Cardiovascular disease prevention in Cochabamba, Bolivia:

The importance of preventable risk factor distribution and inequalities for policy implementation

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This thesis is wholeheartedly dedicated to my beloved parents, who have been my source of inspiration and strength when I thought of giving up, and to all persons and institutions who continually supported me in my PhD journey.
Table of Contents

Abstract ................................................................. i
Abbreviations ........................................................... iv
Prologue ................................................................. vi
Background ........................................................................ 1
CVDs: a worldwide public health problem ........................................ 1
The CVDs epidemic in LMICs ..................................................... 2
Health inequalities associated with CVDs in LMICs .............................. 3
Cardiovascular risk factors: concept and distribution in LMICs ............... 4
CVRFs in the Latin American region ............................................ 5
CVRFs in Bolivia and Cochabamba ............................................. 6
Surveillance of preventable cardiovascular risk factors ......................... 7
The development of CVDs prevention and control policies .................... 10
NCDs and CVDs prevention in the Bolivian health system ..................... 13
NCDs and CVDs in the Bolivian health system .................................. 13
Rationale ............................................................................ 17
Aim ................................................................................... 19
Specific objectives: ................................................................ 19
Conceptual frames .................................................................. 20
Methods ............................................................................... 24
Study setting ........................................................................ 24
Bolivia .............................................................................. 24
Cochabamba ....................................................................... 25
The national health system ....................................................... 28
Data collection ....................................................................... 30
The research team and my role on it .............................................. 30
Adaptation of the WHO-STEPS approach in Cochabamba ...................... 31
Training of the interviewers and health service networks ....................... 32
Sampling ........................................................................... 33
Instruments and measures ....................................................... 37
Variables ........................................................................... 37
Qualitative data collection ........................................................ 40
Data analysis ........................................................................ 42
Sub-study 1 ......................................................................... 42
Sub-study 2 ......................................................................... 42
Sub-study 3 ......................................................................... 43
Sub-study 4 ......................................................................... 44
Ethical considerations ................................................................ 45
Findings ............................................................................... 47
Characteristics of the participants in the survey .................................... 47
Prevalence and risk of CVRFs .................................................... 48
CVRFs by socioeconomic characteristics .......................................................... 50
Smoking ............................................................................................................... 52
Alcohol consumption .......................................................................................... 53
Low fruit and vegetable consumption ................................................................. 54
Low level of physical activity ............................................................................. 55
Metabolic risk factors by socioeconomic characteristics ................................... 56
High blood pressure .......................................................................................... 57
Overweight and obesity ...................................................................................... 58
Abdominal obesity ............................................................................................. 59
Abdominal obesity inequalities from an intersectional perspective ..................... 60
Healthcare access inequalities for CVDs and participation in preventive activities for CVRFs ................................................................. 65
Challenges in implementing the CVDs policy in the Bolivian primary health care system .................................................................................... 69
Discussion ......................................................................................................... 73
Prevalence of CVRFs in Cochabamba ................................................................. 74
Where are the CVRFs concentrated? ................................................................. 75
Social inequalities in health ................................................................................ 78
Gaps in the abdominal obesity prevalence in the intersectional space between gender and ethnicity ............................................................. 78
What explains the joint and referent disparities? ............................................... 78
Socioeconomic inequalities in the use of healthcare for CVDs and preventive activities ....................................................................................... 79
Considerations for the formulation of prevention and control programs for CVDs and CVRFs in Bolivia .............................................................. 80
Methodological considerations ......................................................................... 84
Conclusions ....................................................................................................... 86
Implications for practice .................................................................................... 88
Dissemination and impact .................................................................................. 91
Acknowledgements ........................................................................................... 95
References ......................................................................................................... 96
Abstract

Background: The increase in the prevalence of cardiovascular diseases (CVDs) and cardiovascular risk factors (CVRFs) is considered one of the most important public health problems worldwide, especially in Latin American (LA) countries. Evidence from previous studies from the LA region as well as from Bolivia shows CVDs as the first cause of mortality with a strong social gradient. Accordingly, an accurate and comprehensive picture of the CVRFs situation is needed to prevent CVDs and consequently support the development of health policies to improve population health and reduce health inequalities.

Objective: To estimate the distribution of CVRFs and to examine social inequalities in these factors in Cochabamba – Bolivia in order to provide useful information for public health practice and decision-making. The specific objectives are: i) to estimate the prevalence of preventable risk factors associated with CVDs, ii) to assess and explain obesity inequalities in the intersectional spaces of ethnicity and gender; iii) to assess horizontal and vertical inequity in the access to healthcare services for CVDs and to preventive activities for CVRFs, and iv) to understand the barriers and facilitators of the CVDs policy implementation in the Bolivian primary healthcare system.

Methods: This thesis is based on four studies that used quantitative and qualitative methods. For the sub-studies 1, 2, and 3, the data collection procedure was based on the Pan-American version (V2.0) of the WHO STEPS approach adapted to the Bolivian context. Between 2015 and 2016, 10,754 individuals aged over 18 years old were surveyed. The two first stages of the STEPS approach were conducted: a) Step 1 consisted of the application of a questionnaire to collect demographic and lifestyle data; b) Step 2 involved taking measurements of height, weight, blood pressure, and waist circumference of the participants.

To achieve objective 1, the prevalence of relevant behavioural risk factors and anthropometric measures were calculated, and then odds ratios were estimated for each CVRFs, both in crude and adjusted regression models. Regarding objective 2, an intersectionality approach based on the method suggested by Jackson et al., was used to analyze the ethnic and gender inequalities in obesity followed by the Oaxaca-Blinder decomposition to estimate the contributions of explanatory factors underlying the observed intersectional disparities. For objective 3, bivariate and multivariable regression analyses were carried out to analyze the association between access to CVDs healthcare and to preventive activities for CVRFs, with demographic and socioeconomic factors, and healthcare needs. Odds ratios with 95% confidence intervals were calculated as measures of association and inference respectively. Finally, to achieve objective...
4. In-depth interviews were conducted among 14 key informants focusing on aspects related to the implementation process of the CVDs policy. The interviews were recorded, transcribed verbatim, and analyzed using reflexive thematic analysis.

**Main findings:** Our findings revealed that Cochabamba had a high prevalence of CVRFs, with significant variations among the different socio-demographic groups. Indigenous populations and those living in the Andean region showed, in general, a lower prevalence for most of the risk factors studied. The prevalence of the behavioural risk factors were: current smoking (11.6%); current alcohol consumption (42.76%); low consumption of fruits and vegetables (76.73%); and low level of physical activity (64.77%). The prevalence of the metabolic risk factors were: overweight (35.84%); obesity (20.49%); abdominal obesity (54.13%); and raised blood pressure (17.5%). It is important to highlight that 40.7% of participants had four or more CVRFs simultaneously.

Dually and singly disadvantaged groups (Indigenous women, Indigenous men, and mestizo women) were less obese than the dually advantaged group (mestizo men). The joint disparity showed that the obesity prevalence was 7.26 percentage points higher in the doubly advantaged mestizo men than in the doubly disadvantaged Indigenous women. The lower prevalence of obesity in the doubly disadvantaged group of Indigenous women was mainly due to ethnic differences alone. However, they had higher obesity than expected when considering both genders and ethnicity alone. Health behaviours were important factors in explaining the intersectional inequalities, while differences in socioeconomic and demographic factors played a less important role.

The analysis also suggested a horizontal inequity in education, job status, region, and health insurance ownership regarding access to healthcare for CVDs and preventive activities for CVRFs. In the case of healthcare access, a lower probability of accessing healthcare for those with no formal education (OR=0.63; 95% CI=0.49-0.82) or primary level (OR=0.71; 95% CI=0.59-0.86) compared to those with higher education was found. Participation in preventive activities was significantly less among those with low educational levels, with the lowest participation observed in people with no formal education (OR=0.51; 95% CI=0.40-0.63), primary (OR=0.69; 95% CI=0.58-0.82), and secondary (OR=0.82; 95% CI=0.69-0.96). Individuals who were retired (OR=0.72; 95% CI=0.53-0.99), and those living in the Andean (OR=0.51; 95% CI=0.44-0.60) and Southern cone (OR=0.53; 95% CI=0.45-0.64) also displayed lower odds of participation.

The challenges highlighted for the implementation of the CVDs policy in the Bolivian primary healthcare system were: the importance of i) local research, ii)
a functional surveillance system, iii) effective leadership and coordination, iv) investments in municipal and community-level initiatives, and v) the need for health personnel capacity building.

**Conclusion:** The prevalence of all CVRFs in Cochabamba was high, and nearly two-thirds of the population reported four or more risk factors simultaneously. The intersectional disparities illustrate that abdominal obesity was not distributed according to expected patterns of structural disadvantages in the intersectional spaces of ethnicity and gender in Bolivia. A high social advantage was related to higher rates of abdominal obesity, with health behaviours as the most important factors explaining the observed inequalities. While vertical equity was observed in access to healthcare and in the participation of preventive activities, a horizontal inequity regarding education, region, and health insurance ownership was found. In addition, our findings highlighted five main challenges in the implementation of the CVDs policy in the Bolivian primary healthcare system; including local research; a functional surveillance system; leadership and governance; investment in municipal and community-level; and Health personnel for the implementation of CVD policy and its prevention strategies.

The information generated by this study provides evidence for health policymakers at the regional level to carry out specific interventions to prevent CVDRFs both at the population and at the individual level. It is important to understand the contribution of socioeconomic factors and health needs in the process of formulating strategies that seek to reduce inequalities in access to healthcare in Cochabamba and nationally.
**Abbreviations**

AUDIT  Alcohol Use Disorders Identification Test  
BHM  Bolivian Health Ministry  
BMI  Body Mass Index  
CVDs  Cardiovascular diseases  
CVRFs  Cardiovascular risk factors  
DR-NCDP  Departmental Responsible - NCD Program  
GBD  Global Burden of Disease  
GPAQ  Global Physical Activity Questionnaire  
HD-PCC  Hospital Director - Primary Care Center  
IM  Indigenous men  
IW  Indigenous women  
LA  Latin America  
MET  Metabolic Equivalent  
MM  Mestizo Men  
MW  Mestizo Women  
NCD  Non-communicable diseases  
NR-NCDP  National Responsible - NCD Program  
NHIS  National Health Information System  
NMW  National minimum wage  
PAHO  Pan American Health Organization  
PHC  Primary healthcare  
PSU  Population sampling unit  
WHO  World Health Organization
The thesis is based on the following papers, referred to as papers I, II III and IV:


III. Mamani-Ortiz Y, Mosquera PA, San Sebastián M. Socioeconomic inequalities in use to healthcare for cardiovascular diseases and to preventative activities for cardiovascular risk factors: A horizontal and vertical inequity analysis from Cochabamba, Bolivia. (submitted)

IV. Mamani-Ortiz Y, San Sebastián M, Illanes D, Goicolea I. Barriers, and facilitators for the implementation of non-communicable diseases policy in the primary healthcare system in Bolivia. (Draft)

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Prologue

Since the last century, there has been much discussion about the increase incidence of non-communicable diseases (NCDs) worldwide, which has been linked mainly to socio-economic factors such as poverty, lack of access to healthcare, as well as gender inequalities.

Between 2011 and 2014, I worked in the ONG "World Vision-Bolivia" in Cochabamba, as clinical doctor at primary healthcare centres and as public health practitioner in municipal health management processes and strategic planning for the implementation of prevention programs for regionally prevalent diseases. During this period, I realized of the nutritional transition ongoing in Cochabamba. However, no health program had focused on it because of the lack of local evidence. Also, during this period, I observed that the absence of research and scientific information was (and still is) very common, partly because the available data in the health information systems was incomplete and partly because of its focus on infectious diseases, maternal and child health.

In 2014, I applied for doctoral studies in public health at the Universidad Mayor de San Simon (within the Biomedical and Social Research Institute IIBISMED-UMSS), with support from the Swedish Agency for Development (SIDA). The doctoral positions offered aimed at developing research in the field of neglected diseases, one position for tropical diseases and another for non-communicable diseases. I chose to apply for non-communicable disease because I was convinced (and now even more) that the nutritional transition I observed in my practical work was related to the demographic transition occurring in Cochabamba and Bolivia and was reflected in the epidemiological profile of the general population. I also thought that information was insufficient (and still is) to support strategic changes in public health policies at departmental and national levels. Therefore, when I was accepted, I started this doctoral journey committed to produce relevant information to support real public health changes.

Unfortunately, my registration at Umeå University was delayed two years until the fall of 2016 due to my English-level limitations. However, during 2014–2016, I started working and participated in several research projects at the Epidemiology and Public Health and the Non-communicable Diseases Units of the IIBISMED-UMSS. During this time, we formed a multidisciplinary technical team to develop a situational diagnosis of the implementation of the NCDs national program in Cochabamba. We prepared a proposal for a short- and medium-term action plan that included a system of early diagnosis and epidemiological surveillance of obesity, diabetes mellitus, and hypertension as prioritized NCDs. We also developed instruments to support the plan's
implementation, such as the follow-up of patients with NCDs, prioritization scores for the management of cardiovascular risk, and posters and leaflets with information for the patients with NCDs for the general population. While I was getting ready to start the PhD training in Sweden, we also adapted some instruments recommended by the World Health Organization (WHO) for the Bolivian context, including the Pan-American version of the WHO-STEPS approach which was further tested and implemented at the departmental level in Cochabamba and became part of this thesis.

In 2019 I defended my Licentiate thesis with the first 2 published articles of this thesis because the training program in Bolivia ended that year. However, efforts were made by UMSS and SIDA, to expand the cooperation by another five more years from 2021, including me in the program to be able to conclude the PhD.

During this time, I have been able to share ideas and experiences from my academic work and also learn from other participants’ experiences to get a broader perspective on health systems and policy research; first as part of the inter-institutional network generated between the Faculty of Medicine at UMSS, the Departmental Health Secretariat (DHS) and the National Program of Non-communicable Diseases of Bolivia, and later as Director of the DHS (2020-2021) and Departmental Head of Epidemiology (2021), during the Covid-19 pandemic in Cochabamba.

This thesis is thus a reflection of all the work I have done as part of the IIBISMED in Bolivia and the enriching experiences I have received as PhD student in Sweden. In the first part of the thesis, an overview cardiovascular disease in Latin America, Bolivia, and Cochabamba, their risk factors, and the surveillance, prevention, and control strategies recommended by WHO-PAHO is presented. Then, the Bolivian health system and the non-communicable and cardiovascular diseases policy in Bolivia are introduced. The rationale of the study is then described, followed by the aims and the conceptual framework of the thesis. The study setting, the methods applied to achieve all the objectives, the data collection process, statistical analysis, ethical considerations, as well as the results, are described separately in the subsequent sections. These are followed by a chapter that includes a discussion organized by the conceptual framework, methodological considerations, and conclusions. Finally, the implications for practice and future research are presented, ending the thesis by describing the dissemination of results and their impact has reflected in real policy changes.
Background

This section starts by summarizing some epidemiological evidence pointing out the development of a cardiovascular diseases (CVDs) epidemic and the steady increase of cardiovascular risk factors (CVRFs) worldwide, particularly in low and middle-income countries (LMICs), including the Latin American region. This section also briefly describes the WHO-STEPs approach developed as a strategy to measure and monitor CVRFs as well as to provide useful information for decision making.

CVDs: a worldwide public health problem

CVDs are a major public health problem worldwide and a major barrier to sustainable human development (1, 2); however, many health systems are focused on the treatment of CVDs and its complications but not on the prevention and control of risk factors associated with them (3, 4).

CVDs pose a major public health challenge worldwide, being responsible for nearly 30% of all global mortality (3, 5, 6). The CVDs burden in Latin America (34% of total mortality) may be even greater than the statistics indicate due to underreporting and misclassification (3). These issues require a cautious approach, especially when comparing multiple countries (6, 7).

Additionally, CVDs account for a significant number of healthcare costs in both high-income as well as LMICs (8). The public health approach of primary prevention has been shown to be the most economical, affordable, and sustainable action to stop the epidemic of CVDs worldwide, though its implementation tends to be limited in LMICs (5, 6).

CVDs are growing faster in lower-income countries than in high-income countries, indicating that the burden of CVDs is set to increase in the coming years (9). For this reason, the World Health Organization and the Pan-American Health Organization (WHO/PAHO) emphasize as one of the first preventive steps, the estimation of the prevalence of Cardiovascular Risk Factors (CVRFs) and their distribution in different population subgroups, and the use of the information to generate health policies according to the reality of each country (1, 10, 11).

The top risk factors for CVDs globally are high blood pressure, high cholesterol, smoking, physical inactivity, excess salt consumption and diabetes (10, 12). These risk factors are largely preventable through proper public health policies and interventions (13). These include actions such as increasing the availability of
healthy food, tax policies and restrictions on unhealthy products, promotion of physical activity, or awareness campaigns to discourage smoking (14-16).

Adopting an approach based on the prevention of common risk factors (including behavioural risk factors) for CVDs and other NCDs, as well as considering the differences due to sociodemographic and socioeconomic determinants, represent a significant progress towards integrated health policies relevant to each context (4, 17).

The CVDs epidemic in LMICs
As previously mentioned, the epidemic of CVDs is a major health concern and a leading cause of death, larger in LMICs than in rich countries (18, 19). According to the WHO, nearly 80% of all estimated CVD-related deaths worldwide now – equivalent to 29 million – occur in LMICs, where nearly 30% of all deaths are attributable to CVDs (1, 6, 7). In response to the problem, the United Nations has set as a key target the reduction of 25% of the risk of premature NCD deaths by 2025 (referred to as 25 by 25) (20). Fortunately, between 1990 and 2013, the age-standardized CVDs death rate decreased by 22% for both ischemic heart disease and stroke in LMICs (7, 21); however, further healthcare system changes are still required to achieve the United Nations’ target for 2025.

CVDs in LMICs especially affect people of working ages (under 60 years), and socially disadvantaged groups (1). This is the principal reason to focus on the prevention of CVRFs as well as early diagnosis, follow-up, and treatment of patients with CVDs early in life (1, 6).

At the same time, people in LMIC have the greatest vulnerability and least resilience and capacity to cope with NCDs, especially CVDs (22). One of the reasons is that in many LMICs, the cost of early diagnosis or treatment of these diseases is not covered by the public healthcare systems (23-25). Therefore, most of the care and prevention of CVDs require out-of-pocket expenditures, which can often drain the financial resources of households living below the poverty line and reduce their ability to recover financially due to lost labour productivity (22, 25).

CVDs are also the biggest threat to women’s health since 33.2% of women died because of CVDs in 2016 (10). In LMICs, coronary heart disease deaths outnumber strokes among women. CVDs are also a significant cause of women dying in LMICs during childbearing years as they are linked with pregnancy hypertension, preeclampsia and eclampsia, the main causes of maternal mortality after postpartum haemorrhage (4).
Health inequalities associated with CVDs in LMICs

Health inequalities refer to the differences in health outcomes or the distribution of health-related factors among different populations or groups within a society (26). Health inequalities can manifest in many ways, from disparities in access to healthcare, differences in life expectancy and mortality rates to differences in the prevalence of certain diseases and health outcomes (26). These inequalities can have a significant impact on individuals, families, communities, and entire populations (27).

Many health inequalities related with CVDs have been described worldwide, including the LMICs (22). These inequalities can be caused by a range of factors, including socio-economic status, gender, ethnicity, disability, age, and geographic location (28-30). In many LMICs, access to high-quality healthcare is limited or non-existent, which can lead to delayed diagnosis, inadequate treatment, and poorer health outcomes for individuals with CVDs (31). Additionally, there are often limited resources available for preventive healthcare and health promotion activities (28).

People living in poverty in LMICs, especially Indigenous populations, often have less access to healthcare, nutrition, and other resources that can help prevent CVDs (30). Also, women in LMICs generally are poorer, and low educated compared with men, which can contribute to sex-gender differences in CVDs, related with (32); generally related with a limited Access to Healthcare; this can result in inadequate preventive care, delayed diagnosis, and insufficient management of risk factors for CVD, such as hypertension, diabetes, and high cholesterol.

Generally, each of the factors that generate inequalities for the development of CVDs are generally studied separately (5, 10); however, their joint impact on health disparities must be considered. The simultaneous impact of multiple social factors, such as gender, ethnicity, socioeconomic status, and other intersecting axes of identity, increase the CVD risk outcomes, and healthcare disparities. Intersectionality is a concept that refers to the way in which various identities and social categories, intertwine and intersect, creating unique experiences and challenges for people who have multiple dimensions of identity. Intersectional inequalities in CVDs consider the compounding effects of multiple social identities (33, 34). For example, individuals who belong to marginalized racial or ethnic groups, are women, and have lower socioeconomic status may face greater challenges and cumulative disadvantages in terms of CVD risk, healthcare access, and outcomes. Intersectional experiences may lead to unique health disparities and require targeted interventions and tailored healthcare approaches. By...
recognizing and addressing intersectional inequalities in CVDs, healthcare systems can work towards achieving equitable outcomes and reducing health disparities across diverse populations (33).

In addition while "inequalities" typically refer to differences in a more general sense, particularly when discussing variations in outcomes, conditions, or opportunities, "inequities" go beyond mere differences and imply an added dimension of injustice, unfairness, or imbalances that result in these differences often attributing them to systemic factors and therefore calling for corrective actions to address the root causes (35).

Based on the latter concept, the principle of horizontal equity refers to same treatment for the same need; that is, horizontal equity in healthcare is achieved if individuals have the same access to health services for the same health need independently of their sociodemographic circumstances (35). Correspondingly, vertical equity is a principle by which people with different needs are treated differently; that is, individuals with greater health problems should have greater access to healthcare services (36, 37).

Addressing both horizontal and vertical healthcare inequalities is crucial for effective CVD prevention and control in LMICs (36). Strategies should aim to reduce socioeconomic disparities, improve healthcare access and affordability, promote health education and literacy, and address structural factors that contribute to inequalities in CVD outcomes. This requires a comprehensive and multi-sectoral approach that involves collaboration among healthcare providers, policymakers, community organizations, and other stakeholders to ensure equitable access to healthcare services and address the underlying determinants of health disparities (38).

**Cardiovascular risk factors: concept and distribution in LMICs**

Conceptually, CVRFs are understood as those conditions or features (lifestyle, physiological or biochemical characteristics) that predispose an individual to have one or more CVDs (39). For the WHO, a risk factor is any feature, characteristic or exposure of an individual that increases their likelihood of suffering an illness or injury (5, 40).

There is consensus that CVDs are largely associated with the so-called conventional or modifiable risk factors, i.e., tobacco use, harmful alcohol consumption, physical inactivity, and poor diet, which in turn are related to being overweight, obesity, high blood pressure, high blood glucose, dyslipidaemia, and reduced HDL cholesterol (4, 19, 29, 32).
The overall prevalence of CVRFs in LMICs is high and rising more rapidly than in high-income countries (HICs). For example, according the PAHO report in 2019, more than 1.9 billion people aged 18 and older were overweight, with more than 650 million considered obese (41). The largest increase in obesity was seen in the Americas, from 20% in 2000 to 29% in 2016 (42-44).

According to that 2019 report, 20.3% of men and 14.8% of women aged 18 years and over had elevated blood pressure in 2020 in Americas, and over a quarter of adult women and four in ten adult men presented hypertension (45, 46). While the prevalence of elevated blood pressure in adults has declined in HICs over the last few decades, it has however been stable or increasing in many LMICs (44, 47).

The global prevalence of tobacco smoking decreased from 27% in 2000 to 20% in 2019 (41, 44). While smoking among women remains under 10%, LMICs are seeing overall slower declines in smoking prevalence than HICs (48). Similarly, according to WHO, the level of alcohol consumption worldwide in 2016 was estimated at 6.4 litres of pure alcohol per person aged 15 years and over, with a higher prevalence in LMICs (48).

Although the prevalence of physical inactivity in HICs was more than double that in LMICs, more than a quarter (28%) of adults aged 18 years and over in LMICs did not meet the WHO recommendations for physical activity. Women especially were more affected by sedentary lifestyles (48).

**CVRFs in the Latin American region**

According to PAHO’s 2019 estimates, the prevalence of risk factors for NCDs in Latin America (LA) was the highest among the six WHO regions (44). While in the world the percentage of overweight and obesity (BMI ≥ 25 kg/m2) is 36.6%, it reaches 59.0% in the Americas, placing it as the most obese region in the world (41, 46). Population surveys performed in Latin America and the Caribbean in 2019 indicated that 61% of adults (62.2% of men and 59.8% of women) and 7.2% of children under five years of age were overweight and obese (44). Similarly, the rate of physical inactivity was one-and-a-half times higher than the world average (32.4% vs. 23.3%)(10).

The Americas also ranked second in the world for episodes of heavy drinking, with a prevalence of 14.0% compared to 16.5% in Europe and 7.8% worldwide (10); in 2019 the total alcohol per capita consumption (APC) in adults was 7.6 litters (1.3-fold higher than the global level [5.8 L]) (44). The region is second in the ranking of all WHO regions for high blood cholesterol (12.6% vs. 9.8%.
worldwide), third in the prevalence of elevated fasting glucose, fourth in tobacco consumption and sixth in high blood pressure (10). The only risk factor that is less prevalent in the Americas than in the other six WHO regions was smoking, with a 11.4% prevalence in 2019 (41, 46).

The increase in NCDs in the LA region has been attributed to demographic changes (migration from rural areas to cities), the lack of physical activity, and the “nutrition transition” (49) (characterized by low consumption of fruits, vegetables, whole grains, cereal and legumes, and high consumption of foods rich in saturated fat, sugar and salt, meat, refined grains, and processed foods) (49, 50). In addition, the unequal distribution of CVRFs in different sociodemographic groups represents one of the greatest challenges for the NCD epidemic growth in this century within the region (32, 51, 52).

In response to the high prevalence of CVRFs, PAHO presented a report in 2019 on the prevention and control of NCD risk factors entitled “State of the Most Cost-Effective Measures in Latin America” (53). This report suggested strategies to comply with the global goals proposed in the Action Plan for the Prevention and Control of Non-communicable Diseases 2013–2020 by WHO (54) and PAHO (55). Within this report, the implementation of surveillance for CVRFs was strongly suggested as it has been proven to be inexpensive and therefore useful to apply in low- and middle-income settings (56, 57).

**CVRFs in Bolivia and Cochabamba**

The WHO/PAHO Country Profile report of 2018 estimated (based on the Bolivian NCD National program information) that NCDs were responsible for 64% of overall mortality in Bolivia, of which CVDs alone were responsible for 23% of the total mortality (58). In the same report, it was mentioned that 50% of the population in the country was overweight, 19% of the adult population obese and 15% of the adults had high blood pressure or took medication to treat hypertension. No information about physical inactivity, tobacco use, or fruit and vegetable consumption was provided (58).

Moreover, the last national report analysing the epidemiological situation of NCDs was issued in 2019 (59); it used the progressive method of WHO-STEPS for the surveillance of risk factors for chronic diseases of WHO/PAHO, like my thesis, but applied in a national scale. The findings reported that 17.7% of the population between 18 and 69 years old were current tobacco users, that alcohol consumption reached 32.2% of the population; and that in both there was a higher prevalence among men. In relation to food, it was observed an average consumption of fruits and vegetables of 2.9 servings per day and a high salt
consumption. According to the body mass index (BMI), more than half of the population (63.3%) was categorized as overweight or obese. Regarding physical activity, it was seen that the activity that contributed the most to the age cohort between 45 and 69 years was the one carried out at work for men and transportation for women; in the age group from 18 to 44 years, it was free time (59).

A significant percentage of the population between 18 and 69 years old (53.6%) stated that their blood pressure had been never measured. Of the total population with a history of high blood pressure, only 23.5% were currently taking any medication to control it and the prevalence found was 15.9%. The self-reported prevalence of diabetes was 3.7% in the population aged 18 to 69, 6.5% and 4.0% among women and men aged 45–69 respectively. High cholesterol level was presenting 4.5% of the population. More than 75% of the population had 1 to 2 combined risk factors and 20.1% had 3 to 5 combined risk factors (59).

Unfortunately, the figures presented in the report were only based on a small sample of cities, since the study did not use integrated surveillance information systems to monitor risk factors associated with NCDs. Furthermore, the evidence provided by other research studies is limited in terms of the risk factors included because they are hospital-based, and none of them uses standard methodologies. Today, Bolivia is lacking a comprehensive picture of current cardiovascular and behavioural risk factors, both at national and local levels.

**Surveillance of preventable cardiovascular risk factors**

Surveillance strategies for CVRFs are not recent. WHO has developed several recommendations since the 1980s in response to the continuous increase of NCDs (including CVDs) and their risk factors, both worldwide and in the Americas (44).

WHO promoted the MONICA project in 1988 (60) as a worldwide monitoring system for cardiovascular diseases (61). In 2000, the WHO Global Strategy for prevention and control of NCDs (World Health Assembly) was published (62), highlighting that prevention was key and it should be integrated across sectors; and that the use of tobacco, unhealthy diets and physical inactivity should be prioritized for surveillance since they are relevant risk factors for NCDs (63).

In response to these recommendations, in the Latin American context, the “Actions for the Multifactorial Reduction of Non-Communicable Diseases (CARMEN) initiative” was launched in 2002 (64, 65). A network comprised of the coordinators of national NCDs programs at health ministries in eight
countries under the coordination of PAHO started working toward the shared objective of reducing the burden of NCDs and their risk factors. To achieve this aim, the surveillance of risk factors associated with NCDs at individual and population levels were established as a priority. Individual-level factors included: a) general risk factors – age, sex, schooling, and genetics; b) behavioural risk factors – smoking, inadequate diet, and physical inactivity; and c) intermediate risk factors – serum cholesterol levels, diabetes, hypertension, and obesity. Population-level contextual factors included: a) social and economic conditions – poverty, employment, and family composition; b) environment – climate and air pollution; c) cultural context – practices, norms, and values; and d) urbanization – housing, access to products and services (65).

The 26th Pan-American Sanitary Conference held in Washington, D.C. in September of 2002 (66), acknowledged that NCDs were the leading cause of premature death and morbidity in Latin America and the Caribbean countries. Participants at the conference decided to endorse an integrated approach to the prevention of cardiovascular diseases through the CARMEN initiative, highlighting that this approach represented an opportunity for integrating surveillance and control of risk factors and NCDs (19, 62).

In 2005, the WHO launched the STEPS approach with the aim of supporting CARMEN through the surveillance of CVRFs and developed the guidelines and supporting material for the surveillance of chronic diseases and their risk factors. The STEPS approach intended, among other things, at collecting consistent data across and within countries to enable comparisons over time and across countries, as well as to determine public health priorities (67).

A baseline analysis named “Situational Diagnosis of Health in the Americas” from 2007 (68), reported that NCDs were the cause of two out of three deaths in Latin America. Subsequently, in response to this analysis, PAHO developed a “Regional strategy and plan of action for an integrated approach to the prevention and control of chronic diseases” (11), with four lines of action. One of these lines was related to supporting the development and strengthening of countries’ capacities for better surveillance of chronic diseases and their risk factors, for which the Pan-American version of the WHO STEPS (PanAm STEPS) was developed both in English and Spanish (40, 67).

The STEPS approach not only allows the monitoring of trends within a population group but also making comparisons by using standardized questions and measurement protocols for physical and laboratory tests. In this way, the approach is able to support the identification of risk groups as well as to support the prioritization of interventions and allocation of economic resources (67).
The application of the WHO-STEPs and the PanAm STEPS are based on two main criteria (Figure 1): a) the complexity in collecting the information (Step 1: verbal information, Step 2: routine physical measurements and Step 3: laboratory measurements that require the use of standardized laboratories); and b) the survey’s comprehensiveness (Core, Expanded and Optional variables). In addition, this approach divides the risk factors into social, behavioural and metabolic risk factors (67).

Figure 1: WHO-STEPs wise conceptual framework to surveillance of NCD risk factors

Source: WHO/PAHO (67)

The decision about the comprehensiveness of the application in each country depends on the purpose as well as the resources (technical, financial, and human) to implement it. Although the systematic surveillance of chronic diseases and their risk factors has been recommended for many years, until 2012 only 16 out of 35 countries in the Americas region had implemented national health reporting systems and produced annual reports that included indicators of NCDs and their risk factors (69).

In 2013, WHO proposed as a goal for all countries “to develop, implement and monitor in collaboration with academic and research institutions, as appropriate, a national policy and plan on NCD related research community-based” (54). After this initiative, the number of countries in the Americas region that reported the implementation of a subnational or national survey increased from 16 to 21 in 2016 (70). In the case of South America, only Argentina, Chile and Paraguay have conducted multiple surveys at the national level.

Recently, the WHO started to promote "The Global HEARTS Initiative" (52, 57) to prevent the factors contributing to the development of cardiovascular disease. The HEARTS strategy (Healthy lifestyle, Evidence-based treatment protocols, Access to essential medicines and technology, Risk-based management, Team
care and task-sharing, and Systems for monitoring) includes the WHO-STEPS approach as a tool for measuring the prevalence of CVRFs at the general-population level every three to five years (40, 57).

**The development of CVDs prevention and control policies**

Overall, policies are a necessary key component in promoting public health and reducing the global burden of CVDs (71). The development of policies for the prevention of CVDs is of paramount importance to reduce their mortality and morbidity (4, 57). Also, these policies are essential to reduce the risk of CVDs by promoting healthy lifestyle behaviours and can also encourage healthcare providers to screen for risk factors and provide early interventions to prevent or delay the onset of CVDs. Furthermore, policies can ensure access to medications, treatments, and rehabilitation for those who have been diagnosed with CVDs (72).

The WHO recommends the generation of health policies aimed at creating favourable environments to prevent CVDs, in which healthy options are available and affordable, and are essential to motivate people to adopt and maintain healthy behaviours (73). The WHO also recommends identifying people at high risk of CVDs and ensuring that they receive appropriate treatment to prevent premature deaths associated to these diseases (74).

Likewise, the WHO promotes access to essential medicines and basic health technologies that make it possible to treat NCDs in all primary healthcare centers, free available to all (42, 48).

Thus, in 2016, the WHO developed the Global HEARTS Initiative as an international program to strengthen health systems in LMICs (57). HEARTS strategy for "HEalthcare for cARdiovascular disease prevention, Treatment and Support." The strategy aims to strengthen the prevention and control of CVD through a comprehensive and integrated approach. The aim of the initiative was to reduce the burden of CVDs and related risk factors by improving access to quality care, including diagnosis and treatment, and through effective prevention and control strategies. The initiative should be implemented in partnership with governments, the private sector, civil society, and other stakeholders (39).

HEARTS in the Americas is a national initiative led by the Ministries of Health, involving local stakeholders and technical collaboration from the PAHO (57). The initiative aims to seamlessly and gradually integrate the strategies to prevent CVDs and CRFs into existing health services to promote the adoption of global best practices in the prevention and control of CVDs (75). HEARTS is being implemented and scaled up in 26 countries in the region, including 2,117 HEART
health centers, covering a total of approximately 20 million adults in their respective service areas. By 2025, the HEARTS model should be the model for CVDs risk management, including the management of hypertension, diabetes, and dyslipidaemia, in primary care in America (39, 57) (75).

The HEARTS in the Americas strategy focuses on implementing six key components (39, 52, 57, 75, 76):

- **Government and health system response**: this component emphasizes the importance of strong political commitment and leadership to develop and implement effective policies and programs for CVD prevention and control. It involves engaging different sectors, such as health, finance, and education, to support comprehensive approaches.
- **Strengthening primary health care**: aiming to enhance the capacity of primary health care services to provide high-quality care for CVD prevention and management. It involves improving the skills of health care providers, ensuring the availability of essential medicines, and establishing systems for regular monitoring and follow-up of patients.
- **Creating healthy environments**: focusing on promoting healthy lifestyles and creating supportive environments that encourage individuals to make healthy choices. It involves implementing policies and interventions to reduce tobacco use, promote healthy diets, increase physical activity, and reduce harmful use of alcohol.
- **Access to essential medicines and technologies**: emphasizing the importance of ensuring availability and access to essential medicines and technologies for the prevention and treatment of CVD. It involves strengthening the procurement and supply chain systems, promoting the use of cost-effective medications, and improving affordability and accessibility for all populations.
- **Surveillance, monitoring, and evaluation**: involving establishing robust systems for surveillance, monitoring, and evaluation of CVD and its risk factors. It includes collecting data on the prevalence and trends of CVD, risk factors, and health system performance using the WHO-STEPS approach.
- **Strengthening national and regional capacity**: focusing on building the capacity of countries and the region to implement and sustain the HEARTS approach. It involves providing technical support, training, and knowledge exchange opportunities to strengthen the skills and capacities of health professionals and policymakers.

The HEARTS in the Americas strategy promotes a comprehensive and integrated approach to CVDs prevention and control, emphasizing the importance of addressing risk factors, strengthening health systems, and improving access to
essential services. By implementing the HEARTS approach, countries in the Americas region can work towards reducing the burden of CVDs and improving population health (57).
NCDs and CVDs prevention in the Bolivian health system

This section sets first the scene for this research by introducing the Bolivian health system and afterwards, it presents the national NCDs and CVDs health policies and the different attempts to overcome problems of the national health system.

The Bolivian national health system is decentralized, and financed by a combination of government taxes, payroll contributions, and private insurance (77). Before 2019, less than 40% of the total population had health coverage, and the service package was mainly focused on maternal, child, and elderly health. Since February 2019 (78, 79), Bolivia has been in a transition to Universal Health Coverage; however, the official reports on changes in healthcare coverage of the health insurance indicates a 80.85% of coverage, between the public and the social security subsectors and include all NCDs (80). The characteristics of the sub-systems will be described below in the study setting.

NCDs and CVDs in the Bolivian health system

In 2004, Bolivia approved the "Prevention and Control of NCD National plan 2005–2009" (81). The purpose of the plan was to implement actions and strategies aimed at different levels of care such as: a) promotion of healthy lifestyles; b) prevention strategies (including diagnosis and treatment of acute and chronic complications); and c) control of NCDs and their risk factors (access to treatment, medication, and rehabilitation) (81). In 2007, "The Rules and Procedures for the Prevention and Control of NCD and their risk factors in Primary Healthcare" were issued (82). Both the Plan and Rules are aligned with international guidelines, prioritizing work in relation to cardiovascular, osteo-articular, and chronic respiratory diseases, cancer, diabetes, and obesity (81-83).

In 2007, with the support of PAHO-Bolivia, the so-called "Life Points" community strategy was implemented, and the manual "Guide for Training Health Agents" was published (84). The strategy was implemented until 2014 and consisted of the installation of mobile tents at community fairs where anthropometric and blood pressure measures as well as capillary glucose tests were taken (55). Unfortunately, those responsible for implementing the "Life Points" strategy did not receive training on the screening methods, and therefore each health facility implemented the strategy in its own way based on the technical and logistical resources available (84). Consequently, health measurements were in some cases performed through inadequate techniques and
assessed by outdated cut-off points. Moreover, information collected was never entered into the National Health Information System or any other monitoring system, and therefore no documents/reports systematizing the outcomes of the strategy exist.

In 2010, the Ministry of Health (re)launched the "National Plan for Prevention and Control of Non-communicable Diseases 2010–2015" (85), directed at public health services with emphasis on the first and second levels of care. The National plan identified the following problems to be solved: 1) the lack of CVDs research in Bolivia; 2) the lack of a surveillance system for NCDs; 3) the lack of promotion and prevention programs aimed at tackling preventable risk factors; 4) the lack of continuing education for primary care staff; and 5) the absence of national strategies for social participation and multi-sectoral collaboration. Many of these problems had already been pointed out in the first plan 2005–2009 (81).

In 2013, the law for the “Provision of Comprehensive Healthcare” (86), introduced “free care” to people with disabilities and over 60 years of age. This law focused on NCDs/CVDs in the elderly; however, the lack of resource allocation affected the implementation of the policy since economic resources were not specifically allocated for its operationalization. People in other age groups (between six and 60 years old) were not considered for coverage or monitoring by the public health system (86, 87).

In 2017, the new “National Plan for the Prevention and Control of NCD, 2017–2020” was presented with the same objectives as the previous plan (since the previously stated objectives were not reached), but also including a national registration form for NCDs such as diabetes mellitus, obesity, rheumatic diseases, and cancer in the public healthcare system (88).

Since 2019, universal health insurance has been implemented (78), which includes all people who do not have health insurance; including NCDs in its care coverage. While it is contributing significantly to early diagnosis and timely treatment its coverage is still limited for special surgical procedures such as transplants or chemotherapy, among others. Figure 2 summarizes the evolution and changes in the national NCDs program in the last 15 years.
Despite the existence of a specific plan for the prevention and control of NCDs, Bolivia still does not have the infrastructure required to implement a surveillance system for NCDs in health facilities. Currently, only a few health facilities work in coordination with the national NCDs control program (six centres in Cochabamba and 60 in the country), the same ones that had implemented the "Life Points" strategy (84).

Aside from the lack of infrastructure, the National Health System still focuses its actions mostly on infectious diseases, leaving NCDs and their complications unaddressed, which is contradictory with the existing national health policy mandate (SAFCI: Community and Intercultural Family Health) in which the promotion of healthy lifestyles and health prevention is emphasized (87). This infectious disease focus affects primary care services to the extent that they are unable to implement the strategies proposed in the “National Plan for Control of NCDs” (88).

Between 2020 and 2022, due to the Covid-19 pandemic and the prioritization of its control by the entire Bolivian health system, the preparation of a new strategic plan for the control of NCDs in Bolivia was delayed; however, since 2019 work has been done to implement the WHO/PAHO STEPS Wise survey (results were reported in 2022) (59), and since 2021, with the training of health personnel, also the HEARTS strategy.

HEARTS (89), focuses currently on 70 health establishments in the departments of La Paz, Cochabamba, Santa Cruz, Oruro, and Tarija. In these departments, all
health personnel have been virtually trained and certified in the six modules included in the strategy. In April 2023, HEARTS started its implementation in Cochabamba in 38 health centers in the municipalities of Sacaba (Central valley), Cliza (High Valley), and Mizque (Southern Cone). The expectations of both health personnel and health authorities to implement this strategy are high, given that for many years it was not possible to advance in the prevention and control of NCDs (90).
Rationale

The Bolivian health system faces several challenges regarding the implementation of national health policies and programs aimed at preventing NCDs (81, 82, 84, 85, 87, 88). The fragmentation of the health system and the lack of healthcare coverage for population groups between six and 60 years of age until 2019, forced patients in need of care to go to private hospitals, increasing the financial burden of families (79, 87). The lack of clear and stable sources of funding is also a core limitation for running the prevention programs outlined in the national NCDs plan (60).

In addition, there is little information about CVRFs prevalence in Bolivia, even less in Cochabamba, and to date, there is no national or regional project aimed at producing evidence to fill in this knowledge gap (59). The lack of accurate information is also a major difficulty for planning and implementing preventive local health programs within the country (88). Currently, the only available data comes from the National Health Information System, which has a registration bias because it only captures patients who come to the public health system, leaving aside users of private healthcare, or people who have not accessed the healthcare system (77). Since the NHIS prioritizes infectious diseases and maternal and child health, only information regarding diabetes, hypertension, obesity, cancer (any type) and rheumatoid arthritis is collected (9). Since the planning units of the Departmental Health Services and municipal governments do not have estimates of the magnitude of the problem locally, no prioritized interventions based on their own population characteristics can be properly implemented (77, 78). Reports and observations have suggested that programs are not working as they should, and there has been calls to produce research evidence (59, 88). Consequently, generating up-to-date information about the prevalence of preventable risk factors and their associated demographic and socioeconomic factors is deemed necessary.

At the same time, since it is well known that although CVDs affect all population groups, the impact is expected to be larger in vulnerable populations (elder, poor, women and ethnic groups), given their higher prevalence of risk factors, less access to health services and reduced ability to cope with the financial consequences of CVDs (4, 38, 47). In fact, in LMICs, CVDs mortality rates have declined steadily over the past few decades, yet gender, socioeconomic and ethnic/racial disparities have not, and the pervasive nature of these disparities equates to significant barriers that impede cardiovascular healthcare from reaching all those in need (29, 75).
Studies on the effects of socioeconomic and sociodemographic factors on CVDs risk in LMICs are scarce (29, 32). Moreover, the debate about proper strategies to address cardiovascular risk factors in ethnic/Indigenous groups and to reduce health inequalities affecting them is currently relevant and controversial, not only in Bolivia but in Latin America and worldwide (30, 52). However, this debate is severely hampered by insufficient research evidence (30).

Current social inequalities in health (access to health insurance, access to healthcare, quality education, living wage, availability of food, etc.) are considered barriers to the prevention and control of NCDs and an increasingly pressing concern for the Bolivian society (59, 88), affecting often socioeconomically disadvantaged women from rural areas. In the Bolivian context, women are the most vulnerable group in terms of gender because they have a higher prevalence of health indicators on mortality and morbidity compared to men; on the other hand, in terms of the ethnic-social structure, the Indigenous people are the most vulnerable group in comparison to the mestizos and descendants from European countries (88). Therefore, evaluating whether ethnicity and gender interact as predictors of CVRFs is important for developing appropriate and equitable public policies in Cochabamba and Bolivia.

The NCDs National Program is dependent of the Epidemiology Unit of the Ministry of Health, which is responsible for the planning of actions, national technical standards, recording instruments, and strategies to address the prevention and control of the most prevalent NCDs in Bolivia. Unfortunately, neither documents that systematize the implementation and achievements related to the prevention and control of NCDs nor a proper assessment of the implementation of NCDs policy; have not documents that reflect the current challenges in the implementation of the CVDs policy in the Bolivian primary healthcare system. This information is crucial to support decision-making by knowing if those programs are not working as they should, identifying the most relevant problems in its implementation, and by proposing solutions that could improve the identified problems.

The findings of this research are expected to make an important contribution to informing policymakers about the challenges ahead as well as to be useful for designing a departmental plan to monitor and control NCDs (focused on CVRFs) in Cochabamba. The present project will also provide very important insights that could be useful for developing or updating the Bolivian Plan for Prevention and Control of NCDs, and it will contribute to the research field by producing information about the broader phenomenon of cardiovascular health disparities affecting ethnic groups, an issue that is of considerable relevance in Latin America.
Aim

To disentangle the social distribution of CVRFs and to provide evidence that can strengthen the Bolivian plan of control and prevention of CVDs.

Specific objectives:

1. To assess the prevalence of preventable risk factors associated to CVDs and to identify the demographic and socioeconomic factors associated to them (sub-study 1).

2. To estimate and explain obesity inequalities in the intersectional space of ethnicity and gender (sub-study 2).

3. To assess horizontal and vertical inequity in the use of healthcare services for cardiovascular diseases and of preventive activities for cardiovascular risk factors (sub-study 3).

4. To understand the challenges in the implementation of the CVDs policy in the Bolivian primary healthcare system (sub-study 4).
Conceptual frames

This thesis has adopted four interlinked conceptual points of departure to frame its overall aim.: i) the Global HEARTS Initiative, ii) the intersectional disparities approach, iii) the equity in healthcare perspective and iv) the health policy evaluation and development framework.

The Global HEARTS Initiative

The Global HEARTS Initiative (2018) by the WHO provides a model that articulates the "factors contributing to the development of cardiovascular disease and disorders". This model divides the risk factors into three subgroups: a) social determinants and drivers; b) behavioural; and c) metabolic risk factors (39).

The Global HEARTS Initiative has a clinical focus on the modifiable and the non-modifiable risk factors, assuming a similar contribution of each risk factor for the development of CVDs in a population (Figure 3). According to the model, risk factors are considered modifiable when people can take measures to change them in the short–medium or long term – i.e., behavioural and metabolic risk factors including smoking, harmful alcohol use, high blood pressure, diabetes mellitus, dyslipidaemia, reduced HDL cholesterol, sedentary lifestyle or low physical activity, low consumption of fruits and vegetables, high salt consumption, being overweight and obese (39, 76). The non-modifiable factors, (i.e., social determinants and drivers) are those measurable factors whose variations explain the prevalence and risk distribution of CVRFs or CVDs in the population. The driver factors are: age, family history, gender, socioeconomic factors (level of education, occupation, income or socioeconomic status, health insurance coverage) and sociodemographic factors (place of residence and marital status) (39, 76).
Even though the framework includes social determinants as risk factors, it does not try to understand or explain the social distribution and inequalities in the prevalence of CVRFs related to the advantages or disadvantages in the social structure of the population.

**Intersectional disparities**

In order to better analyze these inequalities, this thesis introduces a second approach: Jackson et al. (91) approach to analyze intersectional disparities. Jackson et Al’s approach is part of a new trend in analysis that goes beyond traditional examination of health inequalities, which typically focus solely on individual factors such as socio-economic status, gender, ethnicity, etc.; Instead, this approach seeks to identify how intersectional disparities affect health —namely, the combined effect of various social positions on health (33, 34).

The intersectional disparities approach considers the concept of joint disparity and its decomposition by comparing absolute differences between dually as well as single advantaged and disadvantaged groups. The approach suggests that the joint disparity should be equal to the sum of single disparities (gender and ethnicity in this thesis). This allow us to visualize how outcomes are patterned for social groups that are disadvantaged across multiple axes of social inequality (Figure 4).

In this thesis, the gender-referent disparity evaluates disparities among mestizos (those who do not face ethnic discrimination) and illustrates how the outcome is patterned by gender disadvantage. Ethnic-referent disparity evaluates the disparities among men (those with an advantage in relation to gender) and describes how the outcome is patterned by racial disadvantage. (Figure 4).
Equity in healthcare

Measuring intersectional disparities, however, is just one aspect of a multifaceted process that entails assessing and analysing various factors to determine whether health and healthcare services are being distributed fairly and without discrimination. Therefore, in this thesis, we incorporate a third conceptual frame, to further explore healthcare services, as another integral component of the inequality analysis.

While there is not a single definitive method for measuring equity in healthcare, Boeckxstaens (92) proposes to focus on the following general domains: i) equal access to care for people in equal need, ii) equal treatment for people in equal need, and iii) equal treatment outcomes for people in equal need (Figure 5). Despite its simplification of the nature of equity, the definition of these three domains provides a useful framework that delineates where inequities in health care may arise. Horizontal inequality is related to the unequal distribution of resources or treatment between people in the same starting position, while vertical inequality refers to disparities in outcomes between people with similar needs but in different starting positions. Both concepts can be applied to access to medical care and treatment, highlighting differences in both the distribution of resources and the results obtained.
Figure 5: Conceptual framework for equity in health care

Methods

Study setting

Bolivia

The Plurinational state of Bolivia is a landlocked country located in western-central South America. The country’s population is estimated at 12 million, and its composition is multi-ethnic, including Amerindians, Mestizos, Europeans, Asians, and Africans. The racial and social segregation that arose from Spanish colonialism continues nowadays. The Bolivian population includes 37 Indigenous nationalities, the most important being the Quechua and Aymara that comprise almost 50% of the general population (94, 95).

Figure 6: Bolivia’s map, highlighting the Department of Cochabamba

Geographically and administratively, Bolivia is divided into nine departments. Its geography varies from the peaks of the Andes in the west, to the eastern lowlands situated within the Amazon. Bolivia belongs to the group of lower-middle-income countries with a gross domestic product per capita of 3,076.8 USD. In general, 34.5% of the population is considered poor according to the poverty line and the Gini index is 40.9 point in 2021 (96) indicating an unequal income distribution.
It is a lower middle-income country, leaving it in 118th place in the table of 191 countries published on the Human Development Index, and the most important health indicators are summarized in Table 1.

The Bolivian population is estimated at approximately 12 million inhabitants by 2022 (97), and it is clearly concentrated in the departments of central axis (La Paz, Cochabamba, and Santa Cruz), where 40% of the national population live. The central departments are considered the economic engine of the country, as well as the destination of internal migration from rural areas and the poorest departments. In the last decade, Bolivia has gone from being considered a low-income to a middle-income country, due to the increase in the oil price in the past 15 years compared to the 90s. However, the poverty gap in the country continues to be one of the highest in Latin America, and the basic health indicators (maternal mortality and infant mortality) are still one of the worst in the region (98, 99).

Table 1: Health indicators from Bolivia and Cochabamba

<table>
<thead>
<tr>
<th></th>
<th>Overall mortality rate (a)</th>
<th>Infant mortality rate (b)</th>
<th>Human Development Index</th>
<th>Gini (nominal)</th>
<th>Life expectancy at birth (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolivia</td>
<td>7.0‰</td>
<td>3.36%</td>
<td>0.692</td>
<td>40.9</td>
<td>63.63 66.80 60.88</td>
</tr>
<tr>
<td>Cochabamba</td>
<td>7.5</td>
<td>40.7</td>
<td>--</td>
<td>--</td>
<td>66.0 63.9 68.2</td>
</tr>
</tbody>
</table>

(a) Per thousand, (b) Per thousand births.

Cochabamba

Cochabamba is one of the nine departments of Bolivia. In 2018, the demographic estimates indicated that about 1.9 million people lived in it, approximately 35–40% of them in rural areas (100). Cochabamba is considered a synthesis of the geography and cultural diversity of the country; since it is in the heart of Bolivia, it shares similarities with all other departments including several ecological niches from the region of the Andes Mountain range to the tropical regions of the Amazon. It is a densely populated department and most of the population is of Quechua origin, and mainly dedicated to agriculture and the manufacturing of food, beverage, textiles, and paper among others.

Cochabamba department is divided into 16 provinces, which comprises 47 municipalities. The municipalities have been further grouped into macro-regions, which is, an integration of the municipal economies based on their geographical...
distribution and their potential for agricultural production, mining, manufacturing, livestock, oil reserves, commerce and others (97).

Currently, Cochabamba is divided into five different macro-regions displayed in the figure 7 and described below.

*Figure 7: Cochabamba’s map*

Source: Constructed by the author, figures from: Departmental Secretary of Health and strategic planning unit of the government from Cochabamba, Departmental Development Plan 2015-2020.

**1) The Central valley:** includes the capital city and other municipalities of the metropolitan area. It has the highest concentration of inhabitants (66% of the total population) according to the National Census of 2012. This feature has increased the change of land use from green or agricultural areas into urbanizations (images 1 and 2). Its economy is based on the manufacturing industry, the provision of services and trade (94, 100).

*Image 1: Cochabamba’s capital city*  
*Image 2: Central valley*
2) **The High valley region** is a semi-humid agricultural area (images 3 and 4). This region comprises 15 municipalities and has a population density of 26 inhabitants per km². Agricultural production and livestock are the bases of the economy in this area (94, 100).

3) **The Andean region**, located in the Andes Mountain range above 3,500 meters (images 5 and 6); it is the less developed area of Cochabamba, with high levels of poverty and one of the lowest Human Development Indexes (HDI) of the country. Its economy is based on agriculture (mainly potatoes and other tubers; some cereals such as tarwi, quinoa and wheat, for own consumption), the breeding of cattle, sheep, and llamas (a camelid typical of the Andes Mountain range) and mining (tin and tungsten). Demographically, this region has a low population density with an average of 17 inhabitants per km² (94, 100).

4) **The Southern cone region** comprises areas of dry or semi-arid valleys; and its population is mostly rural (images 7 and 8). This is the most important agricultural area of the department, especially for production of corn, potatoes, peanuts, onions, wheat, tomatoes, anise, cumin, and beans. The production of fruits includes watermelons, grapes, custard apples and guavas (94, 100).
5) **The Tropical region** includes the Amazon rainforest. It has high ecological diversity since there are large navigable rivers and endless forests (images 9 and 10). Rainforest Indigenous peoples who live in this area (Yuracares, Yuquis, Sirionos, Chimane, and Trinitarios) maintain their ways of life, traditions, and customs. Although it has the lowest population density rate of the department - 6.7 inhabitants per km², it is one of the regions with the highest population growth rate in the country (close to 30% in the last 20 years). In economic terms, it is characterized by production of coca leaf, bananas, hearts of palm, citrus fruits, pineapple, and rice. It is also the most important oil-producing region and recently of gas (94, 100).

The **national health system**

The Bolivian national health system is decentralized, financed by a combination of government taxes, payroll contributions and private insurance. A combination of public and private subsectors is responsible for providing health services, under regulation of the Ministry of Health (MoH), to around 80% of population (80, 101).

The health system includes: The **public subsector**, headed by the MoH, responsible for formulating, regulating, and managing national policies and strategies (77). The MoH is also responsible for the Public Health Insurance (50).
Health personnel depend on the MoH, but the infrastructure, equipment and supplies for patient care are funded by municipal governments (1st level) and the departmental governments (2nd and 3rd level). The social security subsector serves organized, salaried workers and it covers all diseases, maternity, paediatrics, and occupational hazards. Workers make payroll contributions, and it is 50% co-financed by the employer. The social security provides medical care assistance to formal workers both in the private and public sector. The private subsector includes insurance companies, prepaid medicine companies and nongovernmental organizations (NGOs). Finally, the traditional medicine subsector serves approximately 10% of the population, especially in rural areas, including mainly traditional healers (“Kallawayas”), among others (87, 88).

The structure of the healthcare system is organized at four levels: 1) national, corresponding to MoH; 2) departmental, corresponding to Departmental Offices (DOs); 3) sub-regional, corresponding to the healthcare networks in provinces (based on geography and population); and 4) municipal, corresponding to Municipal Offices (MOs), including healthcare centres and mobile medical teams as an operative level. The responsibilities on these levels are: i) policy design, financing, and monitoring at the national level; ii) policy implementation and monitoring at the departmental level and in sub-regional health networks; and iii) service provision at the municipal level (77, 87).

The main competence of the MoH includes the monitoring, the management of services and the formulation of strategies, plans, and programs at the national level. As part of the management function, the MoH is also responsible for the National Health Information System (NHS) which organizes and consolidates the data of the national epidemiological surveillance system. The main task of the NHS is to systematize information related to maternal and child morbidity and mortality (87, 88).

Departmental and Municipal offices are in charge of implementing national policies at both departmental and municipal levels (87). The municipal level includes a first-level hospital, healthcare centres, posts and medical mobile teams which include the physicians of the “Mi Salud” [My Health] program. This program oversees implementing the national subprograms, including the National Plan for Control of NCDs. The “Mi Salud” program has been implemented since 2014 and focuses on preventive activities performed by physicians assigned to a determined group of families. These physicians provide medical check-ups and promotion and preventive services (mobile health brigades) through household visits. While this program could be very appropriate for monitoring chronic diseases, it currently focuses only on monitoring children, pregnant women, and the elderly (87).
During the data collection period of this study, and until 2019, only those with public and social security health insurances had access to free healthcare and treatment, CVDs included. However, CVD preventive activities were available to all the population, independently of their insurance status. In 2020, a new regulation was launched to implement Universal Health Coverage (UHC) and since then all people with permanent residence in Bolivia can access for free health care services and preventive activities (78).

**Data collection**

The data collection procedure was based on quantitative and qualitative methods. For the sub-studies 1, 2, and 3, the Pan-American version (V2.0) of the WHO STEPS approach (40) adapted to the Bolivian context were used. The data was collected between July 2015 and November 2016. For sub-study 4, the in-depth interview method was used for data gathering. The participants of the study consisted of regional manager of NCDs program (3); senior health officials (3), regional (3) and primary care center managers (3). All the key informants that were interviewed have between 5 and 20 years of experience in the implementation of the NCDs national policy.

**Quantitative data collection**

*The research team and my role on it*

A general project about risk factors associated with NCDs served as an umbrella for the STEPS application performed in this thesis and other clinical studies conducted at the Biomedical and Social Research Institute –IIBISMED of the faculty of medicine at San Simón University, Cochabamba.

Two different teams, one for the capital city (personnel from IIBISMED) and one for the other provinces/municipalities (IIBISMED and health workers from Cochabambá´s public health system) were created to apply the STEPS instruments and procedures. I was the principal researcher and coordinator of both teams responsible for the implementation of the STEPS, staff training, data collection and analysis, supported by those responsible for the public health and NCDs units of IIBISMED, and the departmental program of NCDs.

The study was co-funded by the Swedish International Development Cooperation Agency, SIDA; and the Science and Technology Department of San Simón University.
Adaptation of the WHO-STEPS approach in Cochabamba

The inter-institutional research team, comprised by members from IIBISMED, and the Departmental Secretariat of Health, reviewed the original Spanish version of the WHO-STEPS questionnaires and identified questions that required to be re-formulated in order to use Bolivian expressions. As part of the adaptation, new contextual questions/options were added, such as: i) the types of alcoholic beverages ("chicha" derivate from corn, and "guarapo" from grapes were included), ii) the use of traditional medicines and, iii) the use of firewood for cooking. The support material for the application of the survey was also reviewed and adapted, specifically, the instructions and information related to fruit and vegetable consumption portions and the cut-off point to classify people with risk, the categorization of common types of physical activity, and the diagnostic criteria for the physical measurements. The adapted version of the questionnaires as well as the support material for the survey were tested through a pilot study: first, with military personnel from Cochabamba’s air force (n = 204) and second with health personnel (n=421). Based on the results of the pilot study (images 11 and 12), further adaptations were made and a guide for the survey application was developed.

The pilot study helped to identify sensitive questions that people did not feel comfortable to answer. For example, the one about monthly salary, which was then reformulated including different ranges of salary categorized according to the national minimum wage. The pilot study also allowed to identify major limitations to carry out the step 3 at departmental level, because glucose measurement must be done immediately, and primary healthcare centers did not have the necessary laboratory equipment to measure some biochemical indicators. Previous fasting was also very difficult to control and many individuals who completed the steps 1 and 2, were lost in step 3. Therefore, it was decided to use only the questionnaires for steps 1 and 2.
Training of the interviewers and health service networks

The STEPS tools were applied through direct interviews by a group of health personnel (421 undergraduate medical doctors and nurses working in their compulsory rural and social service) and who were trained for two days about the procedure for applying the survey and its components as well as about the sampling methodology to be used (image 13). This group of interviewers was selected because they were distributed in the 47 municipalities of the Cochabamba department, accessing the most remote places, especially in the rural area of the department.

The coordinators of 13 healthcare services were also involved and trained to monitor the survey implementation, its application, and the verification mechanisms to avoid biases and fraud in the information collected (image 14). They were responsible to inform the heads of the primary healthcare centers within their network, as well as to review and approve the filled-in questionnaires, centralize the information, and send it later to the IIBISMED. In both cases, the training consisted of the correct application of the instrument, standardization of physical evaluation techniques, control, and calibration of the instruments for a correct evaluation of the participants.

Members from the research team supervised the work from coordinators and interviewers in some healthcare centers randomly selected. The persons in charge of the rural and social services from the Faculty of Medicine, also conducted periodic supervision of the interviewers (images 15 and 16). In the capital city, the application of the instrument was carried out by staff and students from the master program in Public Health and the Non-Communicable Diseases unit of IIBISMED-UMSS.
Sampling

Based on the estimations of the NHIS in 2014, the population over 15 years-old in Cochabamba department was 1,240,771 persons. A three-stage cluster random sampling was designed to cover the 16 provinces from Cochabamba, through the network of 13 healthcare services following the scheme in figure 8 described in the STEPS manual.

All 47 municipalities were used as the primary sampling units and 968 communities were randomly selected (using the community maps in the situational rooms of healthcare centers) as secondary sampling units. The PAHO rapid house-to-house vaccination coverage monitoring methodology was used as the randomization strategy for sampling population in each community to choose the households.

Within the households, one individual was randomly selected by using the Kish method for selecting members within a household; this method is based in a randomly numbers table by age group and sex, selecting only one participant by each household. One inclusion criterion was considered for a person to be selected: people who have been living in the community at least the last 6 months prior to the survey. This was taken due to the great social and geographical
mobility that characterizes the population of rural and peri-urban areas of the country.

Figure 9: Multi-stage cluster sampling applied.

![Multi-stage cluster sampling diagram](image)

Source: WHO/PAHO (15).
* Shaded boxes indicate the selected cluster or participant

The sample size was calculated based on previous estimates of the prevalence of overweight and obesity in the department (around 30%) using a level of confidence of 5%, a margin of error of 0.05, and a design effect of 1.05 as recommended by the STEPS manual (29). Assuming a response rate of 85%, the target sample size was raised to 12,779 individuals. The sample was calculated for each healthcare centre taking into account the demographic composition of the population (gender and age); based on the population pyramid of each municipality and health centre. The sample was distributed in the same proportion of the population for each age group and in a similar number between both sexes for each primary healthcare centre. Images 17 and 18 depict the sampling procedure and an interview performed in one of the areas surrounding a health centre.
Pregnant women, people with ascites or oedema, and those who did not give informed consent were excluded. From the total 12,527 people originally selected, 85.45% (n=10,754 individuals) were finally included in the analysis.
Figure 10: Steps in the selection of subjects in the WHO/STEP survey

Source: Constructed by the author.

Identification

Total population of Cochabamba department. 
N = 1,900,434

Population of 15 years and over. 
N = 1,240,771

Assignation

Stage I cluster sampling: 
47 Municipalities chosen (100%)

Stage II cluster sampling: 
(Current study): 968 communities randomly selected.

Selection

12527 individuals selected (Kish method) in communities stratified by sex and age group.

Analysis

PAPER I: 10754 individuals
PAPER II: 5758 individuals 
(4996: no information about income)

PAPER II: 10754 individuals
**Instruments and measures**

The WHO-HEFTS instruments used by this study consists of:

- **STEP 1:** questionnaire that collects socio-demographic data (age group, residence, level of education, marital status, occupation, income) and behavioural risk factors (smoking, alcohol consumption, fruit and vegetable consumption, physical activity). The questionnaire was applied through face-to-face interviews in the household. Questions were repeated until they were well understood, and support cards were also used to facilitate the understanding of the different types of fruits, vegetables, and levels of physical activity.

- **STEP 2:** measurement procedure that involves the evaluation and calculation of anthropometric indicators (weight, height, waist circumference, body mass index) and blood pressure (systolic and diastolic in both arms, mean arterial pressure). All measurements were taken in healthcare centers by using calibrated and standardized instruments. Physical measurements included weight (in bare feet without heavy clothing, in consideration of cultural principles) and height (in bare feet and without headwear); with this data, the Body Mass Index (BMI) was calculated, and the participants were then classified as overweight and obese. For the present study, all instruments were standardized before the examination, and the scales were zero calibrated routinely during the study period.

- **STEP 3:** involves the evaluation of blood laboratory indicators.

Sub-study 1 focuses STEPS 1 and 2 with special attention given to the relationship between behavioural risk factors and cardiovascular diseases; sub-study 2 zooms in on social determinants of a specific CVRF (abdominal obesity) and addresses it from the intersectionality point of view; sub-study 3 includes all CVRFs evaluated on STEP 1,2, and history of CVDs from STEP-3 to measure the horizontal and vertical inequities in the healthcare use for CVDs and participation in prevention activities; and finally, sub-study 4 focused on the development and implementation of the prevention and control policy to address all CVRF (STEPS 1,2 and 3) in the Bolivian primary healthcare system.

**Variables**

Table 2 summarizes the operationalization of the sociodemographic variables and risk factors measured in this research.
Table 2: Main operational definition of cardiovascular risk factors and determinants measured.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Categories for the analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STEP 1</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Sociodemographic factors</strong></td>
<td></td>
</tr>
<tr>
<td>Age group</td>
<td>Categorized into four groups according to the Global Burden of Disease-GBD: 18–29, 30–44, 45–59, and ≥ 60 years).</td>
</tr>
<tr>
<td>Gender</td>
<td>Women and men.</td>
</tr>
<tr>
<td>Ethnic group</td>
<td>Self-reported derived from the question: What ethnic group do you belong to? With the possibilities of Quichua, Aymara, Mestizo, African Bolivian, White or foreigner.</td>
</tr>
<tr>
<td>Place of residence</td>
<td>Classified according to the 5 socio-demographic regions of Cochabamba: Andean, Southern cone, Central Valley, Tropic and High Valley.</td>
</tr>
<tr>
<td>Marital status</td>
<td>Categorized than never married (0), currently married (1), or cohabitation/widowed/separated (2).</td>
</tr>
<tr>
<td><strong>Socioeconomic factors</strong></td>
<td></td>
</tr>
<tr>
<td>Education level</td>
<td>Categorized into four groups: no formal schooling, primary school, secondary school, and higher education.</td>
</tr>
<tr>
<td>Job status</td>
<td>Classified into five groups: self-employed, employed, housewife or homemaker, retired, and unemployed.</td>
</tr>
<tr>
<td>Monthly household income</td>
<td>An estimate based in the national minimum wage-NMW, categorized as: Less than 1 NMW (1), between 2 to 4 NMW (2), 5 or more NMW (0).</td>
</tr>
<tr>
<td>Health insurance coverage</td>
<td>Classified as &quot;Yes&quot; if the individual has insurance and &quot;No&quot; otherwise.</td>
</tr>
<tr>
<td><strong>Behavioural risk factors</strong></td>
<td></td>
</tr>
<tr>
<td>Current smoking</td>
<td>The individuals were asked if having smoked in the past 30 days and were categorized as current smoker or non-smoker in accordance WHO-STEPs survey manual.</td>
</tr>
<tr>
<td>Current alcohol consumption</td>
<td>Was explored through the items adapted from “Alcohol Use Disorders Identification Test (AUDIT)” included in the STEPS survey, which collect information about three different aspects: amount, frequency, and patterns of drinking. Participants were classified as harmful use of alcohol if heavy drinking episodes (6 or more standard drinks when alcohol is used) were reported either: a) once a month or more in the last 12 months; b) twice or more in the past 30 days; or c) if drank until getting drunk at least once in the past 7 days.</td>
</tr>
<tr>
<td>Low fruit and vegetables intake</td>
<td>Was classified according to the WHO STEPS manual. I.e., eating less than five servings or approximately 200 grams of fruits and vegetables per day for both food groups were classified as at risk; otherwise as adequate.</td>
</tr>
<tr>
<td>Low physical activity</td>
<td>Was measured through the items from “the Global Physical Activity Questionnaire” included in the STEPS survey, which collect information about four different aspects: physical</td>
</tr>
</tbody>
</table>
activity at workplace, during recreation time, while travelling, and during resting time. This variable was categorized according to the Metabolic Equivalent of Task (MET) as: low (insufficient) physical activity for values lower than 600 MET-minutes per week; and appropriate physical activity for values higher than 600 MET-minutes per week.

<table>
<thead>
<tr>
<th>STEP 2: Physical Measurements and morbidities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overweight and obesity</strong></td>
</tr>
<tr>
<td>Physical measurements included weight and height; with this data, the Body Mass Index (BMI) was calculated, and the participants were classified as overweight (BMI between 25–29.9 kg/m²) and obese (BMI ≥ 30 kg/m²). For older persons (above 60 years), the BMI parameters of the Spanish Society of Geriatrics and Gerontology were used; and the participants were classified with insufficient weight (BMI &lt;22 kg / m²), normal weight (BMI = 22-26.9 kg / m²), overweight (BMI = 27-29.9 kg / m²) and obesity (BMI ≥30 kg / m²).</td>
</tr>
</tbody>
</table>

| **Abdominal obesity**                         |
| Was measured at the narrowest point between the lower costal border and the iliac crest using a constant-tension tape (abdominal obesity being defined as a waist circumference of > 90 cm in men and > 80 cm in women). |

| **Raised blood pressure**                    |
| Two blood pressure readings were obtained from all participants. A third reading was taken if there was a difference of more than 25 mmHg for systolic blood pressure or 15 mmHg for diastolic blood pressure between the first two readings. The mean of all measures was used, based on the recommendations of the WHO research protocol. Raised blood pressure was defined as a systolic blood pressure of ≥ 130 mm/Hg, or a diastolic blood pressure of ≥ 85 mm/Hg or the self-reported use of anti-hypertensive medications, based on the WHO and American College of Cardiology guidelines. |

| **Healthcare utilization**                  |
| **Healthcare use**                          |
| participants were asked: ‘Have you, in the last 12 months, received healthcare for any of these conditions: high blood pressure or hypertension, hypercholesterolemia, history of raised total cholesterol, diabetes mellitus, and/or history of myocardial infarction or stroke, by a doctor or other health worker?’ (27). Participants could answer yes or no for each CVD. Those who answered yes to one of the diseases were coded as healthcare use (= 1), and those that answered no were coded as do not use (= 0). |

| **Participation in preventive activities**   |
| participants were asked: ‘Have you, in the last 12 months, participated in NCD or CVRF preventive activities with a doctor or other health worker related to: advice to reduce salt intake, start or do more exercise, eat more rations of fruits and vegetables every day, reduce fat consumption, advice or treatment to lose weight, stop smoking, and reduce or stop alcohol consumption?’ Like previously, those who answered |
yes to any of the alternatives were coded as participating in the activities (= 1), while the rest were coded as not participating (= 0).

| Healthcare needs | were captured through two variables: self-reported CVRFs and self-reported diagnosis or treatment of CVDs. For the first one, participants were asked about: i) current behavioural risk factors, such as smoking, alcohol consumption, fruit and vegetable intake, and physical activity, as part of the WHO-STEPS 1, and ii) several physical measurements, such as weight and height, abdominal obesity, and blood pressure, as part of the WHO-STEPS 2. |
| Predisposing factors | Two sociodemographic factors identified as non-modifiable risk factors that can increase a person's risk of developing CVDs, were included in this study. Gender was categorised as women and men. Age was categorised into four groups according to the WHO-STEPS manual (27): 18–29, 30–44, 45–59, and ≥ 60 years. Ethnic group was divided into Indigenous and mestizo. |

**Qualitative data collection**

In-depth interviews were used for data gathering in sub-study 4. The participants of the study consisted of regional managers of the NCDs program (6), senior health officials (3) and primary health care center managers (5); their characteristics are described in table 3.

The key informants were selected based on their work experience equal to or greater than 5 years in the implementation of the NCDs program. From the total participants, 5 were women and 9 men; 11 were physicians trained in public health, 2 were epidemiologists, and one was a pulmonologist. All the senior officers worked in La Paz, the regional managers of the NCD program were from La Paz, Cochabamba, Santa Cruz, and Chuquisaca, which are the departments where the implementation of the NCD prevention policy was prioritized in 2017, and all primary care center managers were from Cochabamba, being selected those who worked in hospitals that implemented the NCDs prevention and control policy. All of them were contacted through the Departmental Health Service of Cochabamba, then meetings were scheduled with the principal investigator at their workplace or at the IBISMED.
Table 3: Key informants to qualitative data collection

<table>
<thead>
<tr>
<th>Nº</th>
<th>Work position</th>
<th>Place of work</th>
<th>Gender</th>
<th>Years in NCD program</th>
<th>Profession</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Senior Official</td>
<td>La Paz</td>
<td>Man</td>
<td>15</td>
<td>Medical doctor, MPH</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>La Paz</td>
<td>Women</td>
<td>16</td>
<td>Epidemiologist</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>La Paz</td>
<td>Man</td>
<td>20</td>
<td>Medical doctor, MPH</td>
</tr>
<tr>
<td>4</td>
<td>Regional manager of the NCD program</td>
<td>Cochabamba</td>
<td>Man</td>
<td>7</td>
<td>Medical doctor, MPH</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Cochabamba</td>
<td>Man</td>
<td>8</td>
<td>Medical doctor, MPH</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Cochabamba</td>
<td>Women</td>
<td>20</td>
<td>Pneumologist</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Chuquisaca</td>
<td>Women</td>
<td>7</td>
<td>Medical doctor, MPH</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Santa Cruz</td>
<td>Man</td>
<td>10</td>
<td>Epidemiologist</td>
</tr>
<tr>
<td>9</td>
<td>Primary care center managers</td>
<td>La Paz</td>
<td>Man</td>
<td>13</td>
<td>Medical doctor, MPH</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Cochabamba</td>
<td>Man</td>
<td>5</td>
<td>Medical doctor, MPH</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Cochabamba</td>
<td>Man</td>
<td>6</td>
<td>Medical doctor, MPH</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Cochabamba</td>
<td>Man</td>
<td>5</td>
<td>Medical doctor, MPH</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Cochabamba</td>
<td>Women</td>
<td>9</td>
<td>Medical doctor, MPH</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Cochabamba</td>
<td>Women</td>
<td>7</td>
<td>Medical doctor, MPH</td>
</tr>
</tbody>
</table>

All the interviews were conducted by the principal researcher and the local supervisor, face to face between August 2021 and August 2022, for which I travelled to the departments where the key informants worked, after scheduling a specific meeting for the interview.

The interviews were conducted in Spanish. The interview began with general questions about the participant’s own experience in the implementation of the national policies on CVDs. The general questions included: “What is/has been your job in the field of NCDs/CVDs?”; “What do you know about the plan and how have you been/are you involved with the plan? (Development, implementation, evaluation, etc.)” and “How do you perceive the implementation of the plan: in Bolivia, your region, your health facility?”

For developing the interview guide we were inspired by Meyers et al approach (93) to health policy evaluation, that suggest including questions about the assessment of needs and resources included in the national NCDs plan; the need for evaluation of adjustments to the plan, the preparation and adaptation of the health system to the NCDs policy; the acceptance and favourable climate for its implementation; the general organization and development of staff capacities;
the recruitment and maintenance of personnel, and the training of personnel prior to implementation.

Regarding implementation, specific questions were asked related to the training of implementation teams, the implementation plan, regular supporting strategies including technical assistance, training, and supervision or evaluation of the process, as well as feedback mechanisms for continuous improvement based on the lessons that have been learned about the implementation of this health policy.

Probing questions were also used to clarify information and gain additional data. During the interview, other questions arose, all of which were related to different perspectives about the limitations and facilitators in the implementation of the CVDs national policy. All the interviews were recorded after authorization of the informants and lasted between 30 to 45 minutes.

**Data analysis**

Regarding the quantitative studies, the final sample used for analysis in the sub-studies 1 and 3 comprised 10,754 individuals. For the second sub-study, 4,996 participants were excluded for not answering the questions on income (a necessary variable for analysis) and therefore the effective sample comprised 5,758 individuals. On the other hand, for the qualitative study, the key informants of the study consisted of the regional managers of the NCDs program (6), senior health officials (3) and primary care center managers (5); their characteristics are described in table 3.

**Sub-study 1**

Data collected from the STEPS questionnaires were entered into MS-Excel® and then transferred into Stata/MP version 14.0 (StataCorp) for data cleaning and analysis. The prevalence of relevant behavioural risk factors and anthropometric measures was calculated. The socio-demographic variables included were age, ethnicity, level of education, occupation, place of residence and marital status. Proportions, and then odds ratios (OR) were estimated for each CVRF, both in crude and adjusted models. The 95% confidence intervals were calculated for both indicators.

**Sub-study 2**

For this sub-study, all participants with valid responses on income, gender and ethnicity were eligible for inclusion. An intersectional approach based on the method suggested by Jackson et al was used for analysis. As indicated in the framework section, four intersectional positions were constructed from gender
(woman vs. men) and ethnic group (Indigenous vs. mestizo) to reflect disparate social processes of privilege or advantage, and conversely oppression or disadvantage, which in turn can become expressed in varying degrees of health benefits. The groups included: i) the dually disadvantaged group of Indigenous women; ii) the dually advantaged group of mestizo men, and the singly disadvantaged groups of iii) Indigenous men and iv) mestizo women.

Joint disparity (mestizo men vs Indigenous women) compares outcomes among the dually advantaged/disadvantaged categories, respectively. Gender referent disparity (mestizo men vs mestiza women) evaluates obesity disparities among mestizos (those who does not face ethnic discrimination) and illustrates how the outcome is patterned by gender disadvantage. Ethnic referent disparity (mestizo men vs Indigenous men) evaluates the obesity disparities among men (those with an advantage in relation to gender) and describes how the outcome is patterned by racial disadvantage. The excess intersectional disparity was calculated as the difference between the joint disparity and the sum of ethnicity plus gender disparity.

Joint and excess intersectional disparities in abdominal obesity were estimated as absolute prevalence differences between binary groups, using binomial regression models. After that, the Oaxaca-Blinder decomposition was applied to estimate the contributions of explanatory factors underlying the observed intersectional disparities between advantage and disadvantage groups, using the Oaxaca command in Stata software v15.1.

**Sub-study 3**

Bivariate and multivariable regression analyses were carried out to analyse the association between the use of CVDs healthcare and preventive activities for CVRFs, adjusted for demographic and socioeconomic factors and healthcare needs. Odds ratios with 95% confidence intervals were calculated as measures of association and inference.

To assess horizontal and vertical equity in healthcare, four types of variables representing healthcare utilisation, healthcare needs, predisposing factors, and socioeconomic variables were selected. The inclusion of the variables in each group was based on previous research (10, 16) and their relevance for the objectives of the study.

To assess horizontal equity, the association between socioeconomic variables and healthcare use was examined whilst controlling for health needs factors (number of CVRFs and morbidity), and predisposing factors (gender, age group and ethnicity) in the full model. In assessing vertical equity, the associations between
health need variables and healthcare access were examined whilst adjusting for socioeconomic variables and predisposing factors.

For this analysis, we used all socioeconomic and demographic available variables included in the WHO-STEPs: Healthcare utilization, the outcome of this study, was measured by two variables according to the guidelines of the WHO-STEPs manual (27): Healthcare use, and Participation in preventive activities. Healthcare needs were captured through two variables: self-reported CVRF and self-reported diagnosis or treatment of CVD. Predisposing factors two sociodemographic factors identified; sex categorized and age groups. Socioeconomic status (SES) was measured through four variables: place of residence, education level, job status or occupation, and health insurance coverage.

Three models were developed for each of the two outcomes: healthcare use for CVDs and participation in preventive activities for CVRFs. Model 0, or the crude model, included each of the variables separately. In model 1, the predisposing factors and socioeconomic variables were added, and in model 2, the healthcare need variables were included.

Collinearity was evaluated by the variance inflation factor (VIF); the VIF coefficients were between 1 and 2, indicating low levels of multicollinearity.

Sub-study 4
The interviews were recorded, transcribed verbatim and analysed using reflexive thematic analysis as proposed by Braun and Clark, an adaptable interpretive approach to qualitative data analysis emphasizing the researcher’s active role in knowledge production. The six-phase process involved: a) familiarization with data and note-taking, b) generating initial codes, c) forming initial themes, d) reviewing potential themes, e) refinement, defining, and naming themes, and f) report writing. The iterative nature of the analysis allowed movement back and forth through these phases. (102, 103).

The principal researcher dedicated considerable time in the first phase, immersing themselves in data through repeated listening to audio recordings, reading transcripts, and note-taking. I started to code sections of the text by identifying keywords, phrases, and concepts, and codes from the joint document were examined, identifying general patterns as potential themes, and grouping codes to develop candidate themes. The transcribed data set was transferred to Microsoft Excel to facilitate code development. All authors participated in reading, coding, and discussing multiple transcripts to identify recurring patterns and perform thematization. The principal researcher completed the coding
process, and codes were iteratively examined and grouped to generate potential themes. During the entire process, short descriptions of themes and subthemes were developed and through them, the labels/titles of themes and subthemes were refined to better encompass their description. The process continued until a final list of 5 themes and 10 sub-themes was developed.

A thematic map was created during the review of potential themes, aiding in reconstructing the narrative by visualizing relationships between themes, transcripts, and codes. The final phase involved reviewing potential themes, refining, renaming, and collapsing some, resulting in the identification of five definitive themes presented in the results section. Overall, the analysis demonstrated a meticulous and interactive approach, underscoring the dynamic and non-linear nature of qualitative data analysis.

A summary of the four sub-studies with objectives and methods is presented in Table 4.

<table>
<thead>
<tr>
<th>Objective</th>
<th>Methodological approach</th>
<th>Data</th>
<th>Analytical methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Quantitative analyses (Cross-sectional studies)</td>
<td>WHO/STEPS survey adapted to the Bolivian context including: • Socio-demographic data • Economic and access to health services • Behavioral risk factors • Physical and anthropometric measures</td>
<td>Prevalence measures and regression models</td>
</tr>
<tr>
<td>2</td>
<td>Comparison of means, regression models and Oaxaca-Blinder Decomposition analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Horizontal and vertical inequity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Qualitative study</td>
<td>In-depth interviews with departmental and national key informants</td>
<td>Reflexive Thematic Analysis</td>
</tr>
</tbody>
</table>

**Ethical considerations**

Ethical approval was obtained from the ethical committee at the Medicine School of San Simon University in Cochabamba. All participants in the survey signed an informed consent that offered bilingual (Castilian and Quechua) information about the project. For the case of illiterate participants, the informed consent was
explained orally and after acceptance of participation, the fingerprint was stamped.

The in-depth interviews were recorded with the permission of participants and recordings and transcripts were stored according to the existing regulation on research procedures at UMSS. Before conducting the interviews, informed verbal and written consent was sought from the potential participants. All informants were notified that they were free to withdraw from the study at any point and also assured confidentiality during and after the study period.
Findings

Characteristics of the participants in the survey
More than half (57.38%) of the participants were women, and the mean age (and standard deviation) was 37.89±18 years (women=36.88±17.58 and men = 39.24 ± 18.62). The age distribution of the sample was similar in men and women (Figure 11).

Figure 11: Percentage distribution of the participants by gender and age group

The social characteristics of the sample are presented in Table 5. Most of the participants were living in the Central (37.89%) and High (31.07%) valley regions. Majority of the study population (91.49%) had received formal education; however, men seemed to have achieved higher levels of education more frequently. More than half of the population self-identified as Indigenous (64.33%), were married or cohabitating (60.22%), and half (50.03%) were working at the time of the survey (self-employee and government or non-government employee).

Most of the social determinants were similarly distributed by gender. However, there were differences in some categories of education and occupation. For instance, the proportion of non-formal schooling was higher in women (10.52%) than in men (5.81%); in contrast, the percentage of employed or self-employed was higher in men (75.74%) than in women (36.04%). Moreover, it is important
to highlight that nearly half of the women (45.53%) were housewives or homemakers while reporting this occupation was seldom among men (0.75%).

Table 5: Social characteristics of the total sample and by sex; Cochabamba, Bolivia, 2015–2016

<table>
<thead>
<tr>
<th>Socio-demographic variables</th>
<th>Women (N = 6143–57.39%)</th>
<th>Men (N = 4561–42.61%)</th>
<th>Both Genders (N = 10704)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Residence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Andean</td>
<td>575</td>
<td>9.36</td>
<td>462</td>
</tr>
<tr>
<td>Southern cone</td>
<td>375</td>
<td>6.10</td>
<td>268</td>
</tr>
<tr>
<td>Central Valley</td>
<td>2232</td>
<td>36.33</td>
<td>1824</td>
</tr>
<tr>
<td>Tropics</td>
<td>922</td>
<td>15.01</td>
<td>720</td>
</tr>
<tr>
<td>High Valley</td>
<td>2039</td>
<td>33.19</td>
<td>1287</td>
</tr>
<tr>
<td>Education</td>
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<tr>
<td>No formal schooling</td>
<td>646</td>
<td>10.52</td>
<td>265</td>
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<tr>
<td>Primary school</td>
<td>2691</td>
<td>43.81</td>
<td>1811</td>
</tr>
<tr>
<td>Secondary school</td>
<td>2119</td>
<td>34.49</td>
<td>1849</td>
</tr>
<tr>
<td>Higher education</td>
<td>687</td>
<td>11.18</td>
<td>636</td>
</tr>
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<td>Ethnicity</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Indigenous</td>
<td>4080</td>
<td>66.42</td>
<td>2806</td>
</tr>
<tr>
<td>Mestizo</td>
<td>2015</td>
<td>32.8</td>
<td>1694</td>
</tr>
<tr>
<td>Other</td>
<td>48</td>
<td>0.78</td>
<td>61</td>
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<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never married</td>
<td>1782</td>
<td>29.01</td>
<td>1581</td>
</tr>
<tr>
<td>Currently married or cohabitating</td>
<td>3794</td>
<td>61.76</td>
<td>2652</td>
</tr>
<tr>
<td>Widowed or separated</td>
<td>567</td>
<td>9.23</td>
<td>328</td>
</tr>
<tr>
<td>Occupation/labour market position/status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>964</td>
<td>15.81</td>
<td>743</td>
</tr>
<tr>
<td>Self-employed</td>
<td>1621</td>
<td>26.59</td>
<td>2742</td>
</tr>
<tr>
<td>Employed</td>
<td>557</td>
<td>9.14</td>
<td>708</td>
</tr>
<tr>
<td>Housewife/homemaker</td>
<td>2776</td>
<td>45.53</td>
<td>34</td>
</tr>
<tr>
<td>Retired</td>
<td>81</td>
<td>1.33</td>
<td>182</td>
</tr>
<tr>
<td>Unemployed</td>
<td>98</td>
<td>1.61</td>
<td>108</td>
</tr>
</tbody>
</table>

Source: Mamani-Ortiz et al., 2019.

**Prevalence and risk of CVRFs**

The overall prevalence of the risk factors measured at the departmental level is shown in Figure 12. The observed prevalence was above 50% for low consumption of fruits and vegetables (76.73%), low level of physical activity (64.77%), overweight and obesity (combined prevalence: 56.33%) and abdominal obesity (54.13%).
Figure 12: Prevalence of cardiovascular risk factors, Cochabamba, Bolivia, 2015–2016

Figure 13 displays the distribution of the number of CVRFs per subject in the total sample and by gender. The average CVRF per person was $2.98 \pm 1.36$ and only $1.28\%$ of the population did not have any risk factor. It is important to highlight that $40.7\%$ of participants reported 4 or more CVRFs.

The probability of presenting four or more CVRFs simultaneously was significantly higher ($p<0.05$) in men, middle aged and elderly, those who lived in a different region than the Andean and in all the occupational groups different from being student (Figure 12).
On the other hand, the risk was significantly lower in Indigenous people (OR:0.81; 95%-CI:0.72-0.91) compared with mestizos, and among people with no formal schooling (OR:0.48; 95%-CI:0.37-0.63) or primary education level (OR:0.63; 95%-CI:0.52-0.75) compared to those with high education level. The adjusted odds ratios and their 95% confidence intervals are displayed in Figure 14.

Figure 14: Adjusted OR of having 4 or more CVRF simultaneously by socio-demographic variables.

CVRFs by socioeconomic characteristics

The sub-sections below describe the prevalence distribution and adjusted odds ratios for each of the behavioural CVRFs (STEPS-1).

The table 6 shows the prevalence and 95% confidence intervals (95%-CI) by sociodemographic variables of current daily smoker, current alcohol consumption, low fruit and vegetable consumption and low level of physical activity.
Table 6: Distribution of behavioural risk factors prevalence by socio-demographic variables (95% CI in brackets)

<table>
<thead>
<tr>
<th>Socio-demographic variables</th>
<th>Current daily smoker</th>
<th>Current alcohol consumption</th>
<th>Low fruit and vegetable consumption</th>
<th>Low level of physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>3.25 (2.81-3.69)</td>
<td>33.89 (32.70-35.07)</td>
<td>76.29 (75.23-77.36)</td>
<td>72.78 (71.66-73.89)</td>
</tr>
<tr>
<td>Man</td>
<td>21.57 (20.38-22.76)</td>
<td>54.72 (53.27-56.16)</td>
<td>77.32 (76.11-78.54)</td>
<td>53.97 (52.53-55.42)</td>
</tr>
<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-29</td>
<td>10.53 (9.65-11.42)</td>
<td>37.87 (36.47-39.27)</td>
<td>75.18 (73.93-76.43)</td>
<td>67.90 (66.55-69.25)</td>
</tr>
<tr>
<td>30-44</td>
<td>12.22 (10.99-13.46)</td>
<td>50.64 (48.76-52.53)</td>
<td>76.32 (74.72-77.92)</td>
<td>58.83 (56.97-60.69)</td>
</tr>
<tr>
<td>45-59</td>
<td>12.39 (10.78-13.99)</td>
<td>50.73 (48.30-53.17)</td>
<td>76.75 (74.70-78.81)</td>
<td>58.69 (56.29-61.09)</td>
</tr>
<tr>
<td>≥ 60</td>
<td>9.43 (8.07-10.79)</td>
<td>36.21 (33.98-38.44)</td>
<td>81.35 (79.54-83.16)</td>
<td>71.19 (69.09-73.29)</td>
</tr>
<tr>
<td><strong>Residence</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Andean</td>
<td>11.37 (9.44-13.31)</td>
<td>35.39 (32.47-38.30)</td>
<td>80.32 (77.90-82.74)</td>
<td>59.98 (56.99-62.96)</td>
</tr>
<tr>
<td>Southern cone</td>
<td>12.13 (9.60-14.65)</td>
<td>55.05 (51.20-58.90)</td>
<td>83.04 (80.14-85.95)</td>
<td>54.74 (50.89-58.59)</td>
</tr>
<tr>
<td>Central Valley</td>
<td>11.80 (10.81-12.80)</td>
<td>54.51 (52.97-56.97)</td>
<td>72.14 (70.76-73.52)</td>
<td>66.98 (65.53-68.43)</td>
</tr>
<tr>
<td>Tropics</td>
<td>15.83 (14.06-17.60)</td>
<td>54.56 (52.15-56.97)</td>
<td>76.85 (74.81-78.89)</td>
<td>51.52 (49.10-53.94)</td>
</tr>
<tr>
<td>High Valley</td>
<td>7.48 (6.59-8.38)</td>
<td>59.98 (58.31-61.64)</td>
<td>79.94 (78.58-81.30)</td>
<td>72.03 (70.51-73.56)</td>
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<tr>
<td><strong>Ethnicity</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indigenous</td>
<td>10.57 (9.84-11.29)</td>
<td>41.89 (40.73-43.06)</td>
<td>79.01 (78.05-79.97)</td>
<td>62.08 (60.93-63.22)</td>
</tr>
<tr>
<td>Mestizo</td>
<td>11.97 (10.92-13.01)</td>
<td>44.32 (42.72-45.92)</td>
<td>72.93 (71.50-74.36)</td>
<td>65.69 (63.21-71.17)</td>
</tr>
<tr>
<td>Other</td>
<td>11.00 (5.10-16.91)</td>
<td>44.95 (35.57-54.33)</td>
<td>62.38 (53.24-71.52)</td>
<td>66.97 (58.10-75.84)</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No formal schooling</td>
<td>6.69 (5.07-8.32)</td>
<td>30.51 (27.52-33.50)</td>
<td>83.86 (81.47-86.25)</td>
<td>65.97 (62.89-69.05)</td>
</tr>
<tr>
<td>Primary school</td>
<td>10.28 (9.39-11.17)</td>
<td>41.51 (40.07-42.95)</td>
<td>78.76 (77.57-79.95)</td>
<td>61.32 (59.90-62.75)</td>
</tr>
<tr>
<td>Secondary school</td>
<td>11.92 (10.91-12.92)</td>
<td>42.08 (40.55-43.62)</td>
<td>75.32 (73.98-76.66)</td>
<td>66.53 (65.06-68.00)</td>
</tr>
<tr>
<td>Higher education</td>
<td>14.13 (12.25-16.01)</td>
<td>57.52 (54.85-60.18)</td>
<td>30.83 (28.34-33.32)</td>
<td>70.37 (67.90-72.83)</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never married</td>
<td>11.86 (10.77-12.95)</td>
<td>37.82 (36.18-39.46)</td>
<td>76.00 (74.55-77.44)</td>
<td>68.74 (67.18-70.31)</td>
</tr>
<tr>
<td>Currently married or cohabitating</td>
<td>10.81 (10.05-11.57)</td>
<td>45.84 (44.62-47.05)</td>
<td>76.57 (75.54-77.60)</td>
<td>61.85 (60.66-63.03)</td>
</tr>
<tr>
<td>Widowed or separated</td>
<td>9.83 (7.88-11.78)</td>
<td>39.21 (36.01-42.41)</td>
<td>80.67 (78.08-83.25)</td>
<td>70.83 (67.85-73.81)</td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>6.56 (5.38-7.73)</td>
<td>25.71 (23.64-27.79)</td>
<td>74.45 (72.38-76.52)</td>
<td>78.44 (76.49-80.39)</td>
</tr>
<tr>
<td>Self-employed</td>
<td>17.19 (16.07-18.30)</td>
<td>51.89 (50.40-53.37)</td>
<td>77.72 (76.48-78.95)</td>
<td>49.00 (47.51-50.48)</td>
</tr>
<tr>
<td>Employed</td>
<td>15.88 (13.87-17.90)</td>
<td>58.81 (56.10-61.52)</td>
<td>72.80 (70.35-75.25)</td>
<td>64.18 (61.54-66.83)</td>
</tr>
<tr>
<td>Housewife/homemaker</td>
<td>2.24 (1.69-2.78)</td>
<td>32.98 (31.25-34.72)</td>
<td>78.07 (76.54-79.60)</td>
<td>77.04 (75.49-78.60)</td>
</tr>
<tr>
<td>Retired</td>
<td>10.64 (6.91-14.38)</td>
<td>39.16 (33.25-45.07)</td>
<td>76.04 (70.87-81.21)</td>
<td>87.83 (83.87-91.79)</td>
</tr>
<tr>
<td>Unemployed</td>
<td>8.73 (4.87-12.60)</td>
<td>31.55 (25.19-37.91)</td>
<td>77.18 (71.43-82.92)</td>
<td>86.89 (82.27-91.51)</td>
</tr>
</tbody>
</table>

**Source:** Mamani-Ortiz et al., 2019.
Smoking was more prevalent among men (21.7%), people from the Tropical region (15.83%), the most educated (14.13%) and those currently working (self-employed = 17.19% and employee = 15.88%) (Table 5).

The adjusted risk of being a smoker is displayed in Figure 15. The ORs were statistically significant in men (OR: 6.19; 95%-CI: 5.14-7.44) compared to women; and in self-employed (OR: 2.96; 95%-CI: 2.31-3.78), employed (OR: 2.70; 95%-CI: 2.03-3.78) and retired (OR: 2.05; 95%-CI: 1.24-3.36) groups compared to the students.

On the contrary, the risk was lower and statistically significant in elderly people (OR: 0.72; 95%-CI: 0.56-0.92) compared to the young and among those from the High valley (OR: 0.70; 95%-CI: 0.54-0.89) compared to those from the Andean region.

Figure 15: Adjusted odds ratios of being a smoker by socio-demographic variables.
**Alcohol consumption**

Current alcohol consumption was more prevalent among men (54.72%), people aged 30–44 and 45–59 years old (> than 50%), non-Indigenous groups (around 44%), people with higher education (57.52%), currently married or cohabitating (45.84%), and employees (58.81%) (Table 5).

Figure 16 displays the adjusted risk of being a current alcohol consumer. The ORs were high and statistically significant in men (OR: 2.19; 95%-CI:1.98-2.04) compared to women, adults between 30 to 44 (OR:1.24; 95%-CI:1.10-1.38) and 45-59 years (OR:1.27; 95%-CI:1.10-1.45) compared to people under 30 years, and in all the occupational groups compared to the student group.

On the other hand, odds were lower and statistically significant in elderly (OR: 0.80; 95%-CI:0.68-0.93) compared to young people, and in those with low educational level compared to the highest educational group.

*Figure 16: Adjusted odds ratios of being a current alcohol consumer by socio-demographic variables.*
**Low fruit and vegetable consumption**

Low levels of fruit and vegetable intake were highly prevalent among all socio-demographic groups (above 70%), except among those with higher education (30.83%) (Table 5).

The adjusted odds ratios of low fruit and vegetable consumption are displayed in Figure 17. The ORs were high and statistically significant in men (OR:1.13; 95%-CI:1.01-1.25) compared to women, elderly (OR:1.20; 95%-CI:1.00-1.44) compared to people under 30 years, Indigenous (OR: 1.21; 95%-CI:1.09-1.33) compared to mestizos, and the low compared to the high educated group.

On the opposite, the risk was lower and statistically significant among those living in the Central valley (OR:0.77; 95%-CI:0.64-0.91) compared to the Andean region, and those currently married (OR:0.87; 95%-CI:0.76-0.98) compared to those single.

*Figure 67: Adjusted odds ratios of low fruit and vegetable consumption by socio-demographic variables*
**Low level of physical activity**

Similarly, to the low consumption of fruits and vegetables, the low levels of physical activity also showed high prevalence (above 50%) in all socio-demographic groups with a very high proportion among the retired and unemployed population (87.83% and 86.89%, respectively) (Table 5).

The adjusted risk of the low level of physical activity is displayed in Figure 18. On the one hand, the ORs were high and statistically significant in elderly (OR:1.62) compared to those under 30 years, those living in the High valley (OR:1.46) compared to the Andean region and those retired (OR:1.57) or unemployed (OR:1.64) compared to students.

On the other hand, the risk was low and statistically significant in men (OR:0.56; 95%-CI:0.50-0.61) compared to women, among those living in the Southern Cone (OR:0.75; 95%-CI:0.60-0.93) or the Tropical region (OR:0.67; 95%-CI:0.56-0.79) compared to the Andean region, among people with low compared to high education, and self-employed (OR:0.32; 95%-CI:0.27-0.37) or employed (OR:0.48; 95%-CI:0.39-0.58) compared to students.

*Figure 18: Adjusted odds ratios of the low level of physical activity by socio-demographic variables*
Metabolic risk factors by socioeconomic characteristics

The sub-sections below describe the prevalence distribution and adjusted odds ratios for each of the metabolic CVRFs (STEPS-2) and Table 7 displays the prevalence distribution and 95% CI by the sociodemographic variables included in this study, and a specific description of each factor is detailed below.

Table 7: Distribution of metabolic risk factors prevalence by socio-demographic variables

<table>
<thead>
<tr>
<th>Socio-demographic variables</th>
<th>High blood pressure (%)</th>
<th>Overweight (%)</th>
<th>Obesity (%)</th>
<th>Abdominal obesity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>14.32 (13.40-15.25)</td>
<td>35.17 (33.91-36.43)</td>
<td>23.97 (22.84-25.09)</td>
<td>64.12 (62.86-65.39)</td>
</tr>
<tr>
<td>Men</td>
<td>21.22 (19.98-22.47)</td>
<td>36.75 (35.28-38.22)</td>
<td>15.83 (14.72-16.94)</td>
<td>40.21 (38.71-41.17)</td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30–44</td>
<td>16.90 (15.41-18.39)</td>
<td>41.50 (39.55-43.46)</td>
<td>28.85 (27.06-30.65)</td>
<td>65.67 (63.78-67.55)</td>
</tr>
<tr>
<td>45–59</td>
<td>26.96 (24.69-29.24)</td>
<td>39.54 (37.07-42.05)</td>
<td>32.48 (27.06-30.65)</td>
<td>69.54 (67.18-71.90)</td>
</tr>
<tr>
<td>≥ 60</td>
<td>30.50 (28.27-32.74)</td>
<td>37.20 (34.85-39.54)</td>
<td>22.83 (20.79-24.87)</td>
<td>59.72 (57.34-62.11)</td>
</tr>
<tr>
<td>Residence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Andean</td>
<td>10.01 (8.05-11.96)</td>
<td>38.83 (35.66-42.00)</td>
<td>7.37 (5.67-9.07)</td>
<td>41.80 (38.59-45.01)</td>
</tr>
<tr>
<td>Southern cone</td>
<td>26.99 (23.40-30.58)</td>
<td>40.91 (36.94-44.89)</td>
<td>16.46 (13.47-19.46)</td>
<td>52.63 (48.59-56.66)</td>
</tr>
<tr>
<td>Central Valley</td>
<td>18.06 (16.81-19.30)</td>
<td>35.36 (33.81-36.90)</td>
<td>22.04 (20.70-23.38)</td>
<td>54.10 (52.48-55.71)</td>
</tr>
<tr>
<td>Tropics</td>
<td>17.63 (15.64-19.63)</td>
<td>33.14 (30.68-35.60)</td>
<td>33.14 (30.68-35.60)</td>
<td>61.69 (59.15-64.23)</td>
</tr>
<tr>
<td>High Valley</td>
<td>16.48 (15.17-17.79)</td>
<td>35.81 (34.12-37.50)</td>
<td>20.13 (18.72-21.54)</td>
<td>53.89 (52.13-55.65)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indigenous</td>
<td>17.17 (16.24-18.11)</td>
<td>35.63 (34.44-36.82)</td>
<td>19.80 (18.81-20.79)</td>
<td>53.76 (52.53-55.00)</td>
</tr>
<tr>
<td>Mestizo</td>
<td>17.33 (16.05-18.62)</td>
<td>36.37 (34.74-38.01)</td>
<td>21.74 (20.34-23.15)</td>
<td>54.13 (52.44-55.83)</td>
</tr>
<tr>
<td>Other</td>
<td>21.21 (13.11-29.30)</td>
<td>31.31 (22.13-40.49)</td>
<td>21.21 (13.11-23.90)</td>
<td>53.53 (43.65-63.41)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No formal schooling</td>
<td>23.59 (20.68-26.50)</td>
<td>34.84 (31.57-38.10)</td>
<td>18.94 (16.26-21.63)</td>
<td>60.14 (56.78-63.50)</td>
</tr>
<tr>
<td>Primary school</td>
<td>18.03 (16.85-19.21)</td>
<td>36.17 (34.70-37.64)</td>
<td>23.40 (22.11-24.70)</td>
<td>57.09 (55.58-58.61)</td>
</tr>
<tr>
<td>Secondary school</td>
<td>14.32 (13.17-15.47)</td>
<td>34.33 (32.77-35.88)</td>
<td>17.23 (15.99-18.47)</td>
<td>47.74 (46.11-49.38)</td>
</tr>
<tr>
<td>Higher education</td>
<td>19.21 (16.96-21.47)</td>
<td>40.03 (37.22-42.83)</td>
<td>21.29 (18.95-23.63)</td>
<td>57.06 (54.22-59.88)</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Currently married cohabiting</td>
<td>18.63 (17.63-19.63)</td>
<td>39.48 (38.23-70.73)</td>
<td>24.82 (23.71-25.93)</td>
<td>61.95 (60.71-63.19)</td>
</tr>
<tr>
<td>Widowed or separated</td>
<td>28.98 (25.83-32.13)</td>
<td>37.39 (34.02-40.75)</td>
<td>27.22 (24.13-30.31)</td>
<td>65.74 (62.44-69.04)</td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>7.16 (5.87-8.45)</td>
<td>22.68 (20.58-24.78)</td>
<td>5.28 (4.16-6.39)</td>
<td>26.49 (24.28-28.70)</td>
</tr>
<tr>
<td>Self-employed</td>
<td>20.34 (19.08-21.60)</td>
<td>38.65 (37.13-40.17)</td>
<td>22.07 (20.77-23.37)</td>
<td>54.25 (52.70-55.81)</td>
</tr>
<tr>
<td>Employed</td>
<td>18.22 (15.98-20.47)</td>
<td>39.38 (36.54-42.22)</td>
<td>20.26 (17.92-22.59)</td>
<td>57.40 (54.53-60.27)</td>
</tr>
<tr>
<td>Housewife or homemaker</td>
<td>15.99 (14.57-17.41)</td>
<td>37.33 (35.46-39.21)</td>
<td>27.71 (25.97-29.44)</td>
<td>68.00 (66.20-69.81)</td>
</tr>
<tr>
<td>Retired</td>
<td>38.84 (32.68-44.99)</td>
<td>43.80 (37.53-50.06)</td>
<td>18.59 (13.68-23.50)</td>
<td>57.43 (51.19-63.88)</td>
</tr>
<tr>
<td>Unemployed</td>
<td>19.33 (13.56-25.10)</td>
<td>34.25 (27.32-41.18)</td>
<td>19.33 (13.56-25.10)</td>
<td>56.35 (49.10-63.59)</td>
</tr>
<tr>
<td>Overall</td>
<td>17.15 (16.44-17.87)</td>
<td>35.84 (34.89-36.80)</td>
<td>20.49 (19.68-21.29)</td>
<td>54.13 (53.17-55.08)</td>
</tr>
</tbody>
</table>

Source: Mamani-Ortiz et al., 2019.
High blood pressure

The overall prevalence of high blood pressure was 17.15%, being higher among men (21.22%), people aged over 60 years (30.50%), and housewives or homemakers (38.84%). The prevalence was lower in the 18-29 years age group (8.85%), those who lived in the Andean region (10.1%), and those who belonged to the student group (7.16%) (Table 6).

The adjusted risk of high blood pressure is displayed in Figure 19. The ORs were high and statistically significant in men (OR=1.51; 95%-CI:1.32-1.71) compared to women, in middle aged adults (OR1.82; 95%-CI:1.54-2.15 and OR:3.44; 95%-CI:2.87-4.11) and elderly (OR:4.10) compared to those under 30 years, in those living in different region than the Andean, especially the Southern Cone region (OR:3.87; 95%-CI:2.91-5.14) and in the different occupational categories compared to students, except among unemployed for whom the OR was not significant.

In addition, the risk was low and statistically significant in Indigenous (OR:0.86; 95%-CI:0.76-0.97) compared to mestizos.

Figure 19: Adjusted odds ratios of raised blood pressure by socio-demographic variables
**Overweight and obesity**

The prevalence of overweight was similar among women and men. Singles and students had the lowest prevalence (28.32% and 22.68%, respectively), while those aged 30–44 years (41.50%), living in the Southern Cone region (40.91%), with higher education (40.03%), and retired (43.80%) had the highest. Unlike overweight, obesity was more prevalent in women (23.97%), the 45–59 years age group (32.48%) as well as among those living in the Tropical region (33.14%). The lowest prevalence was found among those who lived in the Andean region (7.37%) and those who belonged to the student group (5.28%) (Table 6).

For the adjusted analysis, the overweight and obesity were combined, and the results are displayed in Figure 20. The ORs were high and statistically significant in young and middle aged adults (OR:2.35; 95%-CI:2.08-2.65 and OR:2.68; 95%-CI:2.31-3.10) and elderly (OR:1.79; 95%-CI:1.52-2.09) compared to people under 30 years, in those living in other regions rather than the Andean, among married (OR:1.48; 95%-CI:1.30-1.66) and widowed or separated (OR:1.56; 95%-CI:1.27-1.89) compared to never married, and among the different occupational categories compared with students. On the contrary, the odds ratios were low and statistically significant in men (OR:0.73; 95%-CI:0.65-0.80) compared to women, in Indigenous (OR:0.79; 95%-CI:0.71-0.86) compared to mestizo, and among people with no formal schooling (OR:0.50; 95%-CI:0.40-0.62) or primary education level (OR:0.79; 95%-CI:0.67-0.92) compared to those with high education level.

*Figure 20: Adjusted odds ratios of overweight and obesity by socio-demographic variables*
**Abdominal obesity**

Abdominal obesity was present in 54.13% of the participants, being higher among women (64.12%) than men (40.21%). It was also higher among people aged 30–44 and 45–59 years (65.67% and 69.54, respectively). The Andean region presented a low prevalence (41.80%) compared to other regions (above 52%); similarly, singles and students (34.99% and 26.49%, respectively) presented a low prevalence compared to the other subgroups. The prevalence was similar among the ethnic groups (around 54%) and higher among those with no formal schooling (60.14%), widowed or separated (65.74%), and housewives/homemakers (68%) (Table 6).

The adjusted risk of abdominal obesity is displayed in Figure 21. The ORs were high and statistically significant in young and middle aged adults (OR:2.21; 95%-CI:1.95-2.49 and OR: 2.85; 95%-CI:2.45-3.29) and elderly (OR:2.02; 95%-CI:1.72-2.37) compared to people under 30 years, among those living in all other regions than the Andean, the married (OR:1.62; 95%-CI:1.77-2.44) and widowed or separated (OR:1.63; 95%-CI:1.42-2.10) compared to the never married, and among the different occupational categories compared to students. On the other hand, the odds ratios were low and statistically significant in men (OR:0.30; 95%-CI:0.26-0.32), Indigenous (OR:0.80; 95%-CI:0.76-0.97), and among people with no formal schooling (OR:0.77; 95%-CI:0.67-0.95) compared to high education level.

*Figure 21: Adjusted odds ratios of abdominal obesity by socio-demographic variables*
Abdominal obesity inequalities from an intersectional perspective

In this section, I focus on abdominal obesity and its distribution in the intersectional space of ethnicity and gender.

The average waist circumference in mestizos was higher (90.25±0.49 in men and 88.28±0.46 in women) than in Indigenous (87.69±0.32 in men and 87.96±0.28 in women). Likewise, mestizo had a higher prevalence of abdominal obesity (men 35.01% and women 30.71%) as compared to Indigenous (men 25.38% and women 27.75%) (Table 8).

Table 8: Abdominal obesity prevalence in the intersectional space between gender and ethnicity

<table>
<thead>
<tr>
<th>Variable</th>
<th>Women (N=3182 - 55.26%)</th>
<th>Men (N=2576 - 44.74%)</th>
<th>Both (N=5758)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Indigenous</td>
<td>Mestizo</td>
<td>Indigenous</td>
</tr>
<tr>
<td>N</td>
<td>2,166</td>
<td>1,016</td>
<td>1,622</td>
</tr>
<tr>
<td>%</td>
<td>57.18</td>
<td>51.57</td>
<td>42.82</td>
</tr>
<tr>
<td>Waist circumference</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean and SD (cm)</td>
<td>87.96 ±0.28</td>
<td>88.28 ±0.46</td>
<td>87.69 ±87.06</td>
</tr>
<tr>
<td>% abdominal obesity</td>
<td>27.75</td>
<td>30.71</td>
<td>25.83</td>
</tr>
</tbody>
</table>

Source: Mamani-Ortiz et al., 2019.

Overall, Indigenous were less obese and showed healthier habits than mestizo but as expected, they reported less favourable socioeconomic conditions. Table 8 shows the distribution of sociodemographic, socioeconomic, and behavioural factors by ethnicity. The data shows a higher proportion of elderly Indigenous, without formal schooling, and with a lower monthly household income compared to mestizos. It also highlights a higher proportion of singles and of higher education levels, as well as a higher prevalence of behavioural risk factors in mestizos.

The distribution of sociodemographic, socioeconomic, and behavioural factors by ethnicity is presented in Table 9.
Table 9: Percentage distribution of sociodemographic, socioeconomic, and behavioural factors by ethnicity

<table>
<thead>
<tr>
<th>Variable</th>
<th>Indigenous N=3182 (55.26%)</th>
<th>Mestizo N=2576 (44.74%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sociodemographic factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age group (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-29</td>
<td>37.33</td>
<td>48.53</td>
</tr>
<tr>
<td>30-44</td>
<td>27.96</td>
<td>26.7</td>
</tr>
<tr>
<td>45-59</td>
<td>16.55</td>
<td>15.53</td>
</tr>
<tr>
<td>≥ 60</td>
<td>18.16</td>
<td>9.24</td>
</tr>
<tr>
<td>Place of Residence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Andean</td>
<td>11.46</td>
<td>4.82</td>
</tr>
<tr>
<td>Southern cone</td>
<td>8.42</td>
<td>2.08</td>
</tr>
<tr>
<td>Central Valley</td>
<td>33.84</td>
<td>49.85</td>
</tr>
<tr>
<td>Tropic</td>
<td>17.61</td>
<td>16.85</td>
</tr>
<tr>
<td>High Valley</td>
<td>28.67</td>
<td>26.4</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never married</td>
<td>23.36</td>
<td>32.58</td>
</tr>
<tr>
<td>Currently married Cohabitate</td>
<td>67.93</td>
<td>61.02</td>
</tr>
<tr>
<td>Widowed or separated</td>
<td>8.71</td>
<td>6.4</td>
</tr>
<tr>
<td><strong>Socioeconomic factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No formal schooling</td>
<td>9.98</td>
<td>1.68</td>
</tr>
<tr>
<td>Primary school</td>
<td>48.65</td>
<td>27.97</td>
</tr>
<tr>
<td>Secondary school</td>
<td>31.49</td>
<td>48.43</td>
</tr>
<tr>
<td>High education</td>
<td>9.87</td>
<td>21.93</td>
</tr>
<tr>
<td>Job status/occupation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>8.95</td>
<td>14.21</td>
</tr>
<tr>
<td>Self-employed</td>
<td>48.39</td>
<td>44.26</td>
</tr>
<tr>
<td>Employed</td>
<td>11.99</td>
<td>19.54</td>
</tr>
<tr>
<td>Homemaker</td>
<td>27.16</td>
<td>18.07</td>
</tr>
<tr>
<td>Retired</td>
<td>2.27</td>
<td>2.55</td>
</tr>
<tr>
<td>Unemployed</td>
<td>1.24</td>
<td>1.37</td>
</tr>
<tr>
<td>Monthly household income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than an NMW</td>
<td>36.91</td>
<td>21.27</td>
</tr>
<tr>
<td>Between 2 to 4 NMW</td>
<td>51.32</td>
<td>59.39</td>
</tr>
<tr>
<td>More than 5 NMW</td>
<td>11.77</td>
<td>19.54</td>
</tr>
<tr>
<td>Health Insurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>15.79</td>
<td>16.45</td>
</tr>
<tr>
<td>No</td>
<td>84.21</td>
<td>83.55</td>
</tr>
<tr>
<td><strong>Behavioural risk factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current smokers</td>
<td>12.51</td>
<td>14.16</td>
</tr>
<tr>
<td>Alcohol consumption</td>
<td>57.71</td>
<td>61.64</td>
</tr>
<tr>
<td>Low Fruit and Vegetables intake</td>
<td>79.41</td>
<td>71.88</td>
</tr>
<tr>
<td>Physial activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>57</td>
<td>65.74</td>
</tr>
<tr>
<td>Moderate</td>
<td>33.87</td>
<td>29.64</td>
</tr>
<tr>
<td>High</td>
<td>9.13</td>
<td>4.62</td>
</tr>
</tbody>
</table>

(*) Numbers are column percentages within each variable.

Source: Mamani-Ortiz et al., 2019.
Figure 2 illustrates the percentage variation between the different intersectional positions. At the upper and bottom corners of the figure are located the dually disadvantaged and advantaged groups of Indigenous-women and mestizo-men, (joint disparity - diagonal arrow). The obesity prevalence in the doubly advantaged mestizo men was 7.26 percentage points higher than in the doubly disadvantaged Indigenous women (Joint disparity=MM-IW). The right side of the figure (gender referent disparity- vertical arrow) shows that mestizo men had 4.30 percentage points higher prevalence than mestizo women (Gender referent disparity: MM – MW). The upper part of the figure (ethnic referent disparity – horizontal arrow) indicates that the mestizo men had a 9.18 percentage points higher prevalence of obesity than Indigenous men (Ethnic referent disparity= MM – IM).

The resulting excess intersectional disparity (Joint - ethnic + gender) was 6.22% representing -86% of the joint disparity, the gender disparity accounted for 59% and the ethnic disparity for 126% of the joint disparity. This means that the 7.26 percentage points difference in obesity between the dually disadvantaged and advantaged groups was to a large degree due to ethnic differences alone, rather than gender-related inequalities. In other words, despite the doubly disadvantaged group of Indigenous women had more than 7 percentage points lower prevalence of abdominal obesity than mestizo men, they also had a markedly higher obesity prevalence - 6 percentage points - than would be expected from the fact that they were women on the one hand, and ethnically disadvantaged on the other.

*Figure 22: Joint and component disparities for the abdominal obesity prevalence.*

Source: constructed by author, based in Gustafsson PE, based in Jackson JW et al. Disparities at the intersection of marginalized groups.
Figure 23 displays a summary of the Blinder-Oaxaca decomposition of the obesity gap between mestizo men and Indigenous women (Joint disparity). The explanatory variables included in the model explained 51.08% (p<0.001) of the gap. The most important group of factors explaining the higher prevalence of obesity in mestizo men compared to Indigenous women were the behavioural risk factors, which alone stood for 45.95% of the explained portion of the health gap. The dominant contributors were alcohol consumption, current smoking, place of residence and monthly household.

These differences in the contribution could be explained by a low prevalence of some specific behavioural risk factors (smoking: 2.95%; current alcohol consumption: 36.52%) in Indigenous women, compared to mestizo men. Indigenous women also had a higher proportion of low income (39.06%) and residence in the Andean (11.96%) and Southern Cone region (8.08%) where the prevalence of obesity was also lower.

Figure 23: Oaxaca-Blinder decomposition of gap in the prevalence of abdominal obesity between mestizo men vs Indigenous women

The higher prevalence of abdominal obesity in mestizo men compared to mestizo women (gender referent disparity) was explained in 83.65% (p<0.001) by the explanatory variables included in the study. The groups of behavioural risk factors (69.97%) and sociodemographic variables (62.52%) were of similar importance. Similarly, to the joint disparity, here, the most important behavioural factors were alcohol consumption and smoking. Among the sociodemographic variables, age stood for 64% of the explanation followed by a 10% explanation from the place of residence (Figure 24).
The differences in the contribution could be explained by the fact that mestizo men had a greater proportion of older than 60 years (11.64%), as well as a higher prevalence of behavioural risk factors (smoking: 23.79%; current alcohol consumption: 61.64%; less than five servings of fruits and vegetables: 72.43% and low physical activity: 65.74%), compared to mestizo women.

In relation to the *ethnic referent disparity* towards mestizo men, the fraction explained by the explanatory factors included in the model was only 11.72%. The results are nevertheless reported here for the sake of completeness. The higher prevalence of obesity among mestizo men compared to Indigenous men seem to be influenced mainly by better socioeconomic conditions (411.24%) and by higher prevalence of behavioural risk factors (328.95%) (Figure 25).
Indeed, these differences in the contribution could be explained by the fact that mestizo men generally reached higher levels of education (23.58%) and were more likely to have higher monthly household income (22.96%) than their Indigenous counterparts. On the contrary, Indigenous men had higher levels of physical activity and lower percentage of alcohol consumption (figure 23).

**Healthcare access inequalities for CVDs and participation in preventive activities for CVRFs**

Table 10 shows the percentages of use of healthcare for CVDs and participation in preventive activities. Similar use of healthcare for CVDs was observed by sex and ethnicity; however, the elderly (30.04%), those residing in the Tropics region (22.90%), people without formal education (21.8%), retired people (41.83%), and people who had health insurance (24.26%) visited healthcare facilities more often. Overall, low rates of healthcare use among people with 4–5 CVRFs (26.47%) and more than 6 CVRFs (43.81%) were observed, but a high rate among people with a single CVD (93.07%) and CVD comorbidity (98.79%) were reported.

Participation in preventive activities was similar by sex, age, ethnicity, occupation, and health insurance; however, those residing in the Tropics region (78.87%) and those with a high educational level (77.10%) participated more frequently than the other groups. Similarly, those with 6 or more CVRFs...
(83.03%) and those with 2 or more CVDs (92.03%) were more active in preventive activities.

Table 10: Distribution of healthcare visits for CVDs and participation in CVRFs activities according to socioeconomic and health characteristics

<table>
<thead>
<tr>
<th>Predisposing factors</th>
<th>Sample (%)</th>
<th>Visit Healthcare (%)</th>
<th>Participation in preventive activities (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>57.39</td>
<td>17.58</td>
<td>70.28</td>
</tr>
<tr>
<td>Man</td>
<td>42.61</td>
<td>16.77</td>
<td>69.77</td>
</tr>
<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–29</td>
<td>42.99</td>
<td>8.63</td>
<td>69.01</td>
</tr>
<tr>
<td>30–44</td>
<td>25.21</td>
<td>17.34</td>
<td>70.43</td>
</tr>
<tr>
<td>45–59</td>
<td>15.15</td>
<td>27.44</td>
<td>73.06</td>
</tr>
<tr>
<td>≥ 60</td>
<td>16.64</td>
<td>30.04</td>
<td>69.46</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indigenous</td>
<td>64.33</td>
<td>16.69</td>
<td>68.85</td>
</tr>
<tr>
<td>Mestizo</td>
<td>35.67</td>
<td>18.23</td>
<td>72.24</td>
</tr>
<tr>
<td><strong>Socioeconomic variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place of Residence/Region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Valley</td>
<td>9.69</td>
<td>10.7</td>
<td>52.56</td>
</tr>
<tr>
<td>Andean</td>
<td>6.01</td>
<td>16.8</td>
<td>56.3</td>
</tr>
<tr>
<td>Southern cone</td>
<td>37.89</td>
<td>21.52</td>
<td>72.51</td>
</tr>
<tr>
<td>Tropic</td>
<td>15.34</td>
<td>22.9</td>
<td>78.87</td>
</tr>
<tr>
<td>High Valley</td>
<td>31.07</td>
<td>11.33</td>
<td>70.84</td>
</tr>
<tr>
<td><strong>Education level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>12.36</td>
<td>20.94</td>
<td>77.1</td>
</tr>
<tr>
<td>Secondary</td>
<td>8.51</td>
<td>21.08</td>
<td>60.37</td>
</tr>
<tr>
<td>Primary</td>
<td>42.06</td>
<td>17.7</td>
<td>68.44</td>
</tr>
<tr>
<td>No formal education</td>
<td>37.07</td>
<td>14.59</td>
<td>71.77</td>
</tr>
<tr>
<td><strong>Job status/occupation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-employed</td>
<td>41.6</td>
<td>18.86</td>
<td>69.8</td>
</tr>
<tr>
<td>Student</td>
<td>1.92</td>
<td>26.21</td>
<td>68.93</td>
</tr>
<tr>
<td>Employed</td>
<td>11.82</td>
<td>17.47</td>
<td>72.57</td>
</tr>
<tr>
<td>Housewife/homemaker</td>
<td>15.95</td>
<td>5.92</td>
<td>70.47</td>
</tr>
<tr>
<td>Retired</td>
<td>26.25</td>
<td>18.47</td>
<td>69.11</td>
</tr>
<tr>
<td>Unemployed</td>
<td>2.46</td>
<td>41.83</td>
<td>70.72</td>
</tr>
<tr>
<td><strong>Health Insurance</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>84.9</td>
<td>15.99</td>
<td>69.63</td>
</tr>
<tr>
<td>Yes</td>
<td>15.1</td>
<td>24.26</td>
<td>72.46</td>
</tr>
<tr>
<td><strong>Healthcare needs factors</strong></td>
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</tr>
<tr>
<td>Cardiovascular Risk Factors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0−1 CVRF</td>
<td>13.11</td>
<td>8.20</td>
<td>64.36</td>
</tr>
<tr>
<td>2−3 CVRF</td>
<td>53.42</td>
<td>12.35</td>
<td>67.87</td>
</tr>
<tr>
<td>4−5 CVRF</td>
<td>29.40</td>
<td>26.47</td>
<td>74.77</td>
</tr>
<tr>
<td>≥6 CVRF</td>
<td>4.07</td>
<td>43.81</td>
<td>83.03</td>
</tr>
<tr>
<td><strong>Morbidity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>81.72</td>
<td>0</td>
<td>76.93</td>
</tr>
<tr>
<td>Single</td>
<td>14.42</td>
<td>78.33</td>
<td>18.00</td>
</tr>
<tr>
<td>Comorbidity</td>
<td>3.87</td>
<td>21.67</td>
<td>5.07</td>
</tr>
</tbody>
</table>
After adjustment by the predisposing factors, socioeconomic variables and healthcare needs (Figure 26), lower odds of using healthcare were found for those with no formal education (OR = 0.66; 95% CI = 0.51–0.86) or primary level education (OR = 0.71; 95% CI = 0.59–0.86) compared to those with higher education. Also, people from the High Valley (OR = 0.43; 95% CI = 0.37–0.50), Andean (OR = 0.47; 95% CI = 0.37–0.59), and Southern Cone (OR = 0.65; 95% CI = 0.51–0.83) regions had lower odds of healthcare use compared to those residing in the Central Valley. Regarding occupation, those who were retired (OR = 1.60; 95% CI = 1.19–2.14) or homemakers (OR = 1.18; 95% CI = 1.03–1.34) visited healthcare facilities more frequently than the self-employed reference group.

Figure 26: Logistic regression models of the association between healthcare visits for CVDs in the last 12 months and predisposing, socioeconomic and healthcare needs factors.

For participation in preventive activities (Figure 27), after adjustment by predisposing variables and healthcare needs factors, the odds of participating in preventive activities was statistically less significant among those with low educational levels, being the lowest in people with no formal education (OR = 0.54; 95% CI = 0.44–0.67) or primary education (OR = 0.73; 95% CI = 0.63–0.86). Also, those living in the Andean (OR = 0.52; 95% CI = 0.44–0.60) and Southern Cone (OR = 0.54; 95% CI = 0.45–0.64) regions had lower odds of
participation in preventive activities. In addition, those with health insurance (OR = 1.18; 95% CI = 1.03–1.35) participated in more preventive activities for CVRFs than those without it.

Figure 27: Logistic regression models of the association between participation in preventive activities for CVRFs in the last 12 months and predisposing, socioeconomic and healthcare needs factors
Challenges in implementing the CVDs policy in the Bolivian primary health care system.

Based on the interviews with stakeholders working in CVDs prevention at different levels and departments within the Bolivian health care system, we developed five themes that describe the main challenges faced when implementing the CVD policy:

1) Lack of local research to inform the development of CVD policies

Local research was perceived as an important domain to ensure that CVD policies are relevant to the Bolivian context, and consequently the perceived lack of local research was considered as hindering adequate planning, as depicted in the following quote:

“The lack of research on CVD in our country is the main cause of poor health policy planning, because by not understanding how the problem develops in our local context, we can hardly propose the best solution alternatives.” (NR-NCDP)

As the quote conveys, the current lack of locally relevant research hinders the possibility to contextualize of CVDs prevention and control, as well as the rest of pathologies prevalent in Bolivia. According to the participants, the NCD prevention and control policy, which includes CVDs, builds upon international studies that can be quite different from the Bolivian, or even the Latin American context.

2) A surveillance system that is neither functional nor credible

According to the local managers, despite the National Health Information System (NHIS) monthly reports allow monitoring of some NCDs such as hypertension, obesity, and diabetes, the epidemiological surveillance system does not have adequate credibility among the health personnel. The following quotes exemplifies one reason for such low credibility:

“Many times, the patient is captured by a CVDs at the first level; he must confirm his diagnosis with a specialist at the 2nd level or referred for complications at the 3rd level and in all 3 cases he is registered as a new patient; raising the prevalence reported by the NHIS.” (DR-NCD)

Since the system is based on the weekly aggregated data collected by healthcare centres, it includes cases from the same person when attended at different levels
of care, which leads to overreporting of cases, because they are notified as new at each level of care.

Participants also claimed that NHIS was developed for the surveillance of infectious diseases and was never adapted to respond to the new epidemiological context of CVDs:

“We do not have a surveillance system that collects information systematically and permanently on non-communicable diseases (the current system) is focused on vertical programs (infectious diseases)” (HD-PCC)

Since the forms are based on infectious diseases, they fail to consider repeated visits for chronic NCDs.

Finally, participants also distrusted the way the data were analysed. Since the private and the social security healthcare centres do not use the same instruments and informatics systems to collect the information, analysis based on these data may not accurately reflect the epidemiological situation of cardiovascular diseases and not allow better visibility of the real situation of the problem.

3) Limited leadership and ineffective coordination

According to the national managers, one of the main challenges for policy implementation was the lack of political will and commitment to prioritize CVD prevention in the policy agenda.

“(…) each of the health sectors and levels applies the recommendations in different ways based on their resources, there is no leadership either by the Ministry of Health or SEDES (Departmental Secretary of Health; by its acronym in Spanish). (HD-PCC).

As presented in the previous quote, the local managers attributed this lack of political will and commitment to an inadequate leadership capacity due to competing health priorities, resource constraints, and a focus on immediate, visible results rather than long-term preventive measures.

Lack of coordination was another perceived barrier:

“Each health program manager asks us to implement different strategies separately (NCDs, Epidemiology, Social promotion, etc.); there is no coordination, it seems that they do not communicate with each other, and they saturate us with activities (…)”. (HD-PCC).
Both national and local managers concurred that the Bolivian fragmented health system impeded an effective coordination and collaboration; furthermore, a lack of clear roles, responsibilities, and communication channels among different entities hindered the policy development and implementation.

4) Lack of investment in municipal and community-level initiatives to investment and prevent CVD

Participants highlighted the lack and need of a regulatory framework involving municipal and departmental governments in prioritizing operational actions for CVD prevention. According to the departmental managers, few municipalities were allocating funds for CVD-related activities in their budgets, hampering the implementation of national strategies.

“In my municipality, we are given resources in our annual budget for NCD prevention activities, but other municipalities do not prioritize them, and health personnel only depend on what the Ministry of Health gives them.” (HD-PCC).

A commonly mentioned suggestion for solving this problem was the need of decentralizing the policy implementation budget to municipalities to be able to improve access to CVD healthcare locally, and to enhance municipal capacities.

Shortages of healthcare personnel at all care levels, particularly in primary care, hindered the effective implementation of preventive activities in communities, given the overwhelming clinical workload in healthcare centers. Participants expressed a need for more investment in this area:

“Investing in health personnel in the PHCs could decongest the 2nd and 3rd-level hospitals due to NCDs since most patients only go to do their follow-up controls or collect medicines that could be delivered at the first level.” (DR-NCDP).

Departmental and national managers highlighted the importance of municipal governments in hiring personnel to support prevention efforts and strengthen the national CVD policy. For them, strengthening local governments with health personnel, and compliance with their responsibility for supplies, equipment, and infrastructure, was crucial for expanding medical coverage and laboratory diagnostics.

5) Health personnel’s insufficient training for the implementation of CVD policy and its prevention strategies

As one participant complained: “I had to learn the whole process (NCD strategies) alone,” (HD-PCC). This reflects a common complain among
participants that training efforts have been insufficient and consequently participants felt left out and depending on themselves to learn about the NCDs plans and strategies.

Participants highlighted that despite several versions of the national policy for NCDs and CVDs prevention and control in Bolivia over the past 15 years, its dissemination across administrative levels of the health system has been insufficient.

“The training on the programs only reaches the hospital directors, and they are not replicated with the health personnel, especially in remote rural areas. This could be solved with virtual training, as the medical association or the universities did for Covid-19.” (HD-PCC).

According to local managers, capacity building activities were often limited to management-level personnel, leaving operational-level staff unaware of the policy's existence; also, they referred that the official documents were not readily available at the health centers or in departmental and ministry websites. Participants emphasized the importance of universities and scientific societies offering courses and specialization in NCDs, including virtual options, benefiting rural health personnel in accessing ongoing training and improving patient care.


**Discussion**

This study applied the WHO-STEPS approach for the first time in Bolivia and provided an updated and accurate CVD risk factor profile of the population in Cochabamba. To the best of my knowledge, this is also the first study estimating and explaining obesity inequalities in the intersection between gender and ethnicity in Bolivia and Latin America; and analysing the vertical and horizontal inequities related with the healthcare use and participation in preventive activities to CVDs and CVRF respectively. Moreover, this study also provided insights of some crucial challenges faced by the implementation of the CVDs policy in Bolivia.

As the Bolivian society transitions through epidemiological stages, there is a shift from infectious diseases to non-communicable diseases like CVD. This shift is driven by changes in lifestyle, diet, and demographics. Public health efforts, healthcare infrastructure, and individual behaviour play a critical role in managing the burden of CVD and its risk factors in different stages of the epidemiological transition.

Overall, our findings suggest that the prevalence of CVRFs in Cochabamba is high and had a significant variation among sociodemographic groups. Indigenous people and those living in the Andean region showed in general a lower prevalence for most of the risk factors considered. The study also found significant joint, gender and ethnic inequalities in obesity and suggested that the dually socially advantaged (mestizo men) were in fact disadvantaged with respect to obesity prevalence. However, the doubly disadvantaged group of Indigenous women had higher obesity than we might expect when considering gender and ethnicity alone. The behavioural risk factors were the most important in explaining the observed inequalities, while differences in socioeconomic and demographic factors played less important roles.

Our study further revealed horizontal inequities in healthcare utilization and participation in preventive activities related to socioeconomic factors; but it also highlighted that the individuals with a higher number of CVRFs and those living with multiple CVDs utilized more healthcare services and participated more in preventive activities, indicating a vertical equity. In addition, our findings underscored five main challenges in the implementation of the CVDs policy in the Bolivian primary healthcare system: a) The lack of local research to inform the development of CVD policies; b) A surveillance system that is neither functional nor credible; c) Limited leadership and ineffective governance in the CVD prevention policy development; d) Lack of investment in municipal and community-level initiatives to prevent CVD; and e) Health personnel’s
insufficient training for the implementation of CVD policy and its prevention strategies.

**Prevalence of CVRFs in Cochabamba.**

Overall, the high prevalence of CVRFs found in Cochabamba follows a similar pattern to several LMICs in Latin America and worldwide. While smoking and hypertension were lower than in other Latin American countries, alcohol consumption, low levels of physical activity, and abdominal obesity were higher (19, 45, 59).

The prevalence of tobacco use in our study was low (16.01%) in comparison to estimations from the Bolivian MoH in 2019 (17.7%) (59), but it was higher than the prevalence estimates for the Andean region (5.2%) (46). According to PAHO, in 2019, the prevalence of smoking in Latin America was 15.6%, which is also lower than our estimation (46).

Our findings related to the prevalence and patterns of alcohol use in Cochabamba (42.76%) were higher compared with the reported by MoH in 2019 (32.2%) (59). Even though the prevalence of harmful alcohol consumption in our study was high, the PAHO reported in 2019 that the average amount of alcohol consumed in Bolivia (10.9 litres per person/year) is one of the lowest in the region (13.8 litres for the Andean Region) (46).

The prevalence of low levels of fruits and vegetable intake was very high (76.73%), more in men (54.72%) than in women (33.89%) but lower than reported in Argentina, where a higher percentage of men (73%) compared to women (55%) did not consume vegetables and fruits according to the PAHO recommendations (55, 56). Other surveys in Bolivia have reported that half of the population between 18 and 69 years consume between 1 and 2 servings of vegetables and only 17.4% of the population consumes vegetables and fruits according to the PAHO recommendations (59).

Nearly two-thirds of the population in our study had a low level of physical activity. According to PAHO, physical inactivity prevalence in 2019 was estimated at 39.3% for the Americas and 25.7% for the Andean Region (46). Similar results to ours have been found in Colombia (44.0%) but lower prevalence has been found in Ecuador (27.2%). However, the results reported by Bolivian MoH in 2019 suggested that only 17.7% of the participants have insufficient physical activity among people between 18 and 69 years (59).
The prevalence of high blood pressure (17.15%) found in our study was low compared to the study conducted by the Bolivian MoH in 2019, 38.5% among people between 18 and 69 years (59). Our prevalence seems to be more similar to the PAHO estimates from 2019 where 17.6% were reported as having high blood pressure in the Americas, and 17.6% in the Andean region (46).

A high prevalence of being overweight and obese measured by BMI was observed in this study (56.33%); though was lower than the reported by the Bolivian MoH in 2019 with 63.3% among people between 18 and 69 years (59). According to PAHO in 2019, 64.1% of men and 60.9% of women were overweight or obese in the Americas; with a similar prevalence reported for the Andean region (men = 56.8% and women = 61.2%) (46). Shifts in eating behaviour towards diets containing energy-dense foods, high in fat and sugars, and less physical activity due to the sedentary nature of many forms of work and modes of transportation are contributing to the rise in obesity according PAHO (46).

Abdominal obesity was present in 54.13% of the participants in our study, which is a worrisome percentage as this indicator has been found to be a more accurate predictor of cardio-metabolic risk than the general obesity measured by BMI (104, 105).

Despite the high prevalence of CVRFs in Bolivia, the issue of healthy eating and control of behavioural risk factors was not properly addressed until 2016 when a new law was launched with the purpose of promoting healthy eating habits and encouraging physical activity (105, 106). This new law regulates advertising of food and non-alcoholic beverages as well as the labelling of food, tobacco and alcoholic beverages (106). It also states that all centres of food retailing must offer healthy food with healthy preparations, non-bottled natural water at no cost, limit the availability of salt and the reuse of oils in fried foods, as well as to include messages on the menu that promote a healthy diet. Nevertheless, the implementation of this law has not included an adequate monitoring mechanism for compliance; thus, it is possible that real changes and effects will take a longer time than would be desirable (107).

**Where are the CVRFs concentrated?**

Our findings revealed significant variations in the prevalence of CVRFs among the different socio-demographic groups. In general, Indigenous people and those living in the Andean region had lower levels for most of the CVRFs evaluated.

Smoking was higher among men (21.25%) than women (3.25%). It was also higher among mestizos, those aged 30–59, living in the tropics, single, highly
educated and currently working. The gender differences in smoking prevalence concur with reports from different countries in the Andean Region, except for Uruguay (men: 22.5%, women: 18.9%) or Chile (men: 49.2%, women: 40.7%) where prevalence differences for sex were relatively smaller (46). This pattern could be due to the social unacceptability of women’s use of tobacco in LMICs (108, 109). The age group most affected by smoking was that of 30–59 years, which is an economically active population. The prevalence of smoking was also higher among single, highly educated and employed people, which has also been commonly found in studies from Latin America and Central Asia (110). Indigenous people had a lower prevalence of smoking than the mestizos, which could be due to cultural aspects but also to accessibility since most of them live in remote rural areas (111). No comparable information exists about smoking in relation to ethnicity in South America. For our context, another explanation for the low prevalence could be the common habit of chewing coca leaves among Indigenous Andean communities (112). Traditionally, the coca leaves are considered to have medicinal qualities and to provide energy (113). That is why they are used as a stimulant, especially among Indigenous manual workers, including farmers and those in other manual occupations (114).

Current alcohol consumption (especially harmful use) in this and other studies from Bolivia (59, 115) was higher among men compared to women and among older age groups compared with young people. It was also higher among the highly educated, married or cohabiting and currently employed. In some previous studies from Bolivia, alcohol consumption has also been shown to increase by age and to have a high correlation with domestic violence and gender-based violence, and poor school performance (116-118). The lowest prevalence of alcohol consumption was found among Indigenous people and those who live in the Andean region, which could be the result of community prohibitions on the sale of alcohol and the intolerance of drunken behaviour outdoors as part of moral regulations introduced by evangelical movements in those populations since the '90s (119).

The prevalence of low levels of fruits and vegetable intake was high in all sociodemographic groups except among those with higher education. Low consumption of fruit and vegetables was particularly high among the Indigenous population (79.01%). This could be explained by the fact that this group consumes mainly what they cultivate. Traditionally, in the Bolivian highlands, the Indigenous people plant potatoes, quinoa and kañiwa (Andean legumes), some barley, corn and wheat (120). Consequently, fruits and vegetables should be purchased from the lowlands or the tropics of Cochabamba. Their limited access to the lowlands might decrease their frequency of consumption of fruits and vegetables as recommended by WHO (39, 121).
The prevalence of low physical activity was high among women (53.97%), old age groups (71.19%), people with a higher education (70.37%), those retired (87.83%) and unemployed (86.89%), which concurs with differences previously reported in the Andean Region (46). These results are also similar those reported in 2019 by the Bolivian MoH, where 51.4% of women were classified as sedentary (59).

In addition, our study also observed that elevated blood pressure was higher in the elderly (30.50%), people from Southern cone area (26.99%), those widowed or separated (28.98%) and retired people (38.84%). Similar to our findings, PAHO estimations in 2019 revealed that elevated blood pressure was higher in men (19.7%) than in women (16.1%) (46).

Our findings show that the proportion of people who were overweight and obese was higher than the estimations by PAHO in 2019 for Bolivia (men: 52.2%, women: 59.8%), and similar to the Andean region (men: 56.8%, women: 61.2%) (46). Other studies in Bolivia have also reported a prevalence of abdominal obesity above 50% (122-124) and have recommended that a routine measurement of this indicator should be introduced during medical care in primary care centres and that preventive measures such as increasing physical activity or even encouraging the use of specific medications or therapies to reduce abdominal fat should be suggested (59, 89, 90).

In our study, abdominal obesity was higher among women (64.12%) than men. It was also higher among people aged 30–44 and 45–59 years. The prevalence was higher among those with no formal schooling (60.14%); widowed or separated (65.74%); and housewives or homemakers (68%). On the other hand, people from the Andean region presented a low prevalence (41.80%) compared to other regions; similarly, singles and student groups presented a low prevalence compared to the other sub-groups. Unfortunately, there are no reports from PAHO or the MoH using this indicator (46, 59). However, it is important to consider its distribution for an adequate prioritization of the most affected population groups because of the direct association of abdominal obesity with metabolic or cardio metabolic syndrome, which was also more prevalent in women, according to some studies in the capital city of the department.

The high prevalence of most of the risk factors found in our study indicates that prevention and management strategies are in dire need (57, 59, 90). Moreover, the low consumption of fruit and vegetables, together with low levels of physical activity and a high burden of obesity in our population are causes of concern as they may lead to increased risk for CVDs in the future.
Social inequalities in health

Measuring and analysing health inequalities is essential for effective health management. By addressing them, health managers can work towards achieving equitable health outcomes and can ensure that healthcare services are accessible to all. This thesis analysed health inequalities from two different perspectives; on the one hand, the intersectional disparities in abdominal obesity, considering the joint disparity and its decomposition based on comparing absolute differences between dually as well as single advantaged and disadvantaged groups; on the other hand, the vertical and horizontal equity in the healthcare use of CVD’s services and CRFs prevention activities.

Gaps in the abdominal obesity prevalence in the intersectional space between gender and ethnicity

As previously mentioned, abdominal obesity prevalence was higher in women compared to men and lower in Indigenous people compared to mestizos. However, when both gender and ethnicity were combined to categorize the population into axes of social advantage or disadvantage, the distribution showed unexpected patterns. We observed that Indigenous women had lower obesity prevalence than mestizo men; however, Indigenous women also had a higher prevalence of obesity among women, and on the contrary, mestizo men had a higher prevalence of obesity compared to their Indigenous peers.

The ethnic-reference disparity presented a greater gap (9.18 percentage points) than the gender-reference disparity (4.30 percentage points). This finding suggests that ethnicity could be more important than gender in explaining the overall gap in the prevalence of abdominal obesity, as Kanter et al. have previously described (125). The patterns found in our study were also in line with the findings by Woolcott et al. (126), who observed a lower prevalence of obesity in the Andean Indigenous population compared to the mestizo. Such differences have been attributed to greater energy consumption, associated with the Indigenous working in agriculture, the walks of long distances on a sloped terrain, and the consumption of foods prepared by themselves, with a lower use of saturated and polyunsaturated fats (121, 125).

In our study, Indigenous women, who are socially disadvantaged due to low levels of education and income as well as low-level occupations (127), were less affected by obesity than the mestizo men. These findings confirm the already reported inequalities in obesity to the disadvantage of mestizos in Bolivia (59, 128) and expands previous research in the Latin American region focusing on a single axis of inequalities such ethnicity (126, 129) and gender (130). In previous studies
from LMICs, obesity has been associated with a better socioeconomic level (131). In our study, the mestizo men were socially advantaged as they had higher levels of income, education, and occupation than Indigenous women. This pattern of obesity being concentrated among the better-off is possibly explained by more access to pre-processed foods and high caloric diets, which are aggravated by a sedentary life due to work activities with lower energetic wear (132, 133).

What explains the joint and referent disparities?

The traditional risk factors included in the WHO-STEPs questionnaire used in this research significantly explained a considerable portion of the joint disparity (51.08%) and the gender disparity (83.65%). However, these factors explained only a very small fraction of the ethnic disparity.

Behavioural risk factors were consistently important in explaining the obesity gaps between the groups. Overall, these factors were more prevalent among men, especially in mestizo men, except for low physical activity, which was more prevalent in women, especially mestizo women. This pattern suggests that prevention strategies aimed at containing the increase in abdominal obesity in men should focus on alcohol consumption and diet; on the contrary, strategies for women should focus on increasing their physical activity (4, 134). Gender norms place the main responsibility on reproductive work on women, that many times has also to be combined with productive informal and low paid activities. Consequently, women have reduced opportunities and time for engaging in physical activities compared to men. Any promotional programs have to take these aspects into consideration. (125) (134, 135).

Socioeconomic and demographic factors were of less importance in explaining the inequalities, except for level of education and age which contributed to the differences of both the ethnic and gender disparities. Indigenous men are mainly involved in non-skilled manual occupations (like agricultural work) which involve vigorous physical activity, while in contrast, their mestizo peers have a greater chance of achieving higher educational levels (136) and therefore are mainly involved in non-manual occupations which are related to sedentary lifestyles (59, 128). With regard to age, elderly Indigenous men continue to perform vigorous physical activity (126) due to their participation in work (commonly agricultural work) until very advanced ages as self-employed men. This situation increases their energy consumption and therefore reduces the prevalence of abdominal obesity in this population subgroup (127).

All these findings illustrate the contextually dependent, interacting and multifaceted structural roots of social processes that may shape complex
population patterns in health and how social disadvantage and oppression may be expressed in paradoxical ways when it comes to health, as well as the unique value of intersectional perspectives to uncover such phenomena (137, 138).

**Socioeconomic inequalities in the use of healthcare for CVDs and preventive activities**

Our findings showed a pattern of horizontal inequity in healthcare utilization and participation in preventive activities, influenced by factors such as education, region, occupation, and health insurance. However, vertical equity was observed in both outcomes.

People with higher income and education reported greater utilization of healthcare services, which aligns with similar findings in other Latin American and LMICs (139-142). Low income and education tend to be associated with low health literacy and limited health insurance coverage, leading to disparities in healthcare-seeking behaviours (140, 141). Inadequate health literacy often poses a barrier for individuals with CVDs to understand and implement preventive measures, such as dietary instructions (143).

Geographical location played also a significant role in healthcare utilization and preventive activities, with all regions exhibiting lower utilization compared to the Central Valley and Tropics regions which are predominantly urban. Rural regions face frequently challenges such as geographical inaccessibility, limited healthcare infrastructure, and lower coverage of health insurance, contributing to the reduced utilization of healthcare services and preventive activities (144, 145). These regions also had a higher proportion of socially disadvantaged populations, characterized by lower education and income levels (143).

Gender differences were observed in healthcare utilization, with women utilizing more curative services compared to men. This difference can be attributed to the frequent utilization of maternal services such as antenatal care, which involves monitoring of some CVRF such as weight, diabetes, and blood pressure (146, 147). In general, women have been reported to actively seek healthcare more often than men, a trend that could be related to masculinity norms (146, 147), as well as higher levels of CVD comorbidities and CVRFs among women, as reported in some LMICs (140-142, 148, 149).

Housewives/homemakers -predominantly women-, were the group with greater healthcare utilization, which could be attributed, as previously mentioned, to increased healthcare needs during pregnancy and postpartum. The retired
individuals also displayed a high utilization of healthcare services, likely as a result of higher prevalence of CVDs among older age groups (148).

Unexpectedly, our study found no significant association between health insurance coverage and healthcare utilization (150). This discrepancy could be explained by certain services related to CVDs not being covered by the insurance, leading to high out-of-pocket expenses, particularly for laboratory diagnosis services (151). Additionally, long waiting times for appointments in public healthcare centres due to a shortage of healthcare providers and cultural/language barriers than affecting indigenous groups, may limit healthcare utilization irrespective of insurance coverage. Further research is needed to better understand the underlying reasons for this finding. On the other hand, our results pointed out that individuals with health insurance had a higher likelihood of participating in preventive activities, suggesting that health insurance at least may contribute to increased health literacy and awareness of prevention strategies (150).

Furthermore, our research showed that individuals with a higher number of CVRFs and those living with multiple CVDs utilized more healthcare services, indicating good accessibility. Our findings revealed a statistically significant gradient between the number of CVDs or CVRFs and healthcare use or participation in preventive activities, with the highest probability among those with 6 or more risk factors compared to those with 2 or more and people who did not self-report any. Similar patterns of vertical equity have been observed in other Latin American settings (140).

Healthcare utilization also showed a gradual increase as people age, while participation in preventive activities was consistently high across all age groups. The higher prevalence of CVDs among the elderly, along with specific health insurance for this age group, likely contributed to their increased healthcare utilization. The active participation of younger individuals in prevention activities can be attributed to successful social media campaigns and community activities implemented as part of the Family, Community, and Intercultural Health Policy (87). The use of radio, television, and social networks for health advertisements, coupled with the expansion of internet coverage in rural areas, has likely also contributed to improved coverage of CVDs and CVRFs prevention campaigns (152). Sustaining these strategies is crucial for future reductions in CVD incidence.
Considerations for the formulation of prevention and control programs for CVDs and CVRFs in Bolivia

To effectively address the CVDs burden, particularly in LMICs such as Bolivia, it is essential to implement and monitor evidence-based policies and strategies. This research has shed light on some key challenges in the current implementation of NCDs policies in Bolivia, with particular focus on CVDs and primary health care. These challenges encompass the importance of i) local research, ii) a functional surveillance system, iii) effective leadership and coordination, iv) investments in municipal and community-level initiatives, and v) the need for health personnel capacity building.

According to our key informants, local research should play a pivotal role in informing the development of CVD policies in Bolivia. Accurate data is required to better understand the scope of the problem locally and to design appropriate health policies (153). Such information can provide valuable insights into the unique burden, risk factors, and contextual nuances specific to local populations (154). By conducting research at the local level, policymakers gain a comprehensive understanding of the disease prevalence, contributing factors, and potential interventions (155). Monitor and evaluation research are also necessary to measure the effectiveness of policies and programs and to make adjustments as needed (4, 156). This knowledge is essential for tailoring policies and strategies that are culturally sensitive, contextually appropriate, and evidence based (128, 138). Unfortunately, there is no experience of evaluating health programs in Bolivia by the MoH, which is why this type of research can help decision makers improve current policies.

This study also highlights that a functional and credible surveillance system is crucial for effective implementation of CVDs prevention policies. According to the American Heart Association, reliable data collection, analysis, and reporting are needed to enable policymakers to monitor disease trends, identify high-risk populations, and evaluate the impact of interventions (157). In Bolivia, as well as in other LMICs, strengthening the surveillance system would require investments in infrastructure, capacity-building, and standardized data collection methods (57, 76, 157). Since the launch of the first non-communicable disease prevention plan in Bolivia, no investment has been made to improve the situation of the implementation of the plan, and recurring problems continue to emphasize the lack of health personnel, their training or updating in the management of CVDs, and the lack of standardized instruments that allow effective surveillance of their risk factors (39).
Leadership and effective governance were deemed crucial in the formulation and implementation of CVD prevention policies, while the presence of a coordination system was considered essential to ensure that all relevant sectors are working together towards a common goal. Additionally, like in other studies, it was highlighted that political will is important to ensure that policies are implemented and enforced (153, 157). Strong political commitment and engagement are also necessary to prioritize CVDs prevention on national agendas (153, 158). Effective governance structures ensure the coordination of efforts across sectors, promote collaboration, and facilitate the allocation of resources (159, 160). Transparent decision-making processes, stakeholder engagement, and accountability mechanisms enhance the credibility and effectiveness of CVD policies (161, 162).

At the same time, health policy implementation required investments in municipal and community-level initiatives that addressed the social determinants of health. As well as in other studies, it is reflected that enough resources are needed to fund the policies and programs necessary to prevent and control NCDs and CVDs (163, 164). These initiatives must be focused on creating supportive environments that promote healthy lifestyles in collaboration with community organizations, thereby enhancing the relevance, acceptance, and sustainability of these efforts (39, 57, 59, 90).

Health providers play a critical role in implementing CVDs policies and prevention strategies, but they need to be adequately trained. Thus, comprehensive training programs are essential to equip healthcare professionals with the necessary knowledge and skills (165). Training should encompass both clinical and community settings, addressing risk factor identification, evidence-based interventions, and interdisciplinary collaboration (166, 167). Moreover, training programs should emphasize cultural competence, health literacy, and the ability to address health disparities to ensure equitable implementation of CVD prevention strategies. Furthermore, the possibility of online training within academic institutions should be encouraged.
Methodological considerations

There are several strengths in this study that needs to be highlighted. The quantitative component, conducted in Cochabamba, based on a representative population sample, and utilizing the STEPS approach, provides valuable insights into the development and implementation of cardiovascular disease (CVD) policies in Bolivia.

However, it is important to consider certain limitations when interpreting the results. Among the limitation are the cross-sectional nature of the data, which does not allow for causal inferences. The study captures a snapshot of the population at a specific point in time, and therefore, it is challenging to establish causal relationships between variables.

Measurement errors are another potential limitation. Although the anthropometric and blood pressure measurement instruments were periodically calibrated, and the health personnel were adequately trained, there is still a possibility of measurement errors. These errors could lead to the under or overestimation of certain prevalence rates, impacting the accuracy of the findings. The reliance on self-reported information is also a limitation. Participants provided information on risk factors, including alcohol and tobacco use, which may have been concealed due to social desirability bias. This bias could result in the underestimation of the prevalence of these risk factors. Additionally, variations in participants' understanding of certain words or concepts could introduce bias and affect the consistency of responses.

In the second sub-study, the exclusion of individuals who did not answer questions about their income reduced the analytical sample size. While this could bias the estimated overall prevalence of abdominal obesity, it is less likely to severely impact the main analyses focusing on group differences and decompositions. Self-reported attributes such as gender and ethnicity may also introduce bias, as some individuals may be hesitant to report themselves as indigenous due to social stigma.

The use of self-reported information on CVD morbidity in the third sub-study is another limitation. Self-reporting introduces the risk of response and recall bias, potentially leading to overestimation of outcomes and underestimation of horizontal inequity. The self-perceived need may not always align with the actual medical need, especially considering that CVDs are often asymptomatic in the early stages.
Regarding the qualitative study, certain methodological aspects should also be taken into account. While the interviews with key informants provide rich and detailed information, budget limitations impacted the scope of the study, as it was not possible to cover all nine departments of Bolivia. Unfortunately, I did not interview professionals located in the most remote places that may face other types or additional challenges that may not be captured in this analysis, and maybe wanting to keep face and not be extremely critical in front of an interviewer that they may have perceived as connected with the MoH.

As the researcher shares experiences with study participants, whether through direct participation in the field, or self-disclosure, a very important process must approach reflexivity carefully, considering that the primary researcher is aware of his or her own experiences, beliefs, values, and prejudices before starting the research; Therefore, we sought to be as transparent as possible about my role and my connection with the participants; to establish empathy and trust with participants. Before data collection, I was trained in reflexivity and research ethics, receiving regular supervision from a supervisor in Bolivia and Sweden, to evaluate and address any potential bias. During data analysis, as the principal investigator, reflect on how my presence may have influenced the participants’ responses and how your own experiences may have affected the interpretation of the results, ensuring confidentiality and respect for the participants’ privacy. so that the team of supervisors then reviews the reflective approach and interpretation of the data to minimize bias and improve the quality of the research.

Despite these limitations, the study provides a comprehensive understanding of the complexities surrounding CVD policy development and implementation in Bolivia. It captures the perspectives and experiences of key stakeholders, including healthcare providers, policymakers, and senior managers. The findings offer valuable insights into the social, cultural, and political contexts in which health policies are formulated and implemented.

By understanding the strengths and limitations of these studies, researchers and policymakers can effectively utilize the study findings to inform decision-making and improve CVD policy implementation in Bolivia.
Conclusions

This study constitutes the first application of the WHO-STEP approach in Bolivia and provided a current CVD risk factor profile of Cochabamba’s population, using a standardized methodology. It is also the first study exploring challenges associated with implementing previous NCDs policies in Bolivia.

Our findings shed light on the different patterns of CVRFs among specific sociodemographic subgroups; pointed out intersectional inequalities in obesity, as well as a horizontal inequity in the utilization of healthcare for CVDs and participation in preventive activities for CVRFs. The results also emphasized the importance of local research, a functional surveillance system, a strong leadership and effective governance, the investments in municipal and community-level initiatives, and the need for health personnel training to implement a successful CVDs policy.

Overall, the findings revealed that:

- Cochabamba has a high prevalence of CVRFs, with a significant variation among the different socio-demographic groups.
- Indigenous populations and those living in the Andean region showed in general a lower prevalence for most of the risk factors evaluated.
- Abdominal obesity, as well as most of its related behavioural risk factors, were associated with high social advantage.
- Dually and singly socially disadvantaged groups (Indigenous women, Indigenous men, and mestizo women) were less obese than the dually advantaged group (mestizo men), meaning that in this study population, the socially advantaged were in fact disadvantaged with respect to health.
- The lower prevalence of obesity in the doubly disadvantaged group of Indigenous women was mainly due to ethnic differences alone. However, they had higher obesity than we might expect from considering both genders alone and ethnicity alone.
- Differences in behavioural risk factors were the most important to explain the observed inequalities, while differences in socioeconomic and demographic factors played a less important role.
- A horizontal inequity in healthcare utilization and participation in preventive activities related to socioeconomic factors was observed.
- The individuals with a higher number of CVRFs and those living with multiple CVDs utilized more healthcare services and participated in preventive activities, indicating a vertical equity.
• Addressing barriers such as low health literacy, limited health insurance coverage, geographical inaccessibility, and cultural/language barriers is crucial for achieving equitable access to healthcare services and improving prevention efforts for CVDs and CVRFs.

• Implementing CVD policies in Bolivia, requires a comprehensive approach that considers various factors: Community-based research should serve as the cornerstone for shaping policy, and a well-structured surveillance system is needed to facilitate the ongoing assessment of interventions. Enhancing competent leadership and governance play a pivotal role in establishing policy priorities, promoting coordination, and ensuring accountability. Allocating resources to initiatives at both the municipal and community levels fosters environments conducive to support healthy behaviours. Moreover, comprehensive training of healthcare personnel bolsters the successful execution of preventive strategies.

• The results from this study highlight the need for specific interventions to improve early diagnosis, monitoring, management, and especially prevention of CVRFs.
Implications for practice

This research has highlighted the challenges faced in implementing local health programs to reduce CVD risk factors in Bolivia. The lack of current and reliable information on the prevalence and associated risk factors of CVDs has hindered effective policymaking and intervention planning. This thesis provides crucial evidence for regional policymakers and serves as baseline data for future department-wide action plans. However, ongoing monitoring is essential to update information and support tailored health strategies.

The high prevalence of cardiovascular risk factors (CVRFs) observed in the study emphasizes the need for a comprehensive multisectoral prevention strategy that focuses on early diagnosis, monitoring, prevention, management, and control of these risk factors. The absence of national programs and inadequate financial resources have been major obstacles to CVD management and prevention in Bolivia. Policymakers should prioritize resource allocation and seek sustainable financing mechanisms for CVD programs. One potential strategy is utilizing tobacco and alcohol taxes to implement a NCD prevention plan, as seen in other countries.

Efforts should also be directed toward developing new strategies and reinforcing existing ones to monitor and reduce the prevalence of obesity. Strengthening the implementation of the food labelling law, regulating fast food establishments, promoting fruit and vegetable consumption in schools and workplaces, and encouraging physical activity through improved cycling infrastructure are some examples of potential interventions.

In addressing health inequalities, it is important to focus not only on socially vulnerable populations but also on the double-advantaged group, which requires a particular attention from the health system. This thesis provides valuable insights into gender and ethnic intersections related to abdominal obesity in Cochabamba. These findings can inform targeted interventions that address the specific needs of different subgroups, such as increasing physical activity among mestizo men and Indigenous women and reducing tobacco and alcohol consumption among both mestizo and Indigenous men.

Another relevant finding was the presence of horizontal inequities in healthcare utilization and preventive activities related to socioeconomic factors. Measuring health inequities is essential for effective health system management since it provides critical insights into disparities, guides resource allocation, evaluates policy effectiveness, targets interventions, promotes accountability, supports advocacy efforts, and strengthens the overall health system. Reducing barriers
such as low health literacy, limited health insurance coverage, geographical inaccessibility, and cultural/language barriers is also crucial for achieving equitable access to healthcare services and improving prevention efforts for CVDs and CVRFs.

The thesis has further provided a comprehensive understanding of the complexities surrounding CVD policy development and implementation in Bolivia, and captured the perspectives and experiences of key stakeholders, including healthcare providers, policymakers, and senior managers. Specifically, it has emphasized the importance of local research, a functional surveillance system, leadership and effective governance, investments in municipal and community-level initiatives, and the need for health personnel training. This analysis underscores the critical role of these factors in combatting CVDs and prevent CVDs and CVRFs.

Finally, the thesis supports the recommendations of the Pan American Health Organization (PAHO) to strengthen primary care systems in Bolivia, including financing, structure, and processes for preventing CVRFs through primary health care. The introduction of the universal health coverage (UHC) national law is a positive step toward improving access to healthcare. However, further plans and strategies are needed to ensure adequate treatment and monitoring for individuals diagnosed with CVD, considering the expected increase in prevalence with expanded health coverage.

Future research should focus on intersectionality and inequity studies that consider other risk factors not covered by the WHO STEPS questionnaire, such as stress, poverty, and diet. Understanding the complex interaction between all CVRF and CVD can highlight healthcare prioritized groups. Exploring ethnic and gender gaps in other CVRFs beyond obesity would also contribute to a better understanding of health inequalities in the Bolivian context; and to addressing health inequities, health managers can work towards achieving equitable health outcomes and ensuring that healthcare services are accessible to all, regardless of socioeconomic or demographic factors.

By addressing all the highlighted factors and adopting a scientific perspective, the policy makers from the Bolivian MoH could make a substantial progress in combating NCDs, especially CVDs. Departmental policymakers, researchers, healthcare professionals, and communities should collaborate to develop and implement evidence-based strategies tailored to their specific context. Through a concerted effort, all municipalities could effectively address the burden of CVDs and improve the well-being of their population.
Dissemination and impact

In 2017, the preliminary results of this research were widely disseminated locally and nationally. We translated the results into press releases that were published in the centerspread sheet of the national newspaper “Los Tiempos” and in an inner page of the local newspaper “Tiempo Universitario” (image 44). I was also invited to two TV interviews (image 20) broadcasted on channel 11 (Televisión Universitaria) in the "Franja Universitaria" program and on the news of several other television channels.

Image 19: dissemination of results in local and national newspapers.

Source: Cochabamba print media.

Image 20: dissemination of results in TV interviews.

Also, during 2017 and 2018, I was also invited to participate in three national technical meetings with the personnel of the Ministry of Health and the national NCD program (image 21). During these meetings, I presented the results of our research and described the experience of implementing the survey. We also were asked to give advice on how the Ministry of Health could implement the STEPS national survey.
Between 2016 and 2019, I participated in several meetings at the local level with the staff of the Departmental Health Secretariat and published a technical report using the results of this research. The purpose of the report was to develop a cardiovascular risk factor profile of Cochabamba to be used for decision making (image 22). The results were further used as evidence to support the inclusion of a specific objective (number 47) within the departmental health plan 2016–2020 (image 23) related to the promotion of healthy habits and lifestyles, especially in secondary schools, and the development of municipal and departmental plans for healthy eating in all populations. Both documents were distributed electronically to the staff of health care institutions, including the three levels of care: PHC, regional hospitals or second level of care, and third level in the capital city.
After four years of lobbying and influenced by our work in Cochabamba, in 2019 the Bolivian Ministry of Health decided to conduct the first nationwide survey on CVRFs using the WHO STEPS survey. The implementation procedures of the STEPS approach were adapted from our experience; specifically, they took into account the lessons learned in this project regarding the organization of the research teams, the sampling procedure, and the process to implement the survey in rural areas. Due to the economic cost involved, the Ministry decided to start by applying only STEPS 1 and 2 in a smaller sample than ours (image 24).

At the national level, we also achieved in 2018 the inclusion of indicators related to obesity, diabetes mellitus and arterial hypertension in the monthly report forms that feed the National Health Information System. Additionally, the results from this and other local research, together with PAHO recommendations, served
to justify the need for developing and implementing a healthy eating public health law.

In 2019, I participate in the development of the bill of law, N° 775, to regulate and monitor advertising and labelling of foods high in saturated fats, sodium and other elements that are harmful to health, as well as to regulate the sale and consumption of fast food.

During the years 2020 and 2021, I was chosen to be the director of the Departmental Health Service, where I led the development of the prevention and control policies for Covid-19. However, I was also able to apply everything I learned during my PhD promoting at the national level the prioritization of prevention and control of NCDs, emphasizing CVDs, so that the Bolivian Ministry of Health applies the agreements with PAHO, foreseen for the implementation of the HEARTS strategy. In 2021, in a national meeting with the directors of the 9 departmental health services, the approval of the implementation of HEARTS in Bolivia was achieved, focusing on 70 health establishments in the departments of La Paz, Cochabamba, Santa Cruz, Oruro, and Tarija.

In April 2023, HEARTS started its implementation in Cochabamba in 38 health centres in the municipalities of Sacaba (Central Valley), Cliza (High Valley), and Mizque (Southern Cone) and some researchers that were part of the technical research team in Bolivia that supported the collection of information for sub-studies 1, 2 and 3, currently are participating in the implementation of the strategy in the capital city.

From 2020 until now, I am leading the public health and epidemiology research unit of the Biomedical and Social Research Institute (IIBISMED) at the faculty of medicine, Universidad Mayor de San Simón. From this position, I continue working to generate and disseminate scientific knowledge applied to the resolution of priority public health problems at the local and national level, in technical meetings, local, national and international medical conferences; and simultaneously contributing to the training of qualified scientists at the master and doctoral level.
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References


79. Kezia M. Gastos de salud según el tipo de seguro y la edad previa a la implementación de la cobertura universal de salud en Bolivia Health Expenditure based on Insurance type and age prior to Implementation of universal health coverage in Bolivia. 2021.
83. OMS. Asamblea Mundial de la Salud; Estrategia mundial sobre régimen alimentario, actividad física y salud: informe de la Secretaría. Organización Mundial de la Salud (OMS); 2004.
100. NIS B. National Institute of Statistics. COCHABAMBA: characteristics of population and housing. La Paz 2012.
105. da Costa Teixeira F, Pereira FEF, Pereira AF, Ribeiro BGJN. Overweight or obesity and abdominal obesity and their association with cardiometabolic risk factors in Brazilian schoolchildren: A cross-sectional study. 2020;78:110780.
112. Grisaffi TJBoLAR. We are originarios...‘We just aren't from here’: Coca leaf and identity politics in the Chapare, Bolivia. 2010;29(4):425-39.
124. Calvo Aponte SL, Cuéllar JDJU, Ciencia y Sociedad. Síndrome metabólico en pacientes entre 35 y 65 años de edad con factores de riesgo (instituto Bioclínico central (ibc)-Santa Cruz de la Sierra. 2013:22.
129. Saich F. Dynamics of nutrition and vulnerability: ethnographic insights from Cusco, Peru: Macquarie University; 2022.


