with diabetes or people at risk of diabetes in Vietnam, especially the elderly and people with high income living in the big cities. However, more research and studies should be conducted further to identify the risk factors of diabetes specifically in Vietnam.

Chapter 6. Recommendations

Following the findings of this study, there were recommendations to be proposed to different related policy makers for strategies of diabetes prevention and control as below:

6.1. Ministry of Health

As the socioeconomic status keeps increasing rapidly, there will be more and more people at risk of diabetes. Hence, there is a need for health promotion, specifically in diabetes, for people in the communities for the prevention. To achieve that, the Ministry of Health should develop a program for training health care workers at the commune level about the knowledge of diabetes prevention, and how to plan activities to effectively promote widely into communities.

Besides, many diabetes people did not know their condition of diabetes because of insufficiency of equipment to support diabetes early diagnosis at primary health care level. Therefore, commune health stations need to be equipped tools for enhancing early diagnosis. The Ministry of Health needs to adjust the health budget to provide sufficient equipment supporting commune health care workers for early diagnosis.

As diabetes and other non-communicable diseases had many common risk factors to be intervened, it would be more efficient if the prevention and control programs of all non-communicable diseases were integrated. It is suggested that the Ministry of Health should develop a framework to involve related stakeholders to cooperate to achieve the same target under limited budget.

6.2. Government and authorities

The prevalence of diabetes was found significantly higher among older group, especially those who had retired. Therefore, there is a need of forum to help these targeted people know how to prevent and control diabetes. The local authorities should establish clubs or community support groups, specializing in diabetes and other non-communicable diseases, to encourage the elderly to practice healthy behaviours and lifestyles for NCDs prevention and control.

Sedentary behaviours were found one of the significant associated factors with diabetes. However, there were many people could not change those habits because of many reasons. Meanwhile, physical activities, such as doing exercise, might help to reduce those harmful effects caused by sedentary lifestyles. Therefore, the government should develop long-term urban planning targeted to encourage people to have more physically active habits, such as building more parks, wider pedestrian, or enhancing the quality of public transportations.

6.3. Researchers

As this work was designed as a descriptive study, the results majorly indicated the burden and the distribution of diabetes in the Vietnamese population. However, there were limitations to identify and measure the effects of risk factors associated with diabetes in Vietnam in this study. To establish optimal plan for diabetes prevention and control, there is a need for more research on causal relationships between diabetes and risk factors, especially those factors which were found significantly associated with the high prevalence of diabetes in our results. The researchers should design and conduct further studies not only diabetes but also other noncommunicable diseases to assure the targeted factors which need to be intervened in the prevention and control program.

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Annexes

Annex 1. STEPS survey questionnaire

STEPS QUESTIONNAIRE
STEP 1 questions

General Information	response	Code
Interviewer ID	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋	I3
Date of completion of the instrument	⌊_⌋⌊_⌋ ⌊_⌋⌊_⌋ ⌊_⌋⌊_⌋⌊_⌋⌊_⌋ day m y	I4
Consent has been read and obtained	YES/CC 1 NO/KH ONG 2	I5
Interview Language *[Insert Language]*	Viet 1 other 2 (……..)	I6
Time of interview (24 hour clock)	⌊_⌋⌊_⌋ : ⌊_⌋⌊_⌋ Hrs Mins	I7
In total, how many years have you spent at school and in full-time study (excluding pre-school)?	N0 of years ⌊_⌋⌊_⌋	C4

Alcohol Consumption

You have just answered some questions on tobacco use and policies. The next questions ask about the consumption of alcohol.

Question	Response	Code
Have you ever consumed any alcohol such as beer, wine, or spirits? [USE SHOWCARD OR SHOW EXAMPLES]	YES 1 NO 2 If No, go to A16	A1
Have you consumed any alcohol within the past 12 months?	YES 1 If Yes, go to A4 NO 2	A2
Have you stopped drinking due to health reasons, such as a negative impact on your health or on the advice of your doctor or other health worker?	YES 1 If Yes, go to A16 NO 2 If No, go to A16	A3
During the past 12 months, how frequently have you had at least one standard alcoholic drink? [READ RESPONSES, USE SHOWCARD:]	Daily 1 5-6 days per week 2 3-4 days per week 3 1-2 days per week 4 1-3 days per month 5 Less than once a 6 Less than 1 standard 7	A4

Have you consumed any alcohol within the past 30 days? Yes / No	YES 1 NO 2 go to A13	A5
During the past 30 days, on how many occasions did you have at least one standard alcoholic drink? [USE SHOWCARD]	Number Don't know 777 ⌊_⌋⌊_⌋⌊_⌋ If "0", go to A13	A6
During the past 30 days, when you drank alcohol, how many standard drinks on average did you have during one drinking occasion? [USE SHOWCARD]	Number Don't know 77 ⌊_⌋⌊_⌋	A7
During the past 30 days, what was the largest number of standard drinks you had on a single occasion, counting all types of alcoholic drinks together?	Largest number Don't Know 77 ⌊_⌋⌊_⌋	A8
During the past 30 days, how many times did you have six or more standard drinks in a single drinking occasion?	Number of times Don't Know 77 ⌊_⌋⌊_⌋	A9
During the past 30 days, did you drive motorized vehicles within 2 hours after drinking?	YES 1 NO 2 Go to A10a	XA9A
During the past 30 days, did you drive motorized vehicles within 2 hours after drinking more than 2 standard drinks?	YES 1 No 2	XA9B
During each of the past 7 days, how many standard drinks did you have each day? [USE SHOWCARD] [IF DON'T KNOW, ENTER 77 IF REFUSED, ENTER 99]	Monday ⌊_⌋⌊_⌋	A10a
	Tuesday ⌊_⌋⌊_⌋	A10b
	Wednesday ⌊_⌋⌊_⌋	A10c
	Thursday ⌊_⌋⌊_⌋	A10d
	Friday ⌊_⌋⌊_⌋	A10e

	Saturday ⌊_⌋⌊_⌋	A10f
	Sunday ⌊_⌋⌊_⌋	A10g
During each of the past 7 days, how many standard drinks did you have each day? [USE SHOWCARD] [IF DON'T KNOW, ENTER 77 IF REFUSED, ENTER 99]	Monday ⌊_⌋⌊_⌋	A10a
	Tuesday ⌊_⌋⌊_⌋	A10b
	Wednesday ⌊_⌋⌊_⌋	A10c
	Thursday ⌊_⌋⌊_⌋	A10d
	Friday ⌊_⌋⌊_⌋	A10e
	Saturday ⌊_⌋⌊_⌋	A10f
	Sunday ⌊_⌋⌊_⌋	A10g

Alcohol Consumption, continued

I have just asked you about your consumption of alcohol during the past 7 days. Now I would like to ask you about the consumption of each kind of alcohol including beer, home brewed spirits, factory produced spirits,

Question	**Response**	**Code**
In total **how many standard drinks** of home brewed spirits (rice spirit, casava spirit, herbal medicine alcohol) did you consume **during the past 7 days**? [USE SHOWCARD]	Number of Standard Drinks ⌊_⌋⌊_⌋ Don't Know 77	A12a
In total **how many standard drinks** of beer did you consume **during the past 7 days**? [USE SHOWCARD]	Number of Standard Drinks ⌊_⌋⌊_⌋ Don't Know 77	XA12b

In total how many standard drinks of factory produced spirits (vodka, whisky) did you consume **during the past 7 days**? [USE SHOWCARD]	Number of Standard Drinks ⌊_⌋⌊_⌋ Don't Know 77	XA12c
In total how many standard drinks of factory produced wine (including Champaign and fruit wine) did you consume **during the past 7 days**? [USE SHOWCARD]	Number of Standard Drinks ⌊_⌋⌊_⌋ Don't Know 77	XA12d
During the **past 12 months,** how often have you found that you were not able to stop drinking once you had started?	Daily or almost daily 1 Weekly 2 Monthly 3 Less than monthly 4 Never 5	A13
During the past 12 months, how often have you failed to do what was normally expected from you because of drinking?	Daily or almost daily 1 Weekly 2 Monthly 3 Less than monthly 4 Never 5	A14
During the past 12 months, how often have you needed a first drink in the morning to get yourself going after a heavy drinking session?	Daily or almost daily 1 Weekly 2 Monthly 3 Less than monthly 4 Never 5	A15
During the past 12 months, have you had family problems or problems with your partner due to someone else's drinking?	Yes, more than monthly 1 Yes, monthly 2 Yes, several times but less than monthly 3 Yes, once or twice 4 No 5	A16
		Diet
The next questions ask about the fruits and vegetables that you usually eat. I have a nutrition card here that shows you some examples of local fruits and vegetables. Each picture represents the size of a serving. As you		

answer these questions please think of a typical week in the last year.

Question	Response	Code
In a typical week, on how many days do you eat fruit?	Number of days ⌊_⌋⌊_⌋ If Zero Don't Know 77 days, go to D3	D1
How many servings of fruit do you eat on one of those days? [USE SHOWCARD TO EXPLAIN ABOUT THE SIZE OF SERVINGS OF DIFFERENT	Number of servings Don't Know 77 ⌊_⌋⌊_⌋	D2
In a typical week, on how many days do you eat vegetables? [USE SHOWCARD]	Number of days ⌊_⌋⌊_⌋ If Zero Don't Know 77 days, go to D5	D3
How many servings of vegetables do you eat on one of those days? [USE SHOWCARD TO EXPLAIN ABOUT THE SIZE OF SERVINGS OF DIFFERENT VEGETABLES]	Number of servings Don't know 77 ⌊_⌋⌊_⌋	D4
		Dietary salt
With the next questions, we would like to learn more about salt in your diet. Dietary salt includes ordinary table salt, unrefined salt such as sea salt, iodized salt, salty stock cubes and powders, and salty sauces such as soya sauce or fish sauce (see show card). The following questions are on adding salt to the food right before you eat it, on how food is prepared in your home, on eating processed foods that are high in salt such as instant noodles, and questions on controlling your salt intake. Please answer the questions even if you consider yourself to eat a diet low in salt.		
How often do you add salt or a salty sauce such as soya sauce to your food right before you eat it or as you are eating it? [READ RESPONSES, USE SHOWCARD:]	Always (every meal) 1 Often (most meals) 2 Sometimes 3 Rarely 4 Never 5 Don't know 7	D5
How often is salt, salty seasoning or a salty sauce added in cooking or preparing foods in your household? [READ RESPONSES, USE SHOWCARD:]	Always (every meal) 1 Often (most meals) 2 Sometimes 3 Rarely 4 Never 5 Don't know 7	D6
How often do you eat processed food high in salt? By processed food high in salt, I mean foods that have been altered from their natural state, such as salted vegetables, salted eggplants, instant noodles, packaged salty snacks, canned salty food including pickles and preserves, salty	Always (every meal) 1 Often (most meals) 2 Sometimes 3 Rarely 4 Never 5 Don't know 7	D7
How much salt or salty sauce do you think you consume?	Far too much 1 Too much 2 Just the right amount 3 Too little 4	D8

	Far too little 5 Don't know 7	
		Diet, continued
Question	Response	Code
Do you think that too much salt or salty sauce in your diet could cause a health problem?	Yes 1 No 2 Go to D11a Don't know 7	D10
Do you think that too much salt or salty sauce in your diet can cause the following diseases?		
Hypertension	YES 1 NO 2 DON'T KNOW 7	XD10a
Strokes	YES 1 NO 2 DON'T KNOW 7	XD10b
Heart attack	YES 1 NO 2 DON'T KNOW 7	XD10c
Stomach cancer	YES 1 NO 2 DON'T KNOW 7	XD10d
Do you do any of the following on a regular basis to control your salt intake?		
Limit consumption of processed foods	YES 1 NO 2	D11a
Put less salt when cooking	YES 1 NO 2 I USUALLY DON'T COOK 3	XD11e1
Restrict adding salt on the table (dipping food to salt and/or adding salt to food)	YES 1 NO 2	XD11e2
Restrict eating of salty foods as stew, fry	YES 1 NO 2	XD11e3
The next questions ask about the oil or fat that is most often used for meal preparation in your household, and about meals that you eat outside a home.		
What type of oil or fat is most often used for meal preparation in your household? [USE SHOWCARD] [SELECT ONLY ONE]	Vegetable oil 1 Lard or suet 2 Butter or ghee 3 Margarine 4 None in particular 5 None 6 Don't know 77	D12

On average, how many meals per week do you eat that were not prepared at a home? By meal, I mean breakfast, lunch and dinner.	Number ⌊_⌋⌊_⌋ Don't know 77	D13

Physical Activity

Next I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person.

Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, harvesting food/crops, fishing or hunting for food, seeking employment. In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.

Question	Response	Code
	Work	
Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like carrying or lifting heavy loads, digging or construction work for at least 10 minutes continuously?	YES 1 NO 2 If No, go to P 4	P1
In a typical week, on how many days do you do vigorous-intensity activities as part of your work?	Number of days ⌊_⌋	P2
How much time do you spend doing vigorous-intensity activities at work on a typical day?	Hours : minutes ⌊_⌋⌊_⌋ : ⌊_⌋⌊_⌋ hrs mins	P3 (a-b)
Does your work involve moderate-intensity activity, that causes small increases in breathing or heart rate such as brisk walking or carrying light loads for at least 10 minutes continuously?	YES 1 NO 2 If No, go to P 7	P4
In a typical week, on how many days do you do moderate-intensity activities as part of your work?	Number of days ⌊_⌋	P5
How much time do you spend doing moderate-intensity activities at work on a typical day?	Hours : minutes ⌊_⌋⌊_⌋ : ⌊_⌋⌊_⌋ hrs mins	P6 (a-b)
	Travel to and from places	

The next questions exclude the physical activities at work that you have already mentioned.

Now I would like to ask you about the usual way you travel to and from places. For example to work, for shopping, to market, to place of worship.

Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places?	YES 1 NO 2 If No, go to P 10	P7
In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?	Number of days ⌊__⌋	P8
How much time do you spend walking or bicycling for travel on a typical day?	Hours : minutes ⌊__⌋⌊__⌋ : ⌊__⌋⌊__⌋ hrs mins	P9 (a-b)
Physical Activity, Continued		
Question	Response	Code
Recreational activities		
The next questions exclude the work and transport activities that you have already mentioned. Now I would like to ask you about sports, fitness and recreational activities (leisure).		
Do you do any vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate like running or football for at least 10 minutes continuously?	YES 1 NO 2 If No, go to P 13	P10
In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational (leisure) activities?	Number of days ⌊__⌋	P11
How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?	Hours : minutes ⌊__⌋⌊__⌋ : ⌊__⌋⌊__⌋ hrs mins	P12 (a-b)
Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that cause a small increase in breathing or heart rate such as brisk walking, cycling, swimming, volley ball for at least 10 minutes continuously?	YES 1 NO 2 If No, go to P16	P13
In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities?	Number of days ⌊__⌋	P14
How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day?	Hours : minutes ⌊__⌋⌊__⌋ : ⌊__⌋⌊__⌋ hrs mins	P15 (a-b)
Sedentary behaviour		
The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent sitting at a desk, sitting during meals, sitting with friends, traveling in car, bus, train, reading, playing cards or watching television, but do not include time spent sleeping. [USE SHOWCARD]		

How much time do you usually spend sitting or reclining on a typical day?	Hours : minutes ⌊_⌋⌊_⌋ : ⌊_⌋⌊_⌋ hrs mins	P16 (a-b)
History of Raised Blood Pressure		
Question	Response	Code
Have you ever had your blood pressure measured by a doctor or other health worker?	YES 1 NO 2 If No, go to H6	H1
Have you ever been told by a doctor or other health worker that you have raised blood pressure or hypertension?	YES 1 NO 2 If No, go to H6	H2a
Have you been told about your high blood pressure in the past 12 months?	YES 1 NO 2	H2b
In the past two weeks, have you taken any drugs (medication) for raised blood pressure prescribed by a doctor or other health worker?	YES 1 NO 2	H3
Have you ever seen a traditional healer for raised blood pressure or hypertension?	YES 1 NO 2	H4
Are you currently taking any herbal or traditional remedy for your raised blood pressure?	YES 1 NO 2	H5
History of Diabetes		
Have you ever had your blood sugar measured by a doctor or other health worker?	YES 1 NO 2 If No, go to XH11a	H6
Have you ever been told by a doctor or other health worker that you have raised blood sugar or diabetes?	YES 1 NO 2 If No, go to XH11a	H7a
Have you been told about your raised blood sugar or diabetes in the past 12 months?	YES 1 NO 2	H7b
In the past two weeks, have you taken any drugs (medication) for diabetes prescribed by a doctor or other health worker?	YES 1 NO 2	H8
Are you currently taking insulin for diabetes prescribed by a doctor or other health worker?	YES 1 NO 2	H9
Have you ever seen a traditional healer for diabetes or raised blood sugar?	YES 1 NO 2	H10
Are you currently taking any herbal or traditional remedy for your diabetes?	YES 1 NO 2	H11

Have you ever been told by a doctor or other health worker that you have COPD or asthma?	YES 1 NO 2	XH11a

History of Raised Total Cholesterol		
Question	Response	Code
Have you ever had your cholesterol (fat levels in your blood) measured by a doctor or other health worker?	YES 1 NO 2 If No, go to H17	H12
Have you ever been told by a doctor or other health worker that you have raised cholesterol?	YES 1 NO 2 If No, go to H17	H13a
Have you been told about your raised cholesterol in the past 12 months?	YES 1 NO 2	H13b
In the past two weeks, have you taken any oral treatment (medication) for raised cholesterol prescribed by a doctor or other health worker?	YES 1 NO 2	H14
Have you ever seen a traditional healer for raised cholesterol?	YES 1 NO 2	H15
Are you currently taking any herbal or traditional remedy for your raised cholesterol?	YES 1 NO 2	H16

Lifestyle Advice		
During the past three years, has a doctor or other health worker advised you to do any of the following?		
Quit using tobacco or don't start	YES 1 NO/DON'T 2	H20a
Reduce salt in your diet	YES 1 NO/DON'T REMEMBER 2	H20b
Eat more fruit and/or vegetables each day	YES 1 NO/DON'T REMEMBER 2	XH20g
Eat at least five servings of fruit and/or vegetables each day	YES 1 NO/DON'T REMEMBER 2	H20c
Reduce fat in your diet	YES 1 NO/DON'T REMEMBER 2	H20d

Start or do more physical activity	YES 1 NO/DON'T REMEMBER 2	H20e
Maintain a healthy body weight or lose weight	YES 1 NO/DON'T REMEMBER 2	H20f

NCD treatment and Management		
If H2a=1 (Yes) or H7a=1 (Yes) or XH11a=1 (Yes), then go to XQL1. Else skip to CX0SEX		
Do you currently have any type of these NCDs: hypertension, diabetes, COPD and asthma that is\are being managed at health facilities? (Management means your medical record is kept at the health facility and you go there periodically to check the condition of your NCD and get a	YES 1 NO 2 -> skip to CX0sex Don't' know 7 -> skip to CX0sex	XQL1
Do you currently have hypertension being managed at a health facility?	YES 1 NO 2 go to *XQL2b*	XQL2a
What health facility is currently managing your hypertension?	COMMUNE HEALTH STATION 1 2 DISTRICT HEALTH FACILITIES 3 4 PROVINCIAL HEALTH FACILITIES 5 6	XQL2a1
	Others (Specify) ……	XQL2a other
Do you currently have diabetes being managed at a health facility?	Yes 1 NO 2 *Go to XQL2c*	XQL2b
What health facility is currently managing your Diabetes?	COMMUNE HEALTH STATION 1 2 DISTRICT HEALTH FACILITIES 3 4	XQL2b1
	Others (Specify) ……	XQL2b other

Do you currently have COPD or asthma being managed at a health facility?	YES 1 NO 2 *go to cx0*	XQL2c
What health facility is currently managing your COPD or Asthma?	COMMUNE HEALTH STATION 1 DISTRICT HEALTH FACILITIES 2 3 4	XQL2c1
	Others (Specify)	XQL2c other

(for women only): Cervical Cancer Screening		
[RECORD GENDER FROM OBSERVATION. ASK IF NECESSARY.]	MALE 1 – Skip to LAST FEMALE 2	CX0SEX
The next question asks about cervical cancer prevention. Screening tests for cervical cancer prevention can be done in different ways, including Visual Inspection with Acetic Acid/vinegar (VIA), VILI, pap smear and Human Papillomavirus (HPV) test. VIA is an inspection of the surface of the uterine cervix after acetic acid (or vinegar) or iodine has been applied to it. For both pap smear and HPV test, a doctor or nurse uses a swab to wipe from inside your vagina, take a sample and send it to a laboratory. It is even possible that you were given the swab yourself and asked to swab the inside of your vagina. The laboratory checks for abnormal cell changes if a pap smear is done, and for the HP virus if an HPV test is done.		
Question	Response	Code
Have you ever had a screening test for cervical cancer, using any of the methods described above?	YES 1 NO 2 DON'T KNOW 7	CX1
Those are all of the questions I have. Thank you very much for participating in this important survey.		LAST for STEPS1

STEP 2-3 Questions

General Information for matching with STEP1	response	Code
Interviewer ID	⌊_⌊_⌊_⌊_⌋	I3
Date of completion of the instrument	⌊_⌊_⌋ ⌊_⌊_⌋ ⌊_⌊_⌊_⌊_⌋ day m y	I4
Consent has been read and obtained	YES/CC 1 NO/KHONG 2	I5
Interview Language *[Insert Language]*	Viet 1 other 2 (……..)	I6
Time of interview (24 hour clock)	⌊_⌊_⌋ : ⌊_⌊_⌋ Hrs Mins	I7
Urine collection		
Had you been fasting prior to the urine collection?	YES/CO 1 NO/KHONG 2	B10
Time of day urine sample taken (24 hour clock)	Giờ : Phút ⌊_⌊_⌋ : ⌊_⌊_⌋ Giờ phút	B13
Blood testing		
During the past 12 hours have you had anything to eat or drink, other than water?	YES/CO 1 NO/KHONG 2	B1
Time of the latest meal you had eaten (24 hour clock)?	Hrs : Mins ⌊_⌊_⌋ : ⌊_⌊_⌋ hour minute	XB1
Technician ID	⌊_⌊_⌊_⌊_⌋	B2
Device ID	⌊_⌊_⌋	B3
Time of day blood specimen taken (24 hour clock)	Hrs : Min ⌊_⌊_⌋ : ⌊_⌊_⌋ hrs mins	B4
Total cholesterol *[MMOL/L]*	mmol/l ⌊_⌊_⌋ . ⌊_⌊_⌋	B8
During the past two weeks, have you been treated for raised cholesterol with drugs (medication) prescribed by a doctor or other health worker?	YES/CO 1 NO/KHONG 2	B9
HDL Cholesterol (MMOL/L)	mmol/l ⌊_⌋ . ⌊_⌊_⌋	B16

Fasting blood glucose *[MMOL/L]*	mmol/l ⌊_⌋⌊_⌋ . ⌊_⌋⌊_⌋	B5
Today, have you taken insulin or other drugs (medication) that have been prescribed by a doctor or other health worker for raised blood glucose?	YES/CO 1 NO/KHONG 2	B6
Blood pressure and Heart rate	**Response**	**Code**
Technician ID	⌊_⌋⌊_⌋⌊_⌋⌊_⌋	M1
Device ID	⌊_⌋⌊_⌋	M2
Reading 1	Systolic (mmHg) ⌊_⌋⌊_⌋⌊_⌋	M4a
	Diastolic (mmHg) ⌊_⌋⌊_⌋⌊_⌋	M4b
	Beats per minute ⌊_⌋⌊_⌋⌊_⌋	M16a
Reading 2	Systolic (mmHg) ⌊_⌋⌊_⌋⌊_⌋	M5a
	Diastolic (mmHg) ⌊_⌋⌊_⌋⌊_⌋	M5b
	Beats per minute ⌊_⌋⌊_⌋⌊_⌋	M16b
Reading 3	Systolic (mmHg) ⌊_⌋⌊_⌋⌊_⌋	M6a
	Diastolic (mmHg) ⌊_⌋⌊_⌋⌊_⌋	M6b
	Beats per minute ⌊_⌋⌊_⌋⌊_⌋	M16c
During the past two weeks, have you been treated for raised blood pressure with drugs (medication) prescribed by a doctor or other health worker?	YES/CO 1 NO/KHONG 2	M7
Height and Weight		
For women: Are you pregnant?	YES/CO 1 NO/KHONG 2	M8
Technician ID	⌊_⌋⌊_⌋⌊_⌋⌊_⌋	M9
Device ID	Height ⌊_⌋⌊_⌋	M10a
	weight ⌊_⌋⌊_⌋	M10b
Height	cm ⌊_⌋⌊_⌋⌊_⌋ . ⌊_⌋	M11
Weight *If too large for scale 666.6*	kg ⌊_⌋⌊_⌋⌊_⌋ . ⌊_⌋	M12
BMI	kg/(m)^2 ⌊_⌋⌊_⌋ . ⌊_⌋	XM12

Annex 2. Items in household to determine household income

1. Electricity
2. Flush toilet
3. Fixed telephone
4. Cell telephone
5. Television
6. Radio
7. Regrigerator
8. Car
9. Motorized bicycle/gasogenic motorbike/motorbike
10. Washing machine
11. Air conditioner
12. Generator
13. Grinder
14. Motor vehicle/motor boat
15. Computer
16. Internet

Annex 3. Jobs specification in five occupation groups

No	Group	Definition
1	White collar wokers	• Leader/manager • Researchers • Office worker • Selling worker • Students
2	Blue collar workers	• Laborer in mining • Laborer in construction • Laborer in industry/processing/crafts
3	Farmers	• Laborer in agriculture • Laborer in forestry • Laborer in aquiculture
4	House services/care	• Childcare • Housewife/Homemaker • Hotel/restaurant service
5	Unemployment	• Unemployment • Retired