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Type 2 Diabetes and hypertension in Vietnam: A systematic review and meta-analysis of studies between 2000 to 2020

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-052725
Article Type:	Original research
Date Submitted by the Author:	17-May-2021
Complete List of Authors:	<p>Biswas, Tuhin; University of Queensland, Tran, Nam; Institute for Social Science Research, University of Queensland 80 Meiers Rd, Indooroopilly, QLD, 4068, Australia</p> <p>Hoang, My Hanh ; Health Strategy and Policy Institute, Vietnam Ministry of Health</p> <p>Phan, Hong Van; Health Strategy and Policy Institute, Vietnam Ministry of Health</p> <p>Pham, Van Hien; Health Strategy and Policy Institute, Vietnam Ministry of Health</p> <p>Nguyen, Cuc ; Health Strategy and Policy Institute, Vietnam Ministry of Health Lane 196, Ho Tung Mau St, CauGiay District, Hanoi, Vietnam</p> <p>Khuong, Anh Tuan ; Health Strategy and Policy Institute, Vietnam Ministry of Health</p> <p>Tran, Mai Oanh ; Health Strategy and Policy Institute, Vietnam Ministry of Health</p> <p>Mamun, Abdullah; University of Queensland, School of Population Health</p>
Keywords:	Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, DIABETES & ENDOCRINOLOGY, Hypertension < CARDIOLOGY, Ischaemic heart disease < CARDIOLOGY

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Type 2 Diabetes and hypertension in Vietnam: A systematic review and meta-analysis of studies between 2000 to 2020

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ABSTRACT

Objectives: The objective of this study was to determine the level of T2DM and HTN in Vietnam and to assess the trend and recommend the future direction of prevention research efforts.

Setting: Vietnam

Participants: We searched scientific literature, databases including PubMed, EMBASE, CINHALL and Google Scholar; grey literature and reference lists for primary research published, nation database websites between 1 January 2000 and September 30, 2020. We adapted the modified Newcastle Ottawa scale for assessing the quality of the study, as recommended by the Cochrane Collaboration.

Results: In total 83 studies met our inclusion criteria, representing data of approximately 239,034 population of more than 15 years of age in Vietnam. The findings show that prevalence rates varied widely across studies, from 1.0% to 29.0% for T2DM and 2.0% to 47.0% for HTN. For the total study period, pooled prevalence of T2DM and HTN in Vietnam for all studies was 6.0% (95% CI: 5.0-8.0%) and 24% (95% CI: 19-30%) respectively. Prevalence rate of both T2DM and HTN were higher among the male population compared to female counterpart.

Conclusion: There is evidence of a rising trend of HTN and T2DM prevalence in Vietnam. Future research should focus on the major drivers, incidence, and prognosis of T2DM and HTN. Policy approaches should be developed that the counter T2DM and HTN. In our study we included both English and Vietnamese language articles and seems that majority of the articles came from Vietnamese language.

Strengths and limitations of this study

- This is the first systematic review and meta-analysis on Type 2 diabetes and hypertension in Vietnam that collected data and documents over 20 years.
- This is also the first review combining available documents published in both English and Vietnamese languages across domestic and international databases.
- The study reported the pooled prevalence trend of Type 2 diabetes which increased around three times from 3% in the period 2000 – 2004 to 9% in 2016 - 2020; and hypertension among adult population in Vietnam increased like diabetes.
- While the current study followed the MOOSE guideline, findings from the review were heterogeneous in nature due to the study design, the outcome measurement, and the potential biases in identified documents. Additionally, the estimate prevalence by sex, ethnicity, and place of residence were not provided due to the data limitation.

Introduction:

Globally, the Non Communicable Diseases (NCDs) have become the leading cause of death[1]. Due to the high number of deaths, non-communicable diseases[2], including cardiovascular diseases, diabetes, cancer, and chronic respiratory diseases, have appeared as key public health challenges worldwide[3]. As a result NCDs are included in Sustainable Development Goal (SDG) target 3.4, to by “2030 reduce by one third premature mortality from NCDs through prevention and treatment and promote mental health and wellbeing”[2, 4]. NCD mortality rate which was high in low middle-income countries (LMICs), nearly three-quarters of NCD deaths occurred in LMICs, expected to increase by 20% in coming years[5]. Due to the increasing prevalence of fast-food consumption and food insecurity [6-8] , population of LMICs have a higher ability to purchase high caloric foods which are associated with higher intake of calories and fat. Such fast-food consumption and food insecurity are responsible for increase in the prevalence of diabetes, hypertension and other NCDs in LMICs. It is estimated that this condition is likely to increasing.

Like other LMICs Vietnam has recently been facing the challenge of NCDs. The number of deaths due to NCDs in Vietnam rose from 296,900 in 2000 to 371,600 in 2010 and 424,000 in 2016[9]. NCD were estimated to account for 73% of all deaths in Vietnam in 2014 [10] and 77% in 2016[11]. Of NCDs cardiovascular diseases (CVDs) represented 31%¹ of all deaths in 2016; hypertension, one of main risk factors for CVDs, accounted for 21% of all deaths in the country[12]. It was estimated in 2016 that about 17% people aged 30-70 in Vietnam will suffer a premature death due to one of four common NCDs (cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes)[13].

The gross domestic product (GDP) per capita was increased gradually in Vietnam which is directly linked to increased behavioural risk factors for NCDs such as the harmful use of alcohol, unhealthy diets, and physical inactivity[3, 14]. NCD risk factor survey in Vietnam (2015) revealed high prevalence of NCD risk factors among the adult population. For example prevalence of overweight/obesity (BMI \geq 25) was 15.6%, hypertension (SBP \geq 140 and/or DBP \geq 90 mmHg or on medication) was 18.9%, raised cholesterol was 30.2%, physical inactivity 28.1%, lack of vegetable/fruit consumption 57.2%; the average population salt intake per day was 9.4 grams, which was almost double the WHO recommendation[15]. These behavioural risk factors play a vital role of rising chronic disease burden including cardiovascular diseases (CVD) and diabetes.

Over the past two decades, The Government of Viet Nam has a number of policies, strategies, plans, and programmes responding to NCDs. Two national programs were implemented for the period 2002 – 2010 and 2012 – 2015 focusing on four disease groups of cardiovascular diseases, diabetes, cancers, and mental and neurological disorders[13] and covering a component project of prevention and control of some dangerous diseases which included some specific NCDs. Despite the efforts these programs did not have expected achievements due to lack of inter-sectoral coordination and direction for NCDs prevention as well as evidence-based research. An updated National Strategy on Prevention and Control of NCDs for the period of 2015-2025 which followed the WHO Global NCD Action plan 2013-2020 was developed in 2015, providing a strong basis for NCD prevention and control in Viet Nam. Under the revised program, the prevention and control of some dangerous infectious diseases and some common NCDs was included as a project component[16].

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In addition to these national policies and programs targeting on HTN and T2DM, over the last few decades, a number of studies have been undertaken in Vietnam to measure the prevalence of HTN and T2DM but none have assessed trend of T2DM and HTN except for a 2001-2009 time trends analysis which showed an annual increase of HTN prevalence of 0.9%. Two reviews on prevalence of HTN and T2DM among adult population in Vietnam were published recently, yet these studies had their own limitations as (i) they were carried out based upon literature available in English[17]; (ii) the review employed only surveys which were conducted by a research institute, therefore the results may have some bias ; (iii) meta-analysis was not implemented to produce the pool estimation[18]; and (iv) they are out of date assessment with regard to the rapid change of T2DM and HTN. There is a need for an updated systematic review and meta-analysis. It is important for both health professionals and policy makers to better understand the trends of T2DM and HTN to develop effective policies and programmatic interventions. In this review, we conducted a systematic review and meta-analysis to comprehensively (1) determine the extent of research that has been done for HTN and T2DM, and (2) to assess the trend and recommend the future direction of prevention research efforts.

Methods:

We followed the Meta-analyses Of Observational Studies in Epidemiology (MOOSE) guidelines to identify studies [19]. The protocol was registered at the international prospective register of systematic reviews (PROSPERO; CRD42020182959).

Search strategy

We used the PICOS criteria to define the research question (**Table-1**)[20]. Our search included studies published from January 1, 2000, to September 30, 2020 in both English and Vietnamese languages. We used a number of different search engines: PubMed, EMBASE, CINAHL, Google Scholar, Google and national website and database including The Database of National Agency for Science and Technology Information (vista.gov.vn) and some Vietnamese journals in the field which are not included in the database.. A full description of the electronic search strategy is available in the **Appendix 1**. The keywords used in the search were “diabetes”, “diabetes mellitus”, “non-insulin dependent diabetes mellitus”, “NIDDM”, “type 2 diabetes”, “cardiovascular disease”, “CVD”, “myocardial infarction”, “ischemic heart disease”, “hypertension”, “high blood pressure”, “coronary artery disease”, “Vietnam”, “đái tháo đường”, “tiểu đường”, “tăng đường huyết”, “tăng huyết áp” “cao huyết áp”. We limited the search to studies that only involved human participants. We screened the studies using the following inclusion criteria: (1) had prevalence or incidence data available on either hypertension or T2DM, (2) had selected a sample included those who are Vietnamese and are living in Vietnam, and (3) had published results between January 1, 2000, to September 30, 2020. Once we identified the eligible studies, we made further exclusions based on sample, study design, and publication type.

Inclusion and exclusion criteria

Studies eligible for inclusion met the following criteria: primary or secondary data, published in the English and Vietnamese languages, conducted in humans, studies that provide an estimate of prevalence of either hypertension or T2DM and population age group 15 years or

older. Studies were excluded if: (1) were reported in reviews, qualitative studies, editorials, abstracts, theses, books, case reports and letters to the editor; (2) the study had participants with type 1 diabetes, GDM, (3) only on the elderly (60 year old and over) and (4) studies employed RCT designs

Data extraction and quality assessment

Data extraction was carried out by at least two independent reviewers following a piloted version of the Cochrane Effective Practice and Organization of Care Group (EPOC) guidelines[19]. They completed a standard data extraction form, summarizing the study design and other relevant data for each article, including author name, sample size, survey year and reference standard. (**Table-1 and 2**). One article did not report survey year, publication year was listed. The main outcomes were prevalence of T2DM and hypertension.

We adapted the modified Newcastle Ottawa scale for assessing the quality of the study, as recommended by the Cochrane Collaboration[21]. Four criteria were used to score studies as 'high quality' (4 points), 'moderate quality' (2-3 points), and 'poor quality' (0-1 points). Criteria included: target population a close representation of the national population (yes = 1, no = 0), sufficient sample size (yes = 1, no = 0), random sampling (yes = 1, no = 0) and ascertainment of T2DM and hypertension measure (yes = 1, no = 0). The cut-off for a sufficient sample size was set at 500 participants[22, 23].

Data analysis

All meta-analyses were performed using MetaXL version 1.4[24]. We calculated pooled prevalence of T2DM and hypertension. In addition we also assessed the pooled prevalence of T2DM and hypertension by year interval and sex. The methodology that we followed for the meta-analysis was described in details by Neyeloff et al.[25]. Briefly, for each study, we calculated the following variables: 1) standard error of the prevalence, 2) variance, 3) study weights (inversed variance), 4) study weight*prevalence estimate, 5) study weight*(prevalence estimate)² and 6) (study weight)². We used these variables to estimate Q (measure of heterogeneity among studies) and I² (percent between-studies variability). Based on Q and I² values, we chose quality effects models to report pooled prevalence estimates (hypertension, T2DM) and the associated 95% confidence interval (CI) to minimize the heterogeneity. We followed the same procedures to calculate the pooled prevalence of T2DM and hypertension by time periods (2000-2004; 2005-2010; 2011-2015; 2016-2020) and sex.

Result:

Study characteristics and quality

Our literature search yielded 4054 records. After exclusion of duplicates and review of titles and abstracts, articles were included for further evaluation. Of these full texts could not be found for 43 articles. The full text of the remaining 341 articles were examined and a total of 259 articles excluded after abstract screening. We included 82 articles in the final synthesis (**Figure-1**). These articles presenting data for 2,39,034 individuals. Out of these 44 articles reported prevalence of T2DM and 39 articles reported prevalence of hypertension. For T2DM all were cross sectional in nature (**Table-2**). Majority of the studies (92.4%) were community

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based and only three studies were facility based (7.6%). For hypertension all were cross sectional in nature (**Table-3**). Majority of the studies (90%) were community based and only four studies were facility based (10%). Quality score of each study presented in **supplementary table 1 and 2**. Majority of the articles came from Vietnamese language.

Estimation of prevalence rates

Prevalence rates varied widely across studies, from 1.0% to 29.0% for T2DM and 2.0% to 47.0% for hypertension. The pooled prevalence of T2DM and hypertension in Vietnam for all studies was 6.0% (95% CI: 5.0-8.0%) and 25% (95% CI: 19-31%) respectively (**Figure-2 and 3**).

Prevalence rates by year of study

To investigate T2DM and hypertension prevalence over time we arranged outcomes by time of study in four aggregated intervals i) 2000-2004, ii) 2005-2010, iii) 2011-2015 and iv) 2016-2020:

2000-2004

We included 9 studies from 2000-2004 in our analysis, 6 of these studies presented findings for T2DM [32, 38-39, 70-72] and 3for hypertension [71,75,81]. The pooled estimate of T2DM was 4.0% (95% CI: 2.0-6.0%), whereas for hypertension it was 17.0% (95% CI: 11.0-24.0%) (**Figure-2.2 and 3.2**).

2005-2010

Nineteen studies between 2005 and 2010 presented both prevalence of T2DM and hypertension in Vietnam in which ten studies [30,40-42,44,47,52-54,72 presented prevalence of T2DMand ten studies focused on hypertension [68,44,69,40,37,57,30,64,65,66].The pooled estimate of T2DMwas 5.0% (95% CI: 4.0-7.0%), whereas for hypertension it was 22.0% (95% CI: 18.0-26.0%)(**Figure-2.2 and 3.2**).

2011-2015

We identified thirty seven studies that presented findings for T2DMbetween the years 2011and 2015.These resulted in a pooled estimate of T2DM 6.0% (95% CI: 4.0-9.0%) from twenty studies [34,45,54,62,63,67,42,43,60,61, 53,56,35,31,52,48] .We identified 18 studies for the same period in Vietnam that presented findings for hypertension [45,54,62,63,67,60,61,42,43,34,53,56,35,31,47,52,33,48] resulting in a pooled estimate of 29% (95% CI: 17-42%).

2016-2020

For the most recent interval we identified eight studies [50,58,59,49,46,51,33,55] for T2DM in Vietnam with a pooled estimate of 10.0% (95% CI: 6.0-16.0%). We also identified eight studies [36,50,51,58,59,49,55,46] for hypertension in the region with a pooled estimate of 24.0% (95% CI: 12.0-40.0%).

Gender specific prevalence

We identified six studies for type T2DM and nineteen for hypertension for use in gender specific prevalence analysis. Pooled estimate for T2DM slightly higher among the male (5.0%, 95% CI: 4.0-7.0%) compared than female (4.0%, 95% CI: 3.0-5.0%). For hypertension, pooled estimate also higher among the male (25.0%, 95% CI: 22.0-28.0%) compared than female (18.0%, 95% CI: 15.0-22.0%).

Discussion:

This is the first systematic evaluation and meta-analysis of the scientific literature on the pooled prevalence trend of T2DM and hypertension among the adult population in Vietnam. In our study we found the pooled prevalence of T2DM has increased around three times from 2000-2004 (3%) to 2016-2020 (9%). A systematic review study by Nguyen et al reported that prevalence estimates of T2DM were 2.7% in 2002 and 5.4% in 2012[18]. To our knowledge this is the updated systematic review and meta-analysis paper on T2DM and hypertension in Vietnam. The growing trend of T2DM in Vietnam in the present review is consistent with secular trends in several Asian countries such as China[26], India[27], Sri Lanka and Bangladesh[28] where researchers also observed the similar magnitudes of a 10-year increase in T2DM prevalence. It is already well known that older age, urban residence, overweight, increased central adiposity, and physical inactivity, genetic factors, hypertension, and high intake of animal protein may contribute to enhanced diabetes[18]. In our study due to data limitation we were not able to assess the major drivers of T2DM in Vietnam however we expect Vietnam shares similar characteristics like others in LMICs.

The pooled analysis from this study found that the prevalence of hypertension has increased dramatically in Vietnam since 2000-2004. Another systematic review and meta-analysis study Meiqari et al reported that pooled prevalence of measured hypertension in Vietnam was 21.1%[17]. In that study they included the only English language studies but in our study we included both English and Vietnamese studies, which we believe it gives a proper scenario of hypertension in Vietnam. A review study by Hoy et al reported that high blood pressure is common among the Vietnamese population and they had knowledge that they have high blood pressure may be low[29].

The main strength of current study is that we followed a systematic and comprehensive approach to identify studies on both T2DM and hypertension following MOOSE guidelines and a registered protocol (CRD42020182959). Risk of bias was assessed using well-established criteria. Within the study we also investigated the sex specific prevalence and as well as time trend. The main weakness of this study comes from the research this review identified. Although the majority of studies included in this review were graded as moderate to high quality, many were cross-sectional in nature and followed a survey-based approach. In addition, findings of this study were extremely heterogeneous in nature, not only in study

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design and data collection, but also in outcome. To minimize the heterogeneity we chose quality effect model, which is now well established. As with all systematic reviews there is the potential for publication bias in the identified studies, with some not initially designed to report on the T2DM and hypertension. The reference standards for determining T2DM and hypertension was not consistent between all studies. In addition, although we attempted to estimate prevalence by sex but not all studies presented prevalence stratified by sex. Moreover, information on certain groups, such as ethnicity and place of residence were not available in enough studies to be included in sub-group analysis.

Although an adequate number of T2DM and hypertension prevalence studies have been conducted, they were mostly reported the overall prevalence. Little data exist on the place of residence specific, education specific, wealth index and geographic location specific prevalence of T2DM and hypertension. We did not find any longitudinal cohort studies on T2DM and hypertension. This is a significant gap in the knowledge and understanding of these chronic diseases in the context of Vietnam. Such studies would provide essential information on the incidence of these diseases, their associated risk factors, and the groups that are at higher risk of developing them. Further, longitudinal data are necessary to understand disease progression and prognosis.

Conclusion

We found increase in the prevalence T2DM and hypertension among the adult population in Vietnam over the study period. We also found T2DM and hypertension higher among the male compared than female. Future research should investigate the driving force behind the increasing rates of T2DM and hypertension and explain the major drivers in both conditions. Policy approaches should be developed that the counter the T2DM and hypertension, with interventions to combat T2DM and hypertension.

Contributors

NT, AM, TB, MOT, and HMH conceptualised and designed the study. NT, AM, and MOT obtained funding from The University of Queensland Global Strategy and Partnership Seed Funding Scheme – Round 2, 2018 for strengthening the collaboration between UQ researchers and research partners in Vietnam. TB, NT, HMH, HVP, VHP, CN, and ATK collected data across databases and conducted the review. NT and TB drafted the manuscript with additional contributions from all authors. All authors reviewed and edited the manuscript. All authors read and approved the final manuscript.

Funding

Not applicable

Competing interests

Not applicable

Ethics approval

We used published data and This systematic and meta-analysis's protocol was registered at the international prospective register of systematic review (PROSPERO; CRD42020182959).

Provenance and peer review

Not commissioned, externally peer reviewed.

Data availability statement

Data are available upon reasonable request

Table 1: PICOS criteria for inclusion and exclusion of studies

Parameter	Inclusion criteria	Exclusion criteria
Population	Those were of age ≥ 15 years	< 15
Intervention/exposure	Collection of data on T2DM and hypertension sociodemographic factors	Lack of data on T2DM and hypertension
Comparator	T2DM and hypertension status of Vietnamese adult	Lack of data on T2DM and hypertension
Outcome	Prevalence of T2DM and hypertension	No reported prevalence measure
Study design	Observational study Cross-sectional study Cohort study	Editorial Methodological article

Table-2: Summary of the reported prevalence rate of diabetes in Vietnam (2000-2020)

SI	Author name	Publication year	Study conducted	Community /hospital based	Reference standard	Study design	Sample size	Age range	Prevalence of diabetes
1	Tran Quang Binh et al [30]	2015	2010	Community	The World Health Organization and International Diabetes Federation diagnostic criteria	Cross-sectional	892	35-70	7.60%
2	Masami Miyakawa et al [31]	2017	2014	Community	Elevated fasting plasma glucose (FPG) level ≥ 7.0 mmol/L (126 mg/dL) or random elevated plasma glucose level ≥ 11.1 mmol/L (200 mg/dL); or 3) history of treatment for DM (lifestyle guidance including diet or exercise advice, oral medication, or insulin).	Cross-sectional	376	20-70	7.20%
3	Duc Son LN et al [32]	2004	2001	Community	NM	Cross-sectional	2932	≥ 15	6.6
4	Tran Quang Binh et al [33]	2014		Community	The glycemic status was classified as normal glucose tolerance (NGT) when FPG < 5.6 mmol/L and 2-h PG < 7.8 mmol/L.	Cross-sectional	2443	48-57	14.30%
5	Vu DuyKien et al [34]	2013	2013	Community	NM	Cross-sectional	3736	NM	11%
6	Ngoc Minh Pham et al [35]	2015	2011-2013	Community	Diabetes was diagnosed when FPG was ≥ 7.0 mmol/L (126 mg/dL) or 2-h post OGTT ≥ 11.1 mmol/L (200 mg/dL)	Cross-sectional	16282	30-69	6.00%
7	N. B. Hoa et al [36]	2018	2016	Facility-based	American Diabetes Association	Cross-sectional	870	>15	13.9%
8	Luc H Pham et al [37]	2015	2009	Community	Based on STEPS rule	Cross-sectional	1978	25- 64	1.00%
9	National Hospital of Endocrinology [38]	2002	2002	Hospital	WHO 1998: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L	Cross-sectional	9122	30-64	2.7
10	Le et al [39]	2004	NM	Community	WHO 1998/ADA 1997: fasting plasma glucose ≥ 7 mmol/L or using	Cross-sectional	2932	>15	3.8
11	Do and Le et al [40]	2008	NM	Community	WHO 1998: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L or self-report	Cross-sectional	1456	30-69	7.0
12	Ta et al [41]	2010	NM	Community	WHO 1998: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L	Cross-sectional	2142	30-64	4
13	Tran et al [42]	2012	NM	Community	WHO 1998: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L or self-report	Cross-sectional	2710	40-64	3.7
14	National Hospital of Endocrinology[43]	2012	NM	Hospital	WHO 1998: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L	Cross-sectional	11 191	30-69	5.4
15	Nguyen, D.T., et al [44]	2008	2008	Workplace	NM but not self-report	Cross-sectional	383	NM	2%
16	Le, H.N., et al [45]	2014	2011	Community	NM but not self-report	Cross-sectional	1401	40+	9.30%
17	Pham, V.B. and Truong, Q.D [46]	2019	2018	Community	Decision 3319/QĐ-BYT, 19/7/2017 – MOH	Cross-sectional	3000	30-69	6.50%
18	Nguyen, Q.V. and Le, N.N [47]	2014	2014	Community	NM but not self report	Cross-sectional	5190	21-70	4.2%
19	Pham, T.L.A., Khuong, V.D., and Pham, Q.C, [48]	2019	2014-2015	workplace	Elevated fasting plasma glucose (FPG) level ≥ 7.0 mmol/L	Cross-sectional	1,595	NM	5.50%
20	Vu, D.T. and Dang, B.T, [49]	2018	2017	Community	capillary blood glucose by Accu-Chek- D10-BIORAD: 2h-OGTT ≥ 11.1 mmol/L= diabetes; OGTT from 7.8-11.0= abnormal ; WHO-IDF 2008 updated 2010: The glycemic status was classified as abnormal when FPG range 5.6-6.9 mmol/L; FPG ≥ 7 mmol/L= diabetes	Cross-sectional	1.450	≥ 25	6.5
21	Nguyen, B.T., et al [50]	2017	2016	Community	Diabetes prevention and control Project, National Institute of Endocrinology; using Onetouchverio machine (Johnson & Johnson)	Cross-sectional	400	45-69	3.5
22	Vo, T.X.H., et [51]	2017	2015-2016	Community	ADA 2005: fasting plasma glucose ≥ 7 mmol/L (≥ 126 mg/dL) or self-reporting having been diagnosed by a health professional	Cross-sectional	758	≥ 40	14.5
23	Hoang, D.H., et al [52]	2016	2014	Community	FPG and post OGTT : fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L (MoH 2011); OGTT: FPG < 7 mmol/L and 2h-OGTT ≥ 7.8 - 11.1 mmol/L or normal but self-report having been diagnosed	Cross-sectional	2402	30-69	7.9
24	Do, T.H., et al [53]	2015	2013	Community	FPG and post OGTT (WHO 1999: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L or self-report and MoH 2011)	Cross-sectional	1200	40-59	5.3
25	Nguyen, V.L. and Nguyen, V.T, [54]	2013	2011	Community	ADA/WHO 2010: fasting plasma glucose 100-126mg/dl or 2h-OGTT from 140-200mg/dl or HbA1c $\geq 6.5\%$	Cross-sectional	1100	≥ 45	11.9
26	Nguyen, T.T.T., Nguyen, T.Q., and Nguyen, N.C, [55]	2017		Community	WHO STEPS: fasting blood glucose values >6.1 mmol/L or taking medications for diabetes; measured fasting blood glucose by Cardiocheck PA	Cross-sectional	2440	18-69	6.7
27	Do, T.H., et al [56]	2014	2013	Community	MoH 2011 on screening diabetes in community	Cross-sectional	1200	40-59	16.6

28	Tran, Q.B., et al [57]	2013	2009	Community	WHO- STEPS: fasting blood glucose values \geq 6.1 mmol/L) or on diabetes medication or having diagnosed by a health professional	Cross-sectional	1714	25-64	4.7
29	Vo, T.D, and Pham, T.T, [58]	2017	2015-2016	community	NM but not self-report	Cross-sectional	1114	>40	16.10%
30	Nguyen, V.L [59]	2018	2015-2016	community	NM but not self-report	Cross-sectional	1250	18-55	16.20%
31	Dang, H.D and Nguyen, V.L, [60]	2016	2012	community	NM but not-self report	Cross-sectional	2700	>20	5.80%
32	Do, M.C [61]	2015	2012	community	Diabetes was diagnosed when FPG was \geq 7.0 mmol/L or 2-h post OGTT \geq 11.1 mmol/L	Cross-sectional	3500	30-96	3.10%
33	Duong, T.H, [62]	2013	2011	community	WHO 2006	Cross-sectional	2000	30-69	4.30%
34	Tran, V.H., and Dam, V.C, [63]	2013	2011	community	WHO (not mentioned the year)	Cross-sectional	2400	30-64	10.30%
35	Dao, T.M.A., Tran, M.L., and Tran, T.P.N, [64]	2012	2010	community	WHO 1999	Cross-sectional	3100	all age	9.35%
36	Do, M.C., and Nguyen, T.H, [65]	2011	2010	community	OMS 1999, ADA 2005	Cross-sectional	3500	30 - 69	6.10%
37	Nguyen, V.Q., and Pham, T.H, [66]	2011	2010	community	NM but not self-report	Cross-sectional	1855	30-60	4.40%
38	Dzoan, T.T.V [67]	2011	2011	hospital based	Diabetes was diagnosed when FPG was \geq 7.0 mmol/L or 2-h post OGTT \geq 11.1 mmol/L	Cross-sectional	2358	30-60	3.60%
39	Hoang, D.M, [68]	2008	2005-2007	community	American diabetes association 1998	Cross-sectional	1335	18-70	3.1
40	Vien, C.C., and Phung, T.T.T, [69]	2008	2008	community	NM but not self-report	Cross-sectional	1620	18-60	2.60%
41	Do, T.T., [70]	2004	2000	community	WHO 1999	Cross-sectional	212	\geq 16	1.42%
42	To, V.H., Vu, M.H., and Nguyen, V.H, [71]	2003	May 2000 - Sep 2000	community	Diabetes was diagnosed when FPG was \geq 7.0 mmol	Cross-sectional	2017	\geq 16	3.62
43	Do, T.K.L., et al [72]	2003	March 2002 - December 2002	community	Diabetes (WHO 1999)	Cross-sectional	890	40-60	6.10%

Table-3: Summery of the reported prevalence rate of hypertension in Vietnam (2000-2020)

SI	Author name	Publication year	Study conducted	Community/hospital based	Reference standard	Study design	Sample size	Age range	Prevalence of hypertension
1	Luc H Pham et al [37]	2009	2015	Community	Raised blood pressure was defined as an average (based on STEPS rule) systolic blood pressure (SBP) ≥ 140 mmHg and/or average diastolic blood pressure (DBP) ≥ 90 mmHg and/or self-reported current medication for high blood pressure in the previous two weeks	Cross-sectional	1978	25–64	18.9
2	Tran Quoc Cuong et al [73]	2019	2019	Community	Systolic/diastolic blood pressure $\geq 140/90$ mmHg or using antihypertensive medication.	Cross-sectional	2203	≥ 18	24.3
3	Nhon Bui Van et al [74]	2018	2017	Community	HTN was specifed that SBP was 140 mmHg or higher and/or DBP was 90 mmHg or higher, if the medications used to treat HTN were used by the individuals for 2 weeks. ISH having a SBP ≥ 140 mmHg and DBP < 90 mmHg was used to diagnose.	Cross-sectional	675	≥ 18	47.3
4	Van Minh Hoang et al [75]	2019	2015	Community	Raised blood pressure was defined as an average (based on STEPS rule) systolic blood pressure (SBP) ≥ 140 mmHg and/or average diastolic blood pressure (DBP) ≥ 90 mmHg and/or self-reported current medication for high blood pressure in the previous two weeks.	Cross-sectional	3,856	18–69	18.9
5	PT Son et al [76]	2011	2002	Community	Defined as BP $\geq 140/90$ mm Hg	Cross-sectional	9832	≥ 25	25.1
6	Ha T.P. Do et al [77]	2014	2005	Community	Hypertension was defined as systolic BP (SBP) ≥ 140 mm Hg and/or diastolic BP (DBP) ≥ 90 mm Hg and/or self-reported current use of antihypertensive medication.	Cross-sectional	17,199	25–64	20.7
7	Tran Quang Binh et al [33]	2014	NM	Community	systolic blood pressure ≥ 130 mmHg or diastolic blood pressure ≥ 85 mmHg or hypertension;	Cross-sectional	2443	48-57	14.3
8	Hoang Van Minh et al [74]	2007	2005	Community	systolic blood pressure (SBP) was at least 140 mm Hg, their diastolic blood pressure (DBP) was at least 90 mm Hg, or they were being treated for hypertension	Cross-sectional	2000	25 to 64	18.8
10	Ngoc Minh Pham et al [78]	2015	2011-2013	Community	Hypertension was defined as systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg or current use of antihypertensive medication	Cross-sectional	5602 men and 10,680 women	30–69	47.0
11	H Van Minh et al [74]	2005	2002	Community	Hypertensive subjects were defined as those with systolic blood pressure (SBP) equal to or more than 140 mmHg or diastolic blood pressure (DBP) equal to or more than 90 mmHg or those being treated for hypertension	Cross-sectional	2000	25–64	14.1
12	Masami Miyakawa et al [31]	2017	2014	Community	Hypertension was defined as elevated blood pressure (BP), with systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg	Cross-sectional	376	20-70	15
13	Tran, T.T., [79]	2007	2005	Community	JNC VII (2003)	Cross-sectional	1991	25-65	26.5
14	Vo, T.D., and Dang, V.P, [80]	2007	2005	Community	JNC VII	Cross-sectional	1288	25 +	28.4
15	Le, Q.D., and Nguyen, D.N, [81]	2011	2010	Community	systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg	Cross-sectional	1991	25-64	16.0
16	Nguyen, D.T., et al [44]	2008	2008	Community (workplace)	NM but not self-report	Cross-sectional	383	NM	16.0
17	Vu, B.N., et al [82]	2005	2004	Community	systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg	Cross-sectional	2366	18+	21.8
18	Nguyen, V.T., et al [83]	2013	2013	Hospital based	NM but not self-report	Cross-sectional	379	NM	13.3
19	Tran, V.H., and Nguyen, D.Q, [84]	2014	2012	Community	systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg	Cross-sectional	872	25-64	15.0
20	Le, H.L., et al [45]	2014	2011	Community	Decision 3192/QĐ-BYT dated 31/8/2010, Vietnam Ministry of Health	Cross-sectional	1401	40+	30.6

21	Nguyen, N.L., [85]	2019	2016-2018	Hospital based	NM but not self-report	Respective	65	NM	49.2
22	Lam, C.C., and Lam, C.Q, [86]	2019	2012-2018	Community	National hypertension program: systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	10188	\geq 40	22.2
23	Pham, T.L.A., Khuong, V.D., and Pham, Q.C., [48]	2019	2014-2015	Community (workplace)	NM (systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg)	Cross-sectional	1,595	NM	15.4
24	Vo, T.X.H., et al [51]	2017	2015-2016	Community	systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg or reporting having diagnosed and on medication by a health professional	Cross-sectional	1153	\geq 18	33.8
25	Nguyen, H., Do, I.T., and Ton, T.T., [87]	2017	2011-2015	Community (	MoH 2010, systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	20000	\geq 25	28.5
26	Pham, T.X., et al [88]	2017	2014	Community	STEPS, systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	459	45-64	35.5
28	Nguyen, T.T.T, Nguyen, T.K.A., and Nguyen, N.C., [89]	2017	2016	Community	systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	2699	18-69	18.97
29	Tran, M.D., et al [90]	2017	2016	workplace	NM but not self-report	Cross-sectional	1930	NM	2.3
30	Do, T.H., et al [53]	2015	2013	Community	JNC7, MoH 2010, systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	1200	40-59	19.7
31	Hong, M.H, [91]	2015	2013	Community	NM (must be systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg be because this was a baseline survey of an intervention with control group)	Cross-sectional	1619	\geq 25	20.7
32	Le, T.H., et al [92]	2015	2013	Community	WHO-Systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg ;	Cross-sectional	800	\geq 18	16.8
33	Do, T.H., et al [56]	2014	2012	Community	JNC-7 - Systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg ;	Cross-sectional	1200	40-59	19.7
34	Chu, T.T.H, [93]	2014	2014	Community	MOH, 2010: 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	2085	\geq 25	18.0
35	Nguyen, H.T, [94]	2014	2011	Community	140 mmHg or diastolic blood pressure \geq 80 mmHg	Cross-sectional	1833	\geq 25	11.8
37	Tran, Q.B., et al [57]	2013	2009	Community	WHO- STEPS: 140 mmHg or diastolic blood pressure \geq 90 mmHg or on medication	Cross-sectional	1714	25-64	17.8
38	Vien, C.C., and Phung, T.T.T., [69]	2008	2008	community	NM but not self-report	Cross-sectional	1620	18-60	15.8
39	Do, T.K.L., et al [72]	2003	March 2002 - December 2002	community	Hypertension dianogsis ($>$ 140/90) Diabetes (WHO 1999)	Cross-sectional	890	40-60	12.7

References:

1. Bukhman, G., et al., *The Lancet NCDI Poverty Commission: bridging a gap in universal health coverage for the poorest billion*. The Lancet, 2020. **396**(10256): p. 991-1044.
2. Bennett, J.E., et al., *NCD Countdown 2030: worldwide trends in non-communicable disease mortality and progress towards Sustainable Development Goal target 3.4*. The Lancet, 2018. **392**(10152): p. 1072-1088.
3. Pham, B.D., et al., *Exposure to Messages on Risk Factors for Noncommunicable Diseases in a Rural Province of Vietnam*. 2019. **2019**.
4. Geldsetzer, P., et al., *Diabetes and hypertension in India: a nationally representative study of 1.3 million adults*. 2018. **178**(3): p. 363-372.
5. WHO, N.D.i.t.S.-E.A.R., India, 2011.
6. Farrell, P., et al., *How food insecurity could lead to obesity in LMICs: When not enough is too much: a realist review of how food insecurity could lead to obesity in low-and middle-income countries*. Health promotion international, 2018. **33**(5): p. 812-826.
7. Li, L., et al., *Fast food consumption among young adolescents aged 12–15 years in 54 low-and middle-income countries*. Global health action, 2020. **13**(1): p. 1795438.
8. Umberger, W.J., J.A. Rupa, and D. Zeng, *Understanding food westernisation and other contemporary drivers of adult, adolescent and child nutrition quality in urban Vietnam*. Public Health Nutrition, 2020. **23**(14): p. 2571-2583.
9. WHO, T.N.D.D.B.C., 2016, <http://www.who.int/gho/countries/vnm/en/>.
10. WHO, G.S.R.o.N.D., Geneva, Switzerland, 2014.
11. Girum, T., T. Shumbej, and M. Shewangizaw, *Burden of malaria in Ethiopia, 2000-2016: findings from the Global Health Estimates 2016*. Tropical diseases, travel medicine and vaccines, 2019. **5**(1): p. 1-7.
12. <https://www.theguardian.com/healthcare-network/gallery/2018/may/17/high-blood-pressure-vietnam-world-hypertension-day#:~:text=Hypertension%20causes%20an%20estimated%2091%2C000>, V.h.
13. <https://www.who.int/nmh/publications/ncd-profiles-2018/en/>.
14. Van Bui, T., et al., *National survey of risk factors for non-communicable disease in Vietnam: prevalence estimates and an assessment of their validity*. 2016. **16**(1): p. 498.
15. MOH, N.S.o.R.F.o.N.i.V., Ministry of Health, Hanoi, Vietnam, 2016.
16. Thuy Duyen, N., et al., *Patterns of behavioral risk factors for non-communicable diseases in Vietnam: A narrative scoping review*. Health Psychology Open, 2020. **7**(2): p. 2055102920967248.
17. Meiqari, L., et al., *Prevalence of hypertension in Vietnam: a systematic review and meta-analysis*. Asia Pacific Journal of Public Health, 2019. **31**(2): p. 101-112.
18. Nguyen, C.T., et al., *Prevalence of and risk factors for type 2 diabetes mellitus in Vietnam: a systematic review*. Asia Pacific Journal of Public Health, 2015. **27**(6): p. 588-600.
19. Cochrane Effective Practice and Organisation of Care Group. Data collection checklist. 2015 [internet], c.A.A.f.h.e.c.o.s.e.
20. Hoque, M.E., et al., *Rapid shift toward overweight from double burden of underweight and overweight among Bangladeshi women: a systematic review and pooled analysis*. Nutrition reviews, 2015. **73**(7): p. 438-447.
21. Higgins JPT, D.J., Altman DG, editors. Chapter 16: Special topics in statistics. In: Higgins JPT Green S. (eds). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 (updated March 2011). The Cochrane Collaboration; 2011. Available from: www.handbook.cochrane.org.

22. Biswas, T., et al., *Double burden of underweight and overweight among women in South and Southeast Asia: a systematic review and meta-analysis*. 2020. **11**(1): p. 128-143.

23. Saquib, N., et al., *Cardiovascular diseases and type 2 diabetes in Bangladesh: a systematic review and meta-analysis of studies between 1995 and 2010*. 2012. **12**(1): p. 434.

24. Biswas, T., et al., *Double burden of underweight and overweight among women in South and Southeast Asia: a systematic review and meta-analysis*. *Advances in Nutrition*, 2020. **11**(1): p. 128-143.

25. Neyeloff, J.L., S.C. Fuchs, and L.B. Moreira, *Meta-analyses and Forest plots using a microsoft excel spreadsheet: step-by-step guide focusing on descriptive data analysis*. *BMC research notes*, 2012. **5**(1): p. 1-6.

26. Zuo, H., Z. Shi, and A. Hussain, *Prevalence, trends and risk factors for the diabetes epidemic in China: a systematic review and meta-analysis*. *Diabetes research and clinical practice*, 2014. **104**(1): p. 63-72.

27. Ramachandran, A., et al., *Trends in prevalence of diabetes in Asian countries*. *World journal of diabetes*, 2012. **3**(6): p. 110.

28. Ramachandran, A., *Ching Wan Ma R, Snehalatha Chamukuttan, et al.* *Diabetes in Asia*. *The Lancet*, 2010. **375**: p. 408-18.

29. Hoy, D., et al., *Risk Factors for Chronic Disease in Viet Nam: A Review of the Literature Posted on January 18, 2013 by*.

30. Binh, T.Q. and B.T. Nhung, *Prevalence and risk factors of type 2 diabetes in middle-aged women in Northern Vietnam*. *International Journal of Diabetes in Developing Countries*, 2016. **36**(2): p. 150-157.

31. Miyakawa, M., et al., *Prevalence, perception and factors associated with diabetes mellitus among the adult population in central Vietnam: a population-based, cross-sectional seroepidemiological survey*. *BMC public health*, 2017. **17**(1): p. 1-8.

32. Duc Son, L., et al., *Prevalence and risk factors for diabetes in Ho Chi Minh City, Vietnam*. *Diabetic medicine*, 2004. **21**(4): p. 371-376.

33. Binh, T.Q., P.T. Phuong, and B.T. Nhung, *Metabolic syndrome among a middle-aged population in the Red River Delta region of Vietnam*. *BMC endocrine disorders*, 2014. **14**(1): p. 1-9.

34. Kien, V.D., et al., *Socioeconomic inequalities in catastrophic health expenditure and impoverishment associated with non-communicable diseases in urban Hanoi, Vietnam*. *International Journal for Equity in Health*, 2016. **15**(1): p. 1-11.

35. Pham, N.M. and K. Eggleston, *Diabetes prevalence and risk factors among Vietnamese adults: findings from community-based screening programs*. *Diabetes Care*, 2015. **38**(5): p. e77-e78.

36. Hoa, N., et al., *Prevalence and associated factors of diabetes mellitus among tuberculosis patients in Hanoi, Vietnam*. *BMC infectious diseases*, 2018. **18**(1): p. 1-9.

37. Pham, L.H., et al., *Prevalence of risk factors for non-communicable diseases in the Mekong Delta, Vietnam: results from a STEPS survey*. *BMC Public Health*, 2009. **9**(1): p. 1-8.

38. National Hospital of Endocrinology . *National program on diabetes control and prevention [in Vietnamese]*. 1st ed. Hanoi, V.M.P., 2002. .

39. Le, N.T.D., L.D. Pham, and T.Q. Vo, *Type 2 diabetes in Vietnam: a cross-sectional, prevalence-based cost-of-illness study*. *Diabetes, metabolic syndrome and obesity: targets and therapy*, 2017. **10**: p. 363.

40. Do, T. and N. Le, *Investigation for associated factors and epidemiology of type 2 diabetes in Hochiminh City [in Vietnamese]*. *Vietnam Journal of Food and Nutrition Sciences*, 2008.

41. Ta, M., et al., *Identification of undiagnosed type 2 diabetes by systolic blood pressure and waist-to-hip ratio*. *Diabetologia*, 2010. **53**(10): p. 2139-2146.

42. Dao-Tran, T.H., et al., *Factors associated with self-management among Vietnamese adults with type 2 diabetes*. Nursing open, 2018. **5**(4): p. 507-516.
43. 2012., N.H.o.E.N.p.o.d.c.a.p.i.V.n.e.H.M.P.
44. Nguyen, D.T., et al., *Health situation and behavioural factors related to health of Saigon brewery workers in 2018*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2008. **12**(4): p. 229 - 233.
45. Le, H.N., et al., *The prevalence of non-communicable disease and its related factors among individuals aged 40 years and older living in Long Thuan commune, Ben Cau district, Tay Ninh province*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2014. **18**(6): p. 746 - 754.
46. Pham, V.B. and Q.D. Truong, *Prevalence of diabetes and its related factors among people aged 30 - 69 in Binh Dinh province in 2018*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2019. **23**(5): p. 58 - 62.
47. Nguyen, Q.V. and N.N. Le, *Prevalence and correlates of pre-diabetes, diabetes in some provinces in southern Vietnam: A cross-sectional study*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2014. **18**(6): p. 451 - 457.
48. Pham, T.L.A., V.D. Khuong, and Q.C. Pham, *Current situation of health and diseases of the traffic police between 2014 - 2015*. Journal of Preventive Medicine, 2019. **29**(3): p. 55 - 63.
49. Vu, D.T. and B.T. Dang, *The prevalence of type 2 diabetes in people aged ≥ 25 years in Thai Binh province 2017*. Journal of Preventive Medicine, 2018. **28**(7): p. 33 - 38.
50. Nguyen, B.T., et al., *Diabetes mellitus prevalence of people aged from 45 to 69 and some related factors in Sa Thay town, Sa Thay district, Kon Tum province 2016*. Journal of Preventive Medicine, 2017. **27**(8): p. 146 - 153.
51. Vo, T.X.H., et al., *Prevalence of hypertension and diabetes among adults in Ho Chi Minh city - a community - based study in an urban district*. Journal of Preventive Medicine, 2017. **27**(8): p. 79 - 87.
52. Hoang, D.H., T.T.H. Chu, and C.D. Bui, *Prevalence of diabetes type 2 and prediabetes of people age 30 - 69 in Hanoi 2014*. Journal of Preventive Medicine, 2016. **26**(2): p. 94 - 101.
53. Do, T.H., et al., *Actual situation on hypertension, diabetes and the health care requirement status among people of the middle-age group (from 40 - 59) at Dong Son district, Thanh Hoa province 2013*. Journal of Preventive Medicine, 2015. **25**(8): p. 381 - 390.
54. Nguyen, V.L. and V.T. Nguyen, *The rate of diabetes and some factors related to the Khmer ethnic minority people who are 45 years and over in Hau Giang province*. Journal of Preventive Medicine, 2013. **23**(6): p. 142 - 149.
55. Nguyen, T.T.T., T.Q. Nguyen, and N.C. Nguyen, *Raised blood glucose situation among adults 18 - 69 years old in Hanoi 2016*. Journal of Preventive Medicine, 2017. **27**(6): p. 92 - 98.
56. Do, T.H., et al., *Prevalence of hypertension, hyperglycemia and certain related factors in middle age group in Dong Son district, Thanh Hoa province 2013*. Journal of Preventive Medicine, 2014. **24**(8): p. 30 - 36.
57. Tran, Q.B., et al., *Steps survey on risk factors for non-communicable diseases in Can Tho city 2009 - 2010*. Journal of Preventive Medicine, 2013. **23**(5): p. 72 - 79.
58. Vo, T.D. and T.T. Pham, *Study on status of diabetes type 2 and assessment of intervention results on adults aged from 40 years old at My Xuyen, Soc Trang in 2015 - 2016*. Can Tho Journal of Medicine and Pharmacy, 2017. **9**: p. 138 - 145.
59. Nguyen, V.L., *Hypertension increase and its risk factors among labor- aged population in Hau Giang province in 2016*. Journal of Community Medicine, 2018. **1**(42): p. 84 - 91.
60. Dang, H.C. and V.L. Nguyen, *Prevalence of diabetes type 2 and its risk factors in Ca Mau province: solutions for management and prevention*. Journal of Community Medicine, 2016. **32**: p. 30 - 35.

61. Do, M.C., *Research on the level of relevance between some risk factors and diabetes and glycemia disorder of people from 30 - 69 years old in three urban districts of Hai Phong in 2012*. Vietnam Journal of Medicine, 2015. **2**: p. 103 - 108.

62. Duong, T.H., *Early Diagnosis of Diabetes and Glucose Disorder among Adults in Hai Phong 2011* Vietnam Journal of Medicine, 2013.

63. Tran, V.H. and V.C. Dam, *Research on diabetes and knowledge, practice on complication prevention of population 30 - 64 years old in Hau Giang province in 2011*. Journal of Practical Medicine, 2013. **4**: p. 23 - 27.

64. Dao, T.M.A., M.L. Tran, and T.P.N. Tran, *Diabetes type II at age group of 30 - 69 in Nghe An population in 2010*. Journal of Medical Research, 2012. **79**(2): p. 186 - 193.

65. Do, M.C. and T.H. Nguyen, *Assessment prevalence of diabetes, glucose tolerance (IGT) and risk factors in the age 30 - 69 in suburbs Hanoi city 2010*. Journal of Malaria and Parasite Diseases Control, 2011. **4**: p. 70 - 78.

66. Nguyen, V.Q. and T.H. Pham, *Survey on prevalence of diabetes and prediabetes in Hai Hau distric, Nam Dinh province 2010*. Vietnam Medical Journal, 2011. **1**: p. 5 - 10.

67. Dzoan, T.T.V., *Some risk factors of diabetes type 2 in subjects aged 30 - 60 years in the hospital 198*. Journal of Food and Nutrition Sciences, 2011. **7**(1): p. 51 - 60.

68. Hoang, D.M., *Studying on prevalence of diabetes in Hai Phong*. Vietnam Medical Journal, 2008. **1**: p. 1 - 4.

69. Vien, C.C. and T.T.T. Phung, *Survey on overweight, hypertension, and diabetes among workers in middle region Vietnam*. Journal of Employment Protection, 2008: p. 17 - 21.

70. Do, T.T., *Prevalence of diabetes and decreased blood sugar in Tan Dan and Thai Son communes, An Lao district, Hai Phong*. Vietnam Medical Journal, 2004. **11**: p. 128 - 132.

71. To, V.H., M.H. Vu, and V.H. Nguyen, *Epidemiological survey on diabetes among population aged 16 and older in three districts in Hanoi*. Vietnam Medical Journal, 2003. **6**: p. 58 - 64.

72. Do, T.K.L., et al., *A study on nutritional status, related factors and high blood glucoza level of adults aged 40 to 60 living in a center district of Hanoi city*. Vietnam Medical Journal, 2003. **9**: p. 78 - 84.

73. Quoc Cuong, T., et al., *Associated factors of hypertension in women and men in vietnam: A cross-sectional study*. International journal of environmental research and public health, 2019. **16**(23): p. 4714.

74. Do Nam, K., et al., *Hypertension in a mountainous province of Vietnam: prevalence and risk factors*. Heliyon, 2020. **6**(2): p. e03383.

75. Hoang, V.M., et al., *Patterns of Raised Blood Pressure in Vietnam: Findings from the WHO STEPS Survey 2015*. International journal of hypertension, 2019. **2019**.

76. Son, P., et al., *Prevalence, awareness, treatment and control of hypertension in Vietnam—results from a national survey*. Journal of human hypertension, 2012. **26**(4): p. 268-280.

77. Do, H.T., et al., *National prevalence and associated risk factors of hypertension and prehypertension among Vietnamese adults*. American journal of hypertension, 2015. **28**(1): p. 89-97.

78. Pham, N.M. and K. Eggleston, *Prevalence and determinants of diabetes and prediabetes among Vietnamese adults*. Diabetes Research and Clinical Practice, 2016. **113**: p. 116-124.

79. Tran, T.T., *The influence factors involve knowledge and practice in adult about high blood pressure in Ho Chi Minh city 2005*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2007. **11**: p. 118-126.

80. Vo, T.D. and V.P. Dang, *Hypertension in Long An province in 2005: Prevalence and risk factors*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2007. **11**: p. 122 - 128.

81. Le, Q.D. and D.N. Nguyen, *The prevalence of hypertension and body mass index among adults aged 25 - 64 years at Lam Dong in 2010*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2011. **15**(3): p. 158 - 164.

82. Vu, B.N., et al., *Prevalence of hypertension among adults living in district 4 - Ho Chi Minh city 2004*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2005. **9**(1): p. 93 - 99.
83. Nguyen, V.T., et al., *Disease model in advanced bureaucrats who are monitored by the health care department of Long An province*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2013. **17**(3): p. 331 - 334.
84. Tran, V.H. and D.N. Nguyen, *Prevalence of hypertension and its risk behaviours at the population among 25 - 64 years old in Ninh Hai district, Ninh Thuan province*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2014. **18**(6): p. 709 - 0716.
85. Nguyen, N.L., *Evaluating the effectiveness of management, protection and health care of cadres in Vinh Long province in 3 years 2016 - 2018*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2019. **23**(3): p. 124 - 129.
86. Lam, C.C. and C.Q. Lam, *The status of hypertension and relevance between risk factors with hypertension in people aged ≥ 40 years old at Ninh Hoa town, Khanh Hoa province, 2012 - 2018*. Journal of Preventive Medicine, 2019. **29**(6): p. 100 - 105.
87. Nguyen, H., I.T. Do, and T.T. Ton, *Prevalence trend of hypertension and risk factors of cardiovascular disease among people aged 25 and older in Da Nang city between 2011 and 2015*. Journal of Preventive Medicine, 2017. **27**(8): p. 55 - 64.
88. Pham, T.X., et al., *Reality of hypertension in aged of 45 - 64 year in Dien Bien district in 2014*. Journal of Preventive Medicine, 2017. **27**(7): p. 67 - 73.
89. Nguyen, T.T., T.K.A. Nguyen, and N.C. Nguyen, *Hypertension status among adults 18 - 69 years old in Hanoi 2016*. Journal of Preventive Medicine, 2017. **27**(6): p. 84 - 91.
90. Tran, M.D., et al., *Workers health conditions of the automobile and motorcycle brake manufacturing company in Vietnam in 2016*. Journal of Preventive Medicine, 2017. **27**(1): p. 126 - 133.
91. Hong, M.H., *Research on the high blood pressure in person from 25 years or older and results of intervention at Phu Tan district in Ca Mau province in 2014*. Journal of Preventive Medicine, 2015. **25**(8): p. 333 - 341.
92. Le, T.H., et al., *Prevalence of Hypertension among Adults in two rural communes, Quang Trach district, Quang Binh province 2013*. Journal of Preventive Medicine, 2015. **XXV**(6): p. 77-84.
93. Chu, T.T.H., *Prevalence of hypertension in Hanoi city in 2012*. Journal of Preventive Medicine, 2014. **24**(1): p. 91 - 95.
94. Nguyen, H.T., *Current status of hypertension of the adult population aged 25 years and older who living in Trang Ha commune, Tu Son town, Bac Ninh province in 2011*. Journal of Preventive Medicine, 2014. **24**(1): p. 80 - 85.

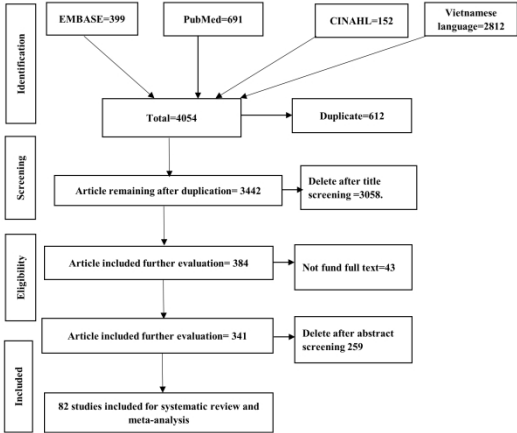
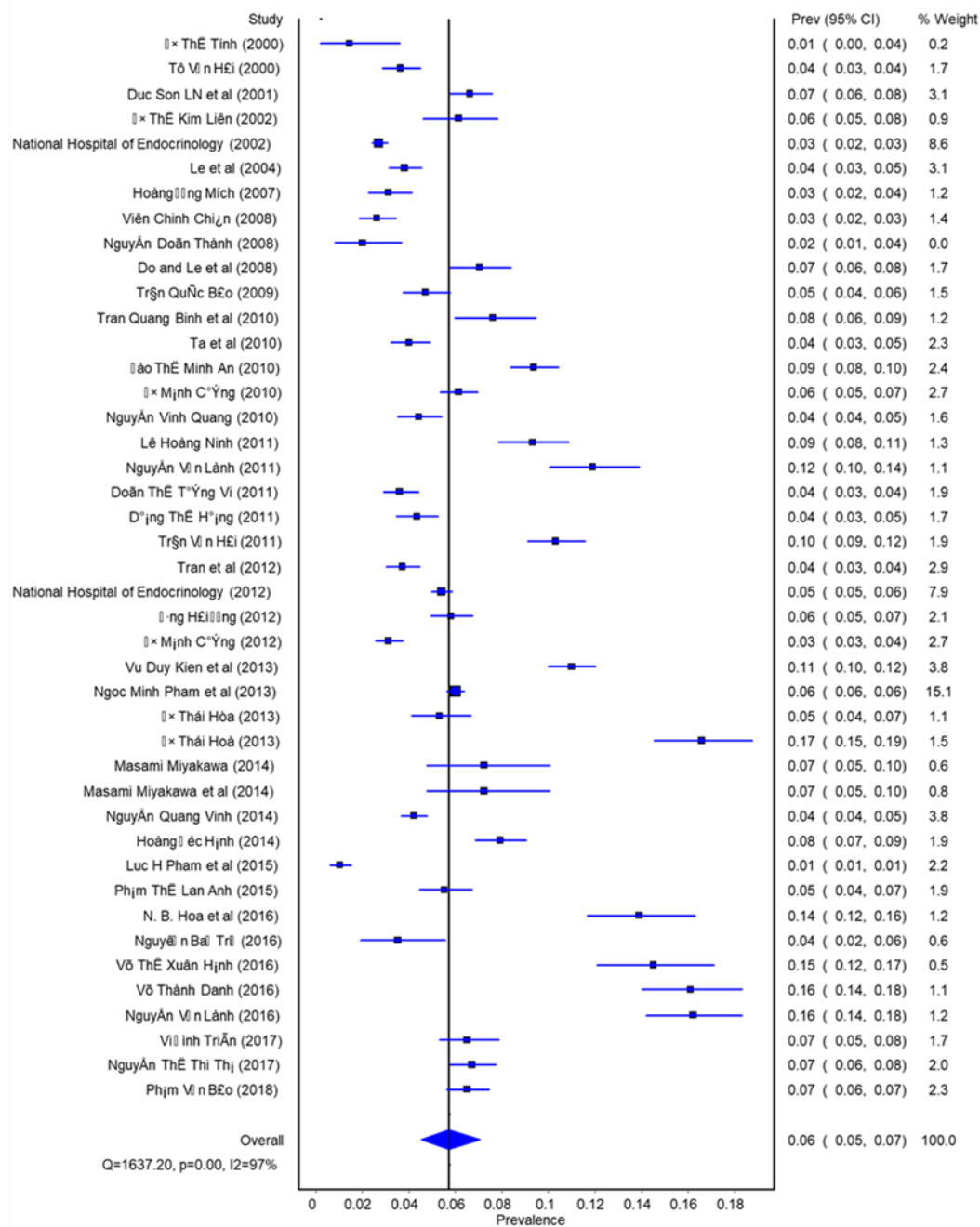
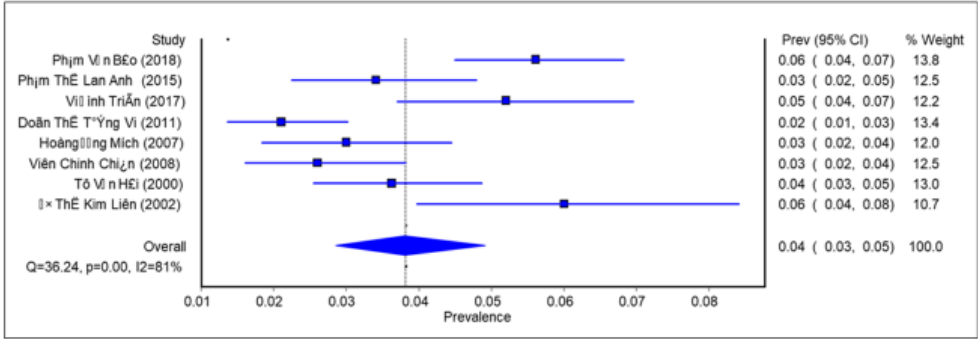
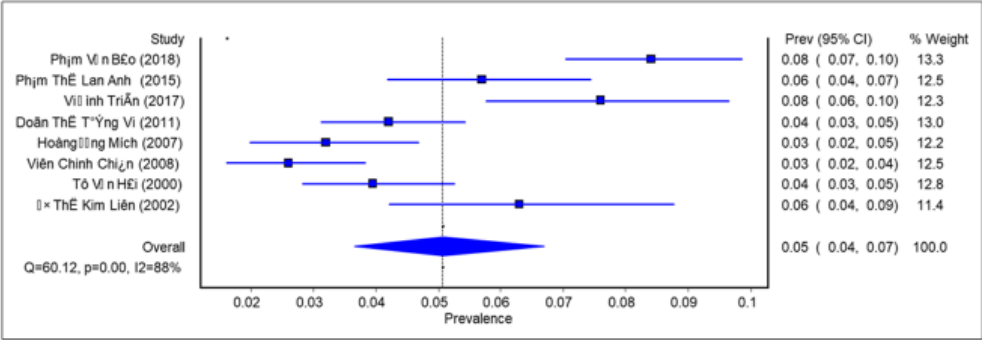
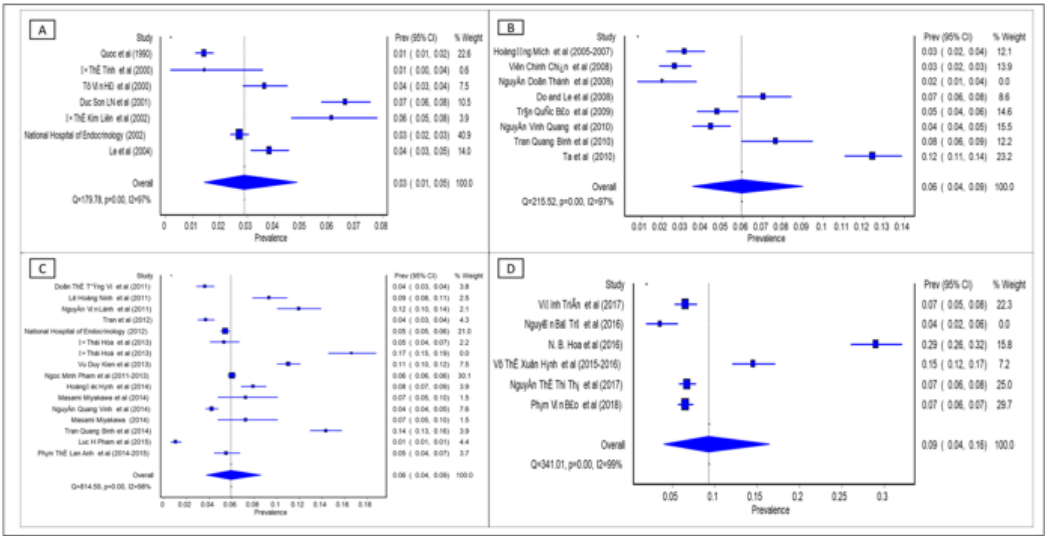
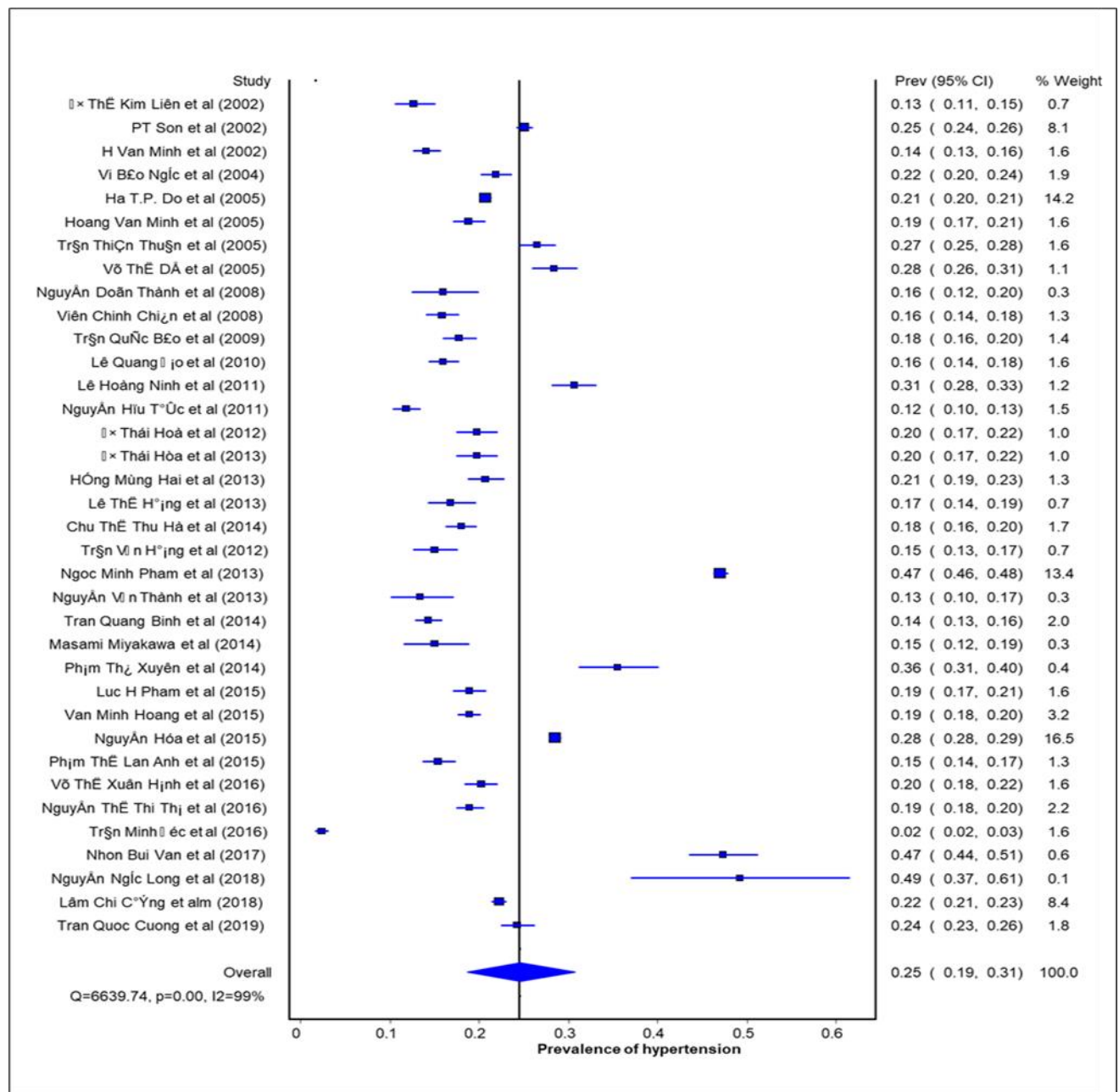


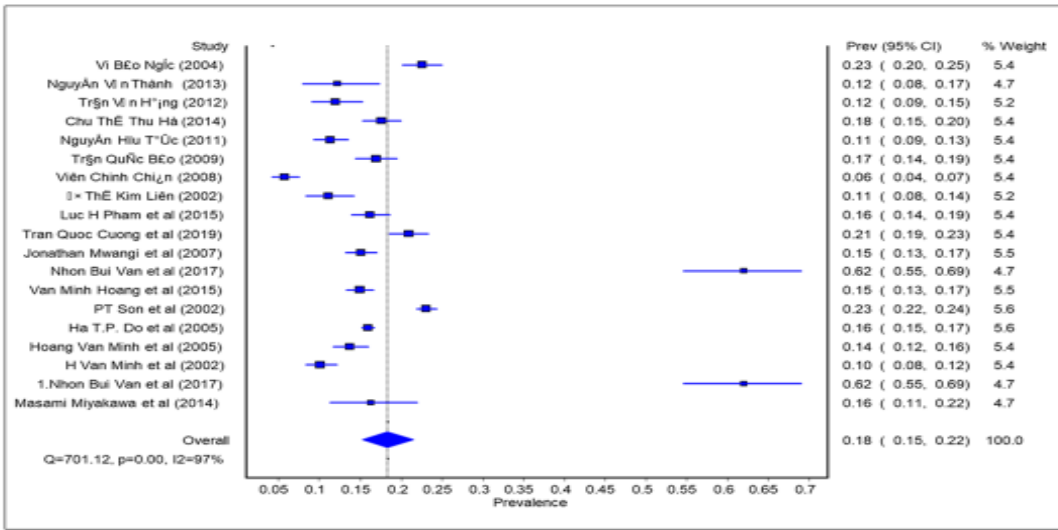
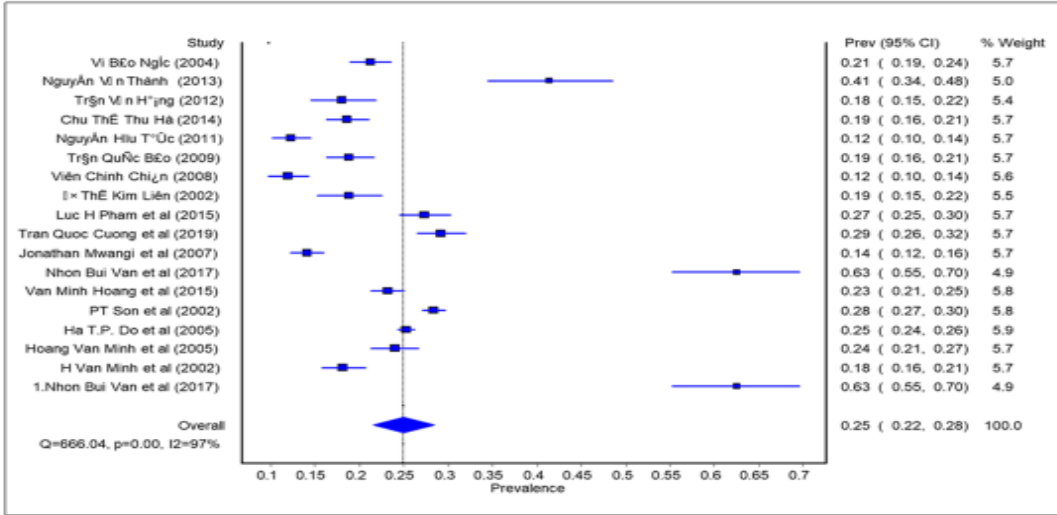
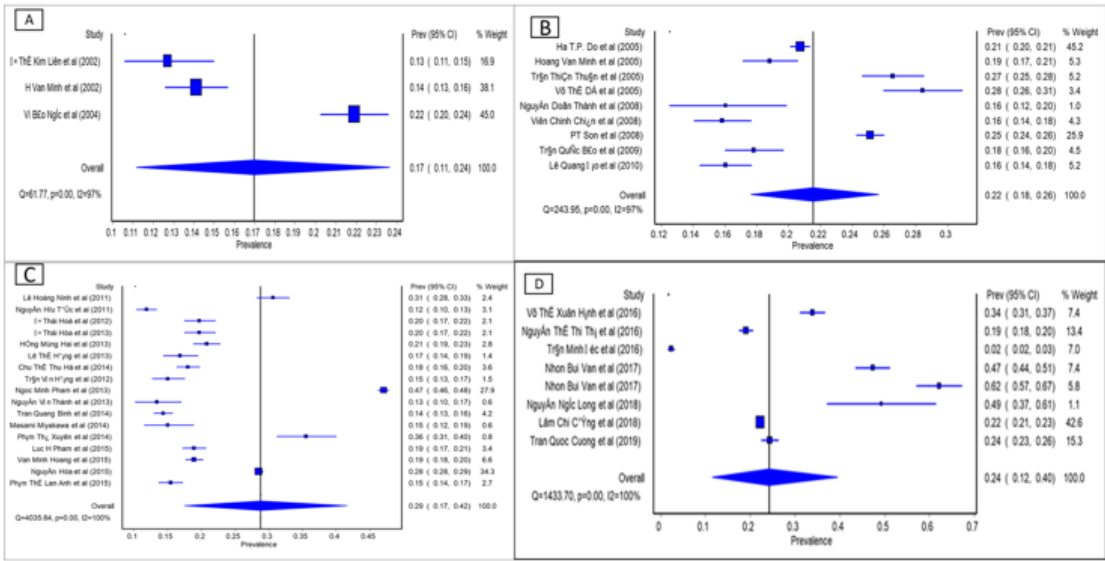
Figure-1: Consort diagram: Search strategy and selection of studies included in this review

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Appendix 1

Detailed search strategy used for PubMed database

Search Query

((((((((((("diabetes mellitus"[MeSH Terms] OR ("diabetes"[All Fields] AND "mellitus"[All Fields]) OR "diabetes mellitus"[All Fields] OR "diabetes"[All Fields] OR "diabetes insipidus"[MeSH Terms] OR ("diabetes"[All Fields] AND "insipidus"[All Fields]) OR "diabetes insipidus"[All Fields]) OR ("diabetes mellitus"[MeSH Terms] OR ("diabetes"[All Fields] AND "mellitus"[All Fields]) OR "diabetes mellitus"[All Fields])) OR ("diabetes mellitus, type 2"[MeSH Terms] OR "type 2 diabetes mellitus"[All Fields] OR ("non"[All Fields] AND "insulin"[All Fields] AND "dependent"[All Fields] AND "diabetes"[All Fields] AND "mellitus"[All Fields]) OR "non insulin dependent diabetes mellitus"[All Fields])) OR ("diabetes mellitus, type 2"[MeSH Terms] OR "type 2 diabetes mellitus"[All Fields] OR "type 2 diabetes"[All Fields])) OR ("cardiovascular diseases"[MeSH Terms] OR ("cardiovascular"[All Fields] AND "diseases"[All Fields]) OR "cardiovascular diseases"[All Fields] OR ("cardiovascular"[All Fields] AND "disease"[All Fields]) OR "cardiovascular disease"[All Fields])) OR CVD[All Fields]) OR ("myocardial infarction"[MeSH Terms] OR ("myocardial"[All Fields] AND "infarction"[All Fields]) OR "myocardial infarction"[All Fields])) OR ("ischaemic heart disease"[All Fields] OR "myocardial ischemia"[MeSH Terms] OR ("myocardial"[All Fields] AND "ischemia"[All Fields]) OR "myocardial ischemia"[All Fields] OR ("ischemic"[All Fields] AND "heart"[All Fields] AND "disease"[All Fields]) OR "ischemic heart disease"[All Fields] OR "coronary artery disease"[MeSH Terms] OR ("coronary"[All Fields] AND "artery"[All Fields] AND "disease"[All Fields]) OR "coronary artery disease"[All Fields] OR ("ischemic"[All Fields] AND "heart"[All Fields] AND "disease"[All Fields])) OR ("hypertension"[MeSH Terms] OR "hypertension"[All Fields])) OR ("hypertension"[MeSH Terms] OR "hypertension"[All Fields] OR ("high"[All Fields] AND "blood"[All Fields] AND "pressure"[All Fields]) OR "high blood pressure"[All Fields])) OR ("coronary artery disease"[MeSH Terms] OR ("coronary"[All Fields] AND "artery"[All Fields] AND "disease"[All Fields]) OR "coronary artery disease"[All Fields])) AND ("vietnam"[MeSH Terms] OR "vietnam"[All Fields])

Supplementary table-1: Quality score of the diabetes study

SI	Author name	Publication year	Target population a close representation of the national population	Sufficient sample size (n=500)	Random sampling	Ascertainment of HTN/DM measure	Quality assessment score
1	Tran Quang Binh et al	2015	1	1	1	1	4
2	Masami Miyakawa et al	2017	1	1	1	1	4
3	Duc Son LN et al	2004	1	1	1	1	4
4	Masami Miyakawa	2017	1	0	1	1	3
5	Vu DuyKien et al	2013	1	1	1	1	4
6	Ngoc Minh Pham et al	2015	1	1	1	1	4
7	N. B. Hoa et al	2018	1	1	1	1	4
8	Luc H Pham et al	2009	1	1	1	1	4
9	National Hospital of Endocrinology	2002	1	1	1	1	4
10	Le et al	2004	1	1	1	1	4
11	Do and Le et al	2008	1	1	1	1	4
12	Ta et al	2010	1	1	1	1	4
13	Tran et al	2012	1	1	1	1	4
14	National Hospital of Endocrinology	2012	1	0	1	1	3
15	Nguyễn DoãnThành	2008	0	0	0	0	0
16	Lê HoàngNinh	2014	0	1	1	1	3
17	Phạm VănBảo	2019	0	1	1	1	3
18	Nguyễn Quang Vinh	2014	0	1	1	1	3
19	Phạm Thị Lan Anh	2019	1	1	1	1	4
20	VũĐìnhTriển	2018	1	1	1	1	4
21	Nguyễn Bá Trí	2017	1	0	1	1	3
22	Võ Thị XuânHạnh	2017	0	1	0	1	2
23	HoàngĐứcHạnh	2016	0	1	1	1	3
24	Đỗ TháiHòa	2015	0	1	1	1	3
25	Nguyễn VănLành	2013	0	1	1	1	3
26	Nguyễn Thị Thị Thơ	2017	0	1	1	1	3
27	Đỗ TháiHoà	2014	1	1	1	1	4
28	Trần QuốcBảo	2013	0	1	1	1	3
29	VõThànhDanh	2017	0	1	1	1	3
30	Nguyễn VănLành	2018	0	1	1	1	3
31	Đặng HảiDăng	2016	0	1	1	1	3
32	Đỗ MạnhCường	2015	0	1	1	1	3
33	Dương Thị Hương	2013	0	1	1	1	3
34	Trần VănHải	2013	0	1	1	1	3
35	Đào Thị Minh An	2012	0	1	1	1	3
36	Đỗ MạnhCường	2011	0	1	1	1	3
37	Nguyễn Vinh Quang	2011	0	1	1	1	3
38	Doãn Thị Tường Vi	2011	0	1	1	1	3
39	HoàngĐặngMịch	2008	0	1	1	1	3
40	ViệnChỉnhChiến	2008	0	1	1	1	3
41	Đỗ Thị Tinh	2004	0	0	1	0	1
42	Tô VănHải	2003	0	1	1	1	3
43	Đỗ Thị Kim Liên	2003	0	1	1	1	3

Supplementary table-2: Quality score of the hypertension study

SI	Author name	Publication year	Target population a close representation of the national population	Sufficient sample size (n=500)	Random sampling	Ascertainment of HTN/DM measure	Quality assessment score
1	Luc H Pham et al	2009	1	1	1		4
2	Tran Quoc Cuong et al	2019	1	1	1		4
3	Jonathan Mwangi et al	2015	1	1	1		4
4	Nhon Bui Van et al	2018	1	1	1		4
5	Van Minh Hoang et al	2019	1	1	1		4
6	PT Son et al	2011	1	1	1		4
7	Ha T.P. Do et al	2014	1	1	1		4
8	Jonathan Mwangi et al	2015	1	1	1		4
9	Tran Quang Binh et al	2014	1	1	1		4
10	Hoang Van Minh et al	2007	1	1	1		4
11	Ngoc Minh Pham et al	2015	1	1	1		4
12	H Van Minh et al	2005	1	1	1		4
13	Masami Miyakawa et al	2017	1	1	1		4
14	Trần Thiện Thuận et al	2007	1	1	1		4
15	Võ Thị Dề et al	2007	1	1	1		4
16	Lê Quang Đạo et al	2011	1	1	1		4
17	Nguyễn Doãn Thành et al	2008	1	1	1		4
18	Vũ Bảo Ngọc et al	2005	1	1	1		4
20	Nguyễn Văn Thành et al	2013	1	1	1		4
21	Trần Văn Hương et al	2014	1	1	1		4
22	Lê Hoàng Ninh et al	2014	1	1	1		4
23	Nguyễn Ngọc Long et al	2019	1	1	1		4
24	Lâm Chí Cường et al	2019	1	1	1		4
25	Phạm Thị Lan Anh et al	2019	1	1	1		4
26	Võ Thị Xuân Hạnh et al	2017	1	1	1		4
27	Nguyễn Hóa et al	2017	1	1	1		4
28	Phạm Thế Xuyên et al	2017	1	1	1		4
29	Nguyễn Thị Thi Thơ et al	2017	1	1	1		4
30	Trần Minh Đức et al	2017	1	1	1		4
31	Đỗ Thái Hòa et al	2015	1	1	1		4
32	Hồng Mừng Hai et al	2015	1	1	1		4
33	Lê Thị Hương et al	2015	1	1	1		4
34	Đỗ Thái Hoà et al	2014	1	1	1		4
35	Chu Thị Thu Hà et al	2014	1	1	1		4
36	Nguyễn Hữu Tước et al	2014	1	1	1		4
37	Trần Quốc Bảo et al	2013	1	1	1		4
38	Viên Chinh Chiến et al	2008	1	1	1		4
39	Đỗ Thị Kim Liên et al	2003	1	1	1		4



PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	3
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and if available, provide registration information including registration number.	4
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	4
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	4
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	4
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I ²) for each meta-analysis.	4



PRISMA 2009 Checklist

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	4
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	NA
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	5
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICO, follow-up period) and provide the citations.	5
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	5-6
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	5-6
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	5-6
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	5-6
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	NA
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	7-8
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	7-8
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	7-8
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data; role of funders for the systematic review).	NA

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Type 2 Diabetes and hypertension in Vietnam: A systematic review and meta-analysis of studies between 2000 to 2020

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-052725.R1
Article Type:	Original research
Date Submitted by the Author:	30-Dec-2021
Complete List of Authors:	Biswas, Tuhin; University of Queensland, Tran, Nam; Institute for Social Science Research, University of Queensland 80 Meiers Rd, Indooroopilly, QLD, 4068, Australia Hoang, My Hanh ; Health Strategy and Policy Institute, Vietnam Ministry of Health Phan, Hong Van; Health Strategy and Policy Institute, Vietnam Ministry of Health Pham, Van Hien; Health Strategy and Policy Institute, Vietnam Ministry of Health Nguyen, Cuc ; Health Strategy and Policy Institute, Vietnam Ministry of Health Lane 196, Ho Tung Mau St, CauGiay District, Hanoi, Vietnam Khuong, Anh Tuan ; Health Strategy and Policy Institute, Vietnam Ministry of Health Tran, Mai Oanh ; Health Strategy and Policy Institute, Vietnam Ministry of Health Mamun, Abdullah; University of Queensland, School of Population Health
Primary Subject Heading:	Epidemiology
Secondary Subject Heading:	Cardiovascular medicine, Epidemiology, Health policy, Health services research
Keywords:	Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, DIABETES & ENDOCRINOLOGY, Hypertension < CARDIOLOGY, Ischaemic heart disease < CARDIOLOGY

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Type 2 Diabetes and hypertension in Vietnam: A systematic review and meta-analysis of studies between 2000 to 2020

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ABSTRACT

Objectives The objective of this study was to determine the level of type 2 diabetes (T2DM) and hypertension (HTN) in Vietnam and to assess the trend and recommend the future direction of prevention research efforts.

Design We searched scientific literature, databases including PubMed, EMBASE, CINAHL and Google Scholar; grey literature and reference lists for primary research published, nation database websites between 1 January 2000 and September 30, 2020. We adapted the modified Newcastle Ottawa scale for assessing the quality of the study, as recommended by the Cochrane Collaboration.

Results In total 83 studies met our inclusion criteria, representing data of approximately 239,034 population of more than 15 years of age in Vietnam. The findings show that prevalence rates varied widely across studies, from 1.0% to 29.0% for T2DM and 2.0% to 47.0% for HTN. For the total study period, pooled prevalence of T2DM and HTN in Vietnam for all studies was 6.0% (95% CI: 5.0-8.0%) and 24% (95% CI: 19-30%) respectively. Prevalence rate of both T2DM and HTN were higher among the male population compared to female counterpart.

Conclusion There is evidence of a rising trend of HTN and T2DM prevalence in Vietnam. Future research should focus on the major drivers, incidence, and prognosis of T2DM and HTN. Policy approaches should be developed that the counter T2DM and HTN. In our study we included both English and Vietnamese language articles and seems that majority of the articles came from Vietnamese language.

Strengths and limitations of this study

- This is the first systematic review and meta-analysis on Type 2 diabetes and hypertension in Vietnam that collected data and documents over 20 years.
- This is also the first review combining available documents published in both English and Vietnamese languages across domestic and international databases.
- The study reported that prevalence of Type 2 diabetes and hypertension among adult population in Vietnam increased over the time.
- While the current study followed the MOOSE guideline, findings from the review were heterogeneous in nature due to the study design, the outcome measurement, and the potential biases in identified documents. Additionally, the estimate prevalence by sex, ethnicity, and place of residence were not provided due to the data limitation.

Introduction:

Globally, the Non Communicable Diseases (NCDs) have become the leading cause of death[1]. Due to the high number of deaths, non-communicable diseases[2], including cardiovascular diseases, diabetes, cancer, and chronic respiratory diseases, have appeared as key public health challenges worldwide[3]. As a result NCDs are included in Sustainable Development Goal (SDG) target 3.4, to by “2030 reduce by one third premature mortality from NCDs through prevention and treatment and promote mental health and wellbeing”[2, 4]. NCD mortality rate which was high in low middle-income countries (LMICs), nearly three-quarters of NCD deaths occurred in LMICs, expected to increase by 20% in coming years[5]. Due to the increasing prevalence of fast-food consumption and food insecurity [6-8] , population of LMICs have a higher ability to purchase high caloric foods which are associated with higher intake of calories and fat. Such fast-food consumption and food insecurity are responsible for increase in the prevalence of diabetes, hypertension and other NCDs in LMICs. It is estimated that this condition is likely to increasing.

Like other LMICs Vietnam has recently been facing the challenge of NCDs. The number of deaths due to NCDs in Vietnam rose from 296,900 in 2000 to 371,600 in 2010 and 424,000 in 2016[9]. NCD were estimated to account for 73% of all deaths in Vietnam in 2014 [10] and 77% in 2016[11]. Of NCDs cardiovascular diseases (CVDs) represented 31%¹ of all deaths in 2016; hypertension, one of main risk factors for CVDs, accounted for 21% of all deaths in the country[12]. It was estimated in 2016 that about 17% people aged 30-70 in Vietnam will suffer a premature death due to one of four common NCDs (cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes)[13].

The gross domestic product (GDP) per capita was increased gradually in Vietnam which is directly linked to increased behavioural risk factors for NCDs such as the harmful use of alcohol, unhealthy diets, and physical inactivity[3, 14]. NCD risk factor survey in Vietnam (2015) revealed high prevalence of NCD risk factors among the adult population. For example prevalence of overweight/obesity (BMI \geq 25) was 15.6%, hypertension (SBP \geq 140 and/or DBP \geq 90 mmHg or on medication) was 18.9%, raised cholesterol was 30.2%, physical inactivity 28.1%, lack of vegetable/fruit consumption 57.2%; the average population salt intake per day was 9.4 grams, which was almost double the WHO recommendation[15]. These behavioural risk factors play a vitalrole of rising chronic disease burden including cardiovascular diseases (CVD) and diabetes.

Over the past two decades, The Government of Viet Nam has a number of policies, strategies, plans, and programmes responding to NCDs. Two national programs were implemented for the period 2002 – 2010 and 2012 – 2015 focusing on four disease groups of cardiovascular diseases, diabetes, cancers, and mental and neurological disorders[13] and covering a component project of prevention and control of some dangerous diseases which included some specific NCDs. Despite the efforts these programs did not have expected achievements due to lack of inter-sectoral coordination and direction for NCDs prevention as well as evidence-based research. An updated National Strategy on Prevention and Control of NCDs for the period of 2015-2025 which followed the WHO Global NCD Action plan 2013-2020 was developed in 2015, providing a strong basis for NCD prevention and control in Viet Nam. Under the revised program, the prevention and control of some dangerous infectious diseases and some common NCDs was included as a project component[16].

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In addition to these national policies and programs targeting on HTN and T2DM, over the last few decades, a number of studies have been undertaken in Vietnam to measure the prevalence of HTN and T2DM but none have assessed trend of T2DM and HTN except for a 2001-2009 time trends analysis which showed an annual increase of HTN prevalence of 0.9%. Two reviews on prevalence of HTN and T2DM among adult population in Vietnam were published recently, yet these studies had their own limitations as (i) they were carried out based upon literature available in English[17]; (ii) the review employed only surveys which were conducted by a research institute, therefore the results may have some bias ; (iii) meta-analysis was not implemented to produce the pool estimation[18]; and (iv) they are out of date assessment with regard to the rapid change of T2DM and HTN. There is a need for an updated systematic review and meta-analysis. It is important for both health professionals and policy makers to better understand the trends of T2DM and HTN to develop effective policies and programmatic interventions. In this review, we conducted a systematic review and meta-analysis to comprehensively (1) determine the extent of research that has been done for HTN and T2DM, and (2) to assess the trend and recommend the future direction of prevention research efforts.

Methods:

We followed the Meta-analyses Of Observational Studies in Epidemiology (MOOSE) guidelines to identify studies [19]. The protocol was registered at the international prospective register of systematic reviews (PROSPERO; CRD42020182959). We followed the guidelines for meta-analyses and systematic reviews outlined by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (supplementary file).

Search strategy

We used the PICOS criteria to define the research question (**Table-1**)[20]. Our search included studies published from January 1, 2000, to September 30, 2020 in both English and Vietnamese languages. We used a number of different search engines: PubMed, EMBASE, CINAHL, Google Scholar, Google and national website and database including The Database of National Agency for Science and Technology Information (vista.gov.vn) and some Vietnamese journals in the field which are not included in the database.. A full description of the electronic search strategy is available in the **Appendix 1**. The keywords used in the search were “diabetes”, “diabetes mellitus”, “non-insulin dependent diabetes mellitus”, “NIDDM”, “type 2 diabetes”, “cardiovascular disease”, “CVD”, “myocardial infarction”, “ischemic heart disease”, “hypertension”, “high blood pressure”, “coronary artery disease”, “Vietnam”, “đái tháo đường”, “tiểu đường”, “tăng đường huyết”, “tăng huyết áp” “cao huyết áp”. We limited the search to studies that only involved human participants. We screened the studies using the following inclusion criteria: (1) had prevalence or incidence data available on either hypertension or T2DM, (2) had selected a sample included those who are Vietnamese and are living in Vietnam, and (3) had published results between January 1, 2000, to September 30, 2020. Once we identified the eligible studies, we made further exclusions based on sample, study design, and publication type.

Inclusion and exclusion criteria

Studies eligible for inclusion met the following criteria: primary or secondary data, published in the English and Vietnamese languages, conducted in humans, studies that provide an estimate of prevalence of either hypertension or T2DM and population age group 15 years or older. Studies were excluded if: (1) were reported in reviews, qualitative studies, editorials, abstracts, theses, books, case reports and letters to the editor; (2) the study had participants with type 1 diabetes, GDM, (3) only on the elderly (60 year old and over) and (4) studies employed RCT designs. Hypertension was defined as raised blood pressure was defined as an average (based on STEPS rule) systolic blood pressure (SBP) ≥ 140 mmHg and/or average diastolic blood pressure (DBP) ≥ 90 mmHg and/or self-reported current medication for high blood pressure in the previous two weeks. T2DM was defined fasting plasma glucose ≥ 7 mmol/L (≥ 126 mg/dL) or self-reporting having been diagnosed by a health professional.

Data extraction and quality assessment

Data extraction was carried out by at least two independent reviewers following a piloted version of the Cochrane Effective Practice and Organization of Care Group (EPOC) guidelines[19]. They completed a standard data extraction form, summarizing the study design and other relevant data for each article, including author name, sample size, survey year and reference standard. (**Table-1 and 2**). One article did not report survey year, publication year was listed. The main outcomes were prevalence of T2DM and hypertension.

All meta-analyses were performed using MetaXL version 1.4[21]. We calculated pooled prevalence of T2DM and hypertension. In addition, we also assessed the pooled prevalence of T2DM and hypertension by year interval and sex. We also assessed publication bias using both a graphical (Doi plot) and quantitative [Luis Furuya-Kanamori (LFK) index] examination for potential small-study effects[22]. The methodology that we followed for the meta-analysis was described in details by Neyeloff et al.[23]. Briefly, for each study, we calculated the following variables: 1) standard error of the prevalence, 2) variance, 3) study weights (inversed variance), 4) study weight*prevalence estimate, 5) study weight* (prevalence estimate)² and 6) (study weight)². We used these variables to estimate Q (measure We adapted the modified Newcastle Ottawa scale for assessing the quality of the study, as recommended by the Cochrane Collaboration[24]. Four criteria were used to score studies as ‘high quality’ (4 points), ‘moderate quality’ (2-3 points), and ‘poor quality’ (0-1 points). Criteria included: target population a close representation of the national population (yes = 1, no = 0), sufficient sample size (yes = 1, no = 0), random sampling (yes = 1, no = 0) and ascertainment of T2DM and hypertension measure (yes = 1, no = 0). The cut-off for a sufficient sample size was set at 500 participants[25, 26].

Data analysis

of heterogeneity among studies) and I^2 (percent between-studies variability). Based on Q and I^2 values, we chose quality effects models to report pooled prevalence estimates (hypertension, T2DM) and the associated 95% confidence interval (CI) to minimize the heterogeneity. We followed the same procedures to calculate the pooled prevalence of T2DM and hypertension by time periods (2000-2004; 2005-2010; 2011-2015; 2016-2020) and sex. We checked for statistical heterogeneity and inconsistency using the Q and I^2 statistics, respectively.

Patient and Public Involvement

No patient involved

Result:

Study characteristics and quality

Our literature search yielded 4054 records. After exclusion of duplicates and review of titles and abstracts, articles were included for further evaluation. Of these full texts could not be found for 43 articles. The full text of the remaining 341articles were examined and a total of 259 articles excluded after abstract screening. We were unable to access the full text of these documents at the time we searched for relevant papers across databases. These papers were published in Vietnamese language. Of them, about two third were government funded- project reports which require fees for archived access; the remaining papers were not available on the Vietnamese journal websites. We included 82 articles in the final synthesis (**Figure-1**). These articles presenting data for 2,39,034 individuals. Out of these 44 articles reported prevalence of T2DM and 39 articles reported prevalence of hypertension. For T2DM all were cross sectional in nature (**Table-2**). Majority of the studies (92.4%) were community based and only three studies were facility based (7.6%). For hypertension all were cross sectional in nature (**Table-3**). Majority of the studies (90%) were community based and only four studies were facility based (10%). Quality score of each study presented in **supplementary table 1 and 2**. Majority of the articles came from Vietnamese language.

Estimation of prevalence rates

Prevalence rates varied widely across studies, from 1.0% to 29.0% for T2DM and 2.0% to 47.0% for hypertension. The pooled prevalence of T2DM and hypertension in Vietnam for all studies was 6.0% (95% CI: 5.0-8.0%) and 25% (95% CI: 19-31%) respectively (**Figure-2 and 3**).

Prevalence rates by year of study

To investigate T2DM and hypertension prevalence over time we arranged outcomes by time of study in four aggregated intervals i) 2000-2004, ii) 2005-2010, iii) 2011-2015 and iv) 2016-2020:

2000-2004

We included 9 studies from 2000-2004 in our analysis, 6 of these studies presented findings for T2DM[27-32] and 3for hypertension[31, 33, 34]. The pooled estimate of T2DM was 4.0% (95% CI: 2.0-6.0%), whereas for hypertension it was 17.0% (95% CI: 11.0-24.0%) (**Figure-2.2 and 3.2**).

2005-2010

Nineteen studies between 2005 and 2010 presented both prevalence of T2DM and hypertension in Vietnam in which ten studies [32, 35-43] presented prevalence of T2DM and ten studies focused on hypertension [35, 36, 39, 43-49]. The pooled estimate of T2DM was 5.0% (95% CI: 4.0-7.0%), whereas for hypertension it was 22.0% (95% CI: 18.0-26.0%) (Figure-2.2 and 3.2).

2011-2015

We identified thirty seven studies that presented findings for T2DM between the years 2011 and 2015. These resulted in a pooled estimate of T2DM 6.0% (95% CI: 4.0-9.0%) from twenty studies [38, 41-43, 50-61]. We identified 18 studies for the same period in Vietnam that presented findings for hypertension [27, 34, 35, 42, 43, 45, 47, 48, 52-54, 56, 60-64] resulting in a pooled estimate of 29% (95% CI: 17-42%).

2016-2020

For the most recent interval we identified eight studies [33, 46, 49, 50, 51, 55, 59] for T2DM in Vietnam with a pooled estimate of 10.0% (95% CI: 6.0-16.0%). We also identified eight studies [36, 46, 49, 50, 51, 55, 58, 59] for hypertension in the region with a pooled estimate of 24.0% (95% CI: 12.0-40.0%).

Gender specific prevalence

We identified six studies for type T2DM and nineteen for hypertension for use in gender specific prevalence analysis. Pooled estimate for T2DM slightly higher among the male (5.0%, 95% CI: 4.0-7.0%) compared than female (4.0%, 95% CI: 3.0-5.0%). For hypertension, pooled estimate also higher among the male (25.0%, 95% CI: 22.0-28.0%) compared than female (18.0%, 95% CI: 15.0-22.0%).

Discussion:

This is the first systematic evaluation and meta-analysis of the scientific literature on the pooled prevalence trend of T2DM and hypertension among the adult population in Vietnam. In our study we found the pooled prevalence of T2DM has increased around three times from 2000-2004 (3%) to 2016-2020 (9%). A systematic review study by Nguyen et al reported that prevalence estimates of T2DM were 2.7% in 2002 and 5.4% in 2012 [18]. To our knowledge this is the updated systematic review and meta-analysis paper on T2DM and hypertension in Vietnam. The growing trend of T2DM in Vietnam in the present review is consistent with secular trends in several Asian countries such as China [65], India [66], Sri Lanka and Bangladesh [67] where researchers also observed the similar magnitudes of a 10-year increase in T2DM prevalence. It is already well known that older age, urban residence, overweight, increased central adiposity, and physical inactivity, genetic factors, hypertension, and high intake of animal protein may contribute to enhanced diabetes [18]. In our study due to data limitation we were not able to assess the major drivers of T2DM in Vietnam however we expect Vietnam shares similar characteristics like others in LMICs.

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The pooled analysis from this study found that the prevalence of hypertension has increased dramatically in Vietnam since 2000-2004. Another systematic review and meta-analysis study Meiqari et al reported that pooled prevalence of measured hypertension in Vietnam was 21.1%[17]. In that study they included the only English language studies but in our study we included both English and Vietnamese studies, which we believe it gives a proper scenario of hypertension in Vietnam. A review study by Hoy et al reported that high blood pressure is common among the Vietnamese population and they had knowledge that they have high blood pressure may be low[68].

The main strength of current study is that we followed a systematic and comprehensive approach to identify studies on both T2DM and hypertension following MOOSE guidelines and a registered protocol (CRD42020182959). Risk of bias was assessed using well-established criteria. Within the study we also investigated the sex specific prevalence and as well as time trend. The main weakness of this study comes from the research this review identified. Although the majority of studies included in this review were graded as moderate to high quality, many were cross-sectional in nature and followed a survey-based approach. In addition, findings of this study were extremely heterogeneous in nature, not only in study design and data collection, but also in outcome. To minimize the heterogeneity we chose quality effect model, which is now well established. As with all systematic reviews there is the potential for publication bias in the identified studies, with some not initially designed to report on the T2DM and hypertension. The reference standards for determining T2DM and hypertension was not consistent between all studies. In addition, although we attempted to estimate prevalence by sex and also factors associated with T2DM and hypertension but insufficient studies reported this information. Another limitation, we searched PubMed, EMBASE, CINAHL, Google Scholar, Google and national website and database. There may be some other relevant data base we may missed it. But in our study, we included articles from Vietnamese journals. Moreover, information on certain groups, such as ethnicity and place of residence were not available in enough studies to be included in sub-group analysis.

Although an adequate number of T2DM and hypertension prevalence studies have been conducted, they were mostly reported the overall prevalence. Little data exist on the place of residence specific, education specific, wealth index and geographic location specific prevalence of T2DM and hypertension. We did not find any longitudinal cohort studies on T2DM and hypertension. This is a significant gap in the knowledge and understanding of these chronic diseases in the context of Vietnam. Such studies would provide essential information on the incidence of these diseases, their associated risk factors, and the groups that are at higher risk of developing them. Further, longitudinal data are necessary to understand disease progression and prognosis.

Conclusion

We found increase in the prevalence T2DM and hypertension among the adult population in Vietnam over the study period. We also found T2DM and hypertension higher among the male compared than female. Future research should investigate the driving force behind the increasing rates of T2DM and hypertension and explain the major drivers in both conditions. Policy approaches should be developed that the counter the T2DM and hypertension, with interventions to combat T2DM and hypertension.

Acknowledgement The authors are grateful for the generous and helpful comments of the reviewers. We acknowledge the important support of The University of Queensland (UQ) Global Strategy and Partnership Seed Funding Scheme 2018 and The Institute for Social Science Research for strengthening the collaboration between UQ researchers and Vietnamese researchers. We also acknowledge the Australian Government through the Australian Research Council's Centre of Excellence for Children and Families over the Life Course (Project ID CE200100025).

Contributors All authors made a substantial contribution to this work. NT, AM, and MOT conceptualised the review. NT, TB, MOT, and AM designed the research. TB, NT, MHH, HVP, VHP, CN, and ATK collected data, read, screened abstracts and titles of potentially relevant studies and took responsibilities for extracting data and rating their quality independently. TB and NT analysed and interpreted the data. TB, NT, and AM drafted manuscript with all the authors critically reviewing it and suggesting amendments prior to submission.

Funding This research received no specific grant from any funding body for publication.

Competing interests None declared.

Patient consent Not required.

Data sharing statement All data are available within the appendices.

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2 **Table 1: PICOS criteria for inclusion and exclusion of studies**

Parameter	Inclusion criteria	Exclusion criteria
Population	Those were of age ≥ 15 years	< 15
Intervention/exposure	Collection of data on T2DM and hypertension sociodemographic factors	Lack of data on T2DM and hypertension
Comparator	T2DM and hypertension status of Vietnamese adult	Lack of data on T2DM and hypertension
Outcome	Prevalence of T2DM and hypertension	No reported prevalence measure
Study design	Observational study Cross-sectional study Cohort study	Editorial Methodological article

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Table-2: Summary of the reported prevalence rate of diabetes in Vietnam (2000-2020)

SI	Author name	Publication year	Study conducted	Community /hospital based	Reference standard	Study design	Sample size	Age range	Prevalence of diabetes
1	Tran Quang Binh et al [69]	2015	2010	Community	The World Health Organization and International Diabetes Federation diagnostic criteria	Cross-sectional	892	35-70	7.60%
2	Masami Miyakawa et al [70]	2017	2014	Community	Elevated fasting plasma glucose (FPG) level ≥ 7.0 mmol/L (126 mg/dL) or random elevated plasma glucose level ≥ 11.1 mmol/L (200 mg/dL); or 3) history of treatment for DM (lifestyle guidance including diet or exercise advice, oral medication, or insulin).	Cross-sectional	376	20-70	7.20%
3	Duc Son LN et al [71]	2004	2001	Community	NM	Cross-sectional	2932	≥ 15	6.6
4	Tran Quang Binh et al [72]	2014		Community	The glycemic status was classified as normal glucose tolerance (NGT) when FPG < 5.6 mmol/L and 2-h PG < 7.8 mmol/L.	Cross-sectional	2443	48-57	14.30%
5	Vu DuyKien et al [73]	2013	2013	Community	NM	Cross-sectional	3736	NM	11%
6	Ngoc Minh Pham et al [74]	2015	2011-2013	Community	Diabetes was diagnosed when FPG was ≥ 7.0 mmol/L (126 mg/dL) or 2-h post OGTT ≥ 11.1 mmol/L (200 mg/dL)	Cross-sectional	16282	30-69	6.00%
7	N. B. Hoa et al [75]	2018	2016	Facility-based	American Diabetes Association	Cross-sectional	870	>15	13.9%
8	Luc H Pham et al [76]	2015	2009	Community	Based on STEPS rule	Cross-sectional	1978	25- 64	1.00%
9	National Hospital of Endocrinology [29]	2002	2002	Hospital	WHO 1998: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L	Cross-sectional	9122	30-64	2.7
10	Le et al [77]	2004	NM	Community	WHO 1998/ADA 1997: fasting plasma glucose ≥ 7 mmol/L or using	Cross-sectional	2932	>15	3.8
11	Do and Le et al [78]	2008	NM	Community	WHO 1998: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L or self-report	Cross-sectional	1456	30-69	7.0
12	Ta et al [79]	2010	NM	Community	WHO 1998: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L	Cross-sectional	2142	30-64	4
13	Tran et al [80]	2012	NM	Community	WHO 1998: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L or self-report	Cross-sectional	2710	40-64	3.7
14	National Hospital of Endocrinology[39]	2012	NM	Hospital	WHO 1998: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L	Cross-sectional	11 191	30-69	5.4
15	Nguyen, D.T., et al [81]	2008	2008	Workplace	NM but not self-report	Cross-sectional	383	NM	2%
16	Le, H.N., et al [82]	2014	2011	Community	NM but not self-report	Cross-sectional	1401	40+	9.30%
17	Pham, V.B. and Truong, Q.D [83]	2019	2018	Community	Decision 3319/QĐ-BYT, 19/7/2017 – MOH	Cross-sectional	3000	30-69	6.50%
18	Nguyen, Q.V. and Le, N.N [84]	2014	2014	Community	NM but not self report	Cross-sectional	5190	21-70	4.2%
19	Pham, T.L.A., Khuong, V.D., and Pham, Q.C. [85]	2019	2014-2015	workplace	Elevated fasting plasma glucose (FPG) level ≥ 7.0 mmol/L	Cross-sectional	1,595	NM	5.50%
20	Vu, D.T. and Dang, B.T. [86]	2018	2017	Community	capillary blood glucose by Accu-Chek- D10-BIORAD: 2h-OGTT ≥ 11.1 mmol/L= diabetes; OGTT from 7.8-11.0= abnormal ; WHO-IDF 2008 updated 2010: The glycemic status was classified as abnormal when FPG range 5.6-6.9 mmol/L; FPG ≥ 7 mmol/L= diabetes	Cross-sectional	1.450	≥ 25	6.5
21	Nguyen, B.T., et al [87]	2017	2016	Community	Diabetes prevention and control Project, National Institute of Endocrinology; using Onetouchverio machine (Johnson & Johnson)	Cross-sectional	400	45-69	3.5
22	Vo, T.X.H., et [88]	2017	2015-2016	Community	ADA 2005: fasting plasma glucose ≥ 7 mmol/L (≥ 126 mg/dL) or self-reporting having been diagnosed by a health professional	Cross-sectional	758	≥ 40	14.5
23	Hoang, D.H., et al [89]	2016	2014	Community	FPG and post OGTT : fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L (MoH 2011); OGTT: FPG < 7 mmol/L and 2h-OGTT ≥ 7.8 - 11.1 mmol/L or normal but self-report having been diagnosed	Cross-sectional	2402	30-69	7.9
24	Do, T.H., et al [90]	2015	2013	Community	FPG and post OGTT (WHO 1999: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L or self-report and MoH 2011)	Cross-sectional	1200	40-59	5.3
25	Nguyen, V.L. and Nguyen, V.T. [91]	2013	2011	Community	ADA/WHO 2010: fasting plasma glucose 100-126mg/dl or 2h-OGTT from 140-200mg/dl or HbA1c $\geq 6.5\%$	Cross-sectional	1100	≥ 45	11.9
26	Nguyen, T.T.T., Nguyen, T.Q., and Nguyen, N.C. [92]	2017		Community	WHO STEPS: fasting blood glucose values >6.1 mmol/L or taking medications for diabetes; measured fasting blood glucose by Cardiocheck PA	Cross-sectional	2440	18-69	6.7
27	Do, T.H., et al [93]	2014	2013	Community	MoH 2011 on screening diabetes in community	Cross-sectional	1200	40-59	16.6

28	Tran, Q.B., et al [94]	2013	2009	Community	WHO- STEPS: fasting blood glucose values \geq 6.1 mmol/L) or on diabetes medication or having diagnosed by a health professional	Cross-sectional	1714	25-64	4.7
29	Vo, T.D, and Pham, T.T, [95]	2017	2015-2016	community	NM but not self-report	Cross-sectional	1114	>40	16.10%
30	Nguyen, V.L [96]	2018	2015-2016	community	NM but not self-report	Cross-sectional	1250	18-55	16.20%
31	Dang, H.D and Nguyen, V.L, [97]	2016	2012	community	NM but not-self report	Cross-sectional	2700	>20	5.80%
32	Do, M.C [98]	2015	2012	community	Diabetes was diagnosed when FPG was \geq 7.0 mmol/L or 2-h post OGTT \geq 11.1 mmol/L	Cross-sectional	3500	30-96	3.10%
33	Duong, T.H, [99]	2013	2011	community	WHO 2006	Cross-sectional	2000	30-69	4.30%
34	Tran, V.H., and Dam, V.C, [100]	2013	2011	community	WHO (not mentioned the year)	Cross-sectional	2400	30-64	10.30%
35	Dao, T.M.A., Tran, M.L., and Tran, T.P.N., [101]	2012	2010	community	WHO 1999	Cross-sectional	3100	all age	9.35%
36	Do, M.C., and Nguyen, T.H, [102]	2011	2010	community	OMS 1999, ADA 2005	Cross-sectional	3500	30 - 69	6.10%
37	Nguyen, V.Q., and Pham, T.H, [103]	2011	2010	community	NM but not self-report	Cross-sectional	1855	30-60	4.40%
38	Dzoan, T.T.V [104]	2011	2011	hospital based	Diabetes was diagnosed when FPG was \geq 7.0 mmol/L or 2-h post OGTT \geq 11.1 mmol/L	Cross-sectional	2358	30-60	3.60%
39	Hoang, D.M, [105]	2008	2005-2007	community	American diabetes association 1998	Cross-sectional	1335	18-70	3.1
40	Vien, C.C., and Phung, T.T.T, [106]	2008	2008	community	NM but not self-report	Cross-sectional	1620	18-60	2.60%
41	Do, T.T., [107]	2004	2000	community	WHO 1999	Cross-sectional	212	\geq 16	1.42%
42	To, V.H., Vu, M.H., and Nguyen, V.H, [108]	2003	May 2000 - Sep 2000	community	Diabetes was diagnosed when FPG was \geq 7.0 mmol	Cross-sectional	2017	\geq 16	3.62
43	Do, T.K.L., et al [109]	2003	March 2002 - December 2002	community	Diabetes (WHO 1999)	Cross-sectional	890	40-60	6.10%

Table-3: Summery of the reported prevalence rate of hypertension in Vietnam (2000-2020)

SI	Author name	Publication year	Study conducted	Community/hospital based	Reference standard	Study design	Sample size	Age range	Prevalence of hypertension
1	Luc H Pham et al [76]	2009	2015	Community	Raised blood pressure was defined as an average (based on STEPS rule) systolic blood pressure (SBP) ≥ 140 mmHg and/or average diastolic blood pressure (DBP) ≥ 90 mmHg and/or self-reported current medication for high blood pressure in the previous two weeks	Cross-sectional	1978	25–64	18.9
2	Tran Quoc Cuong et al [110]	2019	2019	Community	Systolic/diastolic blood pressure $\geq 140/90$ mmHg or using antihypertensive medication.	Cross-sectional	2203	≥ 18	24.3
3	Nhon Bui Van et al [63]	2018	2017	Community	HTN was specified that SBP was 140 mmHg or higher and/or DBP was 90 mmHg or higher, if the medications used to treat HTN were used by the individuals for 2 weeks. ISH having a SBP ≥ 140 mmHg and DBP < 90 mmHg was used to diagnose.	Cross-sectional	675	≥ 18	47.3
4	Van Minh Hoang et al [111]	2019	2015	Community	Raised blood pressure was defined as an average (based on STEPS rule) systolic blood pressure (SBP) ≥ 140 mmHg and/or average diastolic blood pressure (DBP) ≥ 90 mmHg and/or self-reported current medication for high blood pressure in the previous two weeks.	Cross-sectional	3,856	18–69	18.9
5	PT Son et al [112]	2011	2002	Community	Defined as BP $\geq 140/90$ mm Hg	Cross-sectional	9832	≥ 25	25.1
6	Ha T.P. Do et al [113]	2014	2005	Community	Hypertension was defined as systolic BP (SBP) ≥ 140 mm Hg and/or diastolic BP (DBP) ≥ 90 mm Hg and/or self-reported current use of antihypertensive medication.	Cross-sectional	17,199	25–64	20.7
7	Tran Quang Binh et al [72]	2014	NM	Community	systolic blood pressure ≥ 130 mmHg or diastolic blood pressure ≥ 85 mmHg or hypertension;	Cross-sectional	2443	48-57	14.3
8	Hoang Van Minh et al [63]	2007	2005	Community	systolic blood pressure (SBP) was at least 140 mm Hg, their diastolic blood pressure (DBP) was at least 90 mm Hg, or they were being treated for hypertension	Cross-sectional	2000	25 to 64	18.8
10	Ngoc Minh Pham et al [114]	2015	2011-2013	Community	Hypertension was defined as systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg or current use of antihypertensive medication	Cross-sectional	5602 men and 10,680 women	30–69	47.0
11	H Van Minh et al [63]	2005	2002	Community	Hypertensive subjects were defined as those with systolic blood pressure (SBP) equal to or more than 140 mmHg or diastolic blood pressure (DBP) equal to or more than 90 mmHg or those being treated for hypertension	Cross-sectional	2000	25–64	14.1
12	Masami Miyakawa et al [70]	2017	2014	Community	Hypertension was defined as elevated blood pressure (BP), with systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg	Cross-sectional	376	20-70	15
13	Tran, T.T., [115]	2007	2005	Community	JNC VII (2003)	Cross-sectional	1991	25-65	26.5
14	Vo, T.D., and Dang, V.P, [116]	2007	2005	Community	JNC VII	Cross-sectional	1288	25 +	28.4
15	Le, Q.D., and Nguyen, D.N, [117]	2011	2010	Community	systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg	Cross-sectional	1991	25-64	16.0
16	Nguyen, D.T., et al [81]	2008	2008	Community (workplace)	NM but not self-report	Cross-sectional	383	NM	16.0
17	Vu, B.N., et al [118]	2005	2004	Community	systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg	Cross-sectional	2366	18+	21.8
18	Nguyen, V.T., et al [119]	2013	2013	Hospital based	NM but not self-report	Cross-sectional	379	NM	13.3
19	Tran, V.H., and Nguyen, D.Q, [120]	2014	2012	Community	systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg	Cross-sectional	872	25-64	15.0
20	Le, H.L., et al [82]	2014	2011	Community	Decision 3192/QĐ-BYT dated 31/8/2010, Vietnam Ministry of Health	Cross-sectional	1401	40+	30.6

21	Nguyen, N.L., [121]	2019	2016-2018	Hospital based	NM but not self-report	Respective	65	NM	49.2
22	Lam, C.C., and Lam, C.Q., [122]	2019	2012-2018	Community	National hypertension program: systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	10188	\geq 40	22.2
23	Pham, T.L.A., Khuong, V.D., and Pham, Q.C., [85]	2019	2014-2015	Community (workplace)	NM (systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg)	Cross-sectional	1,595	NM	15.4
24	Vo, T.X.H., et al [88]	2017	2015-2016	Community	systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg or reporting having diagnosed and on medication by a health professional	Cross-sectional	1153	\geq 18	33.8
25	Nguyen, H., Do, I.T., and Ton, T.T., [123]	2017	2011-2015	Community (	MoH 2010, systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	20000	\geq 25	28.5
26	Pham, T.X., et al [124]	2017	2014	Community	STEPS, systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	459	45-64	35.5
28	Nguyen, T.T.T, Nguyen, T.K.A., and Nguyen, N.C., [125]	2017	2016	Community	systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	2699	18-69	18.97
29	Tran, M.D., et al [126]	2017	2016	workplace	NM but not self-report	Cross-sectional	1930	NM	2.3
30	Do, T.H., et al [90]	2015	2013	Community	JNC7, MoH 2010, systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	1200	40-59	19.7
31	Hong, M.H., [127]	2015	2013	Community	NM (must be systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg be because this was a baseline survey of an intervention with control group)	Cross-sectional	1619	\geq 25	20.7
32	Le, T.H., et al [128]	2015	2013	Community	WHO-Systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg ;	Cross-sectional	800	\geq 18	16.8
33	Do, T.H., et al [93]	2014	2012	Community	JNC-7 - Systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg ;	Cross-sectional	1200	40-59	19.7
34	Chu, T.T.H., [129]	2014	2014	Community	MOH, 2010: 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	2085	\geq 25	18.0
35	Nguyen, H.T., [130]	2014	2011	Community	140 mmHg or diastolic blood pressure \geq 80 mmHg	Cross-sectional	1833	\geq 25	11.8
37	Tran, Q.B., et al [94]	2013	2009	Community	WHO- STEPS: 140 mmHg or diastolic blood pressure \geq 90 mmHg or on medication	Cross-sectional	1714	25-64	17.8
38	Vien, C.C., and Phung, T.T.T., [106]	2008	2008	community	NM but not self-report	Cross-sectional	1620	18-60	15.8
39	Do, T.K.L., et al [109]	2003	March 2002 - December 2002	community	Hypertension dianogsis ($>$ 140/90) Diabetes (WHO 1999)	Cross-sectional	890	40-60	12.7

Figure-1: Consort diagram: Search strategy and selection of studies included in this review

Figure-2: Pooled prevalence of diabetes in Vietnam

Figure-2.1: *Prevalence* diabetes in Vietnam *by year of study* (A: 2000-2004; B: 2005-2010; C: 2011-2015; D: 2016-2020)

Figure-2.2: Prevalence diabetes in Vietnam by male

Figure-2.3: Prevalence diabetes in Vietnam by female

Figure-3: Pooled prevalence of hypertension in Vietnam

Figure-3.1: *Prevalence* hypertension in Vietnam *by year of study* (A: 2000-2004; B: 2005-2010; C: 2011-2015; D: 2016-2020)

Figure-3.2: *Prevalence* hypertension in Vietnam *by male*

Figure-3.3: *Prevalence* hypertension in Vietnam *by female*

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References:

1. Bukhman, G., et al., *The Lancet NCDI Poverty Commission: bridging a gap in universal health coverage for the poorest billion*. The Lancet, 2020. **396**(10256): p. 991-1044.

2. Bennett, J.E., et al., *NCD Countdown 2030: worldwide trends in non-communicable disease mortality and progress towards Sustainable Development Goal target 3.4*. The Lancet, 2018. **392**(10152): p. 1072-1088.

3. Pham, B.D., et al., *Exposure to Messages on Risk Factors for Noncommunicable Diseases in a Rural Province of Vietnam*. 2019. **2019**.

4. Geldsetzer, P., et al., *Diabetes and hypertension in India: a nationally representative study of 1.3 million adults*. 2018. **178**(3): p. 363-372.

5. WHO, N.D.i.t.S.-E.A.R., India, 2011.

6. Farrell, P., et al., *How food insecurity could lead to obesity in LMICs: When not enough is too much: a realist review of how food insecurity could lead to obesity in low-and middle-income countries*. Health promotion international, 2018. **33**(5): p. 812-826.

7. Li, L., et al., *Fast food consumption among young adolescents aged 12–15 years in 54 low-and middle-income countries*. Global health action, 2020. **13**(1): p. 1795438.

8. Umberger, W.J., J.A. Rupa, and D. Zeng, *Understanding food westernisation and other contemporary drivers of adult, adolescent and child nutrition quality in urban Vietnam*. Public Health Nutrition, 2020. **23**(14): p. 2571-2583.

9. WHO, T.N.D.D.b.C., 2016, <http://www.who.int/gho/countries/vnm/en/>.

10. WHO, G.S.R.o.N.D., Geneva, Switzerland, 2014.

11. Girmu, T., T. Shumbej, and M. Shewangizaw, *Burden of malaria in Ethiopia, 2000-2016: findings from the Global Health Estimates 2016*. Tropical diseases, travel medicine and vaccines, 2019. **5**(1): p. 1-7.

12. <https://www.theguardian.com/healthcare-network/gallery/2018/may/17/high-blood-pressure-vietnam-world-hypertension-day#:~:text=Hypertension%20causes%20an%20estimated%2091%2C000>, V.h.

13. <https://www.who.int/nmh/publications/ncd-profiles-2018/en/>.

14. Van Bui, T., et al., *National survey of risk factors for non-communicable disease in Vietnam: prevalence estimates and an assessment of their validity*. 2016. **16**(1): p. 498.

15. MOH, N.S.o.R.F.o.N.i.V., Ministry of Health, Hanoi, Vietnam, 2016.

16. Thuy Duyen, N., et al., *Patterns of behavioral risk factors for non-communicable diseases in Vietnam: A narrative scoping review*. Health Psychology Open, 2020. **7**(2): p. 2055102920967248.

17. Meiqari, L., et al., *Prevalence of hypertension in Vietnam: a systematic review and meta-analysis*. Asia Pacific Journal of Public Health, 2019. **31**(2): p. 101-112.

18. Nguyen, C.T., et al., *Prevalence of and risk factors for type 2 diabetes mellitus in Vietnam: a systematic review*. Asia Pacific Journal of Public Health, 2015. **27**(6): p. 588-600.

19. Cochrane Effective Practice and Organisation of Care Group. Data collection checklist. 2015 [internet], c.A.A.f.h.e.c.o.s.e.

20. Hoque, M.E., et al., *Rapid shift toward overweight from double burden of underweight and overweight among Bangladeshi women: a systematic review and pooled analysis*. Nutrition reviews, 2015. **73**(7): p. 438-447.

21. Biswas, T., et al., *Double burden of underweight and overweight among women in South and Southeast Asia: a systematic review and meta-analysis*. Advances in Nutrition, 2020. **11**(1): p. 128-143.

22. Furuya-Kanamori, L., J.J. Barendregt, and S.A. Doi, *A new improved graphical and quantitative method for detecting bias in meta-analysis*. International journal of evidence-based healthcare, 2018. **16**(4): p. 195-203.

23. Neyeloff, J.L., S.C. Fuchs, and L.B. Moreira, *Meta-analyses and Forest plots using a microsoft excel spreadsheet: step-by-step guide focusing on descriptive data analysis*. BMC research notes, 2012. **5**(1): p. 1-6.
24. Higgins JPT, D.J., Altman DG, editors. Chapter 16: Special topics in statistics. In: Higgins JPT Green S. (eds). *Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0* (updated March 2011). The Cochrane Collaboration; 2011. Available from: www.handbook.cochrane.org.
25. Biswas, T., et al., *Double burden of underweight and overweight among women in South and Southeast Asia: a systematic review and meta-analysis*. 2020. **11**(1): p. 128-143.
26. Saquib, N., et al., *Cardiovascular diseases and type 2 diabetes in Bangladesh: a systematic review and meta-analysis of studies between 1995 and 2010*. 2012. **12**(1): p. 434.
27. Miyakawa, M., et al., Prevalence, perception and factors associated with diabetes mellitus among the adult population in central Vietnam: a population-based, cross-sectional seroepidemiological survey. BMC public health, 2017. **17**(1): p. 1-8.
28. Pham, L.H., et al., Prevalence of risk factors for non-communicable diseases in the Mekong Delta, Vietnam: results from a STEPS survey. BMC Public Health, 2009. **9**(1): p. 1-8.
29. National Hospital of Endocrinology . National program on diabetes control and prevention [in Vietnamese]. 1st ed. Hanoi, V.M.P., 2002.
30. Vien, C.C.a.T.T.T.P., Survey on overweight, hypertension, and diabetes among workers in middle region Vietnam. Journal of Employment Protection, 2008: p. 17 - 21.
31. Do, T.T., Prevalence of diabetes and decreased blood sugar in Tan Dan and Thai Son communes, An Lao district, Hai Phong. Vietnam Medical Journal, 2004. **11**: p. 128 - 132.
32. To, V.H., M.H. Vu, and V.H. Nguyen, Epidemiological survey on diabetes among population aged 16 and older in three districts in Hanoi. Vietnam Medical Journal, 2003. **6**: p. 58 - 64.
33. Do Nam, K., et al., Hypertension in a mountainous province of Vietnam: prevalence and risk factors. Heliyon, 2020. **6**(2): p. e03383.
34. Vo, T.D.a.V.P.D., Hypertension in Long An province in 2005: Prevalence and risk factors. Ho Chi Minh City Journal of Medicine and Pharmacy, 2007. **11**: p. 122 - 128.
35. Hoy, D., et al., Risk Factors for Chronic Disease in Viet Nam: A Review of the Literature Posted on January 18, 2013 by.
36. Le, N.T.D., L.D. Pham, and T.Q. Vo, Type 2 diabetes in Vietnam: a cross-sectional, prevalence-based cost-of-illness study. Diabetes, metabolic syndrome and obesity: targets and therapy, 2017. **10**: p. 363.
37. Do, T.a.N.L., Investigation for associated factors and epidemiology of type 2 diabetes in Hochiminh City [in Vietnamese]. Vietnam Journal of Food and Nutrition Sciences, 2008.
38. Ta, M., et al., Identification of undiagnosed type 2 diabetes by systolic blood pressure and waist-to-hip ratio. Diabetologia, 2010. **53**(10): p. 2139-2146.
39. 2012., N.H.o.E.N.p.o.d.c.a.p.i.V.n.e.H.M.P.
40. Pham, V.B.a.Q.D.T., Prevalence of diabetes and its related factors among people aged 30 - 69 in Binh Dinh province in 2018. Ho Chi Minh City Journal of Medicine and Pharmacy, 2019. **23**(5): p. 58 - 62.
41. Vo, T.X.H., et al., Prevalence of hypertension and diabetes among adults in Ho Chi Minh city - a community - based study in an urban district. Journal of Preventive Medicine, 2017. **27**(8): p. 79 - 87.
42. Hoang, D.H., T.T.H. Chu, and C.D. Bui, Prevalence of diabetes type 2 and prediabetes of people age 30 - 69 in Hanoi 2014. Journal of Preventive Medicine, 2016. **26**(2): p. 94 - 101.
43. Do, T.H., et al., Prevalence of hypertension, hyperglycemia and certain related factors in middle age group in Dong Son district, Thanh Hoa province 2013. Journal of Preventive Medicine, 2014. **24**(8): p. 30 - 36.

44. Dzoan, T.T.V., Some risk factors of diabetes type 2 in subjects aged 30 - 60 years in the hospital 198. *Journal of Food and Nutrition Sciences*, 2011. 7(1): p. 51 - 60.
45. Hoang, D.M., Studying on prevalence of diabetes in Hai Phong. *Vietnam Medical Journal*, 2008. 1: p. 1 - 4.
46. Hoa, N., et al., Prevalence and associated factors of diabetes mellitus among tuberculosis patients in Hanoi, Vietnam. *BMC infectious diseases*, 2018. 18(1): p. 1-9.
47. Tran, V.H.a.V.C.D., Research on diabetes and knowledge, practice on complication prevention of population 30 - 64 years old in Hau Giang province in 2011. *Journal of Practical Medicine*, 2013. 4: p. 23 - 27.
48. Dao, T.M.A., M.L. Tran, and T.P.N. Tran, Diabetes type II at age group of 30 - 69 in Nghe An population in 2010. *Journal of Medical Research*, 2012. 79(2): p. 186 - 193.
49. Do, M.C.a.T.H.N., Assessment prevalence of diabetes, glucose tolerance (IGT) and risk factors in the age 30 - 69 in suburbs Haoi city 2010. *Journal of Malaria and Parasite Diseases Control*, 2011. 4: p. 70 - 78.
50. Binh, T.Q., P.T. Phuong, and B.T. Nhung, Metabolic syndrome among a middle-aged population in the Red River Delta region of Vietnam. *BMC endocrine disorders*, 2014. 14(1): p. 1-9.
51. Nguyen, D.T., et al., Health situation and behavioural factors related to health of Saigon brewery workers in 2018. *Ho Chi Minh City Journal of Medicine and Pharmacy*, 2008. 12(4): p. 229 - 233.
52. Do, M.C., Research on the level of relevance between some risk factors and diabetes and glycemia disorder of people from 30 - 69 years old in three urban districts of Hai Phong in 2012. *Vietnam Journal of Medicine*, 2015. 2: p. 103 - 108.
53. Duong, T.H., Early Diagnosis of Diabetes and Glucose Disorder among Adults in Hai Phong 2011 *Vietnam Journal of Medicine*, 2013.
54. Nguyen, V.Q.a.T.H.P., Survey on prevalence of diabetes and prediabetes in Hai Hau distric, Nam Dinh province 2010. *Vietnam Medical Journal*, 2011. 1: p. 5 - 10.
55. Dao-Tran, T.H., et al., Factors associated with self-management among Vietnamese adults with type 2 diabetes. *Nursing open*, 2018. 5(4): p. 507-516.
56. Nguyen, V.L., Hypertension increase and its risk factors among labor- aged population in Hau Giang province in 2016. *Journal of Community Medicine*, 2018. 1(42): p. 84 - 91.
57. Dang, H.C.a.V.L.N., Prevalence of diabetes type 2 and its risk factors in Ca Mau province: solutions for management and prevention. *Journal of Community Medicine*, 2016. 32: p. 30 - 35.
58. Nguyen, T.T.T., T.Q. Nguyen, and N.C. Nguyen, Raised blood glucose situation among adults 18 - 69 years old in Hanoi 2016. *Journal of Preventive Medicine*, 2017. 27(6): p. 92 - 98.
59. Kien, V.D., et al., Socioeconomic inequalities in catastrophic health expenditure and impoverishment associated with non-communicable diseases in urban Hanoi, Vietnam. *International Journal for Equity in Health*, 2016. 15(1): p. 1-11.
60. Binh, T.Q.a.B.T.N., Prevalence and risk factors of type 2 diabetes in middle-aged women in Northern Vietnam. *International Journal of Diabetes in Developing Countries*, 2016. 36(2): p. 150-157.
61. Nguyen, Q.V.a.N.N.L., Prevalence and correlates of pre-diabetes, diabetes in some provinces in southern Vietnam: A cross-sectional study. *Ho Chi Minh City Journal of Medicine and Pharmacy*, 2014. 18(6): p. 451 - 457.
62. Do, T.T., *Diabetes prevalence and glucose decreased tolerance at Tan Dan & Thai Son communes, An Lao District-Hai Phong*. *Journal of Vietnamese Medicine*, 2004: p. 128-132.
63. Do Nam, K., et al., *Hypertension in a mountainous province of Vietnam: prevalence and risk factors*. *Heliyon*, 2020. 6(2): p. e03383.

64. Ramachandran, A., et al., Trends in prevalence of diabetes in Asian countries. *World journal of diabetes*, 2012. **3**(6): p. 110.
65. Zuo, H., Z. Shi, and A. Hussain, *Prevalence, trends and risk factors for the diabetes epidemic in China: a systematic review and meta-analysis*. *Diabetes research and clinical practice*, 2014. **104**(1): p. 63-72.
66. Ramachandran, A., et al., *Trends in prevalence of diabetes in Asian countries*. *World journal of diabetes*, 2012. **3**(6): p. 110.
67. Ramachandran, A., *Ching Wan Ma R, Snehalatha Chamukuttan, et al.* Diabetes in Asia. *The Lancet*, 2010. **375**: p. 408-18.
68. Hoy, D., et al., *Risk Factors for Chronic Disease in Viet Nam: A Review of the Literature Posted on January 18, 2013 by*.
69. Binh, T.Q. and B.T. Nhung, *Prevalence and risk factors of type 2 diabetes in middle-aged women in Northern Vietnam*. *International Journal of Diabetes in Developing Countries*, 2016. **36**(2): p. 150-157.
70. Miyakawa, M., et al., *Prevalence, perception and factors associated with diabetes mellitus among the adult population in central Vietnam: a population-based, cross-sectional seroepidemiological survey*. *BMC public health*, 2017. **17**(1): p. 1-8.
71. Duc Son, L., et al., *Prevalence and risk factors for diabetes in Ho Chi Minh City, Vietnam*. *Diabetic medicine*, 2004. **21**(4): p. 371-376.
72. Binh, T.Q., P.T. Phuong, and B.T. Nhung, *Metabolic syndrome among a middle-aged population in the Red River Delta region of Vietnam*. *BMC endocrine disorders*, 2014. **14**(1): p. 1-9.
73. Kien, V.D., et al., *Socioeconomic inequalities in catastrophic health expenditure and impoverishment associated with non-communicable diseases in urban Hanoi, Vietnam*. *International Journal for Equity in Health*, 2016. **15**(1): p. 1-11.
74. Pham, N.M. and K. Eggleston, *Diabetes prevalence and risk factors among Vietnamese adults: findings from community-based screening programs*. *Diabetes Care*, 2015. **38**(5): p. e77-e78.
75. Hoa, N., et al., *Prevalence and associated factors of diabetes mellitus among tuberculosis patients in Hanoi, Vietnam*. *BMC infectious diseases*, 2018. **18**(1): p. 1-9.
76. Pham, L.H., et al., *Prevalence of risk factors for non-communicable diseases in the Mekong Delta, Vietnam: results from a STEPS survey*. *BMC Public Health*, 2009. **9**(1): p. 1-8.
77. Le, N.T.D., L.D. Pham, and T.Q. Vo, *Type 2 diabetes in Vietnam: a cross-sectional, prevalence-based cost-of-illness study*. *Diabetes, metabolic syndrome and obesity: targets and therapy*, 2017. **10**: p. 363.
78. Do, T. and N. Le, *Investigation for associated factors and epidemiology of type 2 diabetes in Hochiminh City [in Vietnamese]*. *Vietnam Journal of Food and Nutrition Sciences*, 2008.
79. Ta, M., et al., *Identification of undiagnosed type 2 diabetes by systolic blood pressure and waist-to-hip ratio*. *Diabetologia*, 2010. **53**(10): p. 2139-2146.
80. Dao-Tran, T.H., et al., *Factors associated with self-management among Vietnamese adults with type 2 diabetes*. *Nursing open*, 2018. **5**(4): p. 507-516.
81. Nguyen, D.T., et al., *Health situation and behavioural factors related to health of Saigon brewery workers in 2018*. *Ho Chi Minh City Journal of Medicine and Pharmacy*, 2008. **12**(4): p. 229 - 233.
82. Le, H.N., et al., *The prevalence of non-communicable disease and its related factors among individuals aged 40 years and older living in Long Thuan commune, Ben Cau district, Tay Ninh province*. *Ho Chi Minh City Journal of Medicine and Pharmacy*, 2014. **18**(6): p. 746 - 754.
83. Pham, V.B. and Q.D. Truong, *Prevalence of diabetes and its related factors among people aged 30 - 69 in Binh Dinh province in 2018*. *Ho Chi Minh City Journal of Medicine and Pharmacy*, 2019. **23**(5): p. 58 - 62.

84. Nguyen, Q.V. and N.N. Le, *Prevalence and correlates of pre-diabetes, diabetes in some provinces in southern Vietnam: A cross-sectional study*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2014. **18**(6): p. 451 - 457.

85. Pham, T.L.A., V.D. Khuong, and Q.C. Pham, *Current situation of health and diseases of the traffic police between 2014 - 2015*. Journal of Preventive Medicine, 2019. **29**(3): p. 55 - 63.

86. Vu, D.T. and B.T. Dang, *The prevalence of type 2 diabetes in people aged ≥ 25 years in Thai Binh province 2017*. Journal of Preventive Medicine, 2018. **28**(7): p. 33 - 38.

87. Nguyen, B.T., et al., *Diabetes mellitus prevalence of people aged from 45 to 69 and some related factors in Sa Thay town, Sa Thay district, Kon Tum province 2016*. Journal of Preventive Medicine, 2017. **27**(8): p. 146 - 153.

88. Vo, T.X.H., et al., *Prevalence of hypertension and diabetes among adults in Ho Chi Minh city - a community - based study in an urban district*. Journal of Preventive Medicine, 2017. **27**(8): p. 79 - 87.

89. Hoang, D.H., T.T.H. Chu, and C.D. Bui, *Prevalence of diabetes type 2 and prediabetes of people age 30 - 69 in Hanoi 2014*. Journal of Preventive Medicine, 2016. **26**(2): p. 94 - 101.

90. Do, T.H., et al., *Actual situation on hypertension, diabetes and the health care requirement status among people of the middle-age group (from 40 - 59) at Dong Son district, Thanh Hoa province 2013*. Journal of Preventive Medicine, 2015. **25**(8): p. 381 - 390.

91. Nguyen, V.L. and V.T. Nguyen, *The rate of diabetes and some factors related to the Khmer ethnic minority people who are 45 years and over in Hau Giang province*. Journal of Preventive Medicine, 2013. **23**(6): p. 142 - 149.

92. Nguyen, T.T.T., T.Q. Nguyen, and N.C. Nguyen, *Raised blood glucose situation among adults 18 - 69 years old in Hanoi 2016*. Journal of Preventive Medicine, 2017. **27**(6): p. 92 - 98.

93. Do, T.H., et al., *Prevalence of hypertension, hyperglycemia and certain related factors in middle age group in Dong Son district, Thanh Hoa province 2013*. Journal of Preventive Medicine, 2014. **24**(8): p. 30 - 36.

94. Tran, Q.B., et al., *Steps survey on risk factors for non-communicable diseases in Can Tho city 2009 - 2010*. Journal of Preventive Medicine, 2013. **23**(5): p. 72 - 79.

95. Vo, T.D. and T.T. Pham, *Study on status of diabetes type 2 and assessment of intervention results on adults aged from 40 years old at My Xuyen, Soc Trang in 2015 - 2016*. Can Tho Journal of Medicine and Pharmacy, 2017. **9**: p. 138 - 145.

96. Nguyen, V.L., *Hypertension increase and its risk factors among labor- aged population in Hau Giang province in 2016*. Journal of Community Medicine, 2018. **1**(42): p. 84 - 91.

97. Dang, H.C. and V.L. Nguyen, *Prevalence of diabetes type 2 and its risk factors in Ca Mau province: solutions for management and prevention*. Journal of Community Medicine, 2016. **32**: p. 30 - 35.

98. Do, M.C., *Research on the level of relevance between some risk factors and diabetes and glycemia disorder of people from 30 - 69 years old in three urban districts of Hai Phong in 2012*. Vietnam Journal of Medicine, 2015. **2**: p. 103 - 108.

99. Duong, T.H., *Early Diagnosis of Diabetes and Glucose Disorder among Adults in Hai Phong 2011* Vietnam Journal of Medicine, 2013.

100. Tran, V.H. and V.C. Dam, *Research on diabetes and knowledge, practice on complication prevention of population 30 - 64 years old in Hau Giang province in 2011*. Journal of Practical Medicine, 2013. **4**: p. 23 - 27.

101. Dao, T.M.A., M.L. Tran, and T.P.N. Tran, *Diabetes type II at age group of 30 - 69 in Nghe An population in 2010*. Journal of Medical Research, 2012. **79**(2): p. 186 - 193.

102. Do, M.C. and T.H. Nguyen, *Assessment prevalence of diabetes, glucose tolerance (IGT) and risk factors in the age 30 - 69 in suburbs Hanoi city 2010*. Journal of Malaria and Parasite Diseases Control, 2011. **4**: p. 70 - 78.

103. Nguyen, V.Q. and T.H. Pham, *Survey on prevalence of diabetes and prediabetes in Hai Hau distric, Nam Dinh province 2010*. Vietnam Medical Journal, 2011. **1**: p. 5 - 10.
104. Dzoan, T.T.V., *Some risk factors of diabetes type 2 in subjects aged 30 - 60 years in the hospital 198*. Journal of Food and Nutrition Sciences, 2011. **7**(1): p. 51 - 60.
105. Hoang, D.M., *Studying on prevalence of diabetes in Hai Phong*. Vietnam Medical Journal, 2008. **1**: p. 1 - 4.
106. Vien, C.C. and T.T.T. Phung, *Survey on overweight, hypertension, and diabetes among workers in middle region Vietnam*. Journal of Employment Protection, 2008: p. 17 - 21.
107. Do, T.T., *Prevalence of diabetes and decreased blood sugar in Tan Dan and Thai Son communes, An Lao district, Hai Phong*. Vietnam Medical Journal, 2004. **11**: p. 128 - 132.
108. To, V.H., M.H. Vu, and V.H. Nguyen, *Epidemiological survey on diabetes among population aged 16 and older in three districts in Hanoi*. Vietnam Medical Journal, 2003. **6**: p. 58 - 64.
109. Do, T.K.L., et al., *A study on nutritional status, related factors and high blood glucoza level of adults aged 40 to 60 living in a center district of Hanoi city*. Vietnam Medical Journal, 2003. **9**: p. 78 - 84.
110. Quoc Cuong, T., et al., *Associated factors of hypertension in women and men in vietnam: A cross-sectional study*. International journal of environmental research and public health, 2019. **16**(23): p. 4714.
111. Hoang, V.M., et al., *Patterns of Raised Blood Pressure in Vietnam: Findings from the WHO STEPS Survey 2015*. International journal of hypertension, 2019. **2019**.
112. Son, P., et al., *Prevalence, awareness, treatment and control of hypertension in Vietnam—results from a national survey*. Journal of human hypertension, 2012. **26**(4): p. 268-280.
113. Do, H.T., et al., *National prevalence and associated risk factors of hypertension and prehypertension among Vietnamese adults*. American journal of hypertension, 2015. **28**(1): p. 89-97.
114. Pham, N.M. and K. Eggleston, *Prevalence and determinants of diabetes and prediabetes among Vietnamese adults*. Diabetes Research and Clinical Practice, 2016. **113**: p. 116-124.
115. Tran, T.T., *The influence factors involve knowledge and practice in adult about high blood pressure in Ho Chi Minh city 2005*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2007. **11**: p. 118-126.
116. Vo, T.D. and V.P. Dang, *Hypertension in Long An province in 2005: Prevalence and risk factors*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2007. **11**: p. 122 - 128.
117. Le, Q.D. and D.N. Nguyen, *The prevalence of hypertension and body mass index among adults aged 25 - 64 years at Lam Dong in 2010*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2011. **15**(3): p. 158 - 164.
118. Vu, B.N., et al., *Prevalence of hypertension among adults living in district 4 - Ho Chi Minh city 2004*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2005. **9**(1): p. 93 - 99.
119. Nguyen, V.T., et al., *Disease model in advanced bureaucrats who are monitored by the health care department of Long An province*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2013. **17**(3): p. 331 - 334.
120. Tran, V.H. and D.N. Nguyen, *Prevalence of hypertension and its risk behaviours at the population among 25 - 64 years old in Ninh Hai district, Ninh Thuan province*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2014. **18**(6): p. 709 -0716.
121. Nguyen, N.L., *Evaluating the effectiveness of management, protection and health care of cadres in Vinh Long province in 3 years 2016 - 2018*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2019. **23**(3): p. 124 - 129.
122. Lam, C.C. and C.Q. Lam, *The status of hypertension and relevance between risk factors with hypertension in people aged ≥40 years old at Ninh Hoa town, Khanh Hoa province, 2012 - 2018*. Journal of Preventive Medicine, 2019. **29**(6): p. 100 - 105.

123. Nguyen, H., I.T. Do, and T.T. Ton, *Prevalence trend of hypertension and risk factors of cardiovascular disease among people aged 25 and older in Da Nang city between 2011 and 2015*. Journal of Preventive Medicine, 2017. **27**(8): p. 55 - 64.

124. Pham, T.X., et al., *Reality of hypertension in aged of 45 - 64 year in Dien Bien district in 2014*. Journal of Preventive Medicine, 2017. **27**(7): p. 67 - 73.

125. Nguyen, T.T., T.K.A. Nguyen, and N.C. Nguyen, *Hypertension status among adults 18 - 69 years old in Hanoi 2016*. Journal of Preventive Medicine, 2017. **27**(6): p. 84 - 91.

126. Tran, M.D., et al., *Workers health conditions of the automobile and motorcycle brake manufacturing company in Vietnam in 2016*. Journal of Preventive Medicine, 2017. **27**(1): p. 126 - 133.

127. Hong, M.H., *Research on the high blood pressure in person from 25 years or older and results of intervention at Phu Tan district in Ca Mau province in 2014*. Journal of Preventive Medicine, 2015. **25**(8): p. 333 - 341.

128. Le, T.H., et al., *Prevalence of Hypertension among Adults in two rural communes, Quang Trach district, Quang Binh province 2013*. Journal of Preventive Medicine, 2015. **XXV**(6): p. 77-84.

129. Chu, T.T.H., *Prevalence of hypertension in Hanoi city in 2012*. Journal of Preventive Medicine, 2014. **24**(1): p. 91 - 95.

130. Nguyen, H.T., *Current status of hypertension of the adult population aged 25 years and older who living in Trang Ha commune, Tu Son town, Bac Ninh province in 2011*. Journal of Preventive Medicine, 2014. **24**(1): p. 80 - 85.

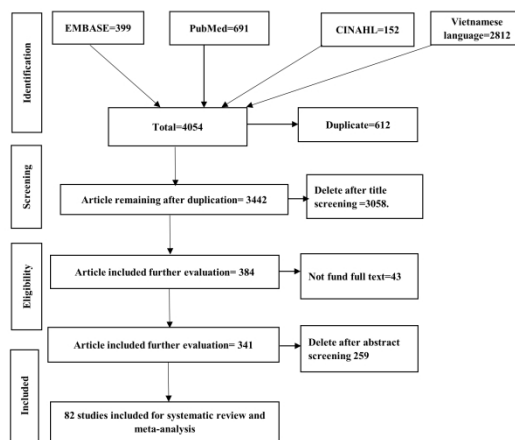
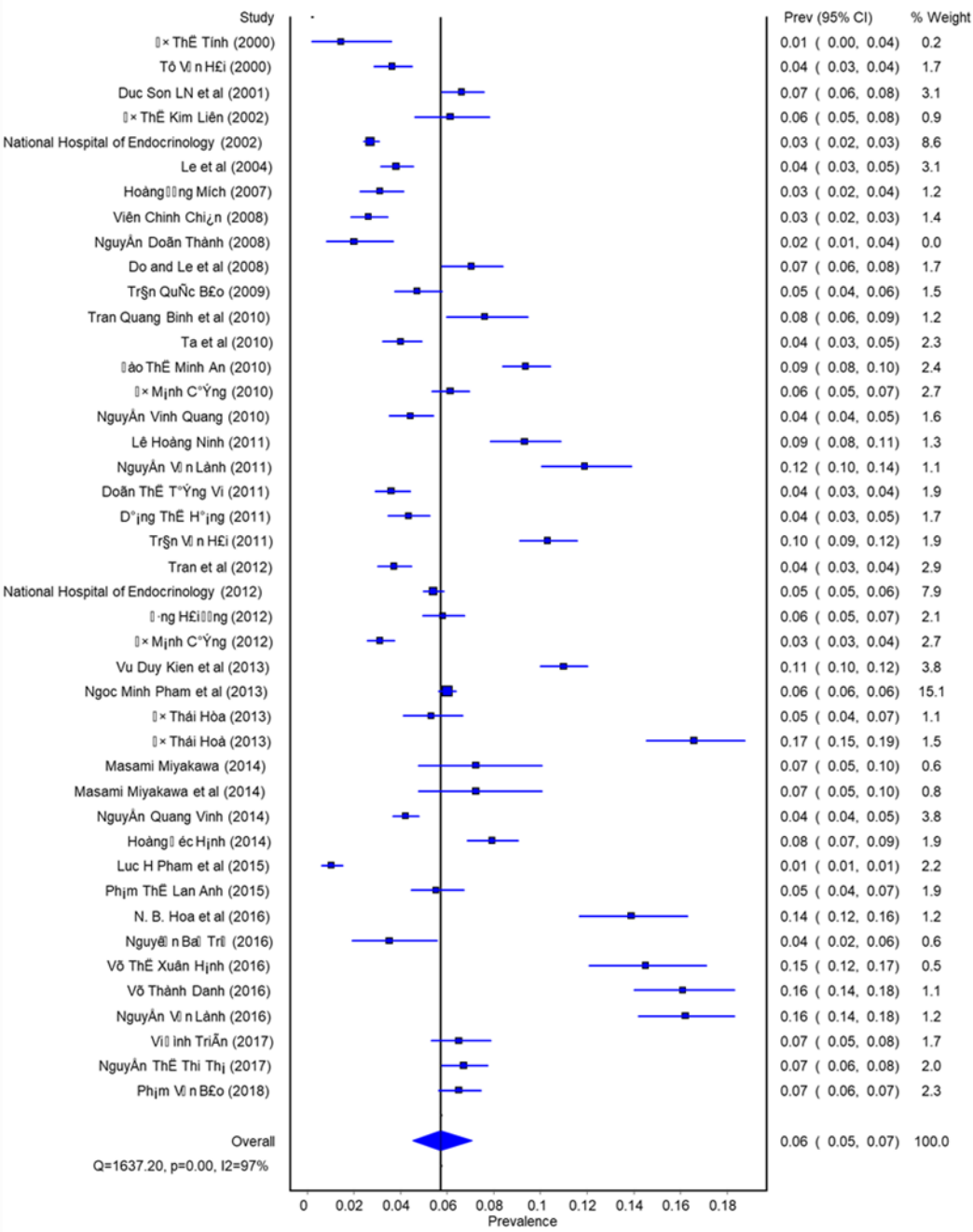
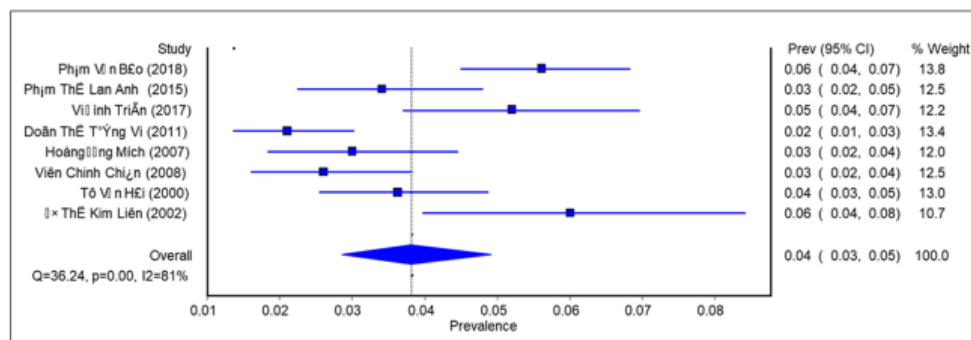
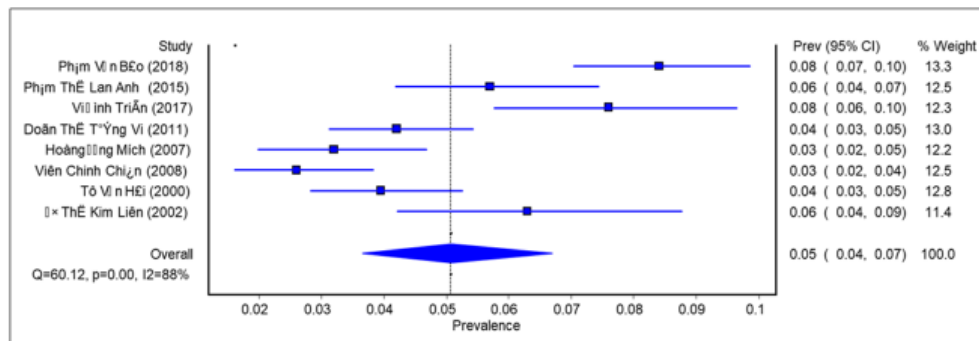
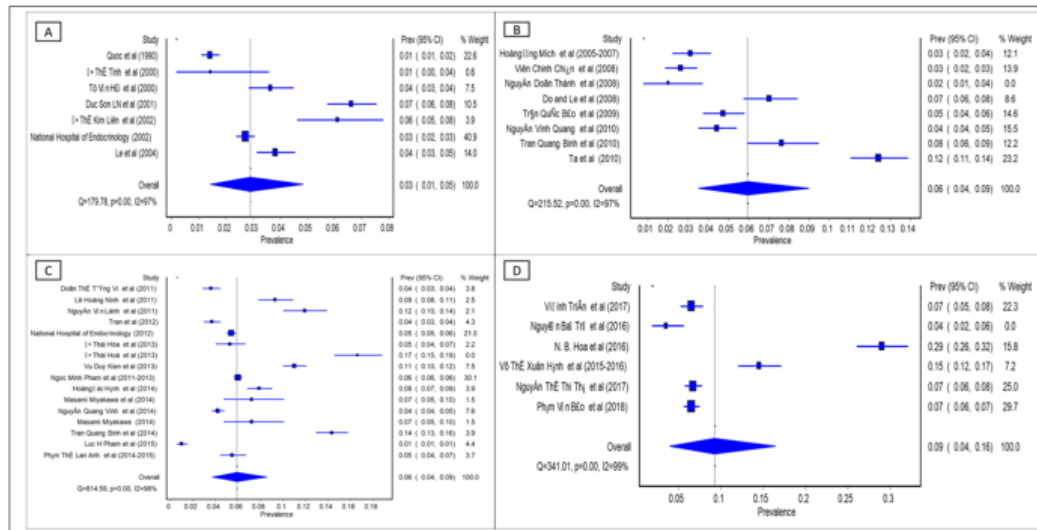
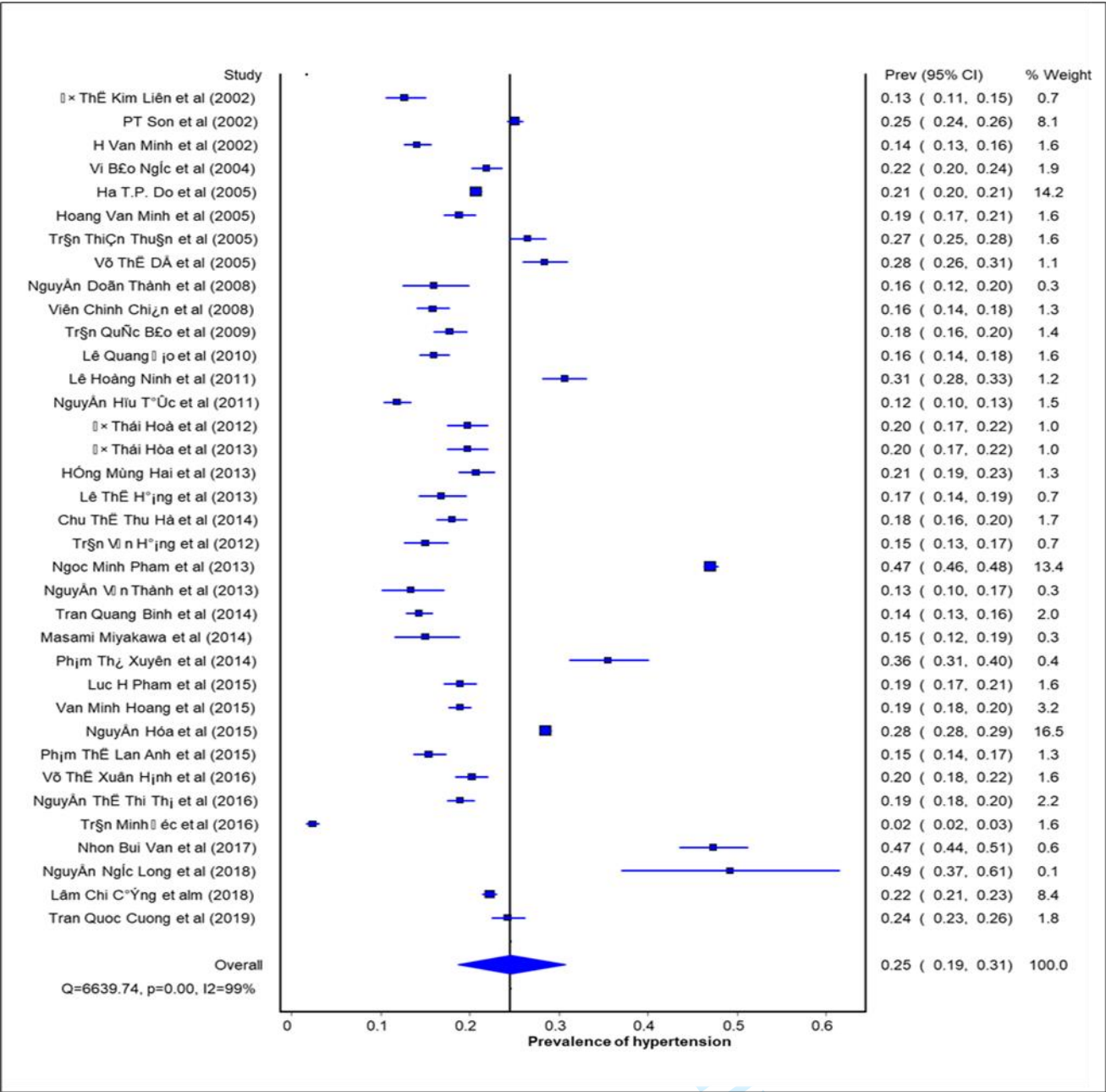


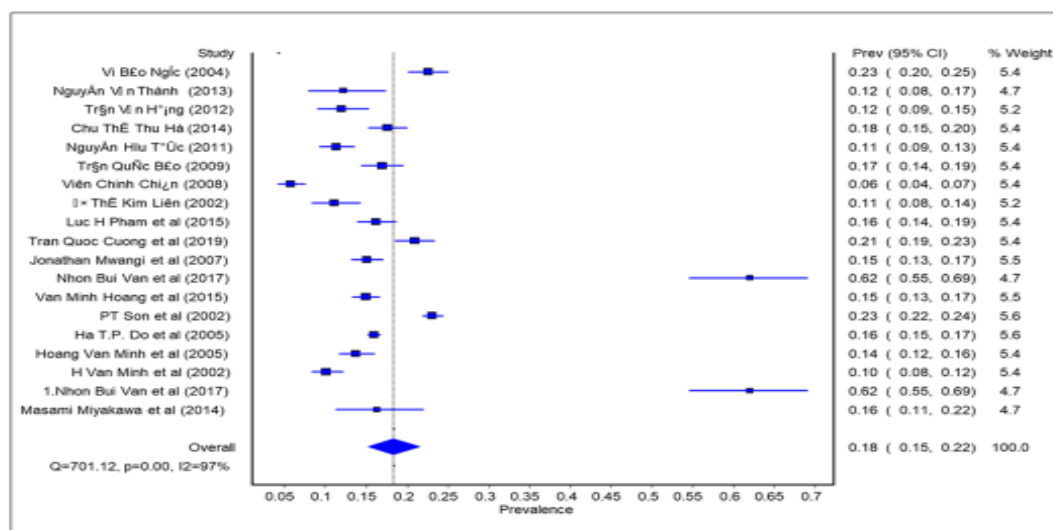
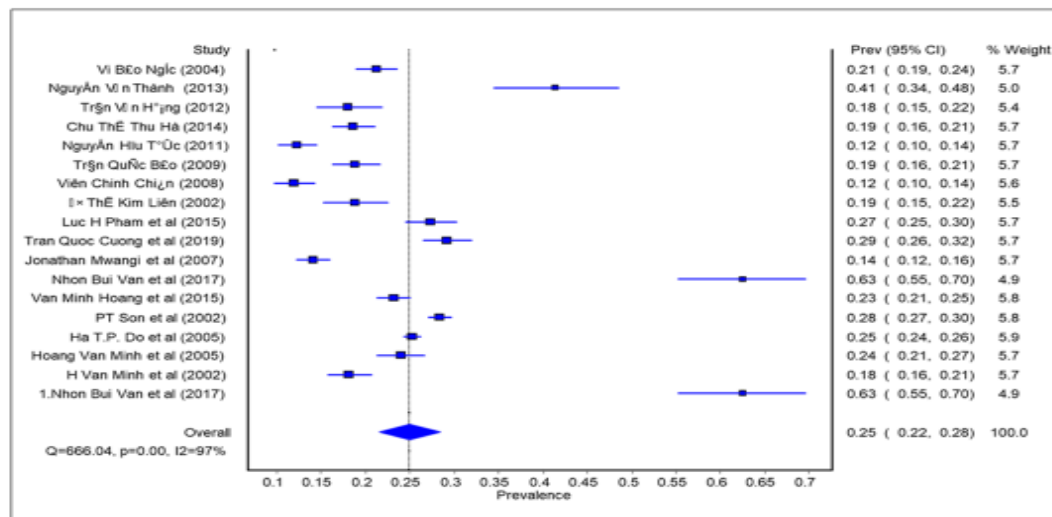
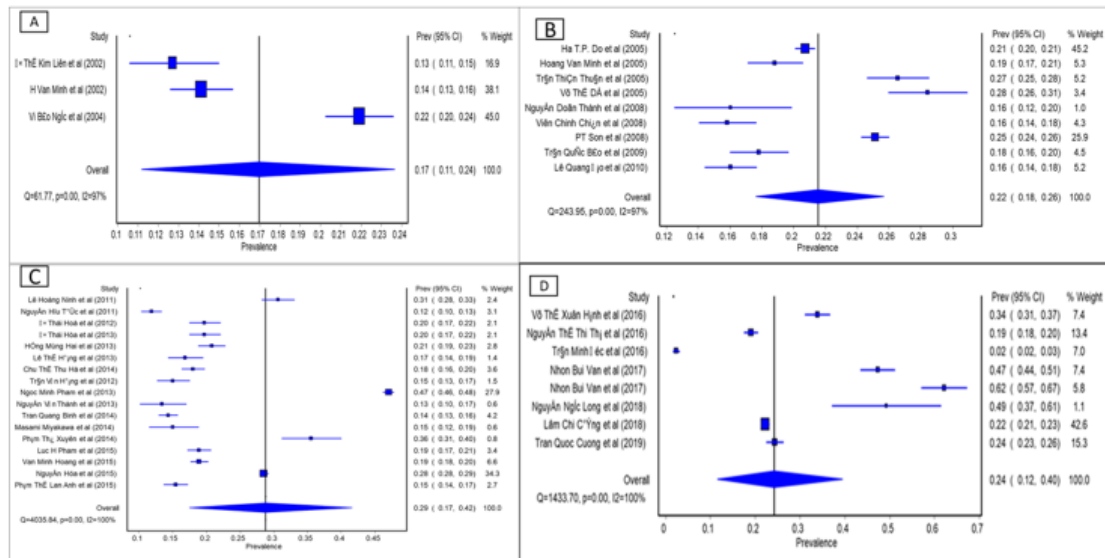
Figure-1: Consort diagram: Search strategy and selection of studies included in this review

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Appendix 1

Detailed search strategy used for PubMed database

Search Query

(((((("diabetes mellitus"[MeSH Terms] OR ("diabetes"[All Fields] AND "mellitus"[All Fields]) OR "diabetes mellitus"[All Fields] OR "diabetes"[All Fields] OR "diabetes insipidus"[MeSH Terms] OR ("diabetes"[All Fields] AND "insipidus"[All Fields]) OR "diabetes insipidus"[All Fields]) OR ("diabetes mellitus"[MeSH Terms] OR ("diabetes"[All Fields] AND "mellitus"[All Fields]) OR "diabetes mellitus"[All Fields])) OR ("diabetes mellitus, type 2"[MeSH Terms] OR "type 2 diabetes mellitus"[All Fields] OR ("non"[All Fields] AND "insulin"[All Fields] AND "dependent"[All Fields] AND "diabetes"[All Fields] AND "mellitus"[All Fields]) OR "non insulin dependent diabetes mellitus"[All Fields])) OR ("diabetes mellitus, type 2"[MeSH Terms] OR "type 2 diabetes mellitus"[All Fields] OR "type 2 diabetes"[All Fields])) OR ("cardiovascular diseases"[MeSH Terms] OR ("cardiovascular"[All Fields] AND "diseases"[All Fields]) OR "cardiovascular diseases"[All Fields] OR ("cardiovascular"[All Fields] AND "disease"[All Fields]) OR "cardiovascular disease"[All Fields])) OR CVD[All Fields]) OR ("myocardial infarction"[MeSH Terms] OR ("myocardial"[All Fields] AND "infarction"[All Fields]) OR "myocardial infarction"[All Fields])) OR ("ischaemic heart disease"[All Fields] OR "myocardial ischemia"[MeSH Terms] OR ("myocardial"[All Fields] AND "ischemia"[All Fields]) OR "myocardial ischemia"[All Fields] OR ("ischemic"[All Fields] AND "heart"[All Fields] AND "disease"[All Fields]) OR "ischemic heart disease"[All Fields] OR "coronary artery disease"[MeSH Terms] OR ("coronary"[All Fields] AND "artery"[All Fields] AND "disease"[All Fields]) OR "coronary artery disease"[All Fields] OR ("ischemic"[All Fields] AND "heart"[All Fields] AND "disease"[All Fields])) OR ("hypertension"[MeSH Terms] OR "hypertension"[All Fields])) OR ("hypertension"[MeSH Terms] OR "hypertension"[All Fields] OR ("high"[All Fields] AND "blood"[All Fields] AND "pressure"[All Fields]) OR "high blood pressure"[All Fields])) OR ("coronary artery disease"[MeSH Terms] OR ("coronary"[All Fields] AND "artery"[All Fields] AND "disease"[All Fields]) OR "coronary artery disease"[All Fields])) AND ("vietnam"[MeSH Terms] OR "vietnam"[All Fields])

Supplementary table-1: Quality score of the diabetes study

SI	Author name	Publication year	Target population a close representation of the national population	Sufficient sample size (n=500)	Random sampling	Ascertainment of HTN/DM measure	Quality assessment score
1	Tran Quang Binh et al	2015	1	1	1	1	4
2	Masami Miyakawa et al	2017	1	1	1	1	4
3	Duc Son LN et al	2004	1	1	1	1	4
4	Masami Miyakawa	2017	1	0	1	1	3
5	Vu DuyKien et al	2013	1	1	1	1	4
6	Ngoc Minh Pham et al	2015	1	1	1	1	4
7	N. B. Hoa et al	2018	1	1	1	1	4
8	Luc H Pham et al	2009	1	1	1	1	4
9	National Hospital of Endocrinology	2002	1	1	1	1	4
10	Le et al	2004	1	1	1	1	4
11	Do and Le et al	2008	1	1	1	1	4
12	Ta et al	2010	1	1	1	1	4
13	Tran et al	2012	1	1	1	1	4
14	National Hospital of Endocrinology	2012	1	0	1	1	3
15	Nguyễn Doãn Thành	2008	0	0	0	0	0
16	Lê Hoàng Ninh	2014	0	1	1	1	3
17	Phạm Văn Bảo	2019	0	1	1	1	3
18	Nguyễn Quang Vinh	2014	0	1	1	1	3
19	Phạm Thị Lan Anh	2019	1	1	1	1	4
20	Vũ Đình Triển	2018	1	1	1	1	4
21	Nguyễn Bá Trí	2017	1	0	1	1	3
22	Võ Thị Xuân Hạnh	2017	0	1	0	1	2
23	Hoàng Đức Hạnh	2016	0	1	1	1	3
24	Đỗ Thái Hòa	2015	0	1	1	1	3
25	Nguyễn Văn Lành	2013	0	1	1	1	3
26	Nguyễn Thị Thị Thơ	2017	0	1	1	1	3
27	Đỗ Thái Hòa	2014	1	1	1	1	4
28	Trần Quốc Bảo	2013	0	1	1	1	3
29	Võ Thành Danh	2017	0	1	1	1	3
30	Nguyễn Văn Lành	2018	0	1	1	1	3
31	Đặng Hải Đăng	2016	0	1	1	1	3
32	Đỗ Mạnh Cường	2015	0	1	1	1	3
33	Dương Thị Hương	2013	0	1	1	1	3
34	Trần Văn Hải	2013	0	1	1	1	3
35	Đào Thị Minh An	2012	0	1	1	1	3
36	Đỗ Mạnh Cường	2011	0	1	1	1	3
37	Nguyễn Vinh Quang	2011	0	1	1	1	3
38	Doãn Thị Tường Vi	2011	0	1	1	1	3
39	Hoàng Đăng Mich	2008	0	1	1	1	3
40	Viện Chỉnh Chiến	2008	0	1	1	1	3
41	Đỗ Thị Tinh	2004	0	0	1	0	1
42	Tô Văn Hải	2003	0	1	1	1	3
43	Đỗ Thị Kim Liên	2003	0	1	1	1	3

Supplementary table-2: Quality score of the hypertension study

SI	Author name	Publication year	Target population a close representation of the national population	Sufficient sample size (n=500)	Random sampling	Ascertainment of outcome measure	Quality assessment score
1	Luc H Pham et al	2009	1	1	1		4
2	Tran Quoc Cuong et al	2019	1	1	1		4
3	Jonathan Mwangi et al	2015	1	1	1		4
4	Nhon Bui Van et al	2018	1	1	1		4
5	Van Minh Hoang et al	2019	1	1	1		4
6	PT Son et al	2011	1	1	1		4
7	Ha T.P. Do et al	2014	1	1	1		4
8	Jonathan Mwangi et al	2015	1	1	1		4
9	Tran Quang Binh et al	2014	1	1	1		4
10	Hoang Van Minh et al	2007	1	1	1		4
11	Ngoc Minh Pham et al	2015	1	1	1		4
12	H Van Minh et al	2005	1	1	1		4
13	Masami Miyakawa et al	2017	1	1	1		4
14	Trần Thiện Thuận et al	2007	1	1	1		4
15	Võ Thị Dề et al	2007	1	1	1		4
16	Lê Quang Đạo et al	2011	1	1	1		4
17	Nguyễn Doãn Thành et al	2008	1	1	1		4
18	Vũ Bảo Ngọc et al	2005	1	1	1		4
20	Nguyễn Văn Thành et al	2013	1	1	1		4
21	Trần Văn Hương et al	2014	1	1	1		4
22	Lê Hoàng Ninh et al	2014	1	1	1		4
23	Nguyễn Ngọc Long et al	2019	1	1	1		4
24	Lâm Chí Cường et al	2019	1	1	1		4
25	Phạm Thị Lan Anh et al	2019	1	1	1		4
26	Võ Thị Xuân Hạnh et al	2017	1	1	1		4
27	Nguyễn Hóa et al	2017	1	1	1		4
28	Phạm Thế Xuyên et al	2017	1	1	1		4
29	Nguyễn Thị Thi Thơ et al	2017	1	1	1		4
30	Trần Minh Đức et al	2017	1	1	1		4
31	Đỗ Thái Hòa et al	2015	1	1	1		4
32	Hồng Mừng Hai et al	2015	1	1	1		4
33	Lê Thị Hương et al	2015	1	1	1		4
34	Đỗ Thái Hoà et al	2014	1	1	1		4
35	Chu Thị Thu Hà et al	2014	1	1	1		4
36	Nguyễn Hữu Tước et al	2014	1	1	1		4
37	Trần Quốc Bảo et al	2013	1	1	1		4
38	Viên Chinh Chiến et al	2008	1	1	1		4
39	Đỗ Thị Kim Liên et al	2003	1	1	1		4



PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria; participants; and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	3
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and if available, provide registration information including registration number.	4
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	4
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	4
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	4
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	4



PRISMA 2009 Checklist

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	4
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	NA
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	5
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICO, follow-up period) and provide the citations.	5
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	5-6
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	5-6
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	5-6
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	5-6
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	NA
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	7-8
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	7-8
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	7-8
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data; role of funders for the systematic review).	NA

BMJ Open

Type 2 Diabetes and hypertension in Vietnam: A systematic review and meta-analysis of studies between 2000 to 2020

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-052725.R2
Article Type:	Original research
Date Submitted by the Author:	12-Mar-2022
Complete List of Authors:	Biswas, Tuhin; University of Queensland, Tran, Nam; Institute for Social Science Research, University of Queensland 80 Meiers Rd, Indooroopilly, QLD, 4068, Australia Hoang, My Hanh ; Health Strategy and Policy Institute, Vietnam Ministry of Health Phan, Hong Van; Health Strategy and Policy Institute, Vietnam Ministry of Health Pham, Van Hien; Health Strategy and Policy Institute, Vietnam Ministry of Health Nguyen, Cuc ; Health Strategy and Policy Institute, Vietnam Ministry of Health Lane 196, Ho Tung Mau St, CauGiay District, Hanoi, Vietnam Khuong, Anh Tuan ; Health Strategy and Policy Institute, Vietnam Ministry of Health Tran, Mai Oanh ; Health Strategy and Policy Institute, Vietnam Ministry of Health Mamun, Abdullah; University of Queensland, School of Population Health
Primary Subject Heading:	Epidemiology
Secondary Subject Heading:	Cardiovascular medicine, Epidemiology, Health policy, Health services research
Keywords:	Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, DIABETES & ENDOCRINOLOGY, Hypertension < CARDIOLOGY, Ischaemic heart disease < CARDIOLOGY

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Type 2 Diabetes and hypertension in Vietnam: A systematic review and meta-analysis of studies between 2000 to 2020

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ABSTRACT

Objectives The objective of this study was to determine the level of type 2 diabetes (T2DM) and hypertension (HTN) in Vietnam and to assess the trend and recommend the future direction of prevention research efforts.

Design We searched scientific literature, databases including PubMed, EMBASE, CINAHL and Google Scholar; grey literature and reference lists for primary research published, nation database websites between 1 January 2000 and September 30, 2020. We adapted the modified Newcastle Ottawa scale for assessing the quality of the study, as recommended by the Cochrane Collaboration.

Results In total 83 studies met our inclusion criteria, representing data of approximately 239,034 population of more than 15 years of age in Vietnam. The findings show that prevalence rates varied widely across studies, from 1.0% to 29.0% for T2DM and 2.0% to 47.0% for HTN. For the total study period, pooled prevalence of T2DM and HTN in Vietnam for all studies was 6.0% (95% CI: 6.0-7.0%) and 25% (95% CI: 19-31%) respectively. Prevalence rate of both T2DM and HTN were higher among the male population compared to female counterpart.

Conclusion There is evidence of a rising trend of HTN and T2DM prevalence in Vietnam. Future research should focus on the major drivers, incidence, and prognosis of T2DM and HTN. Policy approaches should be developed that the counter T2DM and HTN. In our study we included both English and Vietnamese language articles and seems that majority of the articles came from Vietnamese language.

Strengths and limitations of this study

- This is the first systematic review and meta-analysis on Type 2 diabetes and hypertension in Vietnam that collected data and documents over 20 years.
- This is also the first review combining available documents published in both English and Vietnamese languages across domestic and international databases.
- The study reported that prevalence of Type 2 diabetes and hypertension among adult population in Vietnam increased over the time.
- While the current study followed the MOOSE guideline, findings from the review were heterogeneous in nature due to the study design, the outcome measurement, and the potential biases in identified documents. Additionally, the estimate prevalence by ethnicity and place of residence were not provided due to the data limitation.

Introduction:

Globally, the Non Communicable Diseases (NCDs) have become the leading cause of death[1]. Due to the high number of deaths, non-communicable diseases[2], including cardiovascular diseases, diabetes, cancer, and chronic respiratory diseases, have appeared as key public health challenges worldwide[3]. As a result NCDs are included in Sustainable Development Goal (SDG) target 3.4, to by “2030 reduce by one third premature mortality from NCDs through prevention and treatment and promote mental health and wellbeing”[2, 4]. NCD mortality rate which was high in low middle-income countries (LMICs), nearly three-quarters of NCD deaths occurred in LMICs, expected to increase by 20% in coming years[5]. Due to the increasing prevalence of fast-food consumption and food insecurity [6-8], population of LMICs have a higher ability to purchase high caloric foods which are associated with higher intake of calories and fat. Such fast-food consumption and food insecurity are responsible for increase in the prevalence of diabetes, hypertension and other NCDs in LMICs. It is estimated that this condition is likely to increasing.

Like other LMICs Vietnam has recently been facing the challenge of NCDs. The number of deaths due to NCDs in Vietnam rose from 296,900 in 2000 to 371,600 in 2010 and 424,000 in 2016[9]. NCD were estimated to account for 73% of all deaths in Vietnam in 2014 [10] and 77% in 2016[11]. Of NCDs cardiovascular diseases (CVDs) represented 31%¹ of all deaths in 2016; hypertension, one of main risk factors for CVDs, accounted for 21% of all deaths in the country[12]. It was estimated in 2016 that about 17% people aged 30-70 in Vietnam will suffer a premature death due to one of four common NCDs (cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes)[13].

The gross domestic product (GDP) per capita was increased gradually in Vietnam which is directly linked to increased behavioural risk factors for NCDs such as the harmful use of alcohol, unhealthy diets, and physical inactivity[3, 14]. NCD risk factor survey in Vietnam (2015) revealed high prevalence of NCD risk factors among the adult population. For example prevalence of overweight/obesity (BMI \geq 25) was 15.6%, hypertension (SBP \geq 140 and/or DBP \geq 90 mmHg or on medication) was 18.9%, raised cholesterol was 30.2%, physical inactivity 28.1%, lack of vegetable/fruit consumption 57.2%; the average population salt intake per day was 9.4 grams, which was almost double the WHO recommendation[15]. These behavioural risk factors play a vitalrole of rising chronic disease burden including cardiovascular diseases (CVD) and diabetes.

Over the past two decades, The Government of Viet Nam has a number of policies, strategies, plans, and programmes responding to NCDs. Two national programs were implemented for the period 2002 – 2010 and 2012 – 2015 focusing on four disease groups of cardiovascular diseases, diabetes, cancers, and mental and neurological disorders[13] and covering a component project of prevention and control of some dangerous diseases which included some specific NCDs. Despite the efforts these programs did not have expected achievements due to lack of inter-sectoral coordination and direction for NCDs prevention as well as evidence-based research. An updated National Strategy on Prevention and Control of NCDs for the period of 2015-2025 which followed the WHO Global NCD Action plan 2013-2020 was developed in 2015, providing a strong basis for NCD prevention and control in Viet Nam. Under the revised program, the prevention and control of some dangerous infectious diseases and some common NCDs was included as a project component[16].

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In addition to these national policies and programs targeting on HTN and T2DM, over the last few decades, a number of studies have been undertaken in Vietnam to measure the prevalence of HTN and T2DM but none have assessed trend of T2DM and HTN except for a 2001-2009 time trends analysis which showed an annual increase of HTN prevalence of 0.9%. Two reviews on prevalence of HTN and T2DM among adult population in Vietnam were published recently, yet these studies had their own limitations as (i) they were carried out based upon literature available in English[17]; (ii) the review employed only surveys which were conducted by a research institute, therefore the results may have some bias ; (iii) meta-analysis was not implemented to produce the pool estimation[18]; and (iv) they are out of date assessment with regard to the rapid change of T2DM and HTN. There is a need for an updated systematic review and meta-analysis. It is important for both health professionals and policy makers to better understand the trends of T2DM and HTN to develop effective policies and programmatic interventions. In this review, we conducted a systematic review and meta-analysis to comprehensively (1) determine the extent of research that has been done for HTN and T2DM, and (2) to assess the trend and recommend the future direction of prevention research efforts.

Methods:

We followed the Meta-analyses Of Observational Studies in Epidemiology (MOOSE) guidelines to identify studies [19]. The protocol was registered at the international prospective register of systematic reviews (PROSPERO; CRD42020182959). We followed the guidelines for meta-analyses and systematic reviews outlined by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

Search strategy

We used the PICOS criteria to define the research question (Table 1)[20]. Our search included studies published from January 1, 2000, to September 30, 2020 in both English and Vietnamese languages. We used a number of different search engines: PubMed, EMBASE, CINAHL, Google Scholar, Google and national website and database including The Database of National Agency for Science and Technology Information (vista.gov.vn) and some Vietnamese journals in the field which are not included in the database. A full description of the electronic search strategy is available in online supplemental table S1.

The keywords used in the search were “diabetes”, “diabetes mellitus”, “non-insulin dependent diabetes mellitus”, “NIDDM”, “type 2 diabetes”, “cardiovascular disease”, “CVD”, “myocardial infarction”, “ischemic heart disease”, “hypertension”, “high blood pressure”, “coronary artery disease”, “Vietnam”, “đái tháo đường”, “tiểu đường”, “tăng đường huyết”, “tăng huyết áp” “cao huyết áp”. We limited the search to studies that only involved human participants. We screened the studies using the following inclusion criteria: (1) had prevalence or incidence data available on either hypertension or T2DM, (2) had selected a sample included those who are Vietnamese and are living in Vietnam, and (3) had published results between January 1, 2000, to September 30, 2020. Once we identified the eligible studies, we made further exclusions based on sample, study design, and publication type.

Inclusion and exclusion criteria

Studies eligible for inclusion met the following criteria: primary or secondary data, published in the English and Vietnamese languages, conducted in humans, studies that provide an estimate of prevalence of either hypertension or T2DM and population age group 15 years or older. Studies were excluded if: (1) were reported in reviews, qualitative studies, editorials, abstracts, theses, books, case reports and letters to the editor; (2) the study had participants with type 1 diabetes, GDM, (3) only on the elderly (60 year old and over) and (4) studies employed RCT designs. Hypertension was defined as raised blood pressure was defined as an average (based on STEPS rule) systolic blood pressure (SBP) ≥ 140 mmHg and/or average diastolic blood pressure (DBP) ≥ 90 mmHg and/or self-reported current medication for high blood pressure in the previous two weeks. T2DM was defined fasting plasma glucose ≥ 7 mmol/L (≥ 126 mg/dL) or self-reporting having been diagnosed by a health professional.

Data extraction and quality assessment

Data extraction was carried out by at least two independent reviewers following a piloted version of the Cochrane Effective Practice and Organization of Care Group (EPOC) guidelines[19]. They completed a standard data extraction form, summarizing the study design and other relevant data for each article, including author name, sample size, survey year and reference standard (**Table 2 and 3**). Once article did not report survey year, publication year was listed. The main outcomes were prevalence of T2DM and hypertension.

Data analysis

All meta-analyses were performed using MetaXL version 1.4[21]. We calculated pooled prevalence of T2DM and hypertension. In addition, we also assessed the pooled prevalence of T2DM and hypertension by year interval and sex. We also assessed publication bias using both a graphical (Doi plot) and quantitative [Luis Furuya-Kanamori (LFK) index] examination for potential small-study effects[22]. The methodology that we followed for the meta-analysis was described in details by Neyeloff et al.[23]. Briefly, for each study, we calculated the following variables: 1) standard error of the prevalence, 2) variance, 3) study weights (inversed variance), 4) study weight*prevalence estimate, 5) study weight* (prevalence estimate)² and 6) (study weight)². We used these variables to estimate Q measure. We adapted the modified Newcastle Ottawa scale for assessing the quality of the study, as recommended by the Cochrane Collaboration[24]. Four criteria were used to score studies as ‘high quality’ (4 points), ‘moderate quality’ (2-3 points), and ‘poor quality’ (0-1 points). Criteria included: target population a close representation of the national population (yes = 1, no = 0), sufficient sample size (yes = 1, no = 0), random sampling (yes = 1, no = 0) and ascertainment of T2DM and hypertension measure (yes = 1, no = 0). The cut-off for a sufficient sample size was set at 500 participants[25, 26].

We checked for statistical heterogeneity and inconsistency using the Q and I² statistics, respectively of heterogeneity among studies) and I² (percent between-studies variability). Based on Q and I² values, we chose quality effects models to report pooled prevalence estimates (hypertension, T2DM) and the associated 95% confidence interval (CI) to minimize the heterogeneity. We followed the same procedures to calculate the pooled prevalence of T2DM and hypertension by time periods (2000-2004; 2005-2010; 2011-2015; 2016-2020) and sex. We checked for statistical heterogeneity and inconsistency using the Q and I² statistics, respectively.

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198 **Patient and Public Involvement**

199 No patient involved

200 **Result:**

201 **Study characteristics and quality**

202 Our literature search yielded 4,054 records. After exclusion of duplicates and review of titles
203 and abstracts, articles were included for further evaluation. Of these full texts could not be
204 found for 43 articles. The full text of the remaining 341articles were examined and a total of
205 259 articles excluded after abstract screening. We were unable to access the full text of these
206 documents at the time we searched for relevant papers across databases. These papers were
207 published in Vietnamese language. Of them, about two third were government funded- project
208 reports which require fees for archived access; the remaining papers were not available on the
209 Vietnamese journal websites. We included 82 articles in the final synthesis (**Figure 1**). These
210 articles presenting data for 2,39,034 individuals. Out of these 44 articles reported prevalence
211 of T2DM and 39 articles reported prevalence of hypertension. For T2DM all were cross
212 sectional in nature (**Table 2**). Majority of the studies (92.4%) were community based and only
213 three studies were facility based (7.6%). For hypertension all were cross sectional in nature
214 (**Table 3**). Majority of the studies (90%) were community based and only four studies were
215 facility based (10%). Quality score of each study presented in online supplemental tables S2
216 and S3. Majority of the articles came from Vietnamese language.

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218 **Estimation of prevalence rates**

219 Prevalence rates varied widely across studies, from 1.0% to 29.0% for T2DM and 2.0% to
220 47.0% for hypertension. The pooled prevalence of T2DM and hypertension in Vietnam for all
221 studies was 6.0% (95% CI: 5.0-8.0%) and 25% (95% CI: 19-31%) respectively (**Figure 2 and**
222 **3**).
223

224 **Prevalence rates by year of study**

225 To investigate T2DM and hypertension prevalence over time we arranged outcomes by time
226 of study in four aggregated intervals i) 2000-2004, ii) 2005-2010, iii) 2011-2015 and iv) 2016-
227 2020.

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230 **2000-2004**

231 We included 9 studies from 2000-2004 in our analysis, 6 of these studies presented findings
232 for T2DM[27-32] and 3for hypertension[31, 33, 34]. The pooled estimate of T2DM was 3.0%
233 (95% CI: 1.0-5.0%), whereas for hypertension it was 22.0% (95% CI: 14.0-31.0%) (**Figure 4**
234 **and 5**).

2005-2010

Nineteen studies between 2005 and 2010 presented both prevalence of T2DM and hypertension in Vietnam in which ten studies [32, 35-43] presented prevalence of T2DM and ten studies focused on hypertension [35, 36, 39, 43-49]. The pooled estimate of T2DM was 5.0% (95% CI: 3.0-7.0%), whereas for hypertension it was 20.0% (95% CI: 16.0-25.0%) (**Figure 4 and 5**).

2011-2015

We identified thirty seven studies that presented findings for T2DM between the years 2011 and 2015. These resulted in a pooled estimate of T2DM 6.0% (95% CI: 4.0-9.0%) from twenty studies [38, 41-43, 50-61]. We identified 18 studies for the same period in Vietnam that presented findings for hypertension [27, 34, 35, 42, 43, 45, 47, 48, 52-54, 56, 60-64] resulting in a pooled estimate of 29% (95% CI: 17-42%).

2016-2020

For the most recent interval we identified eight studies [33, 46, 49, 50, 51, 55, 59] for T2DM in Vietnam with a pooled estimate of 9.0% (95% CI: 5.0-14.0%). We also identified eight studies [36, 46, 49, 50, 51, 55, 58, 59] for hypertension in the region with a pooled estimate of 20.0% (95% CI: 7.0-36.0%).

Gender specific prevalence

We identified six studies for type T2DM and nineteen for hypertension for use in gender specific prevalence analysis (**Figure 6 and 7**). Pooled estimate for T2DM slightly higher among the male (5.0%, 95% CI: 4.0-7.0%) compared than female (4.0%, 95% CI: 3.0-5.0%). For hypertension, pooled estimate also higher among the male (25.0%, 95% CI: 22.0-28.0%) compared than female (18.0%, 95% CI: 15.0-22.0%).

Publication bias

The funnel plots for the T2DM and hypertension were presented in online supplemental figures S1a-d and S2a-d. According to these figures, large heterogeneity was observed both for the T2DM and hypertension prevalence estimation.

Discussion:

This is the first systematic evaluation and meta-analysis of the scientific literature on the pooled prevalence trend of T2DM and hypertension among the adult population in Vietnam. In our study we found the pooled prevalence of T2DM has increased around three times from 2000-2004 (3%) to 2016-2020 (9%). A systematic review study by Nguyen et al reported that prevalence estimates of T2DM were 2.7% in 2002 and 5.4% in 2012 [18]. To our knowledge

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this is the updated systematic review and meta-analysis paper on T2DM and hypertension in Vietnam. The growing trend of T2DM in Vietnam in the present review is consistent with secular trends in several Asian countries such as China[65], India[66], Sri Lanka and Bangladesh[67] where researchers also observed the similar magnitudes of a 10-year increase in T2DMprevalence. It is already well know that older age, urban residence, overweight, increased central adiposity, and physical inactivity, genetic factors, hypertension, and high intake of animal protein may contribute to enhanced diabetes[18]. In our study due to data limitation we were not able to assess the major drivers of T2DM in Vietnam however we expect Vietnam shares similar characteristics like others in LMICs.

The pooled analysis from this study found that the prevalence of hypertension has increased dramatically in Vietnam since 2000-2004. In another systematic review and meta-analysis study Meiqari et al reported that pooled prevalence of measured hypertension in Vietnam was 21.1%[17]. In that study they included the only English language studies but in our study we included both English and Vietnamese studies, which we believe it gives a proper scenario of hypertension in Vietnam. A review study by Hoy et all reported that high blood pressure is common among the Vietnamese population and they had knowledge that they have high blood pressure may be low[68].

The main strength of current study is that we followed a systematic and comprehensive approach to identify studies on both T2DM and hypertension following MOOSE guidelines and a registered protocol (CRD42020182959). Risk of bias was assessed using well-established criteria. Within the study we also investigated the sex specific prevalence and as well as time trend. The main weakness of this study comes from the research this review identified. Although the majority of studies included in this review were graded as moderate to high quality, many were cross-sectional in nature and followed a survey-based approach. In addition, findings of this study were extremely heterogeneous in nature, not only in study design and data collection, but also in outcome. To minimize the heterogeneity we chose quality effect model, which is now well established. As with all systematic reviews there is the potential for publication bias in the identified studies, with some not initially designed to report on the T2DM and hypertension. The reference standards for determining T2DM and hypertension was not consistent between all studies. In addition, we attempted to explore factors associated with T2DM and hypertension but insufficient studies reported this information. Another limitation, we searched PubMed, EMBASE, CINAHL, Google Scholar, Google and national website and database. There may be some other relevant data base we may missed it. But in our study, we included articles from Vietnamese journals. Moreover, information on certain groups, such as ethnicity and place of residence were not available in enough studies to be included in sub-group analysis.

Although an adequate number of T2DM and hypertension prevalence studies have been conducted, they were mostly reported the overall prevalence. Little data exist on the place of residence specific, education specific, wealth index and geographic location specific prevalence of T2DM and hypertension. We did not find any longitudinal cohort studies on T2DM and hypertension. This is a significant gap in the knowledge and understanding of these chronic diseases in the context of Vietnam. Such studies would provide essential information on the incidence of these diseases, their associated risk factors, and the groups that are at higher risk of developing them. Further, longitudinal data are necessary to understand disease progression and prognosis.

316 **Conclusion**

317 We found increase in the prevalence T2DM and hypertension among the adult population in
318 Vietnam over the study period. We also found T2DM and hypertension higher among the male
319 compared than female. Future research should investigate the driving force behind the
320 increasing rates of T2DM and hypertension and explain the major drivers in both conditions.
321 Policy approaches should be developed that the counter the T2DM and hypertension, with
322 interventions to combat T2DM and hypertension.

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Acknowledgement The authors are grateful for the generous and helpful comments of the reviewers. We acknowledge the important support of The University of Queensland (UQ) Global Strategy and Partnership Seed Funding Scheme 2018 and The Institute for Social Science Research for strengthening the collaboration between UQ researchers and Vietnamese researchers. We also acknowledge the Australian Government through the Australian Research Council's Centre of Excellence for Children and Families over the Life Course (Project ID CE200100025).

Contributors All authors made a substantial contribution to this work. NT, AM, and MOT conceptualised the review. NT, TB, MOT, and AM designed the research. TB, NT, MHH, HVP, VHP, CN, and ATK collected data, read, screened abstracts and titles of potentially relevant studies and took responsibilities for extracting data and rating their quality independently. TB and NT analysed and interpreted the data. TB, NT, and AM drafted manuscript with all the authors critically reviewing it and suggesting amendments prior to submission.

Funding This research received no specific grant from any funding body for publication.

Competing interests None declared.

Patient consent Not required.

Data sharing statement All data are available within the appendices.

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350 **Table 1** PICOS criteria for inclusion and exclusion of studies

Parameter	Inclusion criteria	Exclusion criteria
Population	Those were of age ≥ 15 years	< 15
Intervention/exposure	Collection of data on T2DM and hypertension sociodemographic factors	Lack of data on T2DM and hypertension
Comparator	T2DM and hypertension status of Vietnamese adult	Lack of data on T2DM and hypertension
Outcome	Prevalence of T2DM and hypertension	No reported prevalence measure
Study design	Observational study	Editorial
	Cross-sectional study	Methodological article
	Cohort study	

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Table 2 Summary of the reported prevalence rate of diabetes in Vietnam (2000-2020)

SI	Author name	Publication year	Study conducted	Community /hospital based	Reference standard	Study design	Sample size	Age range	Prevalence of diabetes
1	Tran Quang Binh et al [69]	2015	2010	Community	The World Health Organization and International Diabetes Federation diagnostic criteria	Cross-sectional	892	35-70	7.60%
2	Masami Miyakawa et al [70]	2017	2014	Community	Elevated fasting plasma glucose (FPG) level ≥ 7.0 mmol/L (126 mg/dL) or random elevated plasma glucose level ≥ 11.1 mmol/L (200 mg/dL); or 3) history of treatment for DM (lifestyle guidance including diet or exercise advice, oral medication, or insulin).	Cross-sectional	376	20-70	7.20%
3	Duc Son LN et al [71]	2004	2001	Community	NM	Cross-sectional	2932	≥ 15	6.6
4	Tran Quang Binh et al [72]	2014		Community	The glycemic status was classified as normal glucose tolerance (NGT) when FPG < 5.6 mmol/L and 2h-PG < 7.8 mmol/L	Cross-sectional	2443	48-57	14.30%
5	Vu DuyKien et al [73]	2013	2013	Community	NM	Cross-sectional	3736	NM	11%
6	Ngoc Minh Pham et al [74]	2015	2011-2013	Community	Diabetes was diagnosed when FPG was ≥ 7.0 mmol/L (126 mg/dL) or 2-h post OGTT ≥ 11.1 mmol/L (200 mg/dL)	Cross-sectional	16282	30-69	6.00%
7	N. B. Hoa et al [75]	2018	2016	Facility-based	American Diabetes Association	Cross-sectional	870	> 15	13.9%
8	Luc H Pham et al [76]	2015	2009	Community	Based on STEPS rule	Cross-sectional	1978	25- 64	1.00%
9	National Hospital of Endocrinology [29]	2002	2002	Hospital	WHO 1998: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L	Cross-sectional	9122	30-64	2.7
10	Le et al [77]	2004	NM	Community	WHO 1998/ADA 1997: fasting plasma glucose ≥ 7 mmol/L or using	Cross-sectional	2932	> 15	3.8
11	Do and Le et al [78]	2008	NM	Community	WHO 1998: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L or self-report	Cross-sectional	1456	30-69	7.0
12	Ta et al [79]	2010	NM	Community	WHO 1998: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L	Cross-sectional	2142	30-64	4
13	Tran et al [80]	2012	NM	Community	WHO 1998: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L or self-report	Cross-sectional	2710	40-64	3.7
14	National Hospital of Endocrinology[39]	2012	NM	Hospital	WHO 1998: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L	Cross-sectional	11 191	30-69	5.4
15	Nguyen, D.T., et al [81]	2008	2008	Workplace	NM but not self-report	Cross-sectional	383	NM	2%
16	Le, H.N., et al [82]	2014	2011	Community	NM but not self-report	Cross-sectional	1401	40+	9.30%
17	Pham, V.B. and Truong, Q.D [83]	2019	2018	Community	Decision 3319/QĐ-BYT, 19/7/2017 – MOH	Cross-sectional	3000	30-69	6.50%
18	Nguyen, Q.V. and Le, N.N [84]	2014	2014	Community	NM but not self report	Cross-sectional	5190	21-70	4.2%
19	Pham, T.L.A., Khuong, V.D., and Pham, Q.C, [85]	2019	2014-2015	workplace	Elevated fasting plasma glucose (FPG) level ≥ 7.0 mmol/L	Cross-sectional	1,595	NM	5.50%
20	Vu, D.T. and Dang, B.T, [86]	2018	2017	Community	capillary blood glucose by Accu-Chek- D10-BIORAD: 2h-OGTT ≥ 11.1 mmol/L= diabetes; OGTT from 7.8-11.0= abnormal ; WHO-IDF 2008 updated 2010: The glycemic status was classified as abnormal when FPG range 5.6-6.9 mmol/L; FPG ≥ 7 mmol/L= diabetes	Cross-sectional	1.450	≥ 25	6.5
21	Nguyen, B.T., et al [87]	2017	2016	Community	Diabete prevention and control Project, National Institute of Endocrinology; using Onetouchvero machine (Johnson &Johnson)	Cross-sectional	400	45-69	3.5
22	Vo, T.X.H., et [88]	2017	2015-2016	Community	ADA 2005: fasting plasma glucose ≥ 7 mmol/L (≥ 126 mg/dL) or self-reporting having been diagnosed by a health professional	Cross-sectional	758	≥ 40	14.5
23	Hoang, D.H., et al [89]	2016	2014	Community	FPG and post OGTT : fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L (MoH 2011 IGT: FPG < 7 mmol/L and 2h-OGTT $\geq 7.8- 11.1$ mmol/L or normal but self-report having been diagnosed by a health professional	Cross-sectional	2402	30-69	7.9
24	Do, T.H., et al [90]	2015	2013	Community	FPG and post OGTT (WHO 1999: fasting plasma glucose ≥ 7 mmol/L or 2h-OGTT ≥ 11.1 mmol/L or self-report and MoH 2011)	Cross-sectional	1200	40-59	5.3
25	Nguyen, V.L. and Nguyen, V.T, [91]	2013	2011	Community	ADA/WHO 2010: fasting plasma glucose 100-126mg/dl or 2h-OGTT from 140-200mg/dl or HbA _{1c} $\geq 6.5\%$	Cross-sectional	1100	≥ 45	11.9
26	Nguyen, T.T.T., Nguyen, T.Q., and Nguyen, N.C, [92]	2017		Community	WHO STEPS: fasting blood glucose values > 6.1 mmol/L or taking medications for diabetes; measured fasting blood glucose by Cardiocheck PA	Cross-sectional	2440	18-69	6.7
27	Do, T.H., et al [93]	2014	2013	Community	MoH 2011 on screening diabetes in community	Cross-sectional	1200	40-59	16.6
28	Tran, Q.B., et al [94]	2013	2009	Community	WHO- STEPS: fasting blood glucose values ≥ 6.1 mmol/L) or on diabetes medication or having diagnosed by a healath professional	Cross-sectional	1714	25-64	4.7
29	Vo, T.D. and Pham, T.T, [95]	2017	2015-2016	community	NM but not self-report	Cross-sectional	1114	> 40	16.10%
30	Nguyen, V.L [96]	2018	2015-2016	community	NM but not self-report	Cross-sectional	1250	18-55	16.20%
31	Dang, H.D and Nguyen, V.L, [97]	2016	2012	community	NM but not-self report	Cross-sectional	2700	> 20	5.80%

32	Do, M.C [98]	2015	2012	community	Diabetes was diagnosed when FPG was ≥ 7.0 mmol/L or 2-h post OGTT ≥ 11.1 mmol/L	Cross-sectional	3500	30-96	3.10%
33	Duong, T.H. [99]	2013	2011	community	WHO 2006	Cross-sectional	2000	30-69	4.30%
34	Tran, V.H., and Dam, V.C, [100]	2013	2011	community	WHO (not mentioned the year)	Cross-sectional	2400	30-64	10.30%
35	Dao, T.M.A., Tran, M.L., and Tran, T.P.N. [101]	2012	2010	community	WHO 1999	Cross-sectional	3100	all age	9.35%
36	Do, M.C., and Nguyen, T.H, [102]	2011	2010	community	OMS 1999, ADA 2005	Cross-sectional	3500	30 - 69	6.10%
37	Nguyen, V.Q., and Pham, T.H, [103]	2011	2010	community	NM but not self-report	Cross-sectional	1855	30-60	4.40%
38	Dzoan, T.T.V [104]	2011	2011	hospital based	Diabetes was diagnosed when FPG was ≥ 7.0 mmol/L or 2-h post OGTT ≥ 11.1 mmol/L	Cross-sectional	2358	30-60	3.60%
39	Hoang, D.M, [105]	2008	2005-2007	community	American diabetes association 1998	Cross-sectional	1335	18-70	3.1
40	Vien, C.C., and Phung, T.T.T, [106]	2008	2008	community	NM but not self-report	Cross-sectional	1620	18-60	2.60%
41	Do, T.T., [107]	2004	2000	community	WHO 1999	Cross-sectional	212	≥ 16	1.42%
42	To, V.H., Vu, M.H., and Nguyen, V.H, [108]	2003	May 2000 - Sep 2000	community	Diabetes was diagnosed when FPG was ≥ 7.0 mmol	Cross-sectional	2017	≥ 16	3.62
43	Do, T.K.L., et al [109]	2003	March 2002 - December 2002	community	Diabetes (WHO 1999)	Cross-sectional	890	40-60	6.10%

Table 3 Summery of the reported prevalence rate of hypertension in Vietnam (2000-2020)

SI	Author name	Publication year	Study conducted	Community/hospital based	Reference standard	Study design	Sample size	Age range	Prevalence of hypertension
1	Luc H Pham et al [76]	2009	2015	Community	Raised blood pressure was defined as an average (based on STEPS rule) systolic blood pressure (SBP) ≥140 mmHg and/or average diastolic blood pressure (DBP) ≥90 mmHg and/or self-reported current medication for high blood pressure in the previous two weeks	Cross-sectional	1978	25– 64	18.9
2	Tran Quoc Cuong et al [110]	2019	2019	Community	Systolic/diastolic blood pressure ≥140/90 mmHg or using antihypertensive medication. HTN was specied that SBP was 140 mmHg or higher and/or DBP was 90 mmHg or higher, if the medications used to treat HTN were used by the individuals for 2 weeks. ISH having a SBP ≥140 mmHg and DBP <90 mmHg was used to diagnose.	Cross-sectional	2203	≥18	24.3
3	Nhon Bui Van et al [63]	2018	2017	Community	Raised blood pressure was defined as an average (based on STEPS rule) systolic blood pressure (SBP) ≥140 mmHg and/or average diastolic blood pressure (DBP) ≥90 mmHg and/or self-reported current medication for high blood pressure in the previous two weeks.	Cross-sectional	675	≥18	47.3
4	Van Minh Hoang et al [111]	2019	2015	Community	Defined as BP ≥140/90 mm Hg	Cross-sectional	3,856	18–69	18.9
5	PT Son et al [112]	2011	2002	Community	Hypertension was defined as systolic BP (SBP) ≥140mm Hg and/or diastolic BP (DBP) ≥ 90mm Hg and/or self-reported current use of antihypertensive medication.	Cross-sectional	9832	≥25	25.1
6	Ha T.P. Do et al [113]	2014	2005	Community	systolic blood pressure ≥ 130 mmHg or diastolic blood pressure ≥85 mmHg or hypertension; systolic blood pressure (SBP) was at least 140 mm Hg, their diastolic blood pressure (DBP) was at least 90 mm Hg, or they were being treated for hypertension	Cross-sectional	17,199	25–64	20.7
7	Tran Quang Binh et al [72]	2014	NM	Community	HypertensionwasdefinedassystolicBP140mmHgand/ordiacstolicBP90mmHgorcurrentuseofan tihypertensivemedication	Cross-sectional	2443	48-57	14.3
8	Hoang Van Minh et al [63]	2007	2005	Community	Hypertensive subjects were defined as those with systolic blood pressure (SBP) equal to or more than 140 mmHg or diastolic blood pressure (DBP) equal to or more than 90 mmHg18 or those being treated for hypertension	Cross-sectional	2000	25 to 64	18.8
10	Ngoc Minh Pham et al [114]	2015	2011-2013	Community	Hypertension was defined as elevated blood pressure (BP), with systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg	Cross-sectional	5602 men and 10,680 women	30–69	47.0
11	H Van Minh et al [63]	2005	2002	Community	JNC VII (2003)	Cross-sectional	2000	25–64	14.1
12	Masami Miyakawa et al [70]	2017	2014	Community	JNC VII	Cross-sectional	376	20-70	15
13	Tran, T.T., [115]	2007	2005	Community	systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥90 mmHg	Cross-sectional	1991	25-65	26.5
14	Vo, T.D., and Dang, V.P, [116]	2007	2005	Community	NM but not self-report	Cross-sectional	1288	25 +	28.4
15	Le, Q.D., and Nguyen, D.N., [117]	2011	2010	Community	systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥90 mmHg	Cross-sectional	1991	25-64	16.0
16	Nguyen, D.T., et al [81]	2008	2008	Community (workplace)	systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥90 mmHg	Cross-sectional	383	NM	16.0
17	Vu, B.N., et al [118]	2005	2004	Community	NM but not self-report	Cross-sectional	2366	18+	21.8
18	Nguyen, V.T., et al [119]	2013	2013	Hospital based	systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥90 mmHg	Cross-sectional	379	NM	13.3
19	Tran, V.H., and Nguyen, D.Q. [120]	2014	2012	Community	Decision 3192/QĐ-BYT dated 31/8/2010, Vietnam Ministry of Health	Cross-sectional	872	25-64	15.0
20	Le, H.L., et al [82]	2014	2011	Community	NM but not self-report	Cross-sectional	1401	40+	30.6
21	Nguyen, N.L., [121]	2019	2016-2018	Hospital based	National hypertension program: systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥90 mmHg	Retrospective	65	NM	49.2
22	Lam, C.C., and Lam, C.Q, [122]	2019	2012-2018	Community	NM (systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥90 mmHg)	Cross-sectional	10188	≥40	22.2
23	Pham, T.L.A., Khuong, V.D., and Pham, Q.C, [85]	2019	2014-2015	Community (workplace)	systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥90 mmHg or reporting having diagnosed and on medication by a health professional	Cross-sectional	1,595	NM	15.4
24	Vo, T.X.H., et al [88]	2017	2015-2016	Community		Cross-sectional	1153	≥18	33.8

25	Nguyen, H., Do, I.T., and Ton, T.T, [123]	2017	2011-2015	Community (	MoH 2010, systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	20000	\geq 25	28.5
26	Pham, T.X., et al [124]	2017	2014	Community	STEPS, systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	459	45-64	35.5
28	Nguyen, T.T.T, Nguyen, T.K.A., and Nguyen, N.C., [125]	2017	2016	Community	systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	2699	18-69	18.97
29	Tran, M.D., et al [126]	2017	2016	workplace	NM but not self-report	Cross-sectional	1930	NM	2.3
30	Do, T.H., et al [90]	2015	2013	Community	JNC7, MoH 2010, systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	1200	40-59	19.7
31	Hong, M.H, [127]	2015	2013	Community	NM (must be systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg because this was a baseline survey of an intervention with control group)	Cross-sectional	1619	\geq 25	20.7
32	Le, T.H., et al [128]	2015	2013	Community	WHO-Systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg ;	Cross-sectional	800	\geq 18	16.8
33	Do, T.H., et al [93]	2014	2012	Community	JNC-7 - Systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg ;	Cross-sectional	1200	40-59	19.7
34	Chu, T.T.H, [129]	2014	2014	Community	MOH, 2010: 140 mmHg or diastolic blood pressure \geq 90 mmHg	Cross-sectional	2085	\geq 25	18.0
35	Nguyen, H.T, [130]	2014	2011	Community	140 mmHg or diastolic blood pressure \geq 80 mmHg	Cross-sectional	1833	\geq 25	11.8
37	Tran, Q.B., et al [94]	2013	2009	Community	WHO- STEPS: 140 mmHg or diastolic blood pressure \geq 90 mmHg or on medication	Cross-sectional	1714	25-64	17.8
38	Vien, C.C., and Phung, T.T.T, [106]	2008	2008	community	NM but not self-report	Cross-sectional	1620	18-60	15.8
39	Do, T.K.L., et al [109]	2003	March 2002 - December 2002	community	Hypertension dianogsis (>140/90) Diabetes (WHO 1999)	Cross-sectional	890	40-60	12.7

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- Figure 1** Consort diagram: Search strategy and selection of studies included in this review
- Figure 2** Pooled prevalence of diabetes in Vietnam
- Figure 3** Pooled prevalence of hypertension in Vietnam
- Figure 4** Prevalence of diabetes in Vietnam by year of study
- Figure 5** Prevalence of hypertension in Vietnam by year of study
- Figure 6** Prevalence diabetes in Vietnam by gender
- Figure 7** Prevalence hypertension in Vietnam by gender

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References:

1. Bukhman, G., et al., *The Lancet NCDI Poverty Commission: bridging a gap in universal health coverage for the poorest billion*. The Lancet, 2020. **396**(10256): p. 991-1044.
2. Bennett, J.E., et al., *NCD Countdown 2030: worldwide trends in non-communicable disease mortality and progress towards Sustainable Development Goal target 3.4*. The Lancet, 2018. **392**(10152): p. 1072-1088.
3. Pham, B.D., et al., *Exposure to Messages on Risk Factors for Noncommunicable Diseases in a Rural Province of Vietnam*. 2019. **2019**.
4. Geldsetzer, P., et al., *Diabetes and hypertension in India: a nationally representative study of 1.3 million adults*. 2018. **178**(3): p. 363-372.
5. WHO, N.D.i.t.S.-E.A.R., India, 2011.
6. Farrell, P., et al., *How food insecurity could lead to obesity in LMICs: When not enough is too much: a realist review of how food insecurity could lead to obesity in low-and middle-income countries*. Health promotion international, 2018. **33**(5): p. 812-826.
7. Li, L., et al., *Fast food consumption among young adolescents aged 12–15 years in 54 low-and middle-income countries*. Global health action, 2020. **13**(1): p. 1795438.
8. Umberger, W.J., J.A. Rupa, and D. Zeng, *Understanding food westernisation and other contemporary drivers of adult, adolescent and child nutrition quality in urban Vietnam*. Public Health Nutrition, 2020. **23**(14): p. 2571-2583.
9. WHO, T.N.D.D.b.C., 2016, <http://www.who.int/gho/countries/vnm/en/>.
10. WHO, G.S.R.o.N.D., Geneva, Switzerland, 2014.
11. Girum, T., T. Shumbej, and M. Shewangizaw, *Burden of malaria in Ethiopia, 2000-2016: findings from the Global Health Estimates 2016*. Tropical diseases, travel medicine and vaccines, 2019. **5**(1): p. 1-7.
12. <https://www.theguardian.com/healthcare-network/gallery/2018/may/17/high-blood-pressure-vietnam-world-hypertension-day#:~:text=Hypertension%20causes%20an%20estimated%2091%2C000>, V.h.
13. <https://www.who.int/nmh/publications/ncd-profiles-2018/en/>.
14. Van Bui, T., et al., *National survey of risk factors for non-communicable disease in Vietnam: prevalence estimates and an assessment of their validity*. 2016. **16**(1): p. 498.
15. MOH, N.S.o.R.F.o.N.i.V., Ministry of Health, Hanoi, Vietnam, 2016.
16. Thuy Duyen, N., et al., *Patterns of behavioral risk factors for non-communicable diseases in Vietnam: A narrative scoping review*. Health Psychology Open, 2020. **7**(2): p. 2055102920967248.
17. Meiqari, L., et al., *Prevalence of hypertension in Vietnam: a systematic review and meta-analysis*. Asia Pacific Journal of Public Health, 2019. **31**(2): p. 101-112.
18. Nguyen, C.T., et al., *Prevalence of and risk factors for type 2 diabetes mellitus in Vietnam: a systematic review*. Asia Pacific Journal of Public Health, 2015. **27**(6): p. 588-600.
19. Cochrane Effective Practice and Organisation of Care Group. Data collection checklist. 2015 [internet], c.A.A.f.h.e.c.o.s.e.
20. Hoque, M.E., et al., *Rapid shift toward overweight from double burden of underweight and overweight among Bangladeshi women: a systematic review and pooled analysis*. Nutrition reviews, 2015. **73**(7): p. 438-447.
21. Biswas, T., et al., *Double burden of underweight and overweight among women in South and Southeast Asia: a systematic review and meta-analysis*. Advances in Nutrition, 2020. **11**(1): p. 128-143.
22. Furuya-Kanamori, L., J.J. Barendregt, and S.A. Doi, *A new improved graphical and quantitative method for detecting bias in meta-analysis*. International journal of evidence-based healthcare, 2018. **16**(4): p. 195-203.

23. Neyeloff, J.L., S.C. Fuchs, and L.B. Moreira, *Meta-analyses and Forest plots using a microsoft excel spreadsheet: step-by-step guide focusing on descriptive data analysis*. BMC research notes, 2012. **5**(1): p. 1-6.

24. Higgins JPT, D.J., Altman DG, editors. Chapter 16: Special topics in statistics. In: Higgins JPT Green S. (eds). *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.1.0 (updated March 2011). The Cochrane Collaboration; 2011. Available from: www.handbook.cochrane.org.

25. Biswas, T., et al., *Double burden of underweight and overweight among women in South and Southeast Asia: a systematic review and meta-analysis*. 2020. **11**(1): p. 128-143.

26. Saquib, N., et al., *Cardiovascular diseases and type 2 diabetes in Bangladesh: a systematic review and meta-analysis of studies between 1995 and 2010*. 2012. **12**(1): p. 434.

27. Miyakawa, M., et al., Prevalence, perception and factors associated with diabetes mellitus among the adult population in central Vietnam: a population-based, cross-sectional seroepidemiological survey. BMC public health, 2017. **17**(1): p. 1-8.

28. Pham, L.H., et al., Prevalence of risk factors for non-communicable diseases in the Mekong Delta, Vietnam: results from a STEPS survey. BMC Public Health, 2009. **9**(1): p. 1-8.

29. National Hospital of Endocrinology . National program on diabetes control and prevention [in Vietnamese]. 1st ed. Hanoi, V.M.P., 2002.

30. Vien, C.C.a.T.T.T.P., Survey on overweight, hypertension, and diabetes among workers in middle region Vietnam. Journal of Employment Protection, 2008: p. 17 - 21.

31. Do, T.T., Prevalence of diabetes and decreased blood sugar in Tan Dan and Thai Son communes, An Lao district, Hai Phong. Vietnam Medical Journal, 2004. **11**: p. 128 - 132.

32. To, V.H., M.H. Vu, and V.H. Nguyen, Epidemiological survey on diabetes among population aged 16 and older in three districts in Hanoi. Vietnam Medical Journal, 2003. **6**: p. 58 - 64.

33. Do Nam, K., et al., Hypertension in a mountainous province of Vietnam: prevalence and risk factors. Heliyon, 2020. **6**(2): p. e03383.

34. Vo, T.D.a.V.P.D., Hypertension in Long An province in 2005: Prevalence and risk factors. Ho Chi Minh City Journal of Medicine and Pharmacy, 2007. **11**: p. 122 - 128.

35. Hoy, D., et al., Risk Factors for Chronic Disease in Viet Nam: A Review of the Literature Posted on January 18, 2013 by.

36. Le, N.T.D., L.D. Pham, and T.Q. Vo, Type 2 diabetes in Vietnam: a cross-sectional, prevalence-based cost-of-illness study. Diabetes, metabolic syndrome and obesity: targets and therapy, 2017. **10**: p. 363.

37. Do, T.a.N.L., Investigation for associated factors and epidemiology of type 2 diabetes in Hochiminh City [in Vietnamese]. Vietnam Journal of Food and Nutrition Sciences, 2008.

38. Ta, M., et al., Identification of undiagnosed type 2 diabetes by systolic blood pressure and waist-to-hip ratio. Diabetologia, 2010. **53**(10): p. 2139-2146.

39. 2012., N.H.o.E.N.p.o.d.c.a.p.i.V.n.e.H.M.P.

40. Pham, V.B.a.Q.D.T., Prevalence of diabetes and its related factors among people aged 30 - 69 in Binh Dinh province in 2018. Ho Chi Minh City Journal of Medicine and Pharmacy, 2019. **23**(5): p. 58 - 62.

41. Vo, T.X.H., et al., Prevalence of hypertension and diabetes among adults in Ho Chi Minh city - a community - based study in an urban district. Journal of Preventive Medicine, 2017. **27**(8): p. 79 - 87.

42. Hoang, D.H., T.T.H. Chu, and C.D. Bui, Prevalence of diabetes type 2 and prediabetes of people age 30 - 69 in Hanoi 2014. Journal of Preventive Medicine, 2016. **26**(2): p. 94 - 101.

43. Do, T.H., et al., Prevalence of hypertension, hyperglycemia and certain related factors in middle age group in Dong Son district, Thanh Hoa province 2013. Journal of Preventive Medicine, 2014. **24**(8): p. 30 - 36.

44. Dzoan, T.T.V., Some risk factors of diabetes type 2 in subjects aged 30 - 60 years in the hospital 198. *Journal of Food and Nutrition Sciences*, 2011. 7(1): p. 51 - 60.
45. Hoang, D.M., Studying on prevalence of diabetes in Hai Phong. *Vietnam Medical Journal*, 2008. 1: p. 1 - 4.
46. Hoa, N., et al., Prevalence and associated factors of diabetes mellitus among tuberculosis patients in Hanoi, Vietnam. *BMC infectious diseases*, 2018. 18(1): p. 1-9.
47. Tran, V.H.a.V.C.D., Research on diabetes and knowledge, practice on complication prevention of population 30 - 64 years old in Hau Giang province in 2011. *Journal of Practical Medicine*, 2013. 4: p. 23 - 27.
48. Dao, T.M.A., M.L. Tran, and T.P.N. Tran, Diabetes type II at age group of 30 - 69 in Nghe An population in 2010. *Journal of Medical Research*, 2012. 79(2): p. 186 - 193.
49. Do, M.C.a.T.H.N., Assessment prevalence of diabetes, glucose tolerance (IGT) and risk factors in the age 30 - 69 in suburbs Haoi city 2010. *Journal of Malaria and Parasite Diseases Control*, 2011. 4: p. 70 - 78.
50. Binh, T.Q., P.T. Phuong, and B.T. Nhung, Metabolic syndrome among a middle-aged population in the Red River Delta region of Vietnam. *BMC endocrine disorders*, 2014. 14(1): p. 1-9.
51. Nguyen, D.T., et al., Health situation and behavioural factors related to health of Saigon brewery workers in 2018. *Ho Chi Minh City Journal of Medicine and Pharmacy*, 2008. 12(4): p. 229 - 233.
52. Do, M.C., Research on the level of relevance between some risk factors and diabetes and glycemia disorder of people from 30 - 69 years old in three urban districts of Hai Phong in 2012. *Vietnam Journal of Medicine*, 2015. 2: p. 103 - 108.
53. Duong, T.H., Early Diagnosis of Diabetes and Glucose Disorder among Adults in Hai Phong 2011 *Vietnam Journal of Medicine*, 2013.
54. Nguyen, V.Q.a.T.H.P., Survey on prevalence of diabetes and prediabetes in Hai Hau distric, Nam Dinh province 2010. *Vietnam Medical Journal*, 2011. 1: p. 5 - 10.
55. Dao-Tran, T.H., et al., Factors associated with self-management among Vietnamese adults with type 2 diabetes. *Nursing open*, 2018. 5(4): p. 507-516.
56. Nguyen, V.L., Hypertension increase and its risk factors among labor- aged population in Hau Giang province in 2016. *Journal of Community Medicine*, 2018. 1(42): p. 84 - 91.
57. Dang, H.C.a.V.L.N., Prevalence of diabetes type 2 and its risk factors in Ca Mau province: solutions for management and prevention. *Journal of Community Medicine*, 2016. 32: p. 30 - 35.
58. Nguyen, T.T.T., T.Q. Nguyen, and N.C. Nguyen, Raised blood glucose situation among adults 18 - 69 years old in Hanoi 2016. *Journal of Preventive Medicine*, 2017. 27(6): p. 92 - 98.
59. Kien, V.D., et al., Socioeconomic inequalities in catastrophic health expenditure and impoverishment associated with non-communicable diseases in urban Hanoi, Vietnam. *International Journal for Equity in Health*, 2016. 15(1): p. 1-11.
60. Binh, T.Q.a.B.T.N., Prevalence and risk factors of type 2 diabetes in middle-aged women in Northern Vietnam. *International Journal of Diabetes in Developing Countries*, 2016. 36(2): p. 150-157.
61. Nguyen, Q.V.a.N.N.L., Prevalence and correlates of pre-diabetes, diabetes in some provinces in southern Vietnam: A cross-sectional study. *Ho Chi Minh City Journal of Medicine and Pharmacy*, 2014. 18(6): p. 451 - 457.
62. Do, T.T., *Diabetes prevalence and glucose decreased tolerance at Tan Dan & Thai Son communes, An Lao District-Hai Phong*. *Journal of Vietnamese Medicine*, 2004: p. 128-132.
63. Do Nam, K., et al., *Hypertension in a mountainous province of Vietnam: prevalence and risk factors*. *Heliyon*, 2020. 6(2): p. e03383.

64. Ramachandran, A., et al., Trends in prevalence of diabetes in Asian countries. *World journal of diabetes*, 2012. **3**(6): p. 110.

65. Zuo, H., Z. Shi, and A. Hussain, *Prevalence, trends and risk factors for the diabetes epidemic in China: a systematic review and meta-analysis*. *Diabetes research and clinical practice*, 2014. **104**(1): p. 63-72.

66. Ramachandran, A., et al., *Trends in prevalence of diabetes in Asian countries*. *World journal of diabetes*, 2012. **3**(6): p. 110.

67. Ramachandran, A., *Ching Wan Ma R, Snehalatha Chamukuttan, et al.* *Diabetes in Asia*. *The Lancet*, 2010. **375**: p. 408-18.

68. Hoy, D., et al., *Risk Factors for Chronic Disease in Viet Nam: A Review of the Literature Posted on January 18, 2013 by*.

69. Binh, T.Q. and B.T. Nhung, *Prevalence and risk factors of type 2 diabetes in middle-aged women in Northern Vietnam*. *International Journal of Diabetes in Developing Countries*, 2016. **36**(2): p. 150-157.

70. Miyakawa, M., et al., *Prevalence, perception and factors associated with diabetes mellitus among the adult population in central Vietnam: a population-based, cross-sectional seroepidemiological survey*. *BMC public health*, 2017. **17**(1): p. 1-8.

71. Duc Son, L., et al., *Prevalence and risk factors for diabetes in Ho Chi Minh City, Vietnam*. *Diabetic medicine*, 2004. **21**(4): p. 371-376.

72. Binh, T.Q., P.T. Phuong, and B.T. Nhung, *Metabolic syndrome among a middle-aged population in the Red River Delta region of Vietnam*. *BMC endocrine disorders*, 2014. **14**(1): p. 1-9.

73. Kien, V.D., et al., *Socioeconomic inequalities in catastrophic health expenditure and impoverishment associated with non-communicable diseases in urban Hanoi, Vietnam*. *International Journal for Equity in Health*, 2016. **15**(1): p. 1-11.

74. Pham, N.M. and K. Eggleston, *Diabetes prevalence and risk factors among Vietnamese adults: findings from community-based screening programs*. *Diabetes Care*, 2015. **38**(5): p. e77-e78.

75. Hoa, N., et al., *Prevalence and associated factors of diabetes mellitus among tuberculosis patients in Hanoi, Vietnam*. *BMC infectious diseases*, 2018. **18**(1): p. 1-9.

76. Pham, L.H., et al., *Prevalence of risk factors for non-communicable diseases in the Mekong Delta, Vietnam: results from a STEPS survey*. *BMC Public Health*, 2009. **9**(1): p. 1-8.

77. Le, N.T.D., L.D. Pham, and T.Q. Vo, *Type 2 diabetes in Vietnam: a cross-sectional, prevalence-based cost-of-illness study*. *Diabetes, metabolic syndrome and obesity: targets and therapy*, 2017. **10**: p. 363.

78. Do, T. and N. Le, *Investigation for associated factors and epidemiology of type 2 diabetes in Hochiminh City [in Vietnamese]*. *Vietnam Journal of Food and Nutrition Sciences*, 2008.

79. Ta, M., et al., *Identification of undiagnosed type 2 diabetes by systolic blood pressure and waist-to-hip ratio*. *Diabetologia*, 2010. **53**(10): p. 2139-2146.

80. Dao-Tran, T.H., et al., *Factors associated with self-management among Vietnamese adults with type 2 diabetes*. *Nursing open*, 2018. **5**(4): p. 507-516.

81. Nguyen, D.T., et al., *Health situation and behavioural factors related to health of Saigon brewery workers in 2018*. *Ho Chi Minh City Journal of Medicine and Pharmacy*, 2008. **12**(4): p. 229 - 233.

82. Le, H.N., et al., *The prevalence of non-communicable disease and its related factors among individuals aged 40 years and older living in Long Thuan commune, Ben Cau district, Tay Ninh province*. *Ho Chi Minh City Journal of Medicine and Pharmacy*, 2014. **18**(6): p. 746 - 754.

83. Pham, V.B. and Q.D. Truong, *Prevalence of diabetes and its related factors among people aged 30 - 69 in Binh Dinh province in 2018*. *Ho Chi Minh City Journal of Medicine and Pharmacy*, 2019. **23**(5): p. 58 - 62.

84. Nguyen, Q.V. and N.N. Le, *Prevalence and correlates of pre-diabetes, diabetes in some provinces in southern Vietnam: A cross-sectional study*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2014. **18**(6): p. 451 - 457.
85. Pham, T.L.A., V.D. Khuong, and Q.C. Pham, *Current situation of health and diseases of the traffic police between 2014 - 2015*. Journal of Preventive Medicine, 2019. **29**(3): p. 55 - 63.
86. Vu, D.T. and B.T. Dang, *The prevalence of type 2 diabetes in people aged ≥ 25 years in Thai Binh province 2017*. Journal of Preventive Medicine, 2018. **28**(7): p. 33 - 38.
87. Nguyen, B.T., et al., *Diabetes mellitus prevalence of people aged from 45 to 69 and some related factors in Sa Thay town, Sa Thay district, Kon Tum province 2016*. Journal of Preventive Medicine, 2017. **27**(8): p. 146 - 153.
88. Vo, T.X.H., et al., *Prevalence of hypertension and diabetes among adults in Ho Chi Minh city - a community - based study in an urban district*. Journal of Preventive Medicine, 2017. **27**(8): p. 79 - 87.
89. Hoang, D.H., T.T.H. Chu, and C.D. Bui, *Prevalence of diabetes type 2 and prediabetes of people age 30 - 69 in Hanoi 2014*. Journal of Preventive Medicine, 2016. **26**(2): p. 94 - 101.
90. Do, T.H., et al., *Actual situation on hypertension, diabetes and the health care requirement status among people of the middle-age group (from 40 - 59) at Dong Son district, Thanh Hoa province 2013*. Journal of Preventive Medicine, 2015. **25**(8): p. 381 - 390.
91. Nguyen, V.L. and V.T. Nguyen, *The rate of diabetes and some factors related to the Khmer ethnic minority people who are 45 years and over in Hau Giang province*. Journal of Preventive Medicine, 2013. **23**(6): p. 142 - 149.
92. Nguyen, T.T.T., T.Q. Nguyen, and N.C. Nguyen, *Raised blood glucose situation among adults 18 - 69 years old in Hanoi 2016*. Journal of Preventive Medicine, 2017. **27**(6): p. 92 - 98.
93. Do, T.H., et al., *Prevalence of hypertension, hyperglycemia and certain related factors in middle age group in Dong Son district, Thanh Hoa province 2013*. Journal of Preventive Medicine, 2014. **24**(8): p. 30 - 36.
94. Tran, Q.B., et al., *Steps survey on risk factors for non-communicable diseases in Can Tho city 2009 - 2010*. Journal of Preventive Medicine, 2013. **23**(5): p. 72 - 79.
95. Vo, T.D. and T.T. Pham, *Study on status of diabetes type 2 and assessment of intervention results on adults aged from 40 years old at My Xuyen, Soc Trang in 2015 - 2016*. Can Tho Journal of Medicine and Pharmacy, 2017. **9**: p. 138 - 145.
96. Nguyen, V.L., *Hypertension increase and its risk factors among labor- aged population in Hau Giang province in 2016*. Journal of Community Medicine, 2018. **1**(42): p. 84 - 91.
97. Dang, H.C. and V.L. Nguyen, *Prevalence of diabetes type 2 and its risk factors in Ca Mau province: solutions for management and prevention*. Journal of Community Medicine, 2016. **32**: p. 30 - 35.
98. Do, M.C., *Research on the level of relevance between some risk factors and diabetes and glycemia disorder of people from 30 - 69 years old in three urban districts of Hai Phong in 2012*. Vietnam Journal of Medicine, 2015. **2**: p. 103 - 108.
99. Duong, T.H., *Early Diagnosis of Diabetes and Glucose Disorder among Adults in Hai Phong 2011* Vietnam Journal of Medicine, 2013.
100. Tran, V.H. and V.C. Dam, *Research on diabetes and knowledge, practice on complication prevention of population 30 - 64 years old in Hau Giang province in 2011*. Journal of Practical Medicine, 2013. **4**: p. 23 - 27.
101. Dao, T.M.A., M.L. Tran, and T.P.N. Tran, *Diabetes type II at age group of 30 - 69 in Nghe An population in 2010*. Journal of Medical Research, 2012. **79**(2): p. 186 - 193.
102. Do, M.C. and T.H. Nguyen, *Assessment prevalence of diabetes, glucose tolerance (IGT) and risk factors in the age 30 - 69 in suburbs Hanoi city 2010*. Journal of Malaria and Parasite Diseases Control, 2011. **4**: p. 70 - 78.

103. Nguyen, V.Q. and T.H. Pham, *Survey on prevalence of diabetes and prediabetes in Hai Hau distric, Nam Dinh province 2010*. Vietnam Medical Journal, 2011. **1**: p. 5 - 10.

104. Dzoan, T.T.V., *Some risk factors of diabetes type 2 in subjects aged 30 - 60 years in the hospital 198*. Journal of Food and Nutrition Sciences, 2011. **7**(1): p. 51 - 60.

105. Hoang, D.M., *Studying on prevalence of diabetes in Hai Phong*. Vietnam Medical Journal, 2008. **1**: p. 1 - 4.

106. Vien, C.C. and T.T.T. Phung, *Survey on overweight, hypertension, and diabetes among workers in middle region Vietnam*. Journal of Employment Protection, 2008: p. 17 - 21.

107. Do, T.T., *Prevalence of diabetes and decreased blood sugar in Tan Dan and Thai Son communes, An Lao district, Hai Phong*. Vietnam Medical Journal, 2004. **11**: p. 128 - 132.

108. To, V.H., M.H. Vu, and V.H. Nguyen, *Epidemiological survey on diabetes among population aged 16 and older in three districts in Hanoi*. Vietnam Medical Journal, 2003. **6**: p. 58 - 64.

109. Do, T.K.L., et al., *A study on nutritional status, related factors and high blood glucoza level of adults aged 40 to 60 living in a center district of Hanoi city*. Vietnam Medical Journal, 2003. **9**: p. 78 - 84.

110. Quoc Cuong, T., et al., *Associated factors of hypertension in women and men in vietnam: A cross-sectional study*. International journal of environmental research and public health, 2019. **16**(23): p. 4714.

111. Hoang, V.M., et al., *Patterns of Raised Blood Pressure in Vietnam: Findings from the WHO STEPS Survey 2015*. International journal of hypertension, 2019. **2019**.

112. Son, P., et al., *Prevalence, awareness, treatment and control of hypertension in Vietnam—results from a national survey*. Journal of human hypertension, 2012. **26**(4): p. 268-280.

113. Do, H.T., et al., *National prevalence and associated risk factors of hypertension and prehypertension among Vietnamese adults*. American journal of hypertension, 2015. **28**(1): p. 89-97.

114. Pham, N.M. and K. Eggleston, *Prevalence and determinants of diabetes and prediabetes among Vietnamese adults*. Diabetes Research and Clinical Practice, 2016. **113**: p. 116-124.

115. Tran, T.T., *The influence factors involve knowledge and practice in adult about high blood pressure in Ho Chi Minh city 2005*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2007. **11**: p. 118-126.

116. Vo, T.D. and V.P. Dang, *Hypertension in Long An province in 2005: Prevalence and risk factors*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2007. **11**: p. 122 - 128.

117. Le, Q.D. and D.N. Nguyen, *The prevalence of hypertension and body mass index among adults aged 25 - 64 years at Lam Dong in 2010*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2011. **15**(3): p. 158 - 164.

118. Vu, B.N., et al., *Prevalence of hypertension among adults living in district 4 - Ho Chi Minh city 2004*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2005. **9**(1): p. 93 - 99.

119. Nguyen, V.T., et al., *Disease model in advanced bureaucrats who are monitored by the health care department of Long An province*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2013. **17**(3): p. 331 - 334.

120. Tran, V.H. and D.N. Nguyen, *Prevalence of hypertension and its risk behaviours at the population among 25 - 64 years old in Ninh Hai district, Ninh Thuan province*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2014. **18**(6): p. 709 -0716.

121. Nguyen, N.L., *Evaluating the effectiveness of management, protection and health care of cadres in Vinh Long province in 3 years 2016 - 2018*. Ho Chi Minh City Journal of Medicine and Pharmacy, 2019. **23**(3): p. 124 - 129.

122. Lam, C.C. and C.Q. Lam, *The status of hypertension and relevance between risk factors with hypertension in people aged ≥40 years old at Ninh Hoa town, Khanh Hoa province, 2012 - 2018*. Journal of Preventive Medicine, 2019. **29**(6): p. 100 - 105.

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123. Nguyen, H., I.T. Do, and T.T. Ton, *Prevalence trend of hypertension and risk factors of cardiovascular disease among people aged 25 and older in Da Nang city between 2011 and 2015*. Journal of Preventive Medicine, 2017. **27**(8): p. 55 - 64.
124. Pham, T.X., et al., *Reality of hypertension in aged of 45 - 64 year in Dien Bien district in 2014*. Journal of Preventive Medicine, 2017. **27**(7): p. 67 - 73.
125. Nguyen, T.T., T.K.A. Nguyen, and N.C. Nguyen, *Hypertension status among adults 18 - 69 years old in Hanoi 2016*. Journal of Preventive Medicine, 2017. **27**(6): p. 84 - 91.
126. Tran, M.D., et al., *Workers health conditions of the automobile and motorcycle brake manufacturing company in Vietnam in 2016*. Journal of Preventive Medicine, 2017. **27**(1): p. 126 - 133.
127. Hong, M.H., *Research on the high blood pressure in person from 25 years or older and results of intervention at Phu Tan district in Ca Mau province in 2014*. Journal of Preventive Medicine, 2015. **25**(8): p. 333 - 341.
128. Le, T.H., et al., *Prevalence of Hypertension among Adults in two rural communes, Quang Trach district, Quang Binh province 2013*. Journal of Preventive Medicine, 2015. **XXV**(6): p. 77-84.
129. Chu, T.T.H., *Prevalence of hypertension in Hanoi city in 2012*. Journal of Preventive Medicine, 2014. **24**(1): p. 91 - 95.
130. Nguyen, H.T., *Current status of hypertension of the adult population aged 25 years and older who living in Trang Ha commune, Tu Son town, Bac Ninh province in 2011*. Journal of Preventive Medicine, 2014. **24**(1): p. 80 - 85.

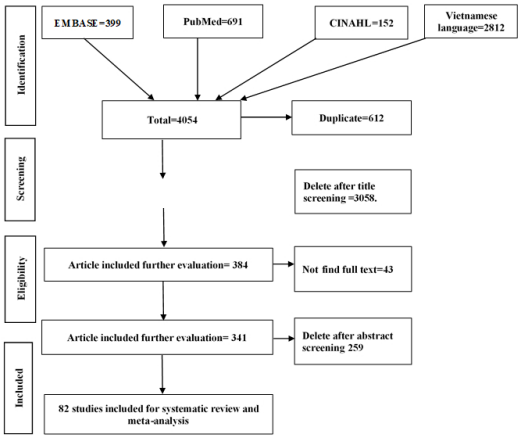


Figure-1: Consort diagram: Search strategy and selection of studies included in this review

Figure 1 Consort diagram: Search strategy and selection of studies included in this review

338x190mm (96 x 96 DPI)

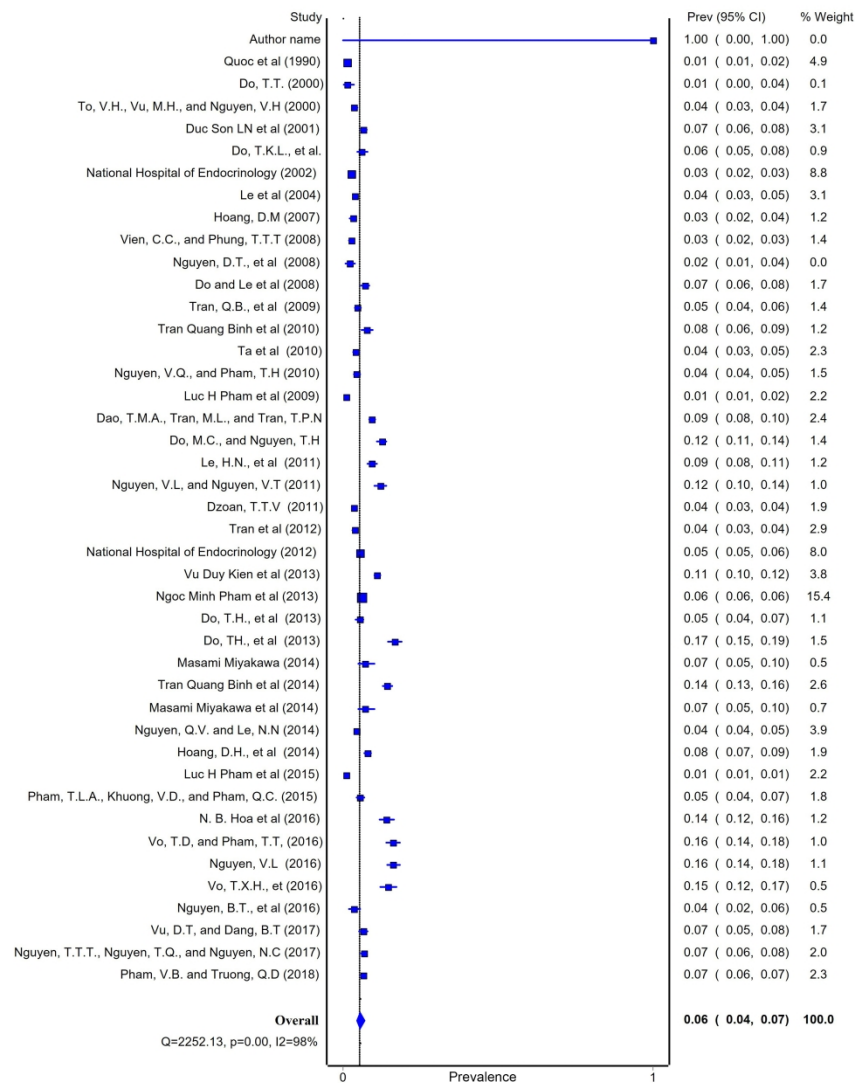


Figure 2 Pooled prevalence of diabetes in Vietnam

272x373mm (300 x 300 DPI)

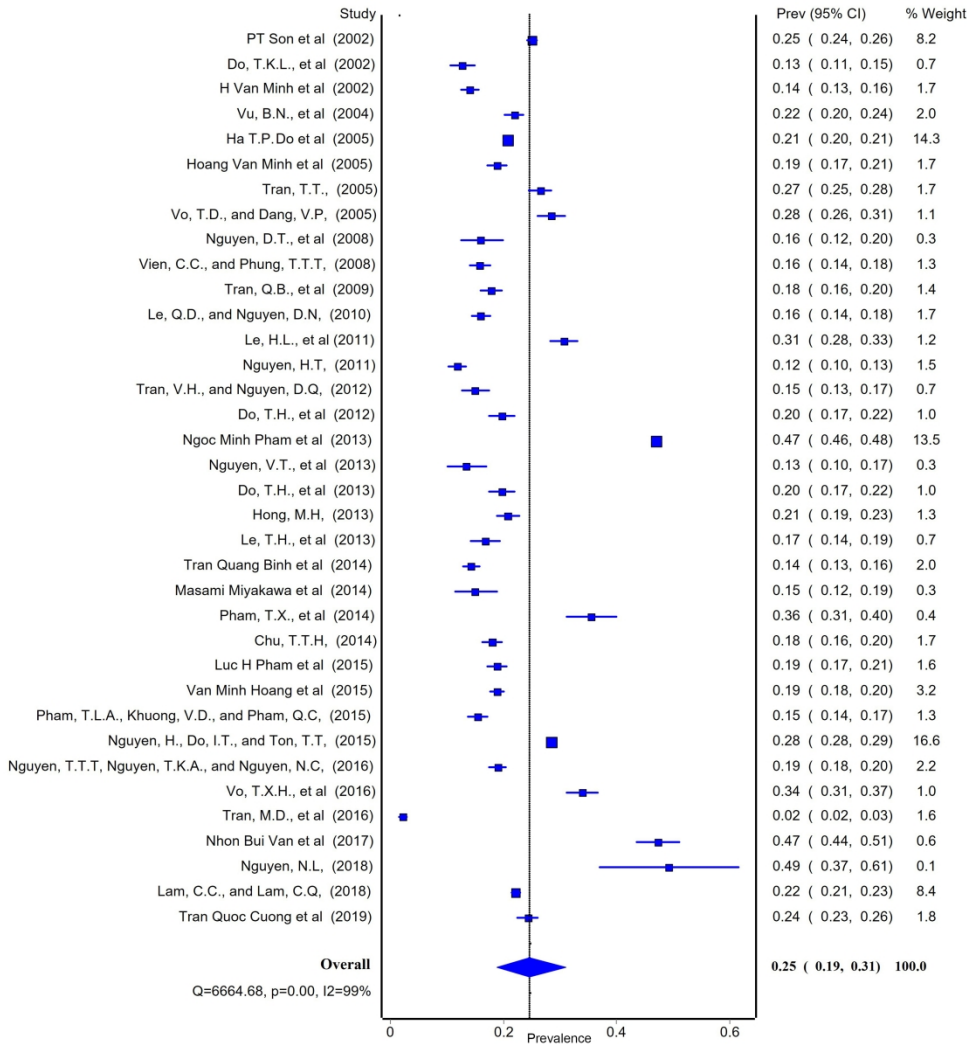


Figure 3 Pooled prevalence of hypertension in Vietnam

272x317mm (300 x 300 DPI)

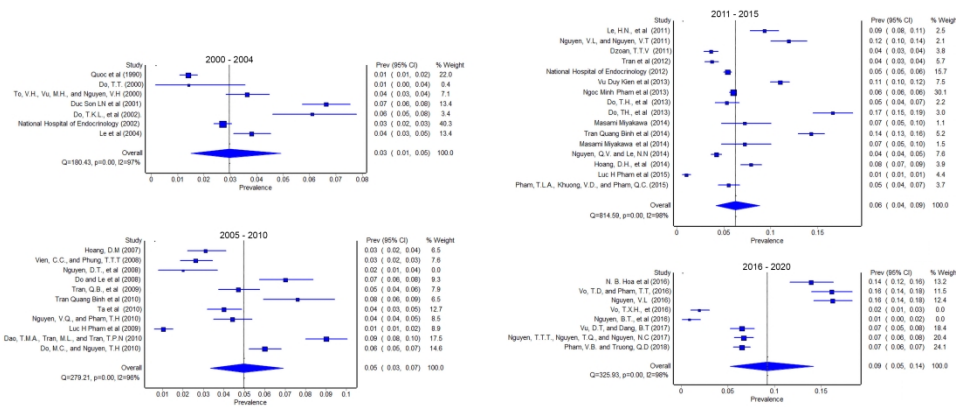


Figure 4 Prevalence of diabetes in Vietnam by year of study

998x475mm (118 x 118 DPI)

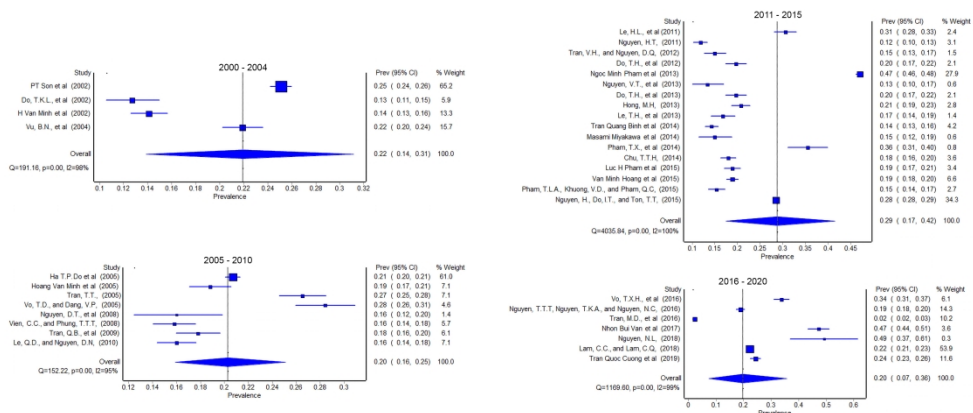


Figure 5 Prevalence of hypertension in Vietnam by year of study
987x486mm (118 x 118 DPI)

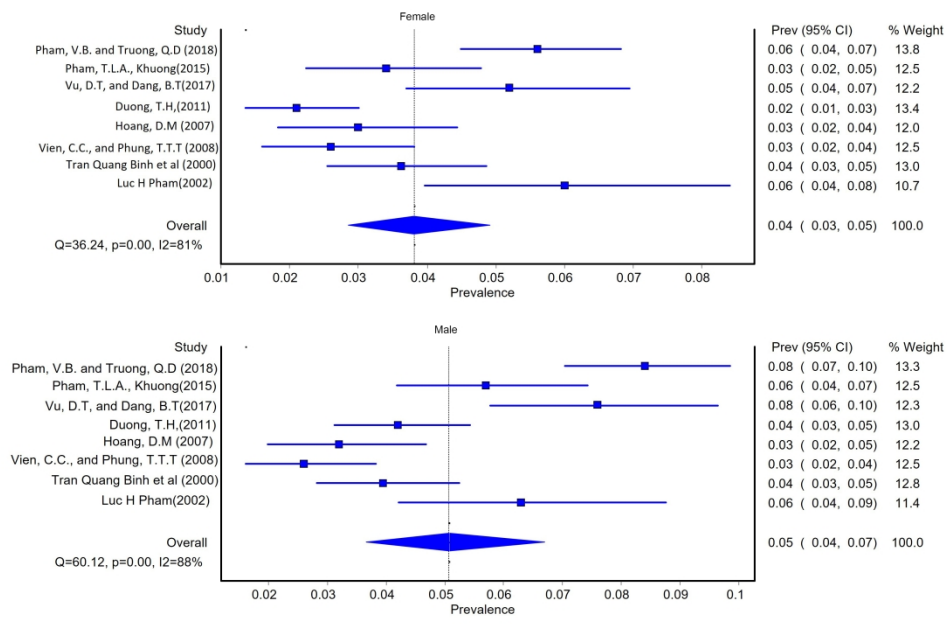


Figure 6 Prevalence diabetes in Vietnam by gender

841x590mm (118 x 118 DPI)

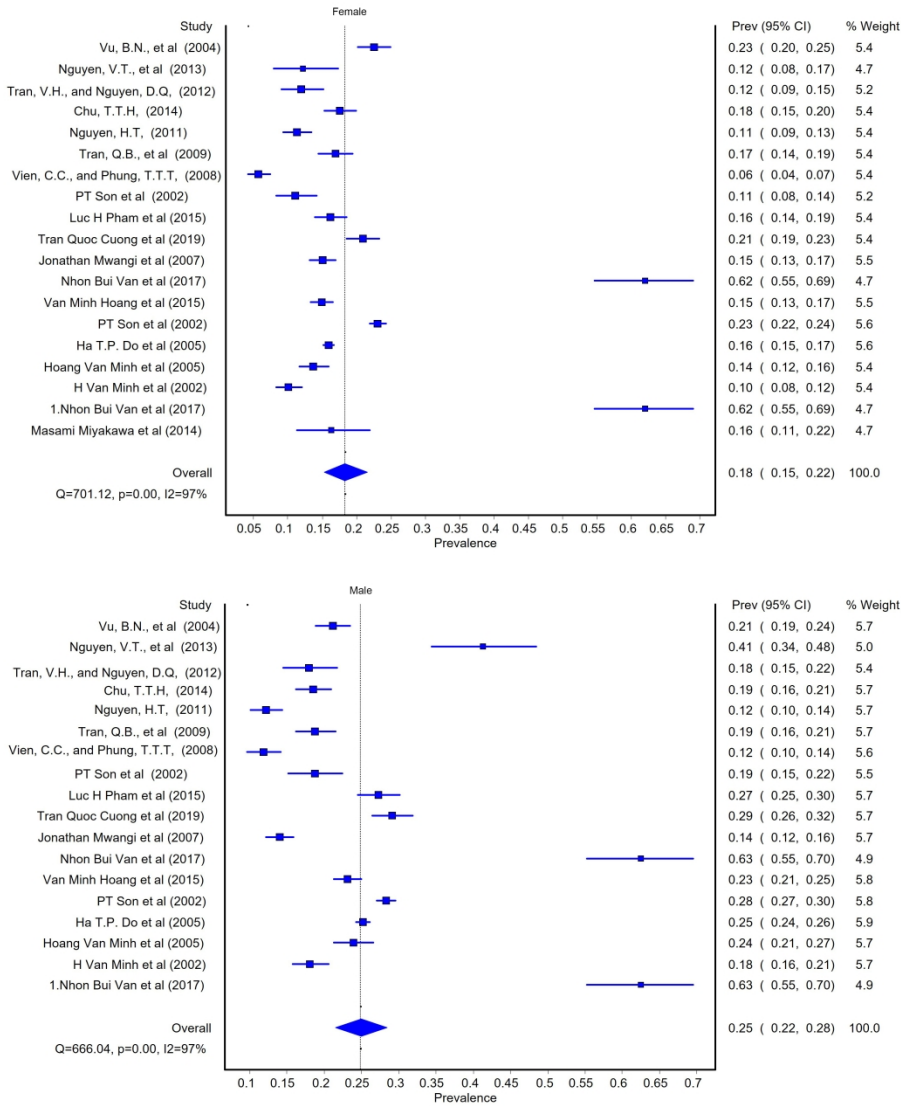


Figure 7 Prevalence hypertension in Vietnam by gender
835x1034mm (118 x 118 DPI)

SUPPLEMENTARY APPENDIX

Type 2 Diabetes and hypertension in Vietnam: A systematic review and meta-analysis of studies between 2000 to 2020

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Supplementary data

Table S1 Detailed search strategy used for PubMed database

Table S2 Quality score of the diabetes study

Table S3 Quality score of the hypertension study

Figure S1a Funnel plot for the estimation of prevalence rates T2DM

Figure S1b Funnel plot for the estimation of prevalence rates T2DM by year of study

Figure S1c Funnel plot for the estimation of prevalence rates T2DM by male

Figure S1d Funnel plot for the estimation of prevalence rates T2DM by female

Figure S2a Funnel plot for the estimation of prevalence hypertension

Figure S2b Funnel plot for the estimation of prevalence hypertension by year of study

Figure S2c Funnel plot for the estimation of prevalence hypertension by male

Figure S2d Funnel plot for the estimation of prevalence hypertension by female

Table S1 Detailed search strategy used for PubMed database

Search Query
((((((((("diabetes mellitus"[MeSH Terms] OR ("diabetes"[All Fields] AND "mellitus"[All Fields]) OR "diabetes mellitus"[All Fields] OR "diabetes"[All Fields] OR "diabetes insipidus"[MeSH Terms] OR ("diabetes"[All Fields] AND "insipidus"[All Fields]) OR "diabetes insipidus"[All Fields]) OR ("diabetes mellitus"[MeSH Terms] OR ("diabetes"[All Fields] AND "mellitus"[All Fields]) OR "diabetes mellitus"[All Fields])) OR ("diabetes mellitus, type 2"[MeSH Terms] OR "type 2 diabetes mellitus"[All Fields] OR ("non"[All Fields] AND "insulin"[All Fields] AND "dependent"[All Fields] AND "diabetes"[All Fields] AND "mellitus"[All Fields]) OR "non insulin dependent diabetes mellitus"[All Fields])) OR ("diabetes mellitus, type 2"[MeSH Terms] OR "type 2 diabetes mellitus"[All Fields] OR "niddm"[All Fields])) OR ("diabetes mellitus, type 2"[MeSH Terms] OR "type 2 diabetes mellitus"[All Fields] OR "type 2 diabetes"[All Fields])) OR ("cardiovascular diseases"[MeSH Terms] OR ("cardiovascular"[All Fields] AND "diseases"[All Fields]) OR "cardiovascular diseases"[All Fields] OR ("cardiovascular"[All Fields] AND "disease"[All Fields]) OR "cardiovascular disease"[All Fields])) OR CVD[All Fields]) OR ("myocardial infarction"[MeSH Terms] OR ("myocardial"[All Fields] AND "infarction"[All Fields]) OR "myocardial infarction"[All Fields])) OR ("ischaemic heart disease"[All Fields] OR "myocardial ischemia"[MeSH Terms] OR ("myocardial"[All Fields] AND "ischemia"[All Fields]) OR "myocardial ischemia"[All Fields] OR ("ischemic"[All Fields] AND "heart"[All Fields] AND "disease"[All Fields]) OR "ischemic heart disease"[All Fields] OR "coronary artery disease"[MeSH Terms] OR ("coronary"[All Fields] AND "artery"[All Fields] AND "disease"[All Fields]) OR "coronary artery disease"[All Fields] OR ("ischemic"[All Fields] AND "heart"[All Fields] AND "disease"[All Fields])) OR ("hypertension"[MeSH Terms] OR "hypertension"[All Fields])) OR ("hypertension"[MeSH Terms] OR "hypertension"[All Fields] OR ("high"[All Fields] AND "blood"[All Fields] AND "pressure"[All Fields]) OR "high blood pressure"[All Fields])) OR ("coronary artery disease"[MeSH Terms] OR ("coronary"[All Fields] AND "artery"[All Fields] AND "disease"[All Fields]) OR "coronary artery disease"[All Fields])) AND ("vietnam"[MeSH Terms] OR "vietnam"[All Fields])

Table S2 Quality score of the diabetes study

SI	Author name	Publication year	Target population a close representation of the national population	Sufficient sample size (n=500)	Random sampling	Ascertainment of HTN/DM measure	Quality assessment score
1	Tran Quang Binh et al	2015	1	1	1	1	4
2	Masami Miyakawa et al	2017	1	1	1	1	4
3	Duc Son LN et al	2004	1	1	1	1	4
4	Masami Miyakawa	2017	1	0	1	1	3
5	Vu DuyKien et al	2013	1	1	1	1	4
6	Ngoc Minh Pham et al	2015	1	1	1	1	4
7	N. B. Hoa et al	2018	1	1	1	1	4
8	Luc H Pham et al	2009	1	1	1	1	4
9	National Hospital of Endocrinology	2002	1	1	1	1	4
10	Le et al	2004	1	1	1	1	4
11	Do and Le et al	2008	1	1	1	1	4
12	Ta et al	2010	1	1	1	1	4
13	Tran et al	2012	1	1	1	1	4
14	National Hospital of Endocrinology	2012	1	0	1	1	3
15	Nguyễn DoãnThành	2008	0	0	0	0	0
16	Lê HoàngNinh	2014	0	1	1	1	3
17	Phạm VănBảo	2019	0	1	1	1	3
18	Nguyễn Quang Vinh	2014	0	1	1	1	3
19	Phạm Thị Lan Anh	2019	1	1	1	1	4
20	VũĐìnhTriển	2018	1	1	1	1	4
21	Nguyễn Bá Trí	2017	1	0	1	1	3
22	Võ Thị XuânHạnh	2017	0	1	0	1	2
23	HoàngĐứcHạnh	2016	0	1	1	1	3
24	Đỗ TháiHòa	2015	0	1	1	1	3
25	Nguyễn VănLành	2013	0	1	1	1	3
26	Nguyễn Thị Thi Thơ	2017	0	1	1	1	3
27	Đỗ TháiHoà	2014	1	1	1	1	4
28	Trần QuốcBảo	2013	0	1	1	1	3
29	VõThànhDanh	2017	0	1	1	1	3
30	Nguyễn VănLành	2018	0	1	1	1	3
31	Đặng HảiĐặng	2016	0	1	1	1	3
32	Đỗ MạnhCường	2015	0	1	1	1	3
33	Dương Thị Hương	2013	0	1	1	1	3
34	Trần VănHải	2013	0	1	1	1	3
35	Đào Thị Minh An	2012	0	1	1	1	3
36	Đỗ MạnhCường	2011	0	1	1	1	3
37	Nguyễn Vinh Quang	2011	0	1	1	1	3
38	Doãn Thị Tường Vi	2011	0	1	1	1	3
39	HoàngĐặngMịch	2008	0	1	1	1	3
40	ViênChinhChiến	2008	0	1	1	1	3
41	Đỗ Thị Tinh	2004	0	0	1	0	1
42	TôVănHải	2003	0	1	1	1	3
43	Đỗ Thị Kim Liên	2003	0	1	1	1	3

Table S3 Quality score of the hypertension study

SI	Author name	Publication year	Target population a close representation of the national population	Sufficient sample size (n=500)	Random sampling	Ascertainment of HTN/DM measure	Quality assessment score
1	Luc H Pham et al	2009	1	1	1		4
2	Tran Quoc Cuong et al	2019	1	1	1		4
3	Jonathan Mwangi et al	2015	1	1	1		4
4	Nhon Bui Van et al	2018	1	1	1		4
5	Van Minh Hoang et al	2019	1	1	1		4
6	PT Son et al	2011	1	1	1		4
7	Ha T.P. Do et al	2014	1	1	1		4
8	Jonathan Mwangi et al	2015	1	1	1		4
9	Tran Quang Binh et al	2014	1	1	1		4
10	Hoang Van Minh et al	2007	1	1	1		4
11	Ngoc Minh Pham et al	2015	1	1	1		4
12	H Van Minh et al	2005	1	1	1		4
13	Masami Miyakawa et al	2017	1	1	1		4
14	Trần Thiện Thuần et al	2007	1	1	1		4
15	Võ Thị Dề et al	2007	1	1	1		4
16	Lê Quang Đạo et al	2011	1	1	1		4
17	Nguyễn Doãn Thành et al	2008	1	1	1		4
18	Vũ Bảo Ngọc et al	2005	1	1	1		4
19	Nguyễn Văn Thành et al	2013	1	1	1		4
20	Trần Văn Hương et al	2014	1	1	1		4
21	Lê Hoàng Ninh et al	2014	1	1	1		4
22	Nguyễn Ngọc Long et al	2019	1	1	1		4
23	Lâm Chi Cường et al	2019	1	1	1		4
24	Phạm Thị Lan Anh et al	2019	1	1	1		4
25	Võ Thị Xuân Hạnh et al	2017	1	1	1		4
26	Nguyễn Hóa et al	2017	1	1	1		4
27	Phạm Thế Xuyên et al	2017	1	1	1		4
28	Nguyễn Thị Thi Thơ et al	2017	1	1	1		4
29	Trần Minh Đức et al	2017	1	1	1		4
30	Đỗ Thái Hòa et al	2015	1	1	1		4
31	Hồng Mừng Hai et al	2015	1	1	1		4
32	Lê Thị Hương et al	2015	1	1	1		4
33	Đỗ Thái Hoà et al	2014	1	1	1		4
34	Chu Thị Thu Hà et al	2014	1	1	1		4
35	Nguyễn Hữu Tước et al	2014	1	1	1		4
36	Trần Quốc Bảo et al	2013	1	1	1		4
37	Viên Chinh Chiến et al	2008	1	1	1		4
38	Đỗ Thị Kim Liên et al	2003	1	1	1		4

Figure S1a Funnel plot for the estimation of prevalence rates T2DM

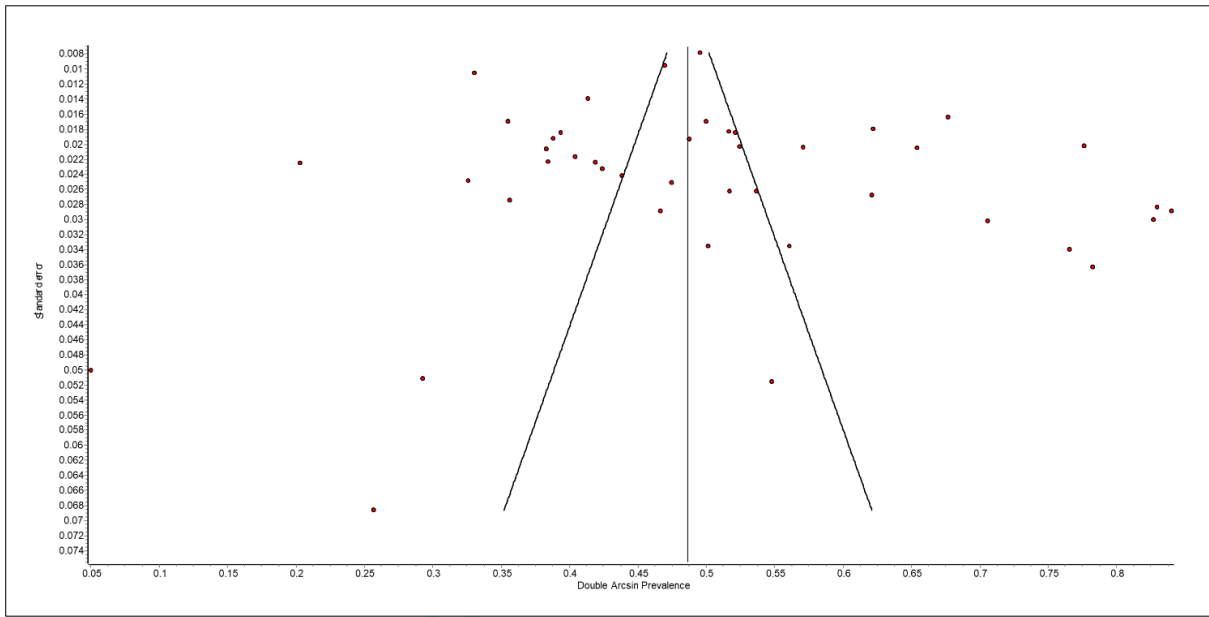
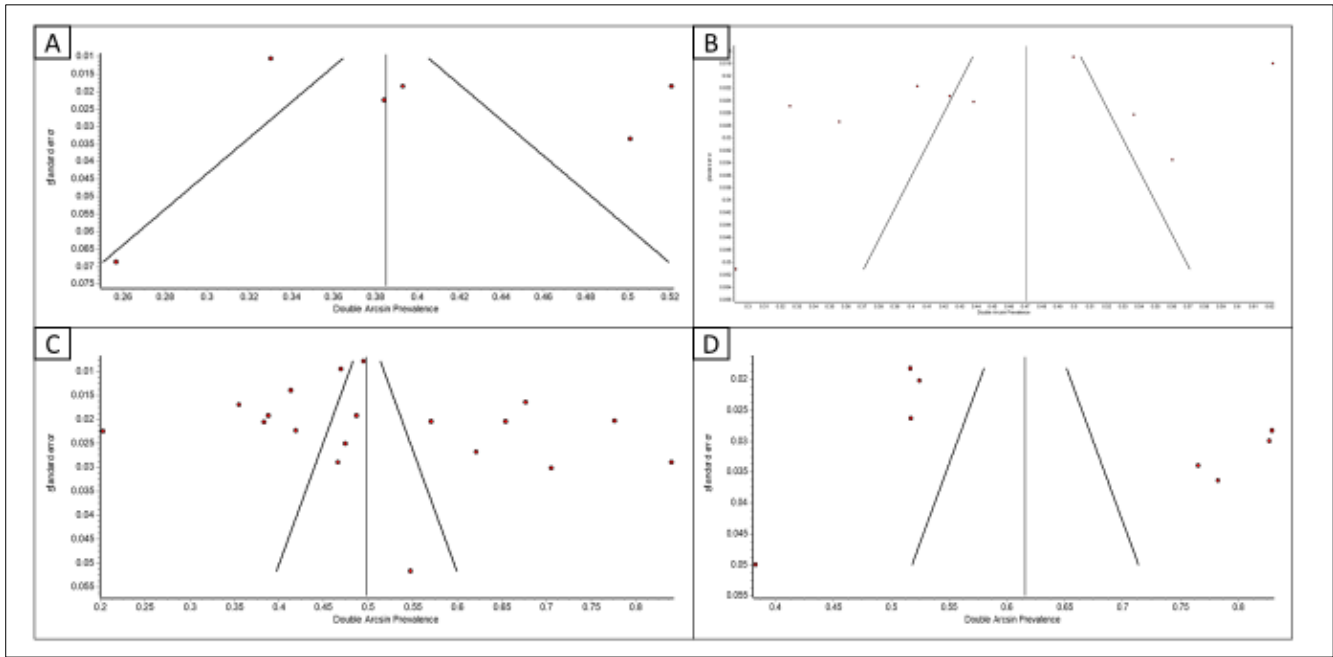


Figure S1b Funnel plot for the estimation of prevalence rates T2DM by year of study



(A: 2000-2004; B: 2005-2010; C: 2011-2015; D: 2016-2020)

Figure S1c Funnel plot for the estimation of prevalence rates T2DM by male

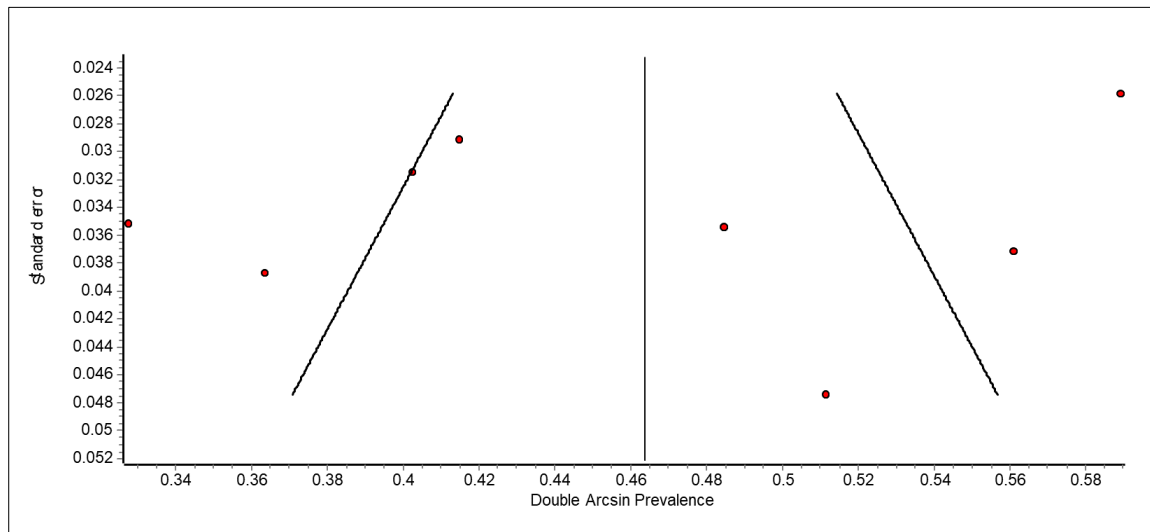


Figure S1d Funnel plot for the estimation of prevalence rates T2DM by female

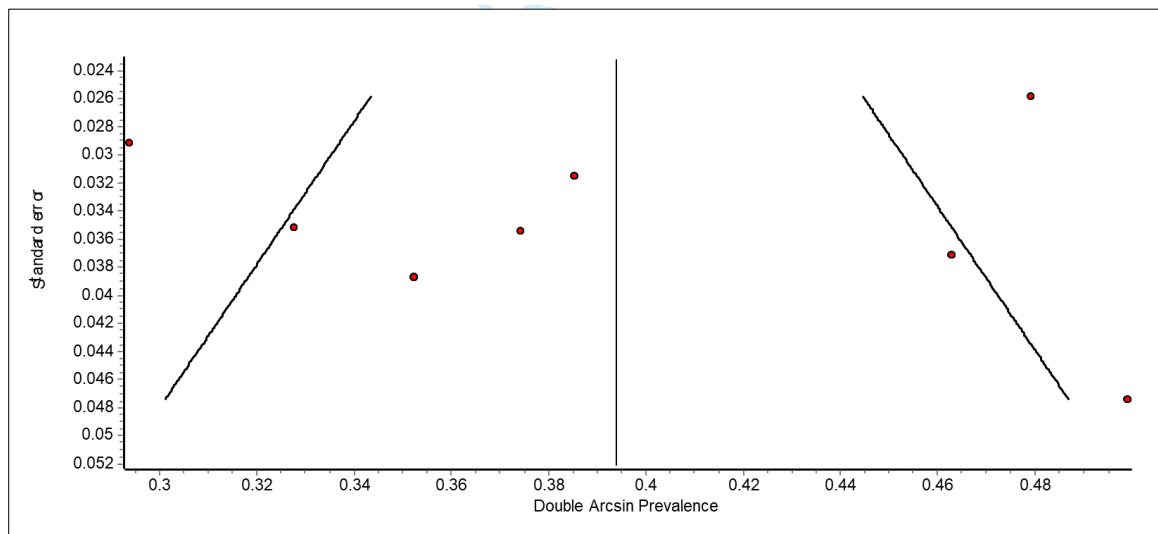


Figure S2a Funnel plot for the estimation of prevalence hypertension

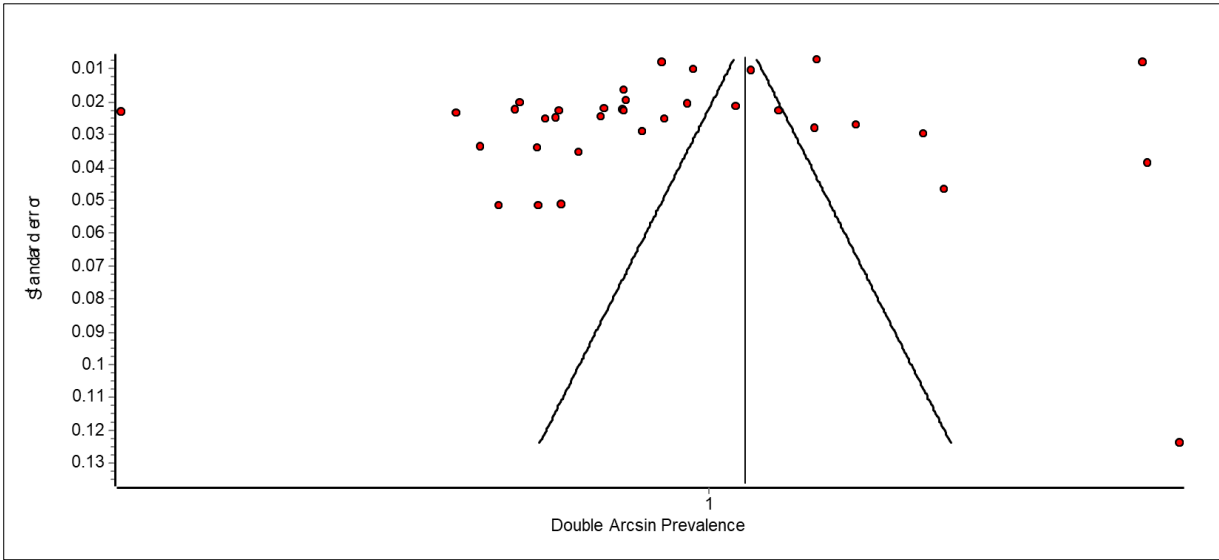
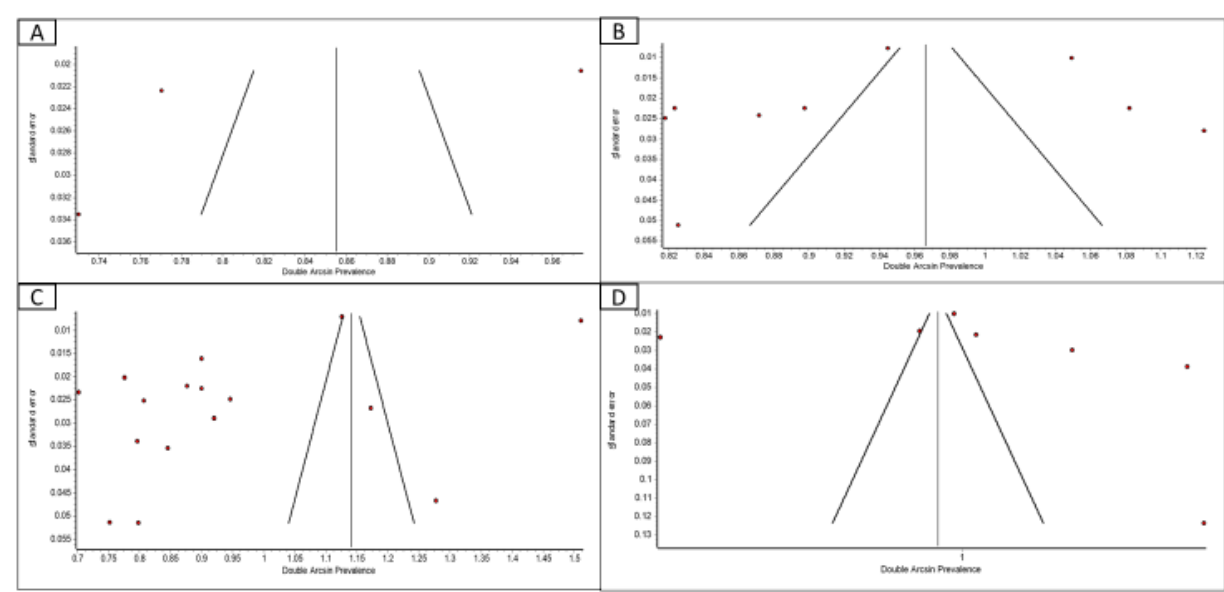


Figure S2b Funnel plot for the estimation of prevalence hypertension by year of study



(A: 2000-2004; B: 2005-2010; C: 2011-2015; D: 2016-2020)

Figure S2c Funnel plot for the estimation of prevalence hypertension by male

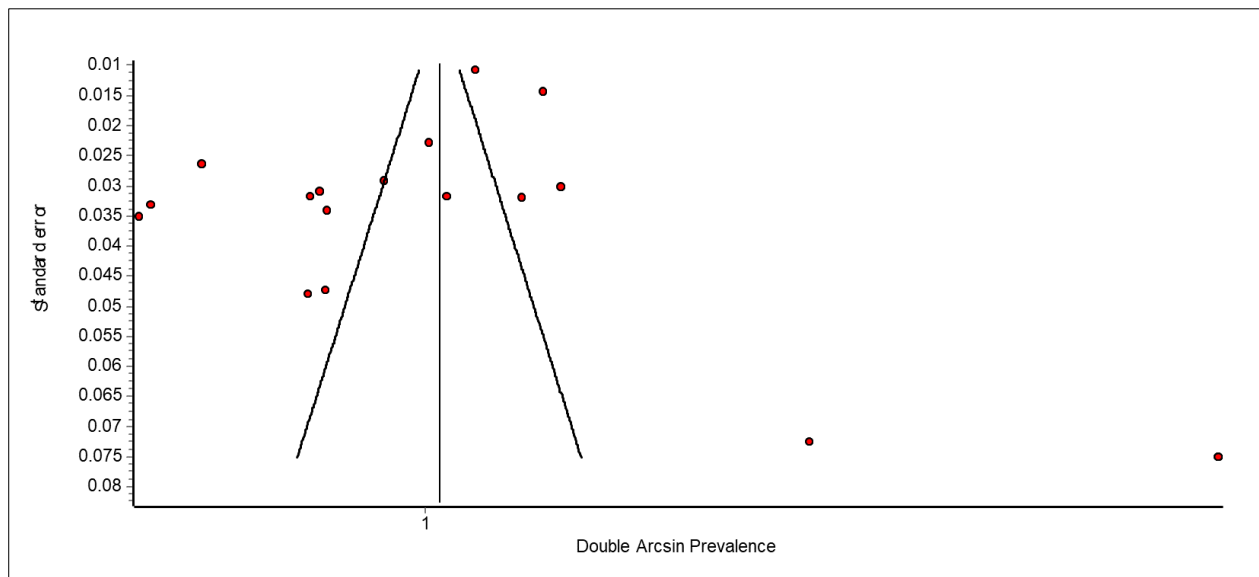
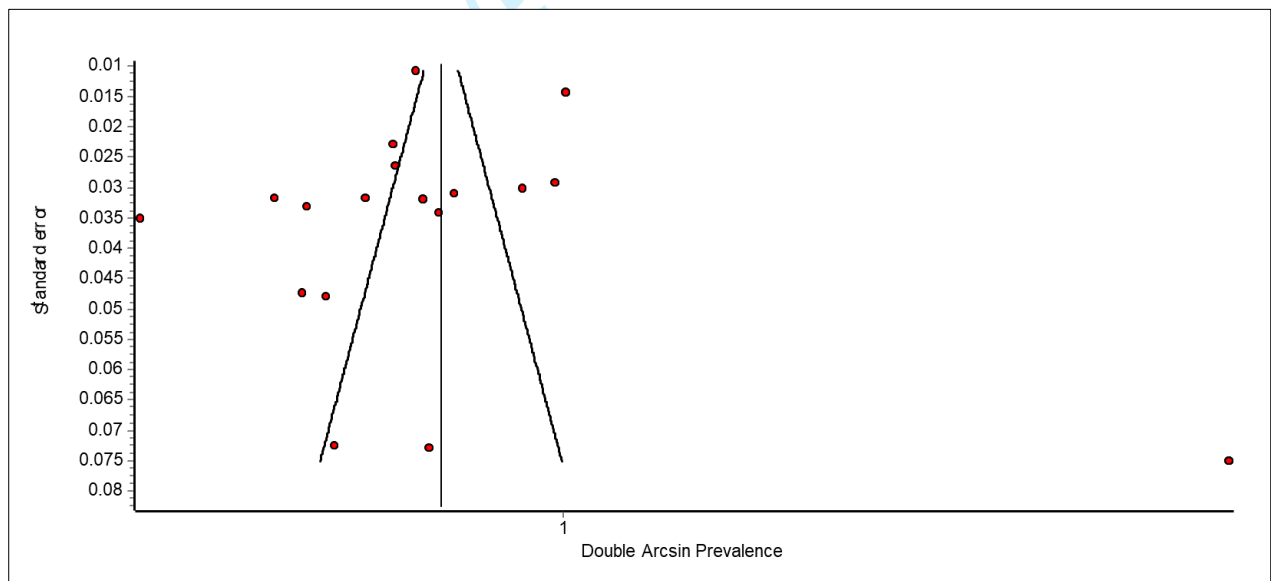


Figure S2d Funnel plot for the estimation of prevalence hypertension by female





PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	3
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and if available, provide registration information including registration number.	4
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	4
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	4
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	4
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I ²) for each meta-analysis.	4



PRISMA 2009 Checklist

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	4
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	NA
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	5
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICO, follow-up period) and provide the citations.	5
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	5-6
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	5-6
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	5-6
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	5-6
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	NA
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	7-8
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	7-8
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	7-8
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data; role of funders for the systematic review).	NA