Facultad de Medicina
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HEALTHY MIGRANT EFFECT ON CARDIOVASCULAR DISEASE AND RISKS FACTORS: ANALYSIS FROM THE SOCIAL DETERMINANTS OF HEALTH APPROACH

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I dedicate my dissertation to those that supported and encouraged me
With great gratitude to my loving parents Alfonso and Janeth, and sisters Karen and Indira
My Chilean family Victor, Carolina, and my love Joaquin who were always by my side
The furry family members Don Vito and Patacón
And all my friends who were always there for me
I could not have undertaken this growing journey without your suppport

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CONTENTS

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List of abbreviations

AL	Activity limitations
ALH	Alcohol consumption
AMI	Acute myocardial infarction
AUGE-GES	Explicit health guarantees plan
CASEN	Encuesta de caracterización socioeconómica
CI	Confidence interval
COVID-19	Coronavirus disease 2019
CM	Chronic morbidity
CVA	Cerebrovascular accident
CVD	Cardiovascular diseases
CVRF	Cardiovascular risk factors
DLD	Dyslipidemia
DIS	Disability
EE. UU	United States
ENS	Encuesta nacional de salud
ESSI	Social support Iinstrument
EU-SILC	Income and Living condition
FV	Low fruits and vegetables intake
GDP	Gross domestic product
HBP	High blood pressure
HME	Healthy migrant effect
HTN	Hypertension
LAC	Latin-America and Caribbean region
LPA	Low physical activity
NCDs	Non-communicable diseases
NHS	Nationa health survey
NSPH	Negative self-perceived health
OBES	Obesity
OR	Odds ratio
P	p value
REF	Reference
SDG	Sustainable development goals
SDH	Social Determinants of Health
SENDA	National Service for prevention and rehabilitation of drugs and alcohol consumption
TOB	Tobacco consumption
T2DM	Type 2 diabetes mellitus

Abstract

The international migration has steadily increased in Chile during the recent decades reaching an estimation of 1.452.104 international migrants. It has been described an intra-regional pattern called south-south migration. The health of this population is recognized as a global public health priority, mainly chronic diseases given the epidemiological transition that also has impacted migrant population. Currently, there is controversial evidence a possible healthy migrant effect on cardiovascular diseases and its risk factors, which suggest to lower prevalence of this conditions in comparison to local population. It has been postulated that the effect might be modulated by social determinants of health. The prevalence of cardiovascular conditions among migrant population residing in Chile is unknown, as well as the existence of the healthy migrant effect on cardiovascular health has not been investigated yet. In order to analyze the existence of this effect in migrant population compared to locals four sub-studies were conducted. The first substudy aimed to describe the scientific evidence of the last five years on healthy migrant effect on cardiovascular risk factors and cardiovascular diseases in the international migrant population vs. locals. A narrative review was conducted following a systematic search. The second substudy analyze the existence of EMS in self-reported chronic morbidity in the international migrant population vs. local, and its related social determinants (demographic, socioeconomic, health insurance, migratory process). From wich a secondary analysis of CASEN 2017 survey was performed with complex samples analyses. The third substudy aimed to analyze the existence of the healthy migrant effect on cardiovascular diseases and risk factors in the international migrant population vs. locations, and their related social determinants (demographic, socioeconomic, health system, psychosocial, and migration). The primary data collection included n=6.626 participants (n=3.324 Chileans and n=3.302 migrants) residing in La Pintana, La Granja and San Ramón who responded a survey of cardiovascular health and social determinants of heath. The second and third substudy analyzed the crude prevalence of health outcomes as proportions, the Pearson's chi-square test was used to compared health outcomes between migrants and locals. Multivariate logistic regression was used to test the association of social determinants of health and health outcomes. The healthy migrant effect was tested by multivariate logistic regression sequentially adjusted by social determinants of health (reference=Chilean). The fourth substudy aimed to offer a regional perspective of the growing challenges faced by international migrants in Latin America in accessing hypertension preventive care from human rights, equity and universal primary health care approaches. The results of the first substudy revealed scarce reports of intraregional in Latin America, heterogeneous evidence which difficults consensus for healthy migrant effect on cardiovascular health. The second substudy showed a lower crude prevalence of chronic diseases that remained significant after adjusting by social determinants of health. Meanwhile the third substudy revealed an unadjusted lower prevalence of cardiovascular diseases, metabolic risk factors, tobacco and alcohol consumption. The advantage on acute myocardial infarcation disappeared after adjusting by demographic determinants of health, while the effect on cerebrovascular accident disappeared after adjusting by access to health care determinants of health. The healthy migrant effect on metabolic risk factors, alcohol and tobacco consumption remained significant after adjusting by all social determinants of health. The present study contributes to the knowledge of health and migration, make visible challengues on cardiovascular health from social determinants of health perspective and provide evidence for local and regional public health.

Resumen

La migración internacional se ha incrementado sostenidamente en Chile durante las últimas décadas alcanzando 1.452.104 migrantes internacionales. Se ha descrito un patrón intrarregional denominado migración sur-sur. La salud de esta población es reconocida como prioridad de salud pública principalmente las enfermedades crónicas dada la transición epidemiológica que también impactó la población migrante. Actualmente, existe evidencia controvertida de un posible efecto del migrante sano sobre las enfermedades cardiovasculares y sus factores de riesgo, lo que sugiere una menor prevalencia de estas condiciones en comparación con la población local. Se ha postulado que el efecto podría ser modulado por determinantes sociales de la salud. Se desconoce la prevalencia de afecciones cardiovasculares entre la población migrante residente en Chile y no se ha investigado la existencia del efecto sobre la salud cardiovascular. Se realizaron cuatro substudios para analizar la existencia de este efecto en la población migrante en comparación con la local. El objetivo del primer subestudio fue describir la evidencia científica de los últimos cinco años sobre el efecto en salud cardiovascular en población migrante internacional vs local. Se realizó una revisión narrativa siguiendo una búsqueda sistemática. El segundo subestudio analizó la existencia del efecto en la morbilidad crónica auto-reportada en población migrante internacional vs. local, y determinantes sociales relacionados (demográficos, socioeconómicos, acceso a salud, proceso migratorio). Se realizó un análisis secundario de la encuesta CASEN 2017 con análisis de muestras complejas. El objetivo del tercer subestudio fue objetivo analizar la existencia del efecto sobre enfermedades cardiovasculares y sus factores de riesgo en Chile, y determinantes sociales relacionados. La recolección primaria de datos incluyó n=6.626 participantes (n=3.324 chilenos y n=3.302 migrantes) de La Pintana, La Granja y San Ramón que respondieron una encuesta de salud cardiovascular y determinantes sociales de la salud. El segundo y tercer subestudio analizaron la prevalencia cruda de resultados de salud como proporciones, se usó la prueba chi-cuadrado de Pearson para comparar los resultados de salud entre migrantes y locales. Se utilizó la regresión logística multivarida para analizar la asociación de los determinantes sociales y los resultados de salud. El efecto del migrante sano se evaluó mediante regresión logística multivariada ajustada secuencialmente por determinantes sociales (referencia=chileno). El objetivo del cuarto subestudio fue generar una perspectiva regional de los crecientes desafíos que enfrentan los migrantes ien Latinoamerica para acceder a servicios preventivos de hipertensión desde enfoques de derechos humanos, equidad y atención primaria de salud universal. Los resultados del primer subestudio revelaron escasos informes intrarregionales, evidencia heterogénea que dificulta el consenso sobre el efecto en la salud cardiovascular. El segundo subestudio mostró una menor prevalencia cruda de enfermedades crónicas que se mantuvo significativa después de ajustar por determinantes sociales. Mientras tanto, el tercer subestudio reveló una menor prevalencia no ajustada de enfermedades cardiovasculares, factores de riesgo metabólicos, consumo de tabaco y alcohol. La ventaja sobre el infarto agudo de miocardio desapareció tras ajustar por determinantes demográficos, mientras que el efecto sobre el accidente cerebrovascular desapareció tras ajustar por determinantes de acceso a salud. El efecto sobre los factores de riesgo metabólicos y consumo de alcohol y tabaco fue significativo tras ajustar por los determinantes sociales. El presente estudio contribuye al conocimiento de la salud y la migración, visibiliza los desafíos de la salud cardiovascular desde la perspectiva de los determinantes sociales de la salud y aporta evidencias para la salud pública local y regional.

1. Introduction and dissertation context

International migration is defined by the International Organization for Migration as *"movement of a person or a group of persons, either across an international border"*(1). This voluntary mobility is influenced by driving factors of a heterogeneous and diverse population. The process of deciding whether to migrate might be related to the socioeconomic and political conditions of the country of origin, as well as the receiving country and the migrant's characteristics. Among these, the following have been identified: i) macro-factors at the societal level including deficient social and economic development, demographic growth, environmental changes, wars and dictatorships; ii) meso-factors connecting individuals with their community, representing facilitators or barriers to migration such as support networks, regulatory frameworks and cost of migration; iv) individual micro-factors such as age, sex, ethnicity, educational level, marital status, language and motivation to migrate (2).

This dynamic and complex process of human mobilization has become a global phenomenon due to facilities for crossing international borders, creation of transnational communities, and demand for migrant labor (3). Globally, it has been estimated 281 million international migrants, most of whom reside in high-income countries and are at productive age. In addition, migration within the region has been described, mainly from middle-income to higher-income countries, as well as migration within developing countries (4). Historically people from Latin America and the Caribbean region have migrated to other regions, however, during the last decades an intra-regional migration known as south-south migration arose from the increased entrance barriers to northern countries, and the growing economic development and favorable sociopolitical conditions of some countries in the region (5). In Chile current reports estimated 1.452.104 international migrants, representing increased migratory influxes as a result of the country's mobility treaties and sociopolitical stability. The majority of migrants were born in Venezuela (30.7%), followed by Peru (16.3%), Haiti (12.5%), Colombia (11.4%) and Bolivia (8.5%) and are mainly residing in the Metropolitan Region (61.3%) (6). Migrants are a heterogeneous group, for example there are migrants with high incomes, while others remain in poverty. In addition, it has been identified through population-based data the deficiencies in affiliation to the health system, habitability, support and social participation (7).

The recognition of migrant's diversity contributes to the understanding of the complex nature of international migration, as well as the impact on population health. Migration represent a dynamic and multidimensional process, that might not be continuous nor definitive, involving a pre-migration phase, a travel phase, a destination phase and a return phase (8). In this process, diverse exposures could influence the risk for certain health conditions both in migrants and host society. However, this is not only limited to the profile of prevalent diseases, but also to the variety of living conditions, experiences, and contexts to which this population is exposed (9). For this reason, it is necessary to address the health of international migrants from a comprehensive approach, considering the determinants that may influence health outcomes, as a public health priority in the receiving countries. According to the World Health Organization, the social determinants (SDH) of health refer to the conditions in which people are born, grow, live, work and get older. These conditions could yield inequities affecting individual's health, given the unfair and avoidable differences in particular groups

(10). Furthermore, the decision to migrate is considered a result of the social determinants of health to which the individual was exposed during their pre-migration phase. Thus, migration itself represents a social determinant of health that could have an impact on health outcomes (11). However, it does not directly imply a health risk, according to the migration circumstances potential risks and social and economic inequities could emerge with potential negative effects on health (12).

Chronic diseases are a public health priority among international migrants in the Region (13). The relationship between risk factors, social determinants of health and migration has been previously suggested, considering both the current migrant's profile and their background. This includes demographic factors such as age, sex, marital status, and ethnicity. As well as, migrant's socioeconomic situation, since the risk of chronic diseases is related to low income, unemployment, low educational level due to limited access to services and poor living conditions produced by these factors (14). On the other hand, the access to the health system might involve barriers favoring low service's utilization by migrant population, besides low knowledge of health rights, procedures, language, among others. Psychosocial factors may reveal the influence of the interactions with the host population and migrant's own resources. In addition to the exposures derived from migration process including family separation, stress, reduced social networks and discrimination that could led to behavioral changes (14). Among the theorical approaches of migrant`s health, the "healthy migrant effect" (HME) postulates a health advantage on mortality and morbidity outcomes when compared to the local population of the destination country (15). However, it has been also suggested that the healthy migrant effect resulted from data overestimations, since migrants tend to have less access and use of the health system which could lead to underdiagnosis and cases under-recording (16). The so-called "salmon bias" or re-emigration bias has also been suggested, in which migrants with severe illnesses return to their country of origin where they have their support network, yielding in underestimations (17). Explanatory models for the healthy migrant effect include: i) positive selection where migrants could be self-selected considering their physical conditions, resources and ability to encounter the migratory process (18); ii) healthy habits and behaviors prior to migration which are preserved in the country of destination (19); iii) the protective role of psychosocial resources, for example support networks of their migrant peers that reinforce healthy behaviors and mutual help. In addition, a greater social integration favors psychosocial resources allowing better stress management, well-being and reduces disease risks (20).

The healthy migrant effect may not be preserved throughout the life cycle. It has been reported that a time of residence from 10 to 20 years might dissolve the advantage and health converges with that of the local population (17). Therefore, the effect can be sustained during middle age, but the exposure of the migratory process would modify results of chronic conditions. Furthermore, the veracity of the healthy migrant effect has been discussed in the international literature, since it has not been consistently observed and remains inconclusive Although, some reports support the health advantage, when exploring specific disease causes the effect selectively applies for some health outcomes (16). This is coupled with the variability given by the countries of origin and destination where the measurement has been carried out. In Chile, cardiovascular diseases are the leading causes of death, and high disease burden has been reported (21) . Hence, the migrant population residing in the country should be prioritized in public health research since they could potentially be affected by these

diseases over time. The healthy migrant effect has been suggested in the national literature. Secondary analysis of population-based data from the National Socioeconomic Characterization Survey (CASEN) have shown a possible advantage on disability among international migrants when compared with Chilean population. However, low socioeconomic status modulated the effect. In addition, a time of residence over 20 years increased the odds of disability (22). Similarly, a subsequent study reported fewer health problems, disability, and chronic conditions among Latin American migrants compared to the Chilean population. The difference found in these health outcomes disappeared with a time of residence over 20 years and when adjusting for socioeconomic status (23). This is the only available study exploring he healthy migrant effect on chronic diseases, being a starting point to delve into non-communicable conditions. Specifically, cardiovascular diseases and its risk factors in which there might be a healthy migrant effect but given the multiple exposures of social determinants of health during migration process this advantage might be vanished.

The above-mentioned background points out the relevance of knowing if this healthy migrant effect exists among international migrants residing in Chile. The identification of specific migrant's exposures and potential health gaps with local population might be a useful input to face a public health problem through timely health planning. A knowledge gap remains about cardiovascular health of international migrants, which represent an opportunity not only to verify it crudely but deepen towards other exposures that could modulate it, vanish it or have a neutral effect. Overall, this further evidence might also serve to provide recommendations to the health authorities, to address the needs identified. As well as serve to the formulation of promotion and prevention strategies acknowledging the diversity of international migrants in Chile.

Given the literature gaps and the opportunity to contribute to the regional evidence, the dissertation based on four substudies from different data sources, presented as follows.

I) The first chapter comprises the substudy 1 addressesing the **research question "what is the available international literature of the healthy migrant effect on cardiovascular health?"** in which a systematic research methodology was used to comprehensively explore evidence in favor, against, and neutral to this health advantage. As well as the social determinants of health influencing cardiovascular diseases and its risk factors. Objective: to describe the evidence of the last five years on EMS in cardiovascular risk factors and cardiovascular diseases in the international migrant population vs. locals.

II) The second chapter comprising the substudy 2 analyze the healthy migrant effect with population-based data available in the country, given the lack of primary data on cardiovascular health. The secondary analysis of the CASEN 2017 survey explores the health status of international migrants including self-reported health, disability, activity limitations, and chronic illness. Specifically, the study addresses **the research question "what do we know about the healthy migrant effect in chronic conditions among which cardiovascular diseases are included, comparing international migrants and local population from population-based data in Chile?"**. This approach explores these conditions as a whole from the social determinants of health perspective, making visible health gaps between migrants and native-born population in Chile. Objective: To analyze the existence of EMS in self-reported chronic morbidity in the international

migrant population vs. local, and its related social determinants (demographic, socioeconomic, health insurance, migratory process).

III) The third chapter comprising the substudy 3 from a primary data collection addresses a **research question: "is there a healthy migrant effect on cardiovascular diseases (CVD) and cardiovascular risk factors (CVRF) between international migrants and Chilean population residing in South East communes of the Metropolitan region, and, if it exists, how does this effect vary according to social determinants of health?".** which allowed to delve into the healthy migrant effect on specific disease causes, such as cardiovascular diseases. In addition, this primary data collection led analysis of metabolic and behavioral risk factors that were not provided in the population-based data (CASEN 2017). The following hypothesis was proposed.

H1.0: Due to the healthy migrant effect, there is a lower proportion of cardiovascular disease and cardiovascular risk factors in international migrants compared to the Chilean local population (unadjusted comparison).

From this main study hypothesis, and in light of international evidence, three additional deepening hypotheses emerged:

H1.1: The healthy migrant effect on CVD and CVRF compared to locals disappears after adjusting for demographic determinants (sex, age, ethnicity) and is attenuated when adjusting for socioeconomic determinants (educational level, income, occupational participation).

H1.2: The healthy migrant effect on cardiovascular disease and risks factors compared to locals, is attenuated after adjusting for access to health care determinants (insurance and access barriers).

H1.3: The healthy migrant effect on cardiovascular disease and risks factors compared to locals, is attenuated after adjusting for psychosocial determinants (stress, discrimination, social capital, and social support).

H1.4: The healthy migrant effect on cardiovascular disease and risks factors compared to locals, is attenuated after adjusting for migratory-related factors (country of origin, time of residence)

Objective: to analyze the existence of the healthy migrant effect on FRCV and CVD in the international migrant population vs. locations, and their related social determinants (demographic, socioeconomic, health system, psychosocial, and migration).
Specific objetives included 1. Description of above-mentioned social determinants of health in international migrant population residing in Chile; 2. Comparison of the crude cardiovascular outcomes between the international migrant population and Chilean population; 4. Analysis of each set of social determinants association with cardiovascular outcomes in both populations; 5. analysis of the healthy migrant effect on cardiovascular health outcomes adjusted

by each set of social determinants of health (demographic, socioeconomic, access to health care, psychosocial.).

IV) The fourth chapter comprising the substudy 4 includes a perspective on the need of prioritizing the health of international migrants in receiving health systems, given the influence and relevance of the health access on cardiovascular health. Specifically, hypertension preventive services, which represents the main risk factor associated with cardiovascular events. This perspective from a regional standpoint offers recommendations considering the diversity of migrant population. The remaining contents of this dissertation are comprised by the results of the primary data collection,

Therefore, this dissertation contains a learning process on the migrant's health field from comprehensive literature review, preventive regional perspective and secondary and primary data approaches from the social determinants of health of this population.

2. Chapter 1

Narrative literature review of healthy migrant effect on cardiovascular diseases and risks factors

Access: https://revcorsalud.sld.cu/index.php/cors/article/view/790/1512

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Review Article

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Is there a healthy migrant effect on cardiovascular health? A narrative review of scientific bibliography

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The authors declare no competinginterests.

Abbreviations
AMI: acute myocardial infarction **CVRF:** cardiovascular risk factors
HBP: high blood pressure
HME: healthy migrant effect
SDH: social determinant of health
T2DM: type 2 diabetes mellitus

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ABSTRACT

International migration is a complex process that impacts population health and is considered a social determinant of health. A possible health advantage in migrants with respect to natives, called the healthy migrant effect has been proposed. Currently its evidence is controversial in cardiovascular health. A search was performed in Web of Science and PubMed databases with terms refer- ring to migration, cardiovascular disease, risk factors, and SDH. The search yield- ed 2933 records, 90 publications were selected: forty-six report evidence for HME (pro, against, mixed or neutral) and 44 describe associated SDH. The HME seems to apply selectively in specific conditions and subgroups according to the ana- lyzed origin and destination. The evidence of associated SDH favors the under- standing of these differences; therefore, a broad analysis approach that integrates the various exposures of the migratory process that could influence cardiovascu- lar health is needed.
Keywords: Human migration, Transients and Migrants, Social determinants of health, Healthy migrant effect, Cardiovascular diseases

¿Existe efecto de migrante sano en salud cardiovascular? Revisiónnarrativa de literatura científica

RESUMEN

*La migración internacional es un proceso complejo que impacta la salud pobla- cional y es considerado un determinante social de la salud (DSS). Se ha expuesto una posible ventaja en salud en migrantes con respecto a nativos, llamada efecto de migrante sano (EMS). Actualmente su evidencia es controversial en salud car- diovascular. Se realizó una búsqueda en Web of Science y PubMed con términos referentes a migración, factores de riesgo, enfermedades cardiovasculares y DSS. La búsqueda arrojó 2933 registros de los cuáles se seleccionaron 90 publicaciones:46 informan evidencia del EMS (a favor, en contra, mixta o neutros) y 44 describenDSS asociados. El EMS parece ocurrir selectivamente en condiciones específicas ysubgrupos según origen y destino analizados. La evidencia de los DSS asociados favorece la comprensión de estas diferencias; por lo tanto, es necesario un enfo- que de análisis amplio que integre las diversas exposiciones del proceso migrato- rio que podrían influir en la salud cardiovascular.**Palabras clave: Migración humana, Migrantes, Determinantes sociales de la salud,Efecto de migrante sano, Enfermedades cardiovasculares*

Introduction

International migration is a dynamic and complex process of human mobilization that can take place voluntarily or involuntarily, generally promoted by the search for better living conditions[1-3]. It is estimated that there were 272 million international migrants in the world up to December 2019, representing 3.5% of the world's population[4]. There are different migration patterns at global level, where the South-to-North pattern towards developed countries stands out, evidenced by a high concentration of migrants in Europe and North America. There is also a considerable mobility between countries within the same region, from middle-income to high-income countries or between developing countries. This last pattern is the most frequent one in Latin America, known as South-to-South migration[1,4].

The international migration process is neither continuous nor definitive, but is composed of dynamic stages[5]; among which are mainly the pre-migration, transit, destination and return phases[6]. In these stages, differential exposures can arise that influence health and well-being[5], from the social determinants of health (SDH) approach. These exposures correspond to the social conditions in which people develop during their life cycle and migration process. Conditions that may present avoidable unfair systematic differences, capable of producing inequities in health[7].

International migration does not directly represent a risk, but the circumstances in which this process takes place can trigger social and health inequities[8]. That is why international migration is recognized as a SDH[9]. Migrants in an irregular situation, women, children and minorities may face barriers to access social and health protection[10].

There are health problems in international migrants that are of great interest to public health, including chronic non-communicable diseases. The relevance of these diseases arises from the transition from patterns centered on infectious diseases to profiles similar to those of the general population[11]. Among chronic non-communicable diseases, cardiovascular diseases[12] and their risk factors stand out, which produce a high burden of disease and disability worldwide, mainly in adults facing some type of socioeconomic vulnerability[13], refugees or in an irregular administrative situation.

In 2017, an estimate of 422.7 million cases globally and 17.92 million deaths per year due to these causes in the world population[14] was published, and it was considered that by 2030 this could reach 23.6 million deaths per year[15]. This conditions variably affect migrants depending on their origin, destination and time of residence[16,17]. In addition, they may result both from their individual susceptibility and from social and health services access disadvantage facing cumulative SDH exposures, including un- healthy lifestyles[18]. A systematic review of studies inmigrants published between 2000-2014 revealed di- versity in cardiovascular diseases risk. For some groups the risk is similar to that of locals, whilein others is higher or even lower[17]. However, a meta-analysis that analyzed causes of mortality by Inter- national Classification of Diseases categories found lower mortality due to circulatory causes and type 2 diabetes mellitus (T2DM) in migrants compared to the general population[19]. These results suggest a pos- sible advantage in cardiovascular health that con- trasts with the accumulated exposures and risks de- rived from the migratory process.

The possible health advantage of migrants is called the “healthy migrant effect” (HME), which hasbetter morbidity and mortality indicators comparedto the population of the host country[20] or even the country of origin[21]. Among the possible explanatory models, positive selection is proposed, in which the individual considers that he or she possesses the characteristics and resources to undertake migra- tion[22]. This selection can also be made by the desti- nation country with selective entry criteria (requir- ing health screening or demonstrating a high level of education)[23]. Another model includes habits previously incorporated by migrants, who maintain —for example— healthy lifestyles during migration. In addition, they can improve their health by accessing better structural conditions in the host country, if they manage to integrate and receive social protec- tion[24]. Finally, the protective role of social support and cohesion has been postulated, as they provide positive reinforcement for healthy behaviors and promote wellbeing[25,26]. Likewise, migrants’ interac- tion in the host society enables a better stress con- trol[27]. However, the HME has also been questioned by authors who argue underregistration of morbidity in migrants, supported by lower access to the health system and the possibility of returning to the coun- try of origin of those with severe diseases. This leadsto the so-called fallacy (or bias) of the minor health problems registration in migrants compared to local inhabitants[28,29].

The population of international migrants is heterogeneous and changing over time, with different ex-

posures that could influence changes in the HME[30]. Migrants do not always live in living conditions that favor better cardiovascular health than the native population. Even when, on average, they are in better health state on arrival, the risks that some groups experience during the migration process could re- sult in long-term cardiovascular diseases. To under- stand the HME in cardiovascular health requires an approach that integrates the various dimensions which shape it. The aim of the current narrative review is to describe the evidence from the last five years on the HME in cardiovascular risk factors (CVRF) and cardiovascular diseases in international migrant population compared with locals, from an integrative approach based on the SDH model.

Method

Search strategy

The search was carried out in Web of Science and PubMed databases in April 2020. It was first carried out in a general way to identify HME studies with the terms "migration, behavioral and metabolic CVRF, and cardiovascular diseases". Then, complementary searches were carried out where specific terms for each SDH group were added to the initial equation (strategy detailed in **table 1**). The search was limited to studies published between 2015 and April 2020 in English and Spanish.

Articles selection

After eliminating duplicates, articles selection was started with the reading of titles and abstracts. Those selected, were considered for the reading of the full text. Applied inclusion criteria were:

1. Type of population: Migrants or refugees, regardless of their legal situation, time of residence or generation, older than 18 years old.
2. Type of study: Any type of observational study.
3. Type of measurement: Self-report (surveys, questionnaires, scales, structured interviews), anthropometric measurements, biochemical examinations, electrocardiogram, imaging.
4. Type of results: Presence of the HME in CVRF or cardiovascular diseases.
5. Some component of the SDH model: Demographic (gender, age, ethnicity); socioeconomic (educational level, occupation, income); psychosocial (acculturation, stress, social capital and support) and migration process (country of origin and time of residence).

Data extraction and synthesis

Data were extracted to a Microsoft Excel template and categorized by studies that posit findings for,

Table 1. Search strategy in the literature.

General search equation "migration, behavioral and metabolic CVRF and major CVD".
- #1 "Transients and Migrants" [Mesh] OR "Emigrants and immigrants" [Mesh] OR "Refugees" [Mesh] OR "Migration background" OR "Immigrant background" OR "Migrant" OR "Migrants" OR "Immigrant" OR "Immigrants" OR "Ethnic minority" OR "human migration" [Mesh] OR "emigration and immigration" [Mesh] OR "floating population"
- #2 "cardiovascular risk" OR "metabolic syndrome" [mesh] OR "hypertension" [mesh] OR "Diabetes Mellitus,Type 2" [mesh] OR "obesity" [mesh] OR "overweight" [mesh] OR "dyslipidemia" [mesh] OR "hypercholesterolemia" [mesh] OR "sedentary behaviour" [mesh] OR "alcohol drinking" [mesh] OR "smoking" [mesh]
- #3 "cardiovascular disease" OR "heart failure" [mesh] OR "myocardial ischemia" [mesh] OR "Myocardial infarction" [mesh] OR "coronary disease" [mesh] OR "stroke" [mesh]
Complementary search of social determinants on health (demographic, socioeconomic, psychosocial and of the migra- tory process) equation.
- #4 "age" OR "gender" OR "women" OR "ethnicity" OR "ethnic"
- #5 "economic status" [mesh] OR "Income" [mesh] OR "remuneration" [mesh] OR "poverty" [mesh] OR "social class" [mesh] OR "socioeconomic factors" [mesh]
- #6 "acculturation" [mesh] OR "cultural assimilation" [mesh] OR "social capital" [mesh] OR "social support" [mesh] OR "social marginalization" [mesh] OR "social discrimination" [mesh] OR "quality of life" [mesh] OR "psychological stress" [mesh]

- #7 “country of origin” OR “nativity” OR “immigrant generation” OR “generation of migration” OR “generational status” OR “duration of residence” OR “length of residence

against, or neutral regarding the HME, and studies reporting each SDH subgroup. For each section they were included:

a) Characteristics of the study (author, year, objective).
b) Characteristics of the population (number of participants, country of origin, ethnicity, age and gender).
c) Source of data, tools and main results.

This information was systematized in a narrative thematic analysis according to the dimensions of interest.

Results

Search results and selected articles

The search yielded 2933 records and 2010 duplicates were eliminated. Thus, the titles and abstracts review was carried out in 923 unique records. At the end of this review, 234 articles that met the inclusion criteria remained, which were subsequently examined in full text, and from which 90 were finally selected for information extraction (**Figure1**). From this total, 46 were included in the report of the HME and 44 in the description of the associatedSDH.

The included studies are cross-sectional and longitudinal (follow-up from one to ten years), whose data sources include questionnaires and population databases. The studies were carried out mainly in North America, Europe, Central America and Oceania. Among these, the destination country with most studies was the United States of America, followed by the Netherlands, Canada and Australia. The origin of the migrants is diverse, coming from all continents, and Asian, Afro-descendant and Hispanic ethnicities were the most represented (the countries of origin are shown in **Figure 2**). Regarding the characteristics of the participants, most report voluntary migration and only two manuscripts include refugees. The gender distribution is similar and the age range goes from 18 to over 75 years old; however, participants are concentrated in the 40 to 60 years old range.

Of the total number of articles included in this review, 17 reported —in general terms— on HME in CVRF and cardiovascular diseases, and 19 were contrary. However, given the variability in health outcomes, a group of ten articles were considered mixed, being in favor of the HME for certain conditions and against for others. In addition, two of these studies (one against and one mixed) also assumed neutral positions in specific conditions (**Table 2**).

Evidence in favor of the HME

Most of the studies in favor of the HME come from North America, where less cardiovascular diseasehas been observed in Asian[31,32] and Hispanic[31,33] migrants, and those with T2DM[34]. Particularly in South Americans, Cubans and Mexicans lower prevalence of coronary artery disease was registered[35]. While strokes or ictus was less probable in Caribbean Afro-descendants and Africans[36]. The HME has been identified in factors such as high blood pressure (HBP) in

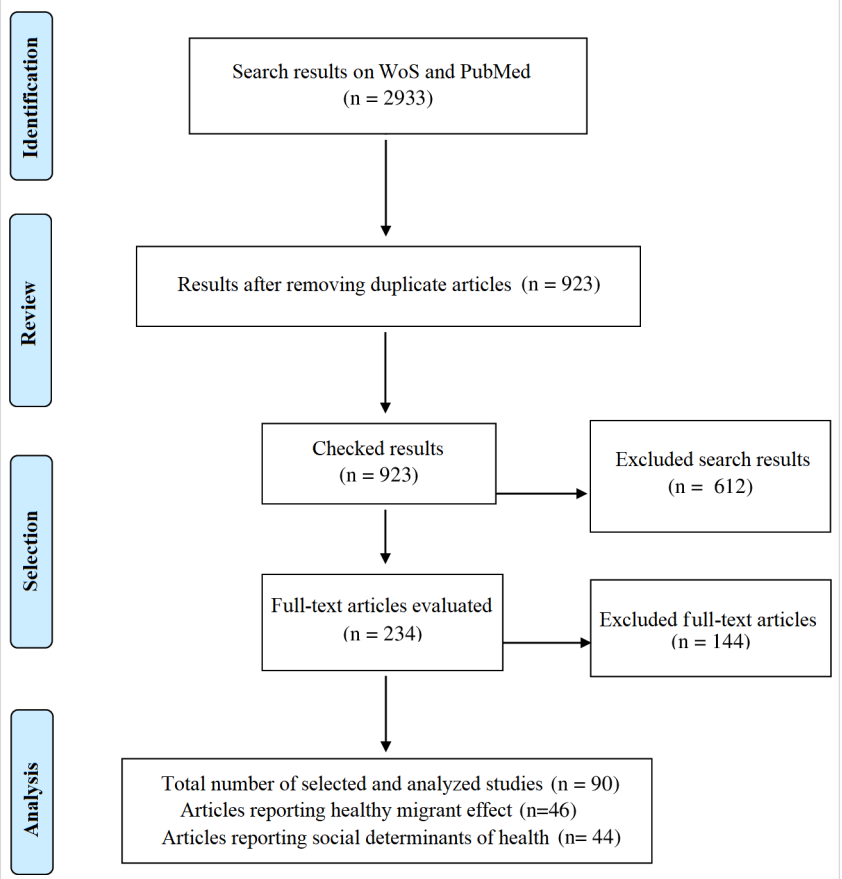

Figure 1. Flowchart of selection and characteristics of the selected articles.

Figure 2. Countries of origin of the international migrants included in the HME evidence.

South Americans[35], Mexicans[37], Africans and Afro-Caribbeans[36,38]. Likewise, T2DM affected a lower proportion to Afro-descendants[38,39], Asians and Europeans, who were also less obese[32,39]. However, one research carried out in Canada and USA suggested that the HME differs according to the country of destination, as only those who resided in Canada had a low prevalence of obesity[40].

In Switzerland, a lower incidence of atrial fibrillation was found in migrants from Iceland, Greece, Italy, Iraq, Turkey, Latin America and Africa[41]. In ad- dition, favorable findings were found for HBP, blood glucose and triglycerides in North Koreans who mi- grated to South Korea[41,42]. On the other hand, mi- grants have been recognized as having healthierhabits, which could explain the presence of theHME. This is the case of Dominicans living in Puerto Rico[33] and Asians in the USA with low tobacco smoking; as well as lower alcohol consumption in Lebanese compared to local Australians[44]. In addi- tion, there are studies that broaden the understand- ing of the selection phenomenon by contrasting mi- grants and the population of the country of origin. From this approach, a lower prevalence of peripher-al vascular disease was detected in Ghanaians mi- grants residing in Europe[45]; while Mexicans living in the USA presented a lower prevalence of metabolic syndrome[46] and tobacco smoking[47].

Evidence against the HME

The evidence contradicting the HME in cardiovascular diseases is located in Europe. In the Netherlands, Indonesian migrants had more heart diseases[48] and Pakistanis had a higher prevalence of acute myocardial infarction (AMI)[49]; similar to the proportion of hospitalizations due to AMI in Asians found in Italy[50]. The literature that in-forms worse indicators in CVRF covers different re- gions. In North America, HBP was more common in Afro-descendants[51,52], Asians[52,53] and Hispanics[54]; mainly Dominicans and Puerto Ricans[52]. Likewise, T2DM and tobacco smoking were more prevalent in Hispanics considered acculturated due to language preference[55]. Furthermore, dyslipidemia and obesity were higher in Hispanics[52,54,56] and Afro-descendants[51,52], compared to locals.

On the other hand, in European countries, T2DM was higher in South Asian[57], Pakistani[49], Chinese[58], Surinamese and Turkish[59] migrants. This condition also affected Africans[57,60], to a greater extent, particu- larly Ghanaians and Moroccans[59]. Russians, Somalis and Kurds were recognized for having elevated blood glucose levels[61]. Meanwhile, Iraqis had earlier onset of T2DM and poor glycemic control, in addi-tion to their obesity[62]. In HBP, the records of Asians [48,52,53,58] and Afro-descendants[63,64] exceeded those of locals, especially Moroccans and Ghanaians[59]. In addition, evidence of obesity[49,59], dyslipidemia[58], sedentariness[57] and tobacco smoking[63] in Afro-de- scendants and Asians contrasts with the HME. This profile in Asians is similar to that found in Oceania, where T2DM[65] and tobacco smoking were morecommon in South Asians and Asian-Europeans, re- spectively[66].

Mixed evidence of the HME

The literature that gathers mixed evidence of theHME is distributed in several regions. In North Amer-

Table 2. Recent evidence of the healthy migrant effect in cardiovascular risk of international migrants.

EVIDENCE IN FAVOR OF THE HEALTHY MIGRANT EFFECT			
Author (year)	**Comparison country**	**Country/region/migrants origin ethnicity**	**Condition in favor of the HME**
Hayfron-Benjamin (2020)[45]	Ghana (non-migrants)	Ghana (migrants in Europe)	Peripheral artery disease
Sharifi (2019)[32]	Canada	Asia Asia and Europe	Coronary artery disease and HBP T2DM and obesity
Song (2018)[42]	South Korea	North Korea	Blood pressure, glucose and triglycer-ides levels
Garcia (2018)[35]	USA	South Americans, Mexicans and Cubans South Americans	Coronary artery disease HBP
Tamez (2018)[33]	Puerto Rico	Dominican Republic	CVD, tobacco smoking
Commodore-Mensah (2018)[38]	USA	Afro descendants, Caribbean and Africa	HBP and T2DM
El Masri (2017)[44]	Australia	Lebanon	Alcohol consumption, sedentariness
Lu (2017)[40]	USA and Canada	Mexico, South America, Central Ameri-ca, Europe, Africa, Middle East, South-east Asia, East Asia,	Obesity
Wändell (2017)[41]	Sweden	Island, Greek, Italy, Iraq, Turkey, Africa and Latin America	Atrial fibrillation
Bacon (2017)[37]	USA	Mexico	HBP
Wirth (2017)[36]	USA	Afro descendants, Caribbean and Africa	Ictus and HBP
Fleischer (2017)[47]	Mexico (non-migrants)	Mexico (in USA)	Tobacco smoking
Lê-Scherban (2016)[31]	USA	(Cardiovascular event, Hispanics, Chi-nese)	(Cardiovascular event, Hispanics, Chi-nese)
Ford (2016)[39]	USA	Africa, Caribbean Asia, Europe	T2DM Obesity
Kuerban (2016)[43]	USA	Asia	Tobacco smoking
Beltrán-Sánchez (2016)[46]	Mexico (no mi-grants)	Mexico (migrants in USA)	Blood pressure, metabolic syndrome
Okrainec (2015)[34]	Canada	Latin America, Mexico, Caribbean, Asia, Europe, Africa, USA	CVD
EVIDENCE AGAINST OF THE HEALTHY MIGRANT EFFECT			
Author (year)	**Comparison country**	**Country/region/migrants origin ethnicity**	**Condition against HME**
Fedeli (2018)[50]	Italy	Asia	AMI
Fedeli (2018)[64]	Italy	Africa	Ictus, heart failure and HBP
Raza (2017)[49]	Netherlands	Pakistan	AMI, T2DM and obesity
Jin (2017)[66]	Australia	Mixed Chinese ethnicity	Tobacco smoking
Snijder (2017)[59,60]	Netherlands	Africa	T2DM
Skogberg (2017)[61]	Finland	Russia, Somali, Kurdistan Kurdistan	Glucose levels and metabolic syn-drome, dyslipidemia
Cohn (2017)[56]	USA	Hispanics	Dyslipidemia
Modesti (2017)[58]	Italy	China	HBP, dyslipidemia and T2DM
Minneboo (2017)[57]	Netherlands	South of Asia, Suriname, Ghana, Turkeyand Morocco. South of Asia, Suriname	Physical inactivity T2DM
Snijder (2017)[59,60]	Netherlands	Suriname, Ghana, Turkey and Morocco Morocco, Ghana, Turkey	T2DM HBP

		Ghana and Turkey	Obesity
Marshall (2016)[51]	USA	Cambodia	HBP and dyslipidemia
Essilfie (2016)[54]	USA	Hispanics	Dyslipidemia and HBP
Yi (2016)[53]	USA	South of Asia	HBP
Agyemang (2015)[63]	Netherlands	Ghana Africa, Asia, Turkey	HBP Tobacco smoking
Gupta (2015)[65]	Australia	South of Asia	T2DM
Nokes (2015)[55]	USA	Hispanics	T2DM and tobacco smoking
Bennet (2015)[62]	Sweden	Iraq	T2DM and obesity
de Back (2015)[48]	Netherlands	Mol Islands (Indonesia)	HBP (women), heart disease
MIXED EVIDENCE OF THE HEALTHY MIGRANT EFFECT			
Author (year)	**Comparison country**	**Country/region/migrants origin ethnicity**	**Condition in favor of the HME**
Di Giuseppe (2019)[69]	Canada	Eastern Asia	Heart failure
Cainzos-Achirica (2019)[71]	Spain	Latin America, Asia, Africa	Atrial fibrillation, dyslipidemia, obesity, tobacco smoking
Fang (2018)[67]	USA	Latin America, Asia, Africa	Coronary artery disease, tobacco smoking
		Europe, Asia, Africa, Latin America	Ictus
		Eastern Asia, Europe	T2DM
		Asia, Europe	Obesity
Etchi (2019)[73]	Finland	Somalia, Kurdistan	HBP
Parackal (2017)[75]	New Zeland	China China, India	Tobacco and alcohol consumption
Rabanal (2017)[72]	Norway	South of Asia	Tobacco smoking
Lee (2016)[76]	Korea	China	Cholesterol, metabolic syndrome, risk of CVD
Tu (2015)[68]	Canada	Asia, Eastern Europe, Latin America	Ictus, AMI
		Afro descendants	HBP
		Asia, Europe Afro descendants	Tobacco smoking
		Europe and Asia	CVD
		Afro-descendant, South of Asia	T2DM and HBP
		Latin America	Obesity
		South of Asia	DM2
		Africa, South of Asia	HBP, obesity
		South of Asia	coronary artery disease, heart failure, dyslipidemia, obesity
		South of Asia, Africa	T2DM
		Somalia, Kurdistan	T2DM
		Asia India	Physical inactivity, obesity
		South of Asia	Dyslipidemia
		China	T2DM, HBP
		South of Asia	HBP
		European	Tobacco

					smoking
Guo (2015)[74]	Australia	Asia	Tobacco smoking and obesity	Southeast of Asia	HBP, T2DM, dyslipidemia
Van Oeffelen (2015)[70]	Netherlands	Morocco	AMI	Indonesia, South of Asia, Turkey	AMI

NEUTRAL EVIDENCE OF THE HEALTHY MIGRANT EFFECT			
Author (year)	**Comparison country**	**Country/region/mi-grants origin ethnicity**	**Neutral condition**
de Back (2015)[48]	Netherlands	Mol Islands (Indonesia)	Ictus, heart failure and HBP
Guo (2015)[74]	Australia	Northeast Asia	T2DM

AMI, acute myocardial infarction; CVD, cardiovascular disease; HBP, high blood pressure; T2DM, type 2 diabetes mellitus.

ica, one study revealed lower prevalence of coro- nary artery disease, stroke, and tobacco smoking in Asians, Africans, and Latin Americans. In addition, Europeans and East Asians were recognized due to lower figures of obesity and T2DM. However, for these diseases the HME was not present in South Asians and Afrodescendants[67]. Other studies have found similar results for stroke, AMI[68] and heart failure[69] in Latin Americans, Asians, Europeans and Afro-descendants. This is added to lower tobacco smoking in Afro-descendants, and HBP in Asians and Europeans[68]. However, migrants from Eastern Europe and Western Asia presented more tobacco smoking[68], while Latin Americans stood out for their obesity[69]; and South Asians and Afro-descendantsfor their T2DM and HBP[68,69].

In Europe, the advantage in cardiovascular dis- eases was shown in Africans[70,71], Latin Americans and Asians[71]; although, particularly, the HME was not fulfilled for AMI in Turks, Indonesians and South Asians[70]. These last also were more affected by coronary artery disease and heart failure[71]. Regarding CVRF, the advantage was evidenced for dyslipidemia, obesity and tobacco smoking in Latin Americans, Africans and Asians[71]; among these, South Asians exhibited less tobacco smoking[72]. In contrast, these studies report disadvantages in South Asian[71], Somali and Kurdish migrants[73] for T2DM. Likewise, it was identified evidence against dyslipidemia, HBP and obesity in South Asians[72]and Afro-descendants[71].

In Oceania, the HME was found for cardiovascular diseases in Europeans and Asians[74]. In addition, these last registered less proportion of obesity, as well as of tobacco smoking alcohol consumption[74,75]. The evidence against the HME was described for sedentariness and obesity in Asians[75], specifically from India[75]. Migrants from Southeast Asia exhibited a higher prevalence of HBP, T2DM and dyslipidem-ia; while Europeans surpassed the smoking habits ofthe locals[74]. The only mixed study in Asia described the advantage of Chinese migrants in terms of cholesterol levels, metabolic syndrome and cardiovascular disease risk compared to native Koreans. However, HBP and T2DM were more prevalent in these migrants, suggesting the simultaneous presence of protection and risk in the same population[76].

Neutral evidence of the HME

The studies containing neutral findings also describe mixed evidence or against the effect. The study that showed mixed cardiovascular indicators in Asians and Europeans also revealed a neutral position for T2DM in Northeast Asian migrants[74]. In addition, there are authors who report contrary results for cardiovascular diseases and HBP in Indonesian women, although in men the evidence is neutral[48]. Generally speaking, the recent literature suggests variability of the HME and reinforces the lack of consensus. The effect applies selectively for certain cardiovascular diseases and CVRF, as well as in specific subgroups, depending on the studied origin and destination.

Influence of the SDH on cardiovascular diseases and CVRF

A. Demographic determinants

In the literature variations of the HME are found according to gender, age and ethnicity. Asian and Afrodescendant women, for example, have experienced disadvantages in heart failure, stroke[64,71], HBP[48] and dyslipidemia[64]; whereas men suffer in greater proportion from ischemic heart disease[48-50,64], HBP[52,54,63,64,68], T2DM[58,60,64-67,69,71] and obesity[52,75]; mainly Asians, Afro-descendants and Hispanics. In some men these diseases appear early, like AMI in persons under 55 years old[70]. There is evidence that migrants in this age range[71] and even between 31 and 40 years old[60], have higher rates of HBP and T2DM. Similar to dyslipidemia, which occurrence has been demonstrated among persons under 45[54] and 60[56] years old. With respect to risk habits, European, African and

Asian men stood out for their tobacco smoking[63,66,74] and sedentariness[66,74,75]. In some cases, after adjustment for demographic variables, the apparent HME in cardiovascular diseases disappears[67,69]. This suggests that the differences between migrants and locals can be explained by biological and identity factors of the individual.

B. Socioeconomic determinants

The HME can be modified by components of the socioeconomic status. For example, this effect on cardiovascular diseases disappears in migrants with a lower level of education[34]; meanwhile, the prevalence of atrial fibrillation tends to increase with this level of education[77]. Regarding the influence of income, the risk of heart failure associated with residing in low-income neighborhoods has been reported[69,78]. Furthermore, there is a positive correlation between income level and mortality due to cardiovascular diseases[56]; while intermediate income is associated with structural and functional cardiac alterations[79].

For CVRF, an inverse correlation has been found with annual income[80], mainly low income; which is associated with obesity, dyslipidemia, metabolic syndrome[81] and HBP[53]. In contrast, a higher income generates protection against HBP[38] and T2DM[39]. In relation to occupational status, unemployment is associated with chronic non-communicable diseases[82] and metabolic syndrome[61]; likewise, the type of employment influences the risk, particularly of HBP[83]. On the other hand, in case of low educational level or income there is a greater diagnosis associated to T2DM[38,84,85]. Generally a low socioeconomic status is associated to the increase of cardiometabolic risk[86,87].

C. Psychosocial determinants

Migrants who adopt separation as an attitude of acculturation (limited interest in their culture of origin) present more T2DM, dyslipidemia, overweight, and sedentariness[88,89]; and those considered acculturat-ed, due to their interaction with the host society,present cardiac alterations[79,90], HBP[90,91], obesity, andtobacco smoking[55]. In turn, discrimination favors the appearance of obesity, dyslipidemia, metabolic syndrome[92], T2DM[86,93] and unhealthy habits[93,94]. In addition, the number of discriminatory experiences increases the risk[94,95]; while chronic stress is associated with CVRF[85,87,96,97]. Psychosocial resources generate protection for metabolic factors[87,98-100] and sedentariness[101]; however, the imbalance of these resources is associated with cardiovascular diseases, through ties with extended family[80], migrant concentration in the neighborhood[56] and functional social support[102].

D. Migratory determinants

Recent literature describes the detection of cardiovascular diseases and CVRF in migrants from Central American and Caribbean countries[35,40,52,67,77,103-106], Asia[48,58,62,68,70,76,83,107-109], Africa[51,57,59,61,63,70,73,110-113] and Europe[61,108,114] (**Table 3**). These studies report variations possibly related to the biological and social diversity of the country. For its part, length of residence has been associated with unfavorable indicators of cardiovascular diseases[31], sedentariness[74,113], obesity, atherosclerosis[89] and tobacco smoking[74,113]. Several articles expose risk of HBP, obesity[111] and sedentariness after five[115] and ten years of residence[104,116-118]. Residence for more than ten years in the host country increases the incidence of AMI and stroke[68] and the probability of T2DM[104]; whereas residence for more than 15 years more than doubles the probability of T2DM and HBP[119].

Discussion

The findings of this research come mostly from developed countries, reflecting the South-North migratory pattern. There are few studies related to theHME involving intraregional migration, as well as specific literature on South-South migration and re- cent migration phenomena in Latin America. The heterogeneity of the evidence on the HME makes it difficult to reach a consensus that supports its existence in cardiovascular diseases and CVRF.

This set of results shows the diversity and complexity of the relationship between international migration and cardiovascular health. The literature in favor of the HME shows wide variability in the conditions in which it takes place and highlights the country and region of origin and ethnicity as possible relevant dimensions. The place of destination also seems to play a differentiating role, since it could determine certain particular exposures.

With respect to explanatory models, the selected articles support the presence of healthy habits in migrant groups, which are preserved during the migratory process. A possible selection process is also discussed, as migrants tend to be healthier than their non-migrant compatriots. However, a slightly higher amount of studies refers results against the HME.

Table 3. Evidence of risk factors and cardiovascular diseases in international migrants per country of origin.

Morbid condition	Country of origin	Author (year)
Cardiovascular disease	Puerto Rico Dominican RepublicMexico Haiti Ghana Iraq, Afganistan Indonesia Morocco, Suriname	Linares (2019)[77], Lu (2017)[40] Linares (2019)[77] Fang (2018)[67] Sirutis (2019)[103] Minneboo (2017)[57] Tu (2015)[68] de Back (2015)[48], Van Oeffelen (2015)[70] Van Oeffelen (2015)[70]
Type 2 diabetes mellitus	Syria Kurdistan, SomaliaIndia, Russia Ghana, Morocco Puerto Rico Mexico Cambodia Ethiopia Kenya, Liberia Iraq	Hani (2019)[107] Etchi (2019)[73] Commodore-Mensah (2018)[38] Snijder (2017)[60] Garcia (2018)[35], Lu (2017)[40] Commodore-Mensah (2016)[98] Marshall (2016)[51] Ghobadzadeh (2015)[110] Sewali (2015)[111] Tu (2015)[68]
High blood pressure	Puerto RicoSyria Russia India China Ghana Morocco Romania Cambodia Ethiopia Kenya, Liberia Indonesia	Linares (2019)[77], Fei (2017)[52], Lu (2017)[40] Hani (2019)[107] Commodore-Mensah (2018)[38] Commodore-Mensah (2018)[89], Shah (2015)[83] Modesti (2017)[58], Lee (2016)[76] Minneboo (2017)[57], Agyemang (2015)[63], Snijder (2017)[59] Snijder (2017)[60] Russo (2017)[114] Marshall (2016)[51] Ghobadzadeh (2015)[110] Sewali (2015)[111] de Back (2015)[48]
Dyslipidemia	Syria India Chin a Morocco, Turkey Salvador, Honduras, Guatemala	Hani (2019)[107] Savadatti (2019)[109] Modesti (2017)[58], Lee (2016)[76] Minneboo (2017)[57] Gill (2017)[105]
Overweight/ obesity	Cambodia India Russia Nigeria Puerto Rico Salvador, Honduras, Guatemala Cuba Mexico Iraq Liberia	Marshall (2016)[51] Savadatti (2019)[109], Shah (2015)[83] Commodore-Mensah (2018)[89,108] Obisesan (2017)[112] Fei (2017)[52] Gill (2017)[105] Affuso (2016)[106] Commodore-Mensah (2016)[98,104] Bennet (2015)[62] Sewali (2015)[111]
Metabolic syndrome	India Salvador, Honduras, Guatemala Kurdistan, Somalia, Russia	Savadatti (2019)[109] Gill (2017)[105] Skogberg (2017)[61]

Tobacco smoking	Puerto Rico Korea Turkey	Fei (2017)[52] Patterson (2016)[113] Agyemang (2015)[63]
Alcohol consumption	Bangladesh	Shah (2015)[83]
	Nigeria	Obisesan (2017)[112]
Physical inactivity	Nigeria Korea	Obisesan (2017)[112] Patterson (2016)[113]

Among these, Asians and Afro-descendants standout for their higher proportion of CVRF and metabol-ic risk factors, which supports the importance of hereditary factors and lifestyles, depending on the culture of origin. Likewise, behavioral CVRF are presented that contradict the theoretical arguments of the HME, in the sense that during the migratory process they acquire less healthy patterns[120].

The mixed evidence is less present and reinforc- es the absence of concluding findings that supportan advantage in migrants. These differences show how the HME applies selectively to some conditionsand subgroups of the group, with variations accord- ing to the countries of origin and destination ana- lyzed. Therefore, the debate is not only focused on better global health indicators, but also on specific causes and determinants of origin, transit and desti- nation. These can determine differential risks for cardiovascular diseases in migrants respect to the locals. This analysis favors the detection of the particular needs of migrants in the host country and the SDH approach as an integrative approach that broadens the understanding of migration and cardiovascular diseases by incorporating into these relationships levels of individual, family, community,and health system determination, as well as social and structural aspects of the migratory process.

The variability of the results can emerge due to the influence of the SDH[121]. Demographic determi- nants predispose to distinctive physiological pro- cesses and cultural practices[122-124], while socioeco- nomic determinants are integrated as mediators in the choice of habits[125], access to services and living conditions[126,127]. Psychosocial resources, for their part, favor the HME, although their imbalance is associated with cardiovascular diseases and mortality[128,129]. In addition, the process of interaction with the host society[130] facilitates the adoption of behav- ioral CVRF[120]. Taken together, these determinants are framed in the migratory process, with baseline[131] and acquired exposures that could dissolve the HME[29].

This review evidences, for the first time, the usefulness and relevance of the SDH approach to understand the complex and multi-dimensional relationship between international migration and cardiovascular diseases/CVRF. This research has as strengths the integrative search and detailed reporting by cardiovascular "condition" (cardiovascular disease and CVRF). Its main weaknesses are related to the admitted evidence period and the low representation of Latin American literature. Future studies should make the situation of migrants in the region more visible and generate knowledge transferable to health planning and public policies in Latin America.

Conclusions

The current evidence for the HME in cardiovascular diseases and CVRF is complex, multidimensional, and inconclusive, so that attention to SDH in this relationship needs to be expanded. Because the migratory experience possibly confers susceptibility to cardiovascular diseases in some migrant groups, similar studies are required that evidence learning and knowledge gaps; as well as new studies thatexplores trajectories during the migratory process,in order to achieve health planning with recognition and understanding of the complexity of health care and the particular risks of diverse groups.

References

1. Segal UA. Globalization, migration, and ethnicity. Public Health. 2019;172:135-42. [DOI]
2. Castelli F. Drivers of migration: why do people move? J Travel Med. 2018;25(1):1-7. [DOI]
3. Organización Internacional para los migrantes. Términos fundamentales sobre migración [Internet]. Ginebra: OIM [cited 8 Mar 2021]; 2020. Available at: https://www.iom.int/es/terminos-fundamentales-sobre-migracion#migracion
4. Organización Internacional para los migrantes. World Migration Report 2020 [Internet]. Ginebra: OIM [cited 8 Mar 2021]; 2020. Available at: https://publications.iom.int/system/files/pdf/wmr_2020.pdf
5. Wickramage K, Vearey J, Zwi AB, Robinson C,

Knipper M. Migration and health: a global public health research priority. BMC Public Health [Internet]. 2018 [cited 9 Mar 2021];18(1):987. Available at: https://doi.org/10.1186/s12889-018-5932-5
6. Zimmerman C, Kiss L, Hossain M. Migration and health: a framework for 21st century policy-making. PLoS Med [Internet]. 2011 [cited 11 Mar 2021];8(5):e1001034. Available at: https://doi.org/10.1371/journal.pmed.1001034
7. Organización Mundial de la Salud. Determinantes sociales de la salud [Internet]. Ginebra: OMS [cited 11 Mar 2021]; 2020. Available at: https://www.paho.org/es/temas/determinantes-sociales-salud
8. Davies A, Basten A, Frattini C. Migration: a social determinant of the health of migrants. Ginebra: International Organization for Migration [Internet]; 2009 [cited 11 Mar 2021]. Available at: https://migrationhealthresearch.iom.int/migration-social-determinant-health-migrants
9. Castañeda H, Holmes SM, Madrigal DS, Young ME, Beyeler N, Quesada J. Immigration as a social determinant of health. Annu Rev Public Health [Internet]. 2015 [cited 15 Mar 2021];36:375-92. Available at: https://doi.org/10.1146/annurev-publhealth-032013-182419
10. Thomas F. Handbook of migration and health. UK: Edward Elgar Publishing; 2016.
11. Castelli F, Tomasoni LR, El Hamad I. Migration and chronic noncommunicable diseases: is the paradigm shifting? J Cardiovasc Med (Hagerstown). 2014;15(9):693-5. [DOI]
12. World Health Organization. Migration and health: key issues [Internet]. Geneva: WHO [cited 15 Mar 2021]; 2020. Available at: https://www.euro.who.int/data/assets/pdf_file/ 0005/293270/Migration-Health-Key-Issues-.pdf
13. Yeates K, Lohfeld L, Sleeth J, Morales F, Rajkotia Y, Ogedegbe O. A Global Perspective on Cardiovascular Disease in Vulnerable Populations. Can J Cardiol. 2015;31(9):1081-93. [DOI]
14. Roth GA, Johnson C, Abajobir A, Abd-Allah F, Abera SF, Abyu G, *et al*. Global, Regional, and National Burden of Cardiovascular Diseases for 10 Causes, 1990 to 2015. J Am Coll Cardiol. 2017; 70(1):1-25. [DOI]
15. Francula-Zaninovic S, Nola IA. Management of Measurable Variable Cardiovascular Disease' Risk Factors. Curr Cardiol Rev. 2018;14(3):153-63. [DOI]
16. Agyemang C, van den Born BJ. Non-communicable diseases in migrants: an expert review. J Travel Med. 2019;26(2):1-9. [DOI]
17. Sohail QZ, Chu A, Rezai MR, Donovan LR, Ko DT, Tu JV. The Risk of Ischemic Heart Disease and Stroke Among Immigrant Populations: A Systematic Review. Can J Cardiol. 2015;31(9):1160-8. [DOI]
18. Davies AA, Blake C, Dhavan P. Social determinants and risk factors for non-communicable diseases (NCDs) in South Asian migrant populations in Europe. Asia Eur J. 2011;8(4):461-73. [DOI]
19. Aldridge RW, Nellums LB, Bartlett S, Barr AL,Patel P, Burns R, *et al*. Global patterns of mortali-ty in international migrants: a systematic review and meta-analysis. Lancet. 2018;392(10164):2553-66. [DOI]
20. Kirch W. Encyclopedia of Public Health. New York: Springer Science & Business Media; 2008.
21. Helgesson M, Johansson B, Nordquist T, Vingård E, Svartengren M. Healthy migrant effect in the Swedish context: a register-based, longitudinal cohort study. BMJ open [Internet]. 2019 [cited 20 Mar 2021];9(3):e026972. Available at: https://doi.org/10.1136/bmjopen-2018-026972
22. Krämer A, Fischer F. Refugee Migration and Health: Challenges for Germany and Europe. Springer Cham; 2018.
23. Kennedy S, Kidd MP, McDonald JT, Biddle N. The healthy immigrant effect: patterns and evi- dence from four countries. J Int Migr Integr. 2015; 16(2):317-32. [DOI]
24. Spallek J, Zeeb H, Razum O. What do we have to know from migrants' past exposures to under-stand their health status? a life course approach. Emerg Themes Epidemiol [Internet]. 2011 [cited20 Mar 2021];8(1):6. Available at: https://doi.org/10.1186/1742-7622-8-6
25. Domnich A, Panatto D, Gasparini R, Amicizia D. The "healthy immigrant" effect: does it exist in Europe today? Ital J Public Health [Internet]. 2012 [cited 20 Mar 2021];9(3):e7532. Available at: https://bit.ly/3ofj6ne
26. Zavaleta-Abad RA, Campos-Uscanga Y. Health effects after migration and the mediating role of acculturation and family cohesion. Univ Salud. 2019;21(3):261-9. [DOI]
27. Hombrados-Mendieta I, Millán-Franco M, Gómez-Jacinto L, Gonzalez-Castro F, Martos-Méndez MJ, García-Cid A. Positive Influences of Social Sup- port on Sense of Community, Life Satisfaction and the Health of Immigrants in Spain. Front Psychol [Internet]. 2019 [cited 21 Mar 2021];10:2555. Available at: https://doi.org/10.3389/fpsyg.2019.02555
28. Riosmena F, Kuhn R, Jochem WC. Explaining the

immigrant health advantage: Self-selection and protection in health-related factors among five major national-origin immigrant groups in the United States. Demography. 2017;54(1):175-200. [DOI]
29. Markides KS, Rote S. The healthy immigrant ef-fect and aging in the United States and other western countries. Gerontologist. 2019;59(2):205-14. [DOI]
30. Loi S, Hale JM. Migrant health convergence andthe role of material deprivation. Demogr Res. 2019;40(32):933-62. [DOI]
31. Lê-Scherban F, Albrecht SS, Bertoni A, Kandula N, Mehta N, Roux AVD. Immigrant status and cardiovascular risk over time: results from the Multi-Ethnic Study of Atherosclerosis. Ann Epi- demiol. 2016;26(6):429-35. [DOI]
32. Sharifi F, Shah BR. Cardiovascular Risk Factors and Events in Iranian Immigrants Versus Other Immigrants from the Middle East. J Immigr Minor Health. 2019;21(4):788-92. [DOI]
33. Tamez M, Ríos-Bedoya CF, Rodríguez-Orengo JF, Tucker KL, Mattei J. Sociodemographic and Life-style Factors, and Health Conditions of Domini- can Adults Living in Puerto Rico. J Immigr Minor Health. 2018;20(5):1085-93. [DOI]
34. Okrainec K, Bell CM, Hollands S, Booth GL. Risk of cardiovascular events and mortality among a population-based cohort of immigrants and long-term residents with diabetes: are all immigrants healthier and if so, for how long? Am Heart J. 2015;170(1):123-32. [DOI]
35. Garcia C, Garcia MA, Ailshire JA. Sociocultural variability in the Latino population: Age patterns and differences in morbidity among older US adults. Demogr Res. 2018;38(52):1605-18. [DOI]
36. Wirth LS, Tobo BB, Hinyard L, Vaughn MG. For-eign-born blacks no different from whites for odds of stroke. J Epidemiol Community Health. 2017; 71(8):786-93. [DOI]
37. Bacon E, Riosmena F, Rogers RG. Does the His-panic health advantage extend to better man-agement of hypertension? The role of socioeco- nomic status, sociobehavioral factors, and health care access. Biodemography Soc Biol. 2017;63(3): 262-77. [DOI]
38. Commodore-Mensah Y, Matthie N, Wells J, Dun-bar SB, Himmelfarb CD, Cooper LA, *et al*. African Americans, African Immigrants, and Afro-Caribbeans differ in social determinants of hyper-tension and diabetes: evidence from the national health interview survey. J Racial Ethn Health Disparities. 2018;5(5):995-1002. [DOI]
39. Ford ND, Narayan KV, Mehta NK. Diabetesamong US-and foreign-born blacks in the USA. Ethn Health. 2016;21(1):71-84. [DOI]
40. Lu Y, Kaushal N, Denier N, Wang JS-H. Health of newly arrived immigrants in Canada and the United States: Differential selection on health. Health Place. 2017;48:1-10. [DOI]
41. Wändell P, Carlsson AC, Li X, Gasevic D, Ärnlöv J, Holzmann MJ, *et al*. Atrial fibrillation in immi- grant groups: a cohort study of all adults 45 years of age and older in Sweden. Eur J Epidemiol. 2017;32(9):785-96. [DOI]
42. Song Y-S, Choi S-W. Low Estimated Glomerular Filtration Rate Is Prevalent among North Korean Refugees in South Korea. Korean J Fam Med. 2018;39(3):161-7. [DOI]
43. Kuerban A. Healthy migrant effect on smoking behavior among Asian immigrants in the United States. J Immigr Minor Health. 2016;18(1):94-101. [DOI]
44. El Masri A, Kolt GS, Astell-Burt T, George ES. Life-style behaviours of Lebanese-Australians: cross-sectional findings from The 45 and Up Study.PLoS One [Internet]. 2017 [cited 27 Mar 2021]; 12(7):e0181217. Available at: https://doi.org/10.1371/journal.pone.0181217
45. Hayfron-Benjamin CF, van den Born B-J, Mait-land-van der Zee AH, Amoah AG, van der Linden EL, Stronks K, *et al*. Higher prevalence of periph-eral arterial disease in Ghana compared to Gha- naian migrants in Europe: The RODAM study. Int J Cardiol. 2020;305:127-34. [DOI]
46. Beltrán-Sánchez H, Palloni A, Riosmena F, Wong R. SES gradients among mexicans in the United States and in Mexico: a new twist to the hispanic paradox? Demography. 2016;53(5):1555-81. [DOI]
47. Fleischer NL, Ro A, Bostean G. Smoking selectivi-ty among Mexican immigrants to the United States using binational data, 1999–2012. Prev Med. 2017;97:26-32. [DOI]
48. de Back TR, Bodewes AJ, Brewster LM, Kunst AE. Cardiovascular health and related health care use of Moluccan-Dutch immigrants. PLoS One [Inter-net]. 2015 [cited 27 Mar 2021];10(9):e0138644. Available at: https://doi.org/10.1371/journal.pone.0138644
49. Raza Q, Nicolaou M, Dijkshoorn H, Seidell JC. Comparison of general health status, myocardial infarction, obesity, diabetes, and fruit and vege-table intake between immigrant Pakistani popula-tion in the Netherlands and the local Amsterdam

population. Ethn Health. 2017;22(6):551-64. [DOI]
50. Fedeli U, Cestari L, Ferroni E, Avossa F, Saugo M, Modesti PA. Ethnic inequalities in acute myocardial infarction hospitalization rates among young and middle-aged adults in Northern Italy: high risk for South Asians. Intern Emerg Med. 2018; 13(2):177-82. [DOI]
51. Marshall GN, Schell TL, Wong EC, Berthold SM, Hambarsoomian K, Elliott MN, *et al*. Diabetes and cardiovascular disease risk in Cambodian refu- gees. J Immigr Minor Health. 2016;18(1):110-7. [DOI]
52. Fei K, Rodriguez-Lopez JS, Ramos M, Islam N, Trinh-Shevrin C, Yi SS, *et al*. Racial and ethnic subgroup disparities in hypertension prevalence, New York City Health and Nutrition Examination Survey, 2013-2014. Prev Chronic Dis [Internet]. 2017 [cited 29 Mar 2021];14:160478. Available at: https://doi.org/10.5888/pcd14.160478
53. Yi SS, Thorpe LE, Zanowiak JM, Trinh-Shevrin C, Islam NS. Clinical characteristics and lifestyle behaviors in a population-based sample of Chineseand South Asian immigrants with hypertension. Am J Hypertens. 2016;29(8):941-7. [DOI]
54. Essilfie G, Shavelle DM, Tun H, Platt K, Kobayashi R, Mehra A, *et al*. Association of elevated triglycerides and acute myocardial infarction in young Hispanics. Cardiovasc Revasc Med. 2016;17(8): 510-4. [DOI]
55. Nokes B, Sim Y, Gibson B, Byreddy S, Labiner DM, Coull B, *et al*. Assessment of stroke risk in southern Arizona, the pairing of acculturation and stroke risk factor development. J Immigr Minor Health. 2015;17(2):513-8. [DOI]
56. Cohn T, Miller A, Fogg L, Braun LT, Coke L. Impact of individual and neighborhood factors on cardiovascular risk in white Hispanic and non-Hispanic women and men. Res Nurs Health. 2017;40(2):120-31. [DOI]
57. Minneboo M, Lachman S, Snijder M, Vehmeijer J, Jørstad H, Peters R. Risk factor control in sec- ondary prevention of cardiovascular disease: re- sults from the multi-ethnic HELIUS study. Neth Heart J. 2017;25(4):250-7. [DOI]
58. Modesti PA, Castellani S, Calabrese M, Malan- drino D, Zhao D. Comparison of type 2 diabetes prevalence in Chinese migrants vs Caucasians and new perspectives for screening of cerebro- vascular disease in Chinese: a proof of concept study. Diabetes Res Clin Pract. 2017;130:196-203. [DOI]
59. Snijder MB, Galenkamp H, Prins M, Derks EM, Peters RJ, Zwinderman AH, *et al*. Cohort profile: the healthy life in an urban setting (HELIUS)study in Amsterdam, The Netherlands. BMJ open [Internet]. 2017 [cited 29 Mar 2021];7(12): e017873. Available at: https://doi.org/10.1136/bmjopen-2017-017873
60. Snijder MB, Agyemang C, Peters RJ, Stronks K, Ujcic-Voortman JK, van Valkengoed IG. Case finding and medical treatment of type 2 diabetes among different ethnic minority groups: the HELIUS study. J Diabetes Res [Internet]. 2017 [cited 30 Mar 2021];2017:9896849. Available at: https://doi.org/10.1155/2017/9896849
61. Skogberg N, Laatikainen T, Jula A, Härkänen T, Vartiainen E, Koponen P. Contribution of socio-demographic and lifestyle-related factors to the differences in metabolic syndrome among Rus- sian, Somali and Kurdish migrants compared with Finns. Int J Cardiol. 2017;232:63-9. [DOI]
62. Bennet L, Lindblad U, Franks PW. A family histo- ry of diabetes determines poorer glycaemic con- trol and younger age of diabetes onset in immi- grants from the Middle East compared with na- tive Swedes. Diabetes Metab. 2015;41(1):45-54. [DOI]
63. Agyemang C, Kieft S, Snijder MB, Beune EJ, van den Born B-J, Brewster LM, *et al*. Hypertension control in a large multi-ethnic cohort in Amster- dam, The Netherlands: the HELIUS study. Int J Cardiol. 2015;183:180-9. [DOI]
64. Fedeli U, Avossa F, Ferroni E, Schievano E, Bilato C, Modesti PA, *et al*. Diverging patterns of cardiovascular diseases across immigrant groups in Northern Italy. Int J Cardiol. 2018;254:362-7. [DOI]
65. Gupta S, Aroni R, Lockwood S, Jayasuriya I, Teede H. South Asians and Anglo Australians with heart disease in Australia. Aust Health Rev. 2015;39(5):568-76. [DOI]
66. Jin K, Neubeck L, Gullick J, Koo F, Ding D. Marked differences in cardiovascular risk profiles in middle-aged and older Chinese residents: Evidence from a large Australian cohort. Int J Cardiol. 2017;227:347-54. [DOI]
67. Fang J, Yuan K, Gindi RM, Ward BW, Ayala C, Loustalot F. Association of birthplace and coro-nary heart disease and stroke among US adults:National Health Interview Survey, 2006 to 2014. JAm Heart Assoc [Internet]. 2018 [cited 30 Mar 2021];7(7):e008153. Available at: https://doi.org/10.1161/JAHA.117.008153
68. Tu JV, Chu A, Rezai MR, Guo H, Maclagan LC, Austin PC, *et al*. Incidence of major cardiovascu-

lar events in immigrants to Ontario, Canada: the CANHEART Immigrant Study. Circulation. 2015; 132(16):1549-59. [DOI]
69. Di Giuseppe G, Chu A, Tu JV, Shanmugasegaram S, Liu P, Lee DS. Incidence of Heart Failure Among Immigrants to Ontario, Canada: A CANHEART Immigrant Study. J Card Fail. 2019;25(6):425-35. [DOI]
70. Van Oeffelen AA, Vaartjes I, Stronks K, Bots ML, Agyemang C. Sex disparities in acute myocardial infarction incidence: Do ethnic minority groups differ from the majority population? Eur J Prev Cardiol. 2015;22(2):180-8. [DOI]
71. Cainzos-Achirica M, Vela E, Cleries M, Bilal U, Mauri J, Pueyo MJ, *et al*. Cardiovascular risk factors and disease among non-European immi- grants living in Catalonia. Heart. 2019;105(15): 1168-74. [DOI]
72. Rabanal KS, Meyer HE, Tell GS, Igland J, Pylypchuk R, Mehta S, *et al*. Can traditional risk factors explain the higher risk of cardiovascular diseasein South Asians compared to Europeans in Nor-way and New Zealand? Two cohort studies. BMJopen [Internet]. 2017 [cited 1 Apr 2021];7(12):e016819. Available at: https://doi.org/10.1136/bmjopen-2017-016819
73. Etchi DT, Lilja E, Koponen P, Laatikainen T. Disparities in treatment of diabetes and hyperten- sion among groups of foreign origin and the gen- eral Finnish population. Eur J Public Health. 2019; 29(5):894-9. [DOI]
74. Guo S, Lucas RM, Joshy G, Banks E. Cardiovascular disease risk factor profiles of 263,356 older Australians according to region of birth and acculturation, with a focus on migrants born in Asia. PLoS One [Internet]. 2015 [cited 1 Apr 2021]; 10(2):0115627. Available at: https://doi.org/10.1371/journal.pone.0115627
75. Parackal S, Stewart J, Ho E. Exploring reasons for ethnic disparities in diet-and lifestyle-relatedchronic disease for Asian sub-groups in New Zea- land: a scoping exercise. Ethn Health. 2017;22(4): 333-47. [DOI]
76. Lee H, Cho S, Kim YK, Kim JH. Is there disparity in cardiovascular health between migrant work- ers and native workers? Workplace Health Saf. 2016;64(8):350-8. [DOI]
77. Linares JD, Jackson II LR, Dawood FZ, Swett K, Benjamin EJ, Schneiderman N, *et al*. Prevalence of atrial fibrillation and association with clinical, sociocultural, and ancestral correlates among Hispanic/Latinos: The Hispanic Community Health Study/Study of Latinos. Heart Rhythm. 2019;16(5): 686-93. [DOI]
78. Li X, Sundquist J, Forsberg P-O, Sundquist K. Association Between Neighborhood Deprivation and Heart Failure Among Patients With Diabetes Mellitus: A 10-Year Follow-Up Study in Sweden. J Card Fail. 2020;26(3):193-9. [DOI]
79. López L, Swett K, Rodriguez F, Kizer JR, Penedo F, Gallo L, *et al*. Association of acculturation with cardiac structure and function among Hispanics/Latinos: a cross-sectional analysis of the echocardiographic study of Latinos. BMJ Open [Internet]. 2019 [cited 1 Abr 2021];9(11):e028729. Available at: https://doi.org/10.1136/bmjopen-2018-028729
80. Hernandez R, Carnethon M, Giachello AL, Penedo FJ, Wu D, Birnbaum-Weitzman O, *et al*. Structural social support and cardiovascular disease risk factors in Hispanic/Latino adults with diabe-tes: results from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). Ethn Health. 2018;23(7):737-51. [DOI]
81. Morbach C, Gelbrich G, Tiffe T, Eichner F, Wag- ner M, Heuschmann PU, *et al*. Variations in cardiovascular risk factors in people with and with-out migration background in Germany–Results from the STAAB cohort study. Int J Cardiol. 2019;286:186-9. [DOI]
82. Lo CC, Adame JL, Cheng TC. Explaining Chronic Illness and Self-Rated Health Among Immigrants of Five Hispanic Ethnicities. J Racial Ethn Health Disparities. 2020;7(1):177-91. [DOI]
83. Shah SM, Loney T, Sheek-Hussein M, El Sadig M, Al Dhaheri S, El Barazi I, *et al*. Hypertension prevalence, awareness, treatment, and control, in male South Asian immigrants in the United Arab Emirates: a cross-sectional study. BMC Cardio-vasc Disord [Internet]. 2015 [cited 1 Apr 2021];15(1):30. Available at: https://doi.org/10.1186/s12872-015-0024-2
84. Addo J, Agyemang C, Aikins Ad-G, Beune E, Schulze MB, Danquah I, *et al*. Association be- tween socioeconomic position and the preva- lence of type 2 diabetes in Ghanaians in different geographic locations: the RODAM study. J Epi- demiol Community Health. 2017;71(7):633-9. [DOI]
85. Shah AD, Vittinghoff E, Kandula NR, Srivastava S, Kanaya AM. Correlates of prediabetes and type II diabetes in US South Asians: findings from the Mediators of Atherosclerosis in South Asians Living in America (MASALA) study. Ann Epidemiol.

2015;25(2):77-83. [DOI]

86. Wassink J, Perreira KM, Harris KM. Beyond race/ethnicity: Skin color and cardiometabolic health among blacks and hispanics in the United States. J Immigr Minor Health. 2017;19(5):1018-26. [DOI]
87. McCurley JL, Penedo F, Roesch SC, Isasi CR, Carnethon M, Sotres-Alvarez D, *et al*. Psychosocial factors in the relationship between socioeconom-ic status and cardiometabolic risk: the HCHS/SOL Sociocultural Ancillary Study. Ann Behav Med. 2017;51(4):477-88. [DOI]
88. Al-Sofiani ME, Langan S, Kanaya AM, Kandula NR, Needham BL, Kim C, *et al*. The relationship of acculturation to cardiovascular disease risk fac- tors among US South Asians: Findings from the MASALA study. Diabetes Res Clin Pract [Inter-net]. 2020 [cited 2 Apr 2021];161:108052. Availableat: https://doi.org/10.1016/j.diabres.2020.108052
89. Commodore-Mensah Y, Ukonu N, Cooper LA, Agyemang C, Himmelfarb CD. The association between acculturation and cardiovascular disease risk in Ghanaian and Nigerian-born African immi- grants in the United States: the Afro-Cardiac Study. J Immigr Minor Health. 2018;20(5):1137-46.[DOI]
90. Effoe VS, Chen H, Moran A, Bertoni AG, Bluemke DA, Seeman T, *et al*. Acculturation is associated with left ventricular mass in a multiethnic sample: the Multi-Ethnic Study of Atherosclerosis. BMC Cardiovasc Disord [Internet]. 2015 [cited 3 Apr 2021];15(1):161. Available at: https://doi.org/10.1186/s12872-015-0157-3
91. Divney A, Echeverria SE, Thorpe L, Trinh-Shevrin C, Islam N. Hypertension prevalence jointly influenced by acculturation and gender in US immi- grant groups. Am J Hypertens. 2019;32(1):104-11. [DOI]
92. Fox RS, Carnethon MR, Gallo LC, Wiley JF, Isasi CR, Daviglus ML, *et al*. Perceived Discrimination and Cardiometabolic Risk Among US Hispanics/Latinos in the HCHS/SOL Sociocultural Ancillary Study. Int J Behav Med. 2019;26(4):331-42. [DOI]
93. Whitaker KM, Everson-Rose SA, Pankow JS, Rodriguez CJ, Lewis TT, Kershaw KN, *et al*. Experiences of discrimination and incident type 2 dia- betes mellitus: the Multi-Ethnic Study of Athero- sclerosis (MESA). Am J Epidemiol. 2017;186(4): 445-55. [DOI]
94. Everson-Rose SA, Lutsey PL, Roetker NS, Lewis TT, Kershaw KN, Alonso A, *et al*. Perceived discrimination and incident cardiovascular events: The Multi-Ethnic Study of Atherosclerosis. Am J Epidemiol. 2015;182(3):225-34. [DOI]
95. Chilunga FP, Boateng D, Henneman P, Beune E, Requena-Méndez A, Meeks K, *et al*. Perceived discrimination and stressful life events are associated with cardiovascular risk score in migrant and non-migrant populations: The RODAM study. Int J Cardiol. 2019;286:169-74. [DOI]
96. Castañeda SF, Buelna C, Giacinto RE, Gallo LC, Sotres-Alvarez D, Gonzalez P, *et al*. Cardiovascular disease risk factors and psychological distress among Hispanics/Latinos: the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). Prev Med. 2016;87:144-50. [DOI]
97. Isasi CR, Parrinello CM, Jung MM, Carnethon MR, Birnbaum-Weitzman O, Espinoza RA, *et al*. Psychosocial stress is associated with obesity and diet quality in Hispanic/Latino adults. Ann Epi- demiol. 2015;25(2):84-9. [DOI]
98. Commodore-Mensah Y, Hill M, Allen J, CooperLA, Blumenthal R, Agyemang C, *et al*. Sex Differ-ences in Cardiovascular Disease Risk of Ghana- ian-and Nigerian-Born West African Immigrants in the United States: The Afro-Cardiac Study. JAm Heart Assoc [Internet]. 2016 [cited 3 Apr 2021];5(2):e002385. Available at: https://doi.org/10.1161/JAHA.115.002385
99. Lagisetty PA, Wen M, Choi H, Heisler M, Kanaya AM, Kandula NR. Neighborhood social cohesion and prevalence of hypertension and diabetes in a South Asian population. J Immigr Minor Health. 2016;18(6):1309-16. [DOI]
100. Gallo LC, Fortmann AL, McCurley JL, Isasi CR, Penedo FJ, Daviglus ML, *et al*. Associations of structural and functional social support with diabetes prevalence in US Hispanics/Latinos: Results from the HCHS/SOL Sociocultural Ancillary Study. J Behav Med. 2015;38(1):160-70. [DOI]
101. Morrison EJ, Clark MM, Wieland ML, Weis JA, Hanza MM, Meiers SJ, *et al*. Relationship be- tween negative mood and health behaviors in an immigrant and refugee population. J Immigr Mi- nority Health. 2017;19(3):655-64. [DOI]
102. Fortmann AL, Roesch SC, Penedo FJ, Isasi CR, Carnethon MR, Corsino L, *et al*. Glycemic control among US Hispanics/Latinos with diabetes from the HCHS/SOL Sociocultural Ancillary Study: Do structural and functional social support play a role? J Behav Med. 2015;38(1):153-9. [DOI]
103. Sirutis B, Brown C, Lopez JG, Weppelmann T,

Ashourian K, Lozano J, *et al*. A Comparative CaseSeries of Haitian and non-Haitian Stroke Patientsat a Single Center in Miami, Florida. J Health Care Poor Underserved. 2019;30(4):1560-8. [DOI]

104. Commodore-Mensah Y, Ukonu N, Obisesan O,Aboagye JK, Agyemang C, Reilly CM, *et al*. Lengthof residence in the United States is associatedwith a higher prevalence of cardiometabolic risk factors in immigrants: a contemporary analysisof the National Health Interview Survey. J AmHeart Assoc [Internet]. 2016 [cited 3 Apr 2021]; 5(11):e004059. Available at: https://doi.org/10.1161/JAHA.116.004059
105. Gill RM, Khan SA, Jackson RT, Duane M. Preva- lence of the Metabolic Syndrome in Central and South American Immigrant Residents of the Washington, DC, Area. J Nutr Metab [Internet]. 2017 [cited 3 Apr 2021];2017:9531964. Available at: https://doi.org/10.1155/2017/9531964
106. Affuso O, Singleton CR, Brown SC, Perrino T,Huang S, Szapocznik J. Associations between neighborhood socioeconomic environment and physical activity in Cuban immigrants. SSM Pop- ul Health. 2016; 2:130-5. [DOI]
107. Hani AB, Abeeleh MA, Al Smady M, Shaban M, Al Kharabsheh M, Al-Tamimi Z, *et al*. Heart Dis- ease in Adult Syrian Refugees: Experience at Jordan University Hospital. Ann Glob Health [In- ternet]. 2019 [cited 4 Apr 2021];85(1):36. Availa- ble at: https://doi.org/10.5334/aogh.2474
108. Commodore-Mensah Y, Selvin E, Aboagye J,Turkson-Ocran R-A, Li X, Himmelfarb CD, *et al*.Hypertension, overweight/obesity, and diabetesamong immigrants in the United States: an anal-ysis of the 2010–2016 National Health InterviewSurvey. BMC Public Health [Internet]. 2018 [cit-ed 4 Apr 2021];18(1):773. Available at: https://doi.org/10.1186/s12889-018-5683-3
109. Savadatti SS, Bell EM, Gates MA, Hosler AS, Yu- cel RM, Misra R. Metabolic Syndrome Among Asian Indians in the United States. J Public Health Manag Pract. 2019;25(1):45-52. [DOI]
110. Ghobadzadeh M, Demerath EW, Tura Y. Preva- lence of blood pressure, blood glucose and se- rum lipids abnormalities among Ethiopian immi- grants: A community-based cross-sectional study.J Immigr Minor Health. 2015;17(4):1070-7. [DOI]
111. Sewali B, Harcourt N, Everson-Rose SA, Leduc RE, Osman S, Allen ML, *et al*. Prevalence of car- diovascular risk factors across six African Immi- grant Groups in Minnesota. BMC Public Health [Internet]. 2015 [cited 4 Apr 2021];15(1):411. Available at: https://doi.org/10.1186/s12889-015-1740-3
112. Obisesan O, Kuo W-H, Brunet M, Obisesan A,Akinola O, Commodore-Mensah Y. Predictors of obesity among Nigerian immigrants in the United States. J Immigr Minor Health. 2017;19(2):328-32.[DOI]
113. Patterson F, Zhang G, Davey A, Tan Y, Ma GX. American Heart Association's ideal cardiovascu-lar health metrics in under-represented Asian Americans. J Community Health. 2016;41(6):1282-9. [DOI]
114. Russo V, Santarelli S, Magrini L, Moscatelli P,Altomonte F, Cremonesi G, *et al*. Multicentre Ital- ian analysis on cardiovascular diseases: impact of immigrants' referral to emergency depart- ment. J Cardiovasc Med (Hagerstown). 2017; 18(3):136-43. [DOI]
115. Obiang-Obounou BW. The Length of Residence is Associated with Cardiovascular Disease Risk Factors among Foreign-English Teachers in Ko-rea. Behav Sci [Internet]. 2018 [cited 4 Apr 2021]; 8(1):2. Available at: https://doi.org/10.3390/bs8010002
116. López-Cevallos DF, Escutia G, González-Peña Y, Garside LI. Cardiovascular disease risk factors among Latino farmworkers in Oregon. Ann Epi- demiol. 2019;40:8-12. [DOI]
117. Gany F, Bari S, Gill P, Ramirez J, Ayash C, Loeb R, *et al*. Step on it! Workplace cardiovascular risk assessment of New York City yellow taxi drivers. J Immigr Minor Health. 2016;18(1):118-34. [DOI]
118. Bharmal N, Kaplan RM, Shapiro MF, Mangione CM, Kagawa-Singer M, Wong MD, *et al*. The as- sociation of duration of residence in the United States with cardiovascular disease risk factors among South Asian immigrants. J Immigr Minor Health. 2015;17(3):781-90. [DOI]
119. Bayog ML, Waters CM. Nativity, Chronic Health Conditions, and Health Behaviors in FilipinoAmericans. J Transcult Nurs. 2018;29(3):249-57. [DOI]
120. Klöfvermark J, Hjern A, Juárez SP. Acculturation or unequal assimilation? Smoking during preg- nancy and duration of residence among mi- grants in Sweden. SSM Popul Health [Internet]. 2019 [cited 4 Apr 2021];8:100416. Available at: https://doi.org/10.1016/j.ssmph.2019.100416
121. Parekh T, Desai R, Pemmasani S, Cuellar A. Im- pact of social determinants of health on cardio-vascular diseases. J Am Coll Cardiol. 2020;75(11

Supp 2):1989. [DOI]

122. Muncan B. Cardiovascular disease in racial/eth- nic minority populations: illness burden and overview of community-based interventions. Public Health Rev. 2018;39(1):1-11. [DOI]
123. Bays HE. Ten Things to Know About Ten Cardi- ovascular Disease Risk Factors ("ASPC Top Ten- 2020"). Am J Prev Cardiol [Internet]. 2020 [cited4 Apr 2021];1:100003. Available at: https://doi.org/10.1016/j.ajpc.2020.100003
124. van Anders SM, Schudson ZC, Abed EC, Bei- schel WJ, Dibble ER, Gunther OD, *et al*. Biologi- cal sex, gender, and public policy. Policy In- sights Behav Brain Sci. 2017;4(2):194-201. [DOI]
125. Nielsen SS, Hempler NF, Krasnik A. Issues to consider when measuring and applying socioec- onomic position quantitatively in immigrant health research. Int J Environ Res Public Health. 2013;10(12):6354-65. [DOI]
126. Keister LA, Aronson B. Immigrants in the one percent: The national origin of top wealth own-ers. PLoS One [Internet]. 2017 [cited 4 Apr 2021];12(2):e0172876. Available at: https://doi.org/10.1371/journal.pone.0172876
127. Schultz WM, Kelli HM, Lisko JC, Varghese T, Shen J, Sandesara P, *et al*. Socioeconomic statusand cardiovascular outcomes: challenges and in- terventions. Circulation. 2018;137(20):2166-78. [DOI]
128. Choi M, Mesa-Frias M, Nüesch E, Hargreaves J, Prieto-Merino D, Bowling A, *et al*. Social capital, mortality, cardiovascular events and cancer: a systematic review of prospective studies. Int J Epidemiol. 2014;43(6):1895-920. [DOI]
129. Lindström M, Rosvall M. Two theoretical strands of social capital, and total, cardiovascular, can- cer and other mortality: A population-based pro- spective cohort study. SSM Popul Health [Inter- net]. 2019 [cited 4 Apr 2021];7:100337. Available at: https://doi.org/10.1016/j.ssmph.2018.100337
130. Berry JW. Acculturation strategies and adapta- tion. Immigrant families in contemporary socie- ty. Duke series in child development and public policy. New York: Guilford Press; 2007. p.69-82.
131. Gushulak BD, MacPherson DW. Health aspects of the pre-departure phase of migration. PLoS Med [Internet]. 2011 [cited 4 Apr 2021];8(5): 1001035. Available at: https://doi.org/10.1371/journal.pmed.1001035

3. Chapter 2 Population-based secondary analysis of healthy migrant effect on self-reported health, disability, activity limitations and chronic diseases in Chile

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A comparative analysis of health status of international migrants and local populationin Chile: a population-based, cross-sectional analysis from a social determinants of health perspective

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Abstract

Background: During recent decades intraregional migration has increased in Latin America. Chile became one of the main receiving countries and hosted diverse international migrant groups. Evidence have suggested a healthy migrant effect on health status, but it remains scarce, controversial and needs to be updated. This study performed a comprehensive analysis verifying the existence of HME and its association with social determinants ofhealth

Methods: We analyzed data from the Chilean National Socioeconomic Characterization Survey (CASEN, version 2017). Unadjusted prevalence of health status indicators such as negative self-perceived health, chronic morbidity, disability, and activity limitations were described in both international migrants and local population. Adjusted associations between these outcomes and sets of demographics, socioeconomic, access to healthcare, psychosocial and migration-related SDH were tested using multivariate logistic regression in each population. The HME for each health outcome

was also tested using multivariate logistic regression and sequentially adjusting for each set of SDH (ref = Chilean).

Results: International migrants had lower unadjusted prevalence of all health indicators compared to Chileans. That is, unadjusted analysis revealed an apparent HME in all health outcomes. Age, unemployment, and health care system affiliation were associated with health outcomes in both populations. Psychosocial determinants were both risk and protective for the analysed health outcomes. After adjustment for each set of SDH, the immigrant health advantage was only significant for chronic morbidity. Being migrant was associated with 39% lower odds of having chronic diseases compared to locals (OR: 0.61; 95% CI: 0.44–0.84; $P = 0.0003$). For all other outcomes, HME disappeared after adjusting by SDH, particularly unemployment, type of health system and psychosocial factors.

Conclusions: Testing the HME in Chile revealed an advantage for chronic morbidities that remained significant after adjustment for SDH. This analysis shed light on health disparities between international migrants and local population in the Latin American region, with special relevance of unemployment, type of health system and psychosocial SDH.

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It also informed about differential exposures faced during migration process that could dissolve the HME over time. Evidence from this analytical approach is useful for informing health planning and intersectoral solutions from a SDH perspective.

Keywords: International migration, Healthy migrant effect, Social determinants of health, Health disparities

Background

International migration is a complex process of voluntary or involuntary human mobility [1] that has an influence on health status. Among existing theories related to migration and health, literature has proposed the "healthy migrant effect" hypothesis. This phenomenon postulates that migrants have on average better health outcomes,empirically observed by lower morbidity and mortalityrates when compared to native-born populations. That is, migrants appear to be healthier despite of coming -in many cases- from lower-income developing countries, and despite facing multiple social disadvantages through- out the migration process [2]. One explanatory model has proposed a *positive self-selection* in which those who are healthier and wealthier have a higher chance of moving away from their place of residence [3]. For example, selec-tion applies to those who are younger and those with skillsrelevant to labor market needs [4]. A second explanation is based on healthy behaviors preserved during the migra- tion process, which could be enhanced with favorable life conditions in the destination country [5]. Moreover, it has been postulated that psychosocial resources like social support and social cohesion may be protective for positive reinforcement of healthy behaviors [6, 7], stress manage- ment and disease risk prevention [8].

Approximately 3.6% of the world's population are international migrants, as estimated in 2020 [9]. In Latin America, one of the main migratory flows throughout the last decades has been intraregional, often knownas the south-south migration pattern [10]. Within the region, Chile has experienced a steady increase of inter-national migration fluxes since the early 2000s, withthe latest estimations from the National Institute of Statistics reporting 1.462.103 international migrants at the end of 2020 (8% of the total population). The same report indicated that migrant men were slightly over- represented (50.9%) compared to women, almost halfof migrants were aged between 25 and 35 years old and most of international migrants came from countries within the region such as Venezuela (representing abouta third of all international migrants in the country), Perú, Haiti, Colombia and Bolivia [11]. Similar to other coun-tries and regions, there is great heterogeneity between the international migrant population and the local popu-lation in Chile, as well as within different migrant com-munities, based on demographic and socioeconomic characteristics [12]. This variability is particularly important, since diverse exposures to demographic, socioeconomic and psychosocial determinants during the migration process might have distinctive influences on health and wellbeing [13, 14]. Furthermore, migra- tion itself has been recognized as a social determinant ofhealth, given the potential effect of certain migration cir-cumstances on health risks [15], which makes the rela-tionship between migration and health a public health priority [13].

In Chile, evidence from population-based studies have reported the probable existence of the HME on unadjusted or crude health indicators, such as disability [16, 17], illness, accidents and chronic health conditions[17]. This has also been reported when analyzing hos- pital discharges rates in this country, where migrants have had a lower proportion of infectious diseases, metabolic disorders, mental health conditions, and car-diorespiratory diseases [18]. Recent studies have also observed this advantage in the context of emergency consultations of migrants residing in the northern area of the capital of Chile. For instance, migrants reported lower hospitalization rates and lower prevalence of a number of health conditions [19]. Meanwhile, Peruvian mothers living in Santiago have also shown an advan- tage on perinatal outcomes over native Chilean moth- ers [20]. Interestingly, some studies have proposed that migrants living in different cities in Chile might have healthier behaviors than locals, as they have reported regular physical activity more often than the Chilean- born, which could in turn promote their integration and increase their psychosocial resources [21].

Among the above-mentioned evidence from the Chil-ean context, some authors have tested the healthy migranteffect from the perspective of social determinants of health , defined as "*the conditions in which people are born, grow, work, live and age, and the wider set of forcesand systems shaping the conditions of daily life*" [22]. Forexample, a population-based study showed that the unad- justed advantage of migrants over Chilean population on disability, any health problem and chronic conditionsor cancer disappeared after adjusting by socioeconomic determinants like household income and educational level. Similarly, determinants related to the migration process like length of stay in the country also had an influence on migrants health over time, as it seemed that having been

in Chile for 10 years or more attenuated and dissolvedthe healthy migrant effect [17]. Likewise, another study of Chilean hospital discharges proposed that lower discharges rates could be explained by demographic factors (e.g., age) and reduced access to health care [18]. Therefore, positive selection might not apply to all cases. Evidence suggests that diverse exposures during the migration process could influence the health of international migrants, including determinants such as social exclusion, socioeconomic status and poverty [23].

Literature describes SDH that influence the healthof international migrants, including: i) economic dis- advantage and poor living conditions; ii) the effect ofeducational level on health literacy and behavioral decisions; iii) public policies and migratory laws acting either as facilitators or limiters [24]; iv) psychosocial determinants that could also promote risk according to context of migration and interactions with the host society; for example, the lack or imbalance of psychoso- cial resources such as social support and limited social network could have negative impact on health out- comes [8]; v) access to health care often determined by migratory status (regular versus irregular administra- tive status in the host country) and sociocultural bar- riers to health care [24]. Noteworthy, previous studies have described that migrant population in Chile are more likely to be uninsured and to report a lower useof healthcare services compared to the local popula- tion [25]. International literature has suggested that lower access to healthcare might lead to under-reported existing medical conditions among migrants, raising questions around its influence on HME analysis [26]. Overall, the SDH approach can go beyond merely unad- justed and average comparisons, as it comprehensively explores its influence on the HME.

Currently there is little evidence testing the HME on the health status of international migrants residing in Chile and the Latin American region more generally. Local literature remains inconclusive but recognizes the potential impact of diverse exposures during the migration process. The migrant population in Chile has changed over time in terms of its composition and social determinants, becoming an increasingly heterogeneous group. The evolution of the structure and trends of migration inflows to Chile points out the need of an update analysis of HME under the social determinants of health approach. Since recent evidence does not consider the SDH perspec- tive, conducting this type of analysis would contribute to a more comprehensive understanding of the complex relationship between migration and health, and its implications for public health in Chile and the region. The present study aimed at analyzing the existence of the healthy migrant effect (HME) on self-perceived health, chronic morbidity, disability and activity limitations and its association with different social determinants of health (SDH). This analysis was performed by comparing the health status of international migrants and the Chilean population from a population-representative dataset. In order to test the HME, we investigated the influence of demographic, socioeconomic, access to healthcare, psychosocial and migration-related determinants on such health outcomes. This updated analysis also brings atten- tion to the multidimensional nature of migration in the South American region and the identification of unique determinants of the health among international migrantsin Chile from a SDH perspective.

Methods

Cross-sectional observational study. We conducted a secondary analysis of the National Socioeconomic Characterization Survey (CASEN version 2017). The CASEN survey is regularly applied by the Ministry of Social Development to Chilean households and their residents every two to three years in Chile. Its aim is to describe their socioeconomic situation, multidimensional pov- erty, and income distribution, as well as to identify updated socioeconomic needs among prioritized under- served groups. It is a voluntary survey that encompasses a structured interview conducted by a trained field interviewer and answered by an adult who provides dataon him/herself and all the other household members. This survey is designed with a probabilistic, stratified and multistage sampling that is representative at each national, regional (16 regions), and urban/rural level. It excludes a limited number of hard-to-reach geographical boroughs in the country and institutionalized individu- als (people residing in hospitals, prisons, home cares). The total sample of the 2017 CASEN survey comprised 70.947 households and 216.439 residents, representing an estimated total of 16.843.471 Chilean-born inhab- itants and 777.407 international migrants (those who reported being born in a different country than Chile, i.e., first generation international migrants) residing in the country at the time of data collection. The CASEN survey dataset is public and free of access upon complet-ing an online form from the Ministry of Social Devel- opment Web page [27]. The anonymous dataset can be downloaded after this procedure. This study was partof the Fondecyt Regular project 1,201,461 approved bythe Ethics Committee of the Faculty of Medicine of TheUniversidad del Desarrollo and the Ethics Committee ofthe Servicio de Salud Metropolitano Sur Oriente (South- East Metropolitan Public Health Service). The study complied with ethical guidelines and regulations accord-ing to the principles of the Declaration of Helsinki.

Health status

Health status was examined using the framework of the health module from the European Statistics of Income and Living Condition (EU-SILC) as a reference. The instrument contains 3 different variables with its corresponding concepts [28]. These concepts were used to create new variables from the questions available in the CASEN survey.

Negative Self-perceived health (NSPH): the new variable was created based on the question "from 1 to 7 how would you rate your current health status". According to previous literature the seven-grade scale could be interpreted as 1 very poor health to 7 excellent healththat could not be improved [29]. Like previous studies [30], scores ranging 4–7 represented positive health and scores ranging 1–3 represented negative health. This study focused on negative self-perceived health as an indicator, in order to maintain consistency with the other negative health indicators included in the analysis.

Chronic morbidity (CM): based on the question "haveyou been receiving medical treatment for the past 12 months?". Dichotomized as yes or no according to the presence of hypertension/dental Emergency, diabetes, depression, acute myocardial infarction, cataracts, chronic obstructive pulmonary disease, leukemia, bronchial asthma, cancer (gastric, cervical uterine, breast, testicular, prostate, colorectal), preventive cholecystectomy, chronic kidney failure, ischemic brain accident, bipolar disorder, lupus or another chronic condition.

Disability (DIS): although the EU-SILC framework doesnot separate disability from the activity limitation variable, the CASEN survey includes the following questionfocused on disability [31], from whom the new variable was created: "Do you have any of the following permanent conditions?" Dichotomized as yes or no according to the presence of one or more physical/speaking/psychiatric/mental/hearing/visual conditions.

Activity limitations (AL): The variable was created using all types of daily living activities limitations asked by CASEN. "How much difficulty do you have for...?". This question was restricted to population over 6 years. Dichotomized as yes or no according to the presence of mild, moderate, severe, or extreme difficulty for one or more activities (eating, showering, displacing, using the bathroom, lying down or getting out of bed/ getting dressed).

Social determinants of health

Demographic determinants: age as a continuous and categorical variable (< 6 years, 6–14, 15–29, 30–44, 45–64 and > 64 years). Sex (male, female). Ethnicity for thosebelonging to or being descendant of minority groups in Chile (yes, no), marital status (single, married/cohabitant, separated/divorced/annulled, widow), area (urban, rural).

Socioeconomic determinants: educational level according to the highest level achieved or current level of the household informant (categorized as university or higher, technical, high school, primary, none) according to the adjusted and standardized Chilean educational system, in which the gross categories share similarities with other systems within theregion. This categorization has been used in previous Chilean research performing demographic analysis of both local and migrant population [16, 17]. Household income categorized in five quintiles of equal size sorted in ascending order according to the autonomous per capita household income (I: 273.414 Chilean pesos equivalent to 414 US dollars; II: 486.332 Chilean pesos equivalent to 736 US dollars; III: 687.569 Chilean pesos equivalent to 1040 US dollars; IV: 951.021 Chilean pesos equivalent to 1438 US dollars; V: 2.331.479 Chilean pesos equivalent to 3.526 US dollars). Occupation defined by the occupational activity of the household informant. The variable was created from questions related to current job/occasional job/ on work leave/searching for a job/ attending an educational institution (categorized as unemployed, is not studying, studying, employed, and studying and working).

Access to health care: The variable affiliation to the health care system was used as a proxy of access and created from the question "Which health insurance systemdo you use?". Further categorized as none, public health system affiliation, private health system affiliation, other.

Psychosocial factors: These factors refer to characteristics that could have a psychological and/or social impacton an individual, involving social-level and individual-level processes [32]. Among psychosocial factors, there are protective resources in the social environment such as social support, defined as the perception of value, affection and care from others and social capital relatedto reciprocal interactions based on trust [32, 33]. The social support variable was created from available questions that were mainly related to instrumental social support networks; dichotomized yes or no according to the presence of one or more supportive behaviors from someone at home and outside. The social capital variable was created from a question focusing on belonging and participation in diverse organizations or organized groups over the last 12 months. It was dichotomized asyes or no according to the participation in one or more of these groups.

Migration-related factors: the" country of origin" variable was created as a categorical variable based on the question "When you were born, what country did your mother live in?". The categories were selected according to the intraregional pattern reported in migratory

statistics [11] (Venezuela, Perú, Haiti, Colombia, Bolivia, Argentina, Ecuador, other countries in South America and other). The "length of stay or time of residence in the country" variable was created based on the year period in which the migrant arrived and categorized (2015 or later, 2010–2014, 2005–2009, 2000–2004, 1999 or before).

Statistical analysis

Health status outcomes were analyzed descriptively for international migrants and the Chilean born popu- lation separately. Unadjusted (or crude) prevalence of selected health outcomes was presented as proportions and then stratified by demographic, socioeconomic, access to health care and migration-related determi- nants. The Pearson's chi-square test was used to test independence between migration status (migrant ver- sus Chilean) and health status outcomes. Multivariate logistic regression was used to estimate the probability (odds ratio, OR) of reporting these health outcomes crude and adjusted by each set of SDH in international migrants and local population separately. The asso- ciation between migration-related factors and health outcomes was explored with multivariate logisticregression adjusted by sex and age. Then, the healthy migrant effect (HME) was examined using multivari- ate logistic regression sequentially adjusted for SDH, where NSPH, CM, DIS and AL were dependent vari- ables and migratory status was the main independent variable (reference: Chilean born). The Hosmer-Leme- show goodness of fit test was used as post-estimation after logistic regression. Data analyses were performed with STATA 14 software (Stata Corp) and weighted according to the survey's sampling design. Significance was set at 0.05 with 95% confidence interval (95% CI).

Results

The total sample represented 16.843.471 Chilean-born individuals and 777.407 international migrants (4.4%of the total population in Chile based on the CASEN 2017 analysis). The majority of the sample were women (52.5% Chileans and 51.4% migrants). Regard- ing the age distribution, over 50% of the migrant population were aged 15 to 44 years (34.6% were 15–29 years and 36.1% were 30–44 years old). Mean- while, 22.9% of the local population were 15–29 years old and 17.9% ranged between 30 and 44 years old. Furthermore, 49.7% of Chileans and 44.9% of migrants were single. The educational level differed across these populations, 0.6% of migrants did not have formal edu- cation compared to 2.4% of the native born. In addition, 35.8% of migrants had higher education, whereas 17.4% of Chileans did.

Unadjusted (crude) prevalence of health outcomes International migrants had lower crude prevalence ofNSPH (3.97% vs 5.91%), CM (9.55% vs. 25.97%), DIS (14.63% vs. 23.89%) and AL (5.56 vs. 11.52%). After strati- fying by SDH, both groups showed higher prevalenceof health status outcomes among females, people over64 years, widows, the unemployed and those affiliated to the public health system. The outcomes differed by geo- graphical area, for example prevalence of CM and DIS were higher among local and migrant population livingin rural areas. In contrast, negative self-perceived health and AL were higher among Chileans living in rural areas but lower among migrants. When stratifying by socioeconomic determinants, we observed a clear social gradient in self- perceived health across income quintiles of both groups, migrants and the Chilean-born. Among migrants, higher prevalence of NSPH was observed in those who were uninsured and those with only primary level education. However, CM was higher in migrants with the highest education level and those with private health system affiliation. Conversely, DIS and AL, was higher in those who were affiliated to the public health system (Tables 4, 5 and 6). Furthermore, migrants from Peru showed the highest prevalence of NSPH (6.43%), disability (7.69%) and AL (4.15%) whereas those from Ecuador had the higher percentage of CM (23.37%). Meanwhile, migrants who had arrived in 2015 or later showed higher rates of negative health perception (4.5%), but those who expended more than 20 years had higher rates of CM (31.08%), DIS (16.58%) and activity AL(7.34%) (Table 7).

SDH associated with health outcomes

Logistic regression models for NSPH, CM and DIS adjusted by different set of SDH in migrant populationare presented in Table 8. Models for Activity Limitations in both populations are presented in Table 9. Age was associated with all health outcomes in both popula- tions. Among international migrants, after adjusting for demographic variables, the odds of having NSPH was 7.44 times higher in those unemployed (OR: 7.44; 95%CI: 1.05–52.61). CM was associated with affiliation tothe health system, particularly affiliation to the private health system (OR 4.99; 95% CI: 2.70–9.25), whereas the risk of CM was also associated with having social sup- port (OR: 3.29; 95% CI: 1.29–8.40) and social capital (OR: 1.84; 95% CI:1.23–2.75). Conversely, social support was associated with reduced odds of DIS (OR: 0.23; 95% CI: 0.09–0.60). Moreover, other variables were associ- ated with both reduced and higher odds, for example having social support reduced by 77% the odds of NSPH (OR: 0.23; 95% CI: 0.10–0.55) and AL (OR: 0.13; 95% CI:0.05–0.35) but increased the odds for CM (OR: 3.29; 95%

Table 4 Unadjusted global and stratified prevalence of health outcomes by SDH factors in immigrant population (*n* = 777.407)

Social determinant of health	Negative self-perceived health		Chronic morbidity		Disability	
	n = 30.601		*n* = 74.216		*n* = 43.236	
	%	95% CI	%	95% CI	%	95% CI
	3.97%	**[2.8–5.7%]**	**9.55%**	**[8.3–10.9%]**	**14.63%**	**[13.1–16.3%]**
Sex						
Female	4.67%	[2.7–8.0%]	10.34%****	[8.9–12.0%]	7.07%***	[5.0–10.0%]
Male	3.22%**	[2.4–4.4%]	8.92%****	[6.6–12.0%]	4.01%****	[3.1–5.2%]
Age categories						
<6	1.66%****	[0.5–5.3%]	5.00%****	[2.6–9.5%]	6.45%****	[3.4–11.8%]
6–14 years	3.78%****	[2.1–6.6%]	3.21%****	[1.6–6.3%]	6.02%****	[3.8–9.3%]
15–29 years	2.90%****	[1.8–4.6%]	5.28%****	[2.5–10.7%]	2.98%****	[2.0–4.5%]
30–44 years	3.93%****	[1.6–9.5%]	7.40%****	[6.1–9.0%]	5.53%****	[3.0–10.0%]
45–64 years	5.40%****	[4.0–7.2%]	23.55%****	[19.4–28.2%]	6.29%****	[4.8–8.2%]
65 years or more	13.33%****	[8.9–19.5%]	49.88%****	[41.9–57.9%]	29.41%****	[22.3–37.6%]
Ethnicity						
Yes	5.67%	[3.6–8.8%]	10.44%****	[7.5–14.5%]	7.40%*	[5.2–10.4%]
No	3.92%*	[2.7–5.7%]	9.63%****	[8.4–11.1%]	5.53%****	[4.2–7.3%]
Marital Status						
Single	4.21%	[2.1–8.4%]	7.71%**	[5.4–11.0%]	6.05%	[3.7–9.6%]
Married/cohabitant	3.02%****	[2.2–4.1%]	9.35%****	[7.9–11.1%]	4.39%****	[3.6–5.4%]
Separated/divorced/annulled	7.55%	[3.8–14.6%]	22.55%****	[15.8–31.1%]	6.16%***	[3.4–10.9%]
Widow	19.81%	[12.1–30.8%]	46.18%****	[35.3–57.4%]	32.13%	[22.4–43.7%]
Area						
Urban	4.02%	[2.8–5.8%]	9.51%****	[8.2–11.0%]	5.56%****	[4.2–7.3%]
Rural	2.40%**	[1.2–4.9%]	13.76%****	[9.7–19.1%]	6.27%***	[4.2–9.3%]
Educational level						
None	3.65%	[1.8–7.3%]	5.60%****	[3.2–9.6%]	8.42%*	[5.2–13.3%]
University	2.90%	[1.7–4.9%]	13.96%*	[9.9–19.4%]	3.80%**	[2.7–5.4%]
Technical	1.68%**	[1.0–3.0%]	7.52%****	[5.2–10.8%]	3.56%**	[2.0–6.1%]
High School	4.73%	[2.4–9.3%]	7.77%****	[6.5–9.3%]	5.91%*	[3.5–9.9%]
Primary	5.67%**	[4.2–7.7%]	9.95%****	[7.7–12.8%]	8.25%****	[6.3–10.7%]
Income quintile						
I	4.71%*	[3.0–7.4%]	8.73%****	[6.5–11.7%]	5.63%****	[3.7–8.4%]
II	6.01%	[4.3–8.4%]	8.68%****	[6.9–10.9%]	7.68%**	[5.2–11.2%]
III	5.80%	[1.9–16.8%]	8.29%****	[6.3–10.8%]	9.40%	[4.7–18.0%]
IV	1.91%****	[1.3–3.0%]	7.73%****	[6.2–9.6%]	3.93%****	[2.8–5.5%]
V	3.30%	[2.0–5.3%]	14.10%****	[10.1–19.3%]	3.13%****	[2.1–4.7%]
Occupation						
Does not study	0.91%	[0.2–3.6%]	2.73%	[1.0–7.6%]	4.12%	[1.5–11.0%]
Unemployed	9.41%	[4.8–17.8%]	17.46%****	[14.1–21.4%]	13.05%**	[8.1–20.3%]
Studying	3.85%	[1.1–12.2%]	8.53%	[5.2–13.8%]	4.33%	[2.5–7.4%]
Employed	2.59%**	[1.9–3.5%]	7.37%****	[6.0–9.0%]	3.38%****	[2.7–4.3%]
Studying or/and employed	0.54%*	[0.1–2.9%]	45.35%**	[13.9–81.0%]	1.92%	[0.5–6.6%]
Access to healthcare						
None	2.48%**	[1.5–4.2%]	3.78%****	[2.5–5.6%]	4.70%*	[2.8–7.8%]
Public health system affiliation	4.36%	[2.7–7.0%]	9.15%****	[7.8–10.8%]	6.48%****	[4.7–8.9%]
Private health system affiliation	4.10%	[2.1–7.9%]	18.78%	[11.1–29.9%]	2.95%****	[1.9–4.5%]
Others	2.55%	[1.0–6.2%]	13.67%**	[7.6–23.3%]	3.93%**	[1.7–8.7%]

Table 4 (continued)

Social determinant of health	Negative self-perceived health		Chronic morbidity		Disability	
	n =30.601		*n* =74.216		*n* =43.236	
	%	95% CI	%	95% CI	%	95% CI
	3.97%	**[2.8–5.7%]**	**9.55%**	**[8.3–10.9%]**	**14.63%**	**[13.1–16.3%]**
Social Support						
Yes	4.33%***	[3.2–5.9%]	13.54%****	[10.7–17.1%]	4.30%****	[3.3–5.6%]
No	30.13%	[6.6–72.5%]	3.54%****	[1.4–8.7%]	30.54%	[6.8–72.7%]
Social capital						
Yes	3.93%**	[2.7–5.7%]	15.42%****	[12.5–18.9%]	6.03%****	[4.6–7.9%]
No	4.05%*	[2.6–6.3%]	9.05%****	[7.4–11.0%]	5.44%****	[3.9–7.6%]

* *p* value < 0.05; ** *p* value < 0.01; *** *p* value < 0.001; **** *p* value < 0.0001 when comparing the same category between the Chilean-born and the immigrant populations (Chi-square test). *CI* confidence interval

CI: 1.29–8.40). Likewise, being married/cohabitating was associated with less chances of DIS (OR: 0.50; 95% CI: 0.29–0.87) and AL (OR: 0.24; 95% CI: 0.09–0.62).

Regarding migration-related factors (Table 10.), those from Haiti had higher odds of NSPH (OR: 4.67; 95% CI: 1.31–16.66) and DIS (OR: 2.88; 95% CI: 0.15–7.19), while those from Argentina showed higher risk of CM (OR: 1.42; 95% CI: 0.59–3.42). Staying over 20 years in Chile was associated with 11.04 times more chances of DIS (OR: 11.04; 95% CI: 3.65–33.40).

Diverse variables were associated with health status among the Chilean population, including all demographic factors (Table 11.). After adjusting by demographics, the lack of educational attainment wasassociated with a higher risk of NSPH, CM and DIS. Inaddition, being unemployed was associated with having NSPH (OR: 2.23; 95% CI: 1.72–2.89) and DIS (OR: 3.04; 95% CI: 2.49–3.70). The public health system affiliation was associated with higher odds of CM (OR: 1.83; 95% CI: 1.60–2.10) and DIS (OR: 1.24; 95% CI: 1.05–1.47).

Meanwhile, those married/cohabitating were 58% less likely to have AL (OR: 0.42; 95% CI: 0.39–0.45), and 45% of having DIS (OR: 0.55; 95% CI: 0.52–0.58), while also presenting reduced odds of NSPH and CM. The highest level of income quintile was associated with 48% less chance of having NSPH (OR: 0.52; 95% CI: 0.46–0.59),as well as reduced odds of DIS (OR: 0.76; 95% CI: 0.69– 0.85) and AL (OR: 0.73; 95% CI: 0.63–0.84). Among psychosocial factors, having social support was asso- ciated with 38% less odds of NSPH (OR: 0.62; 95% CI: 0.50–0.76), whereas social capital increased the odds of having CM (OR: 1.21; 95% CI: 1.15–1.27).

Findings on the healthy migrant effect

The odds of reporting each health outcome under study when being an international migrant (compared to Chileans as the reference) were calculated and progressively adjusted by each set of SDH (Table 12.). The unadjusted crude analysis revealed a healthy migrant effect, since being an immigrant was significantly associated with lower odds of presenting all health outcomes. After controlling for demographics, being an internationalmigrant was no longer protective for NSPH and AL. However, after adjusting by socioeconomic covariates, only the association with CM remained significant. The subsequent models showed the presence of a healthy migrant effect for CM after controlling for access to health care and psychosocial factors. Being an interna- tional migrant was associated with 39% lower odds of chronic morbidity compared to Chilean population (OR: 0.61; 95% CI: 0.44–0.84; *P* =< 0.000).

Discussion

Based on a secondary analysis of a nationally representa- tive and anonymous survey conducted in Chile in 2017,we estimated the prevalence of a number of health out- comes among international migrants and the local pop- ulation, as well as their association with demographic,socioeconomic, healthcare, psychosocial, and migratorySDH. After this, we tested the existence of the HME in each of these health outcomes. Results showed that migrants reported lower unadjusted prevalence of all the health outcomes under study compared to locals. In both groups, unemployment, affiliation to the health sys- tem and psychosocial factors were significantly associ- ated with these outcomes. Among migrants, having lived in Chile for 20 years or more was associated with higher odds of reporting disability. Crude unadjusted models showed an apparent migrant's health advantage regard-ing NSPH, CM, DIS and AL. However, after adjustingby demographics, socioeconomics, health care affiliation and psychosocial factors, being an international migrant

Table 5 Unadjusted global and stratified prevalence of health outcomes by SDH factors in Chilean born population (*n* = 16.843.471)

Social determinant of health	Negative self-perceived health		Chronic morbidity		Disability	
	n = 985.235		*n* = 4.374.959		*n* = 1.939.571	
	%	95% CI	%	95% CI	%	95% CI
	5.91%	**[5.7–6.1%]**	**25.97%**	**[25.6–26.4%]**	**23.89%**	**[23.6–24.2%]**
Sex						
Female	6.61%	[6.4–6.9%]	30.55%****	[30.0–31.1%]	12.59%***	[12.2–13.0%]
Male	5.14%**	[4.9–5.4%]	21.47%****	[21.1–21.9%]	10.43%****	[10.1–10.7%]
Age categories						
<6	2.81%***	[2.5–3.2%]	7.95%***	[7.2–8.7%]	5.10%***	[5.4–6.4%]
6–14 years	2.61%***	[2.3–2.9%]	8.56%***	[8.1–9.1%]	5.10%***	[4.6–5.6%]
15–29 years	2.48%***	[2.3–2.7%]	8.85%***	[8.4–9.3%]	5.87%***	[5.4–6.4%]
30–44 years	4.25%***	[3.9–4.6%]	16.29%***	[15.7–17.0%]	5.87%***	[5.4–6.4%]
45–64 years	7.98%***	[7.7–8.3%]	39.44%***	[38.8–40.1%]	8.93%***	[8.6–9.2%]
65 years or more	14.23%***	[13.7–14.8%]	67.80%***	[67.0–68.6%]	32.04%***	[31.1–32.9%]
Ethnicity						
Yes	5.69%	[5.2–6.2%]	21.36%****	[20.5–22.2%]	11.24%*	[10.6–11.9%]
No	5.93%*	[5.7–6.1%]	26.78%****	[26.4–27.2%]	11.61%****	[11.3–11.9%]
Marital Status						
Single	3.77%	[3.6–4.0%]	13.57%**	[13.1–14.0%]	8.17%	[7.9–8.5%]
Married/cohabitant	7.15%****	[6.9–7.4%]	35.04%****	[34.4–35.7%]	12.43%****	[12.0–12.9%]
Separated/divorced/annuled	8.54%	[7.9–9.2%]	40.18%****	[39.0–41.3%]	15.12%***	[14.3–16.0%]
Widow	14.54%	[13.7–15.4%]	67.53%****	[66.4–68.7%]	35.48%	[34.2–36.8%]
Area						
Urban	5.80%	[5.6–6.0%]	25.93%****	[25.5–26.4%]	11.45%****	[11.1–11.8%]
Rural	6.67%**	[6.3–7.1%]	28.31%****	[27.4–29.2%]	12.34%***	[11.7–13.0%]
Educational level						
None	6.32%	[5.9–6.8%]	18.08%****	[17.2–19.0%]	13.89%*	[13.2–14.6%]
University	2.92%	[2.7–3.2%]	19.89%*	[19.2–20.6%]	6.78%**	[6.3–7.3%]
Technical	3.71%**	[3.3–4.2%]	21.58%****	[20.5–22.7%]	7.57%**	[6.9–8.3%]
High School	5.71%	[5.5–6.0%]	26.68%****	[26.1–27.2%]	10.60%*	[10.3–11.0%]
Primary	8.30%**	[8.0–8.6%]	33.48%****	[32.8–34.1%]	15.74%****	[15.2–16.3%]
Income quintile						
I	7.89%*	[7.5–8.3%]	27.31%****	[26.6–28.0%]	14.24%****	[13.7–14.8%]
II	6.60%	[6.3–7.0%]	26.08%****	[25.4–26.7%]	12.34%**	[11.8–12.9%]
III	6.08%	[5.7–6.5%]	26.58%****	[25.8–27.4%]	11.92%	[11.4–12.5%]
IV	5.02%****	[4.7–5.4%]	26.45%****	[25.7–27.2%]	10.20%****	[9.7–10.7%]
V	2.99%	[2.7–3.3%]	24.33%****	[23.4–25.3%]	7.90%****	[7.3–8.5%]
Occupation						
Does not study	2.91%	[2.4–3.5%]	6.59%	[5.8–7.5%]	5.03%	[4.4–5.8%]
Unemployed	11.88%	[11.5–12.3%]	48.73%****	[48.1–49.4%]	23.46%**	[22.9–24.1%]
Studying	2.10%	[1.9–2.4%]	9.49%	[8.9–10.2%]	5.51%	[5.1–6.0%]
Employed	4.20%**	[4.0–4.4%]	23.54%****	[23.1–24.0%]	7.61%****	[7.3–7.9%]
Studying or/and employed	2.94%*	[2.2–3.9%]	10.76%**	[9.5–12.2%]	5.71%	[4.6–7.1%]
Access to healthcare						
None	4.98%**	[4.1–6.1%]	13.63%****	[12.3–15.1%]	8.01%*	[6.9–9.2%]
Public health system affiliation	6.54%	[6.3–6.7%]	27.77%****	[27.3–28.2%]	12.68%****	[12.4–13.0%]
Private health system affiliation	2.86%	[2.5–3.2%]	20.68%	[19.7–21.7%]	6.34%****	[5.8–6.9%]
Others	5.66%	[4.9–6.6%]	28.49%**	[26.4–30.7%]	11.22%**	[9.9–12.6%]

Table 5 (continued)

Social determinant of health	Negative self-perceived health		Chronic morbidity		Disability	
	n = 985.235		*n* = 4.374.959		*n* = 1.939.571	
	%	95% CI	%	95% CI	%	95% CI
	5.91%	**[5.7–6.1%]**	**25.97%**	**[25.6–26.4%]**	**23.89%**	**[23.6–24.2%]**
Social Support						
Yes	7.54%***	[7.3–7.8%]	40.40%****	[39.8–41.0%]	15.00%****	[14.5–15.5%]
No	14.06%	[11.8–16.6%]	40.92%****	[36.7–45.3%]	20.26%	[17.4–23.5%]
Social capital						
Yes	6.36%**	[6.1–6.7%]	36.23%****	[35.6–36.9%]	13.71%****	[13.2–14.2%]
No	6.41%*	[6.2–6.6%]	26.18%****	[25.7–26.6%]	12.05%****	[11.7–12.4%]

* *p* value < 0.05; ** *p* value < 0.01; *** *p* value < 0.001; **** *p* value < 0.0001 when comparing the same category between the Chilean-born and the immigrant populations (Chi-square test). *CI* confidence interval

only conferred protection for chronic morbidity. Previous evidence from the CASEN survey-2006 revealed a crude and adjusted by demographics advantage for any disability, health problem/accident and any chronic condition. In contrast to our findings, this advantage was no longer significant after controlling for socioeconomic and material covariates. Thus, the healthy migrant effectdid not persist for any health outcome, highlighting the influence of poor socioeconomic status on health decline[17]. Other crude comparisons between international migrants and local population in South America, have suggested a probable existence of healthy migrant effect on chronic conditions. In Colombia, migrants from Ven-ezuela had a lower self-reported prevalence of chronic diseases such as hypertension, cardiovascular diseases, diabetes mellitus and cancer than local population [34], similar to the smaller percentage of chronic conditions reported by Venezuelans in Peru [35]. Data from other sources such as hospital discharges, have revealed crudelower rates of CM in migrants residing in Chile [18]. Moreover, adjusted analysis on cancer hospital dischargesalso showed a potential advantage on this indicator [36].

The migrant advantage on CM could be explained by a positive selection, where those who decide to migrate are healthier than those who decided to stay. This better baseline health could be derived from access to a healthy diet and lower environmental risks, among other exposures in the country of origin, as well as their attitude towards long-term health by adopting healthier behaviors that might reduce risks factors for chronic diseases, while those who have medical conditions are more prone to returning [37]. This explanation might be complementary to the "cultural buffering" of the migrant's group, whose norms reduce risky behaviors and promotes healthy decision making [38]. CASEN survey does not provide information related to behavioral factors; however, data from the Chilean national health survey (ENS 2016–2017) revealed elevated levels of alcohol consumption, smoking, sedentary lifestyle and low fruit and vegetable consumption among the general population. It also reported growing prevalence of chronic conditions such as type II diabetes mellitus, hypertension, dyslipidemia and obe- sity in the country [39]. Chile has experienced an epidemiological transition in the past century, moving away from infectious diseases and towards chronic conditions.In this process, the overall non-communicable disease (NCDs) burden has increased significantly, on average the Chilean adult population has four or more diseases [40] and NCDs have become the leading causes of deathin Chile [41]. Compared to other countries in the Latin American region, Chile has a relatively higher rate ofdeaths caused by chronic diseases, which in turn con-trasts with the lower self-reported rates of such condi- tions in the countries of origin of international migrants [42]. Therefore, the advanced epidemiological transitionin Chile could yield a health gap between migrants and locals, that needs to be analyzed throughout the migrant life trajectory and with a SDH perspective.

The existing literature has suggested that HME disappears over time, meaning that the longer the length of stay in the receiving country, the higher the chance that migrants´ health assimilates to that of the native population [43]. This deterioration might be the result of cumulative exposures to health risk factors and other determinants, such as unhealthy behaviors that couldbe observed in the host society (e.g. smoking, alcohol consumption, poor diet), acculturative stress, discrimination and precarious living conditions [43, 44]. Our findings show a higher prevalence of unadjusted CM for migrants who have been living in Chile for over 20 years. However, time of residence was not associated with CMin the partially adjusted model. Thus, the exposure to

Table 6 Unadjusted global and stratified prevalence of activity limitations by SDH in immigrant (n = 746.600) and Chilean bornpopulation (n = 15.538.162), aged 6 years or more

Social determinants of health	Activity limitations			
	Chilean born population		Migrant population	
	n = 812.277		n = 17.846	
	%	95% CI	%	95% CI
	11.52%	**[11.2–11.8%]**	**5.56%**	**[4.3–7.2%]**
Sex				
Female	6.18%	[6.0–6.4%]	3.39%	[1.6–7.1%]
Male	4.16%****	[4.0–4.4%]	1.33%****	[0.9–2.1%]
Age categories				
< 6				
6–14 years	4.57%****	[4.2–5.0%]	4.46%****	[1.9–10.4%]
15–29 years	0.81%****	[0.7–0.9%]	0.34%****	[0.2–0.8%]
30–44 years	1.27%****	[1.1–1.5%]	2.45%****	[0.6–9.5%]
45–64 years	4.59%****	[4.3–4.9%]	1.75%****	[0.1–2.8%]
65 years or more	19.01%****	[18.4–19.7%]	21.14%****	[15.1–28.8%]
Ethnicity				
Yes	4.68%	[4.3–5.1%]	4.79%	[3.1–7.4%]
No	5.29%**	[5.1–5.5%]	2.32%**	[1.3–4.2%]
Marital Status				
Single	3.50%	[3.3–3.7%]	3.16%	[1.2–8.2%]
Married/cohabitant	4.65%****	[4.4–4.9%]	1.12%****	[0.7–1.7%]
Separated/divorced/annulled	6.34%****	[5.8–7.0%]	1.17%****	[0.5–2.9%]
Widow	23.99%	[22.9–25.1%]	29.22%	[19.9–40.7%]
Area				
Urban	5.15%**	[5.0–5.3%]	2.40%**	[1.3–4.3%]
Rural	5.75%**	[5.4–6.1%]	2.21%**	[1.2–4.0%]
Educational level				
None	24.50*	[23.0–26.1%]	9.33%*	[3.0–25.3%]
University	1.73%*	[1.5–2.0%]	0.95%*	[0.6–1.6%]
Technical	1.66%**	[1.4–2.0%]	0.49%**	[0.2–1.2%]
High School	3.78%	[3.6–4.0%]	2.85%	[0.9–8.3%]
Primary	8.19%**	[7.9–8.5%]	4.15%**	[2.6–6.6%]
Income quintile				
I	7.38%****	[7.0–7.8%]	2.86%****	[1.8–4.6%]
II	5.76%****	[5.5–6.1%]	1.71%****	[1.1–2.6%]
III	5.15%	[4.8–5.5%]	5.17%	[1.4–17.7%]
IV	4.16%*	[3.9–4.5%]	1.75%*	[0.9–3.6%]
V	2.99%***	[2.7–3.3%]	1.38%***	[0.9–2.2%]
Occupation				
Does not study	33.81%****	[21.8–48.3%]	1.77%****	[0.2–14.0%]
Unemployed	12.33%	[11.9–12.7%]	7.69%	[3.4–16.5%]
Studying	0.62%	[0.5–0.8%]	0.95%	[0.4–2.5%]
Employed	1.61%****	[1.5–1.8%]	0.61%****	[0.4–1.1%]
Studying and work	0.29%	[0.1–0.6%]	0.93%	[0.2–5.6%]
Access to healthcare				
None	2.51%	[1.9–3.2%]	1.58%	[0.7–3.7%]
Public health system affiliation	5.92%*	[5.7–6.1%]	2.75%*	[1.3–5.8%]
Private health system affiliation	1.93%	[1.7–2.2%]	1.47%	[0.8–2.7%]
Others	5.84%	[4.9–6.9%]	2.71%	[1.0–7.0%]

Table 6 (continued)

Social determinants of health	Activity limitations			
	Chilean born population		Migrant population	
	n = 812.277		*n* = 17.846	
	%	95% CI	%	95% CI
	11.52%	**[11.2–11.8%]**	**5.56%**	**[4.3–7.2%]**
Social support				
Yes	6.48%****	[6.2–6.8%]	1.62%****	[1.0–2.5%]
No	8.18%	[6.6–10.1%]	29.01%	[5.8–73.0%]
Social capital				
Yes	5.42%****	[5.2–5.7%]	2.06%****	[1.3–3.2%]
No	5.19%*	[5.0–5.4%]	2.30%*	[1.1–4.8%]

*p value < 0.05; **p value < 0.01; ***p value < 0.001; ****p value < 0.0001 when comparing the same category between the Chilean-born and the immigrant populations (Chi-square test). *CI* confidence interval

diverse factors during the migration process does not seem to dissolve the advantage for chronic diseases seen in international migrants residing in Chile. In contrast, this protection might not apply for some long-term con-ditions such as disability, which was associated with a time of residence of 20 years or more. Findings suggest that even when migrants experience advantages in other health outcomes, they continue to face higher preva- lence of disability compared to locals. There is also datasuggesting that cumulative disadvantage resulting from social vulnerability could lead to occupational risks like high physical job demands, abuse and unsafe conditions that might play a role in the development of functional impairment [45]. There are some studies indicating that older migrants with a longer length of stay tend to dis- play higher disability rates than both recent migrants and the local population [45, 46]. Furthermore, lengthof stay in the host country has also been inversely asso-ciated with self-perceived health which is in accordancewith evidence reporting poor health perception in recent

Table 7 Crude and stratified prevalence of health outcomes by migration-related factors in immigrant population

Negative self-perceivedhealth			Chronic morbidity		Disability		Activity limitations	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Country of Origin								
Venezuela	1.93%	[0.94–3.90%]	7.90%	[3.97–15.11%]	4.36%	[2.57–7.33%]	0.96%	[0.44–2.07%]
Peru	6.43%	[2.71–14.50%]	8.65%	[6.94–10.74%]	7.69%	[3.76–15.08%]	4.15%	[1.04–15.21%]
Haiti	4.67%	[2.60–8.25%]	1.79%	[0.79–3.99%]	2.94%	[1.65–5.17%]	0.58%	[0.20–1.70%]
Colombia	2.75%	[1.37–5.47%]	6.22%	[4.14–9.25%]	4.23%	[2.50–7.06%]	1.91%	[0.69–5.18%]
Bolivia	2.95%	[1.89–4.59%]	7.11%	[5.22–9.63%]	5.85%	[4.28–7.93%]	3.15%	[2.12–4.67%]
Argentina	2.36%	[1.22–4.52%]	20.49%	[16.24–25.50%]	7.21%	[5.04–10.22%]	2.27%	[1.28–3.99%]
Ecuador	4.48%	[2.41–8.17%]	23.37%	[14.00–36.37%]	4.47%	[2.55–7.71%]	1.37%	[0.43–4.24%]
Other countries inSouth America	4.61%	[1.95–10.49%]	14.46%	[9.40–21.59%]	4.06%	[1.59–10.01%]	1.53%	[0.46–4.93%]
Others	5.79%	[3.81–8.71%]	18.52%	[14.63–23.17%]	7.89%	[5.80–10.65%]	4.32%	[2.96–6.27%]
Time of residence								
2015 o later	4.56%	[2.71–7.58%]	8.04%	[3.47–17.54%]	3.00%	[2.11–4.23%]	0.23%	[0.03–1.62%]
2010–2014	3.71%	[1.14–11.37%]	6.84%	[3.40–13.27%]	3.12%	[1.29–7.34%]	2.48%	[1.69–3.63%]
2005–2009	1.11%	[0.33–3.67%]	4.46%	[1.16–15.67%]	8.07%	[3.23–18.76%]	0.29%	[0.04–2.13%]
2000–2004	0.73%	[0.16–3.28%]	7.99%	[2.57–22.18%]	3.65%	[0.58–19.76%]	0.23%	[0.03–1.72%]
1999 or before	2.68%	[0.86–7.99%]	31.08%	[21.69–42.34%]	16.58%	[10.02–26.19%]	7.34%	[3.38–15.23%]
doesn't know	4.00%	[2.11–6.70%]	13.73%	[10.84–17.23%]	6.12%	[4.51–8.24%]	3.47%	[2.39–5.03%]

CI confidence interval

Table 8 Logistic regression models of health outcomes by SDH in immigrant population

	Self-perceived bad health			Chronic morbidity			Disability		
	OR	**95% CI**	***P* value**	**OR**	**95% CI**	***P* value**	**OR**	**95% CI**	***P* value**
Demographic									
Age	**1.02****	**[1.01–1.03]**	**< 0.000**	**1.06****	**[1.05–1.07]**	**< 0.000**	**1.03****	**[1.02–1.04]**	**< 0.000**
Sex (ref = male)	1.33	[0.67–2.66]	0.410	1.01	[0.61–1.65]	0.983	**1.65***	**[1.05–2.60]**	**0.029**
Ethnicity: (ref = no ethnicity)	1.62	[0.89–2.95]	0.114	0.85	[0.52–1.41]	0.532	1.29	[0.82–2.04]	0.267
Marital status (ref = single)									
Married/Cohabitant	0.54	[0.23–1.29]	0.167	0.65	[0.41–1.05]	0.076	**0.50****	**[0.29–0.87]**	**0.014**
Separated/divorced/annuled	1.07	[0.32–3.57]	0.917	1.01	[0.57–1.80]	0.965	0.49	[0.22–1.10]	0.081
Widow	1.66	[0.42–6.57]	0.473	0.67	[0.37–1.19]	0.169	1.50	[0.60–3.77]	0.387
Zone (ref = urban)	**0.48****	**[0.27–0.83]**	**0.009**	1.13	[0.67–1.93]	0.628	0.96	[0.66–1.40]	0.848
GOF test			< 0.000			0.033			0.129
Socioeconomic									
Educational level (ref = none)									
University	0.72	[0.22–2.39]	0.596	1.56	[0.58–4.18]	0.380	**0.33***	**[0.14–0.82]**	**0.017**
Technical	0.39	[0.12–1.31]	0.128	1.04	[0.41–2.63]	0.933	**0.29****	**[0.12 - 0.75]**	**0.011**
High School	0.92	[0.29–2.97]	0.891	1.14	[0.46–2.79]	0.777	**0.42***	**[0.19–0.97]**	**0.042**
Primary	1.12	[0.38–3.30]	0.836	1.37	[0.57–3.29]	0.484	0.48	[0.22 - 1.03]	0.061
Income quintile (ref = I lower income level)									
II	1.43	[0.75–2.73]	0.273	1.09	[0.66–1.78]	0.742	1.49	[0.76 - 2.92]	0.245
III	1.43	[0.36–5.67]	0.609	0.92	[0.56–1.52]	0.758	2.44	[0.85 - 7.00]	0.097
IV	0.54	[0.27–1.10]	0.090	0.82	[0.50–1.36]	0.446	0.99	[0.47–2.05]	0.969
V	0.86	[0.35–2.14]	0.753	1.16	[0.68–1.97]	0.588	0.81	[0.36 - 1.80]	0.602
Occupation (ref = does not study)									
Unemployed	**7.44***	**[1.05–52.61]**	**0.044**	0.54	[0.13–2.24]	0.400	2.61	[0.52 - 13.17]	0.242
Studying	4.01	[0.52–31.04]	0.183	1.28	[0.32–5.15]	0.614	1.66	[0.38 - 7.29]	0.503
Employed	2.98	[0.51–17.22]	0.223	0.35	[0.10–1.30]	0.118	1.03	[0.26 - 4.08]	0.966
Studying and work	0.73	[0.07–7.47]	0.793	5.30	[0.57–49.68]	0.144	0.91	[0.15 - 5.44]	0.919
GOF test			0.084			0.536			0.220
Access to healthcare (ref = none)									
Public health system affiliation	2.02	[0.93–4.42]	0.076	**2.94****	**[1.82–4.73]**	**< 0.000**	1.41	[0.68–2.96]	0.357
Private health system affiliation	**3.40****	**[1.30–8.86]**	**0.012**	**4.99****	**[2.70–9.25]**	**< 0.000**	0.77	[0.34 - 1.72]	0.521
Other	1.11	[0.39–3.10]	0.849	**2.99****	**[1.29–6.91]**	**0.011**	0.74	[0.26 - 2.17]	0.593
Doesn't know	1.28	[0.50–3.26]	0.602	0.98	[0.38–2.57]	0.973	0.73	[0.26 - 2.11]	0.567
GOF test			0.574			0.000			0.445
Psychosocial									
Social support (ref = no)	**0.23*****	**[0.10–0.55]**	**0.001**	**3.29****	**[1.29–8.40]**	**0.013**	**0.23****	**[0.09 - 0.60]**	**0.003**
Social capital (ref = no)	0.88	[0.51–1.53]	0.651	**1.84***	**[1.23–2.75]**	**0.030**	1.09	[0.59–2.01]	0.774
GOF test			0.014			< 0.000			0.747

CI confidence interval; *p value < 0.05; **p value < 0.01; ***p value < 0.001; ****p value < 0.0001

migrants [47]. However, studies on self-perceived health trajectories have shown that it could either remain sta- ble or decline over time at a similar rate as locals. This evidence contrast to the inverse relationship commonly reported in cross-sectional studies [48].

Regarding the psychosocial resources, previous evi- dence have highlighted their protective role for migrants' health [6, 8]. Our results showed both risk and protective associations between psychosocial factors and the health outcomes under study. Particularly, these factors were associated with increased odds of DI and CM but were protective for the remaining health outcomes. This dual effect has been previously suggested for migrant's networks [49]. Depending on the composition of the networks, international migrants might be differentially exposed to healthyor risky behaviors (e.g., alcohol consumption determined

Table 9 Logistic regression models of activity limitations by SDH in immigrant and Chilean born populations

	Activity limitations					
	Immigrant			**Chilean born**		
	OR	**95% Cl**	**P value**	**OR**	**95% Cl**	**P value**
Demographic						
Age	**1.04*** **	**[1.02-1.07]**	**0.001**	**1.06**** **	**[1.05-1.06]**	**<0.000**
Sex (ref— male)	2.13	[0.77 - 5.90]	0.146	**1.18**** **	**[1.12-1.24]**	**<0.000**
Ethnicity: (ref—no ethnicity)	2.25'	[1.13-4.50]	0.021	**1.17*** **	**[1.07-1.28]**	**0.001**
Marital status (ref— single)						
Married/Cohabitant	**0.24** **	**[0.09-0.62]**	**0.003**	**0.42**** **	**[0.39-0.45]**	**<0.000**
Separated/divorced/annuled	**0.15** **	**[0.04 - 0.55]**	**0.004**	**0.54**** **	**[0.48-0.60]**	**<0.000**
Widow	1.67	(0.46-6.01]	0.434	**0.89***	**[0.81-0.98]**	**0.014**
Zone (ref= urban)	0.69	[037-1.28)	0.239	1.04	[096-1.12]	0.384
GOF test			<0.000			<0.000
Socioeconomic						
Educational level (ref—none)						
University	0.36	(0.10- 1.27]	0.112	**0.22**** **	**[0.18-0.27]**	**<0.000**
Technical	**0.20***	**[0.43 - 0.90]**	**0.037**	0.22	[0.18-0.27]	0.057
High School	1.03	(0.31 -3.43]	0.958	0.29	[026-0.34]	0.235
Primary	0.67	[0.20 - 2.30]	0.527	0.38	[0.33-0.43]	0.604
Income quintile (ref= lower income level)						
II	0.71	[0.31 - 165]	0.434	0.93	[0.86-1.01]	0.083
III	4.23	[089 - 19.98]	0.069	**0.85**** **	**[0.77-0.93]**	**<0.000**
IV	0.98	[0.31-308]	0.975	**0.79**** **	**[0.71-0.88]**	**<0.000**
V	1.12	[0.38 - 3.33]	0.840	**0.73**** **	**[0.63-0.84]**	**<0.000**
Occupation (ref = none)						
Studying or/and employed	1.66	[0.38 - 7.29]	0.503	**0.01**** **	**[0.00-0.02]**	**<0.000**
GOF test			0.220			<0.000
Access to healthcare (ref = none)						
Public health system affiliation	1.32	[0.34-5.18]	690	1.33	[099-1.79	0.058
Private health system affiliation	1.21	[0.32 - 4.67]	0.777	0.95	[068-1.31]	0.740
Other	0.55	[0.08 - 3.55]	0.527	1.21	[0.85-1 74]	0.292
Doesn't know	1.45	[0.38 - 5.54]	0.584	1.15	[080-1.68]	0.450
GOF test			0.445			<0.000
Psychosocial						
Social support (ref= no)	**0.13**** **	**[0.05-0.35]**	**< 0.000**	1_06	[0.83-1.35]	0.648
Social capital (ref—no)	0.72	[0.29-1.81]	0.484	**0.83**** **	**[0.76-0.90]**	**<0.000**
GOF test			0.747			<0000

Cl confidence Interval; *p value <0.05; **p value <0.01; ***p value <0.001; ****p value <0.0001;

by social situations, religious norms and ethnic identity) [50]. Meanwhile, social support might differ according to the migrant's characteristics, migration-related factors, social contexts and types of supportive social ties. There is literature describing the "isolation paradox", accord-ing to which migrants with poor social support were healthier than natives with similar isolation levels. The expected gradient between social support and good health has not always been seen in migrant population, as those with greater social support could also display poor health

outcomes [51]. Moreover, the CASEN survey asks if the participant was under treatment in the past 12 months for CM. Thus, the association might result from the positive influence of social networks on health care utilization and health seeking behavior. Similarly, having health insurance could lead to increased access to diagnosis and treatment [52], which could explain the association between CM and healthcare affiliation, as these priority conditions are covered by the "Explicit Health Guarantees" of the Chilean health care system.

Table 10 Logistic regression models of health outcomes by migration-related factors in immigrant population

Negative Self-perceived health				Chronic morbidity			Disability		
OR		**95% CI**	***P* value**	**OR**	**95%CI**	***P* value**	**OR**	**95% CI**	***P* value**
sex + age + **Country of Origin (ref = Peru)**									
Venezuela	2.57	[0.29–22.78]	0.395	1.91	[0.43–8.89]	0.395	–		
Haiti	**4.67***	**[1.31–16.66]**	**0.018**	–			**2.88***	**[0.15–7.19]**	**0.024**
Colombia	0.57	[0.05–6.25]	0.645	1.08	[0.34–3.45]	0.891	0.67	[0.11–3.99]	0.658
Argentina	0.29	[0.02–4.64]	0.380	1.42	[0.59–3.42]	0.420	**0.13****	**[0.03–0.58]**	**0.008**
Other countries in South America	1.26	[0.20–7.85]	0.802	2.09	[0.68–6.01]	0.200	0.44	[0.13–1.49]	0.186
Others	3.86	[0.45–32.77]	0.214	1.90	[0.66–5.47]	0.232	0.79	[0.31–2.04]	0.625
Time of residencia (ref = 2010 or later)									
2009–2000	**0.25***	**[0.06–0.99]**	**0.048**	0.63	[0.22–1.77]	0.375	**2.89***	**[1.04–8.04]**	**0.042**
1999 or before	0.45	[0.05–4.22]	0.481	1.66	[0.43–4.60]	0.324	**11.04******	**[3.65–33.40]**	**<0.000**
GOF test			<0.000			<0.000			<0.000

CI confidence Interval; *p value < 0.05; **p value < 0.01; ***p value < 0.001; ****p value < 0.0001

The present study contributes to the current understanding of the healthy migrant effect by comparing international migrants and the local population from a population-based secondary analysis. Our findings provide an insight of the influence of access to healthcare and psychosocial factors on migrant's health status, beyond the influence of socioeconomic factors already described in previous research in Chile. This new evidence sheds light on plausible underlying mechanisms that produce health disparities between these populations and brings attention to its importance for health planning. However,the study has important limitations including the cross- sectional dataset that does not allow us to identify causalassociations or detect changes over time of residence inthe country among migrants. Estimations were basedon self-reported data without medical confirmation and we used treatment for the past 12 months as a proxy of having chronic morbidity as available in the survey, since access to treatment in Chile requires a proven medical diagnosis. In addition, the CASEN survey does not pro-vide data of behavioral and occupational risk factors to better understand the prevalence of long-term condi- tions. Moreover, it was not possible to include other psy- chosocial variables in the analysis, given that the survey did not ask for other indicators beyond social capital and social support, which restricted a more comprehen- sive analysis of this SDH. Similarly, we lacked additional migratory variables, such as reasons for migrating or risks involved during transit. Furthermore, it is pos-sible that some migrants did not report that they were born abroad or those with irregular administrative statusmight have chosen not to participate. Therefore, migrants who experience greater social vulnerability might not be fully represented in this survey and their social determinants of health were not fully studied in this analysis. Future research should analyze migration trajectories, examining risks factors and health outcomes over time with longitudinal studies. The HME needs to be comprehensively tested by specific causes of morbidity from the SDH approach. Given the heterogeneity of the migrant population and the diversity of exposures they might face during the migration process, longitudinal studies in this matter could more effectively inform about the existence and relevance of the HME.

Our findings have practical implication towards inclu-sive public health responses. There is a number of SDHthat could be targeted from a public health perspective, such as unemployment, type of affiliation to the health- care system and psychosocial factors. These could be potentially modified by migrant-sensitive intersectoral actions and contribute to leaving no one behind in termsof healthcare and health status. Any initiative towards the social integration and the protection of the healthof migrant communities should be based on equity and human rights approaches at both local and national level. For instance, it is necessary to foster social protection strategies and counteract socioeconomic vulnerability and poor living conditions that might result from unemployment and social marginalization regardless of immigration status. Public health efforts should also address barriers to healthcare affiliation and promote effec- tive access and use of healthcare for everyone regard- less of country of origin. Finally, the above-mentioned should be integrated with psychosocial support-based activities, while encompassing community based-inter- ventions, intercultural competence in health care and

Table 11 Logistic regression models of health status outcomes by SDH in the Chilean born population

	Self-perceived bad health			Chronic morbidity			Disability			Activity limitations		
	OR	**95% Cl**	**P value**	**OR**	**95% Cl**	**P value**	**OR**	**95% Cl**	**P value**	**OR**	**95% Cl**	**P value**
Demographic												
Age	**1.03******	**[1.03 - 1.041]**	**< 0.000**	**1.06******	**[1.05 - 1.061**	**< 0.000**	**1.04******	**[1.04-1.041]**	**<0.000**	**1.06******	**[1.05-1.06]**	**<0.000**
Sex (ref = male)	**1.18******	**[1.13-1.24]**	**< 0.000**	**1.54******	**[1.48 - 1.59]**	**< 0.000**	**1.05****	**[1.02-1.101]**	**0.002**	**1.18******	**[1.12-1.24]**	**<0.000**
Ethnicity: (ref = no ethnicity)	**1.16****	**[1.05 - 1.28]**	**0.003**	0.99	[0.93- 1.05]	0.696	**1.22******	**[1.13-1.311]**	**< 0.000**	**1.17*****	**[1.07-1.28]**	**0.001**
Marital status (ref—single)												
Married/Cohabitant	**0.84******	**[0.78 - 0.89]**	**<0.000**	**0.94****	**[0.91 -0.98]**	**0.007**	**0.55******	**[0.52-0.581]**	**<0.000**	**0.42******	**[0.39-0.45]**	**<0.000**
Separated/divorced/annuled	0.93	[0.84 - 1.03]	0.161	0.98	[0.93 - 1.04]	0.526	**0.64******	**[0.60-0.69]**	**<0.000**	**0.54******	**[0.48-0.601**	**<0.000**
Widow	**0.85*****	**[0.77-0.94]**	**0.001**	1.06	[0.99 - 1.13]	0.107	**0.90****	**[0.84-0.981]**	**0.009**	**0.89****	**[0.81-0.98]**	**0.014**
Zone (ref = urban)	**1.08****	**[1.00-1.17]**	**0.004**	1.04	[0.98-1.09]	172	1.00	[0.93-1.08]	0.971	1.04	[0.96-1.12]	0.384
GOF test			<0.000			<0.000			<0.000			<0.000
Socioeconomic												
Educational level (ref—none)												
University	**0.34******	**[0.29-0.39]**	**<0.000**	**0.55******	**[0.49 - 0.62]**	**< 0.000**	**0.24******	**[0.21-0.27]**	**<0.000**	**0.22******	**[0.18-0.27]**	**<0.000**
Technical	**0.38******	**[0.33-0.45]**	**< 0.000**	**0.60******	**[0.53 - 0.69]**	**<0.000**	**0.27******	**[0.23-0.31]**	**<0.000**	0.22	[0.18-0.27]	0.057
High School	**0.46******	**[0.41-0.52]**	**< 0.000**	**0.60******	**[0.54-0.68]**	**< 0.000**	**0.29******	**[0.26-0.32]**	**<0.000**	0.29	[0.26-.334]	0.235
Primary	**0.61******	**(0.54-0.69]**	**0.000**	**0.74******	**[0.66-0.831**	**< 0.000**	**0.39******	**[0.36-0.441**	**<0.000**	38	[0.33-0.43]	0.604
Income quintile (ref— lower income level)												
II	**0.89****	**[0.82-0.97]**	**0.005**	1.00	[0.95 • 1.05]	913	1.00	[0.91-1.03]	0.310	0.93	[0.86-.001]	0.083
III	**0.84******	**[0.78-0.92]**	**< 0.000**	0.99	[0.94 • 1.05]	0.742	0.94	[088-1.00]	0.074	**0.83******	**[0.77-0.93]**	**< 0.000**
IV	**0.73******	**[0.66-0.81]**	**< 0.000**	0.97	[0.91-1.03]	270	**0.83******	**[0.78-0.89]**	**< 0.000**	**0.79******	**[0.71-0.88]**	**<0.000**
V	**0.52******	**[0.46-0.59]**	**< 0.000**	0.97	[0.90-1.05]	0.498	**0.76******	**[0.69-0.85]**	**<0.000**	**0.73******	**[0.63-0.84]**	**< 0.000**
Occupation (ref—does not study)												
Unemployed	**2.23******	**[1.72-2.89**	**0.000**	**0.80******	**[0.67 - 0.97**	**< 0.000**	**3.04******	**[2.49-3.70]**	**<0.000**	**0.04******	**[0.02-0.07]**	**< 0.000**
Studying	1.13	[0.87-1.46]	0.350	0.87	[0.72-1.05]	0.151	**2.15******	**[1.74-2.67]**	**<0.000**	**0.19******	**[0.01-0.04]**	**< 0.000**
Employed	1.21	[0.93-1.57]	0.152	**0.51******	**[0.43-0.62]**	**< 0.000**	**1.44******	**[1.18-1.741**	**<0.000**	**0.01******	**[0.01-0.02]**	**< 0.000**
Studying and work	**1.61***	**[1.10-2.37]**	**0.015**	**0.63******	**[0.50 - 0.79]**	**< 0.000**	**2.11******	**[1.56-2.851**	**< 0.000**	**0.01******	**[0.00-0.02]**	**< 0.000**
GOF test			0.011			<0.000			< 0.000			< 0.000
Access to healthcare (ref—none)												
public health system afliation	1.01	[0.82-1.24]	0.944	**1.83******	**[1.60-2.10]**	**< 0.000**	**1.24****	**[1.05-1.47]**	**0.010**	1.33	[0.99-1.79	0.058
Private health system affiliation	0.85	[0.66-1_09]	0.195	**1.91******	**[1.62-2.24]**	**< 0.000**	1.03	[0.85-1.24]	0.757	0.95	[0.68-1.31]	0.740
Other	0.91	[0.70-1.19]	0.470	**1.65******	**[1.40 -1.95]**	**0.000**	1.02	[0.83-1.25]	0.876	121	[0.85-1.74]	0.292
Doesn't know	89	[0.67-1.19]	0.437	1.21	[1.00 - 1.47]	0.045	1.13	[0.90-1.42]	0.302	1.15	[0.80-.668]	0.450
GOF test			0.002			<0.000			<0.000			<0.000

Table 11 (continued)

	Self-perceived bad health			Chronic morbidity			Disability			Activity limitations		
	OR	**95% CI**	***P* value**	**OR**	**95% CI**	***P* value**	**OR**	**95% CI**	***P* value**	**OR**	**95% CI**	***P* value**
Psychosocial												
Social support (ref = no)	**0.62******	**[0.50–0.76]**	**< 0.000**	1.16	[0.98 - 1.37]	0.079	0.87	[0.72–1.05]	0.137	1.06	[0.83–1.35]	0.648
Social capital (ref = no)	**0.80******	**[0.74–0.87]**	**< 0.000**	**1.21******	**[1.15–1.27]**	**< 0.000**	0.97	[0.90–1.03]	0.319	**0.83******	**[0.76–0.90]**	**< 0.000**
GOF test			0.384			< 0.000			0.001			< 0.000

CI confidence Interval; $^{*}p$ value < 0.05; $^{**}p$ value < 0.01; $^{***}p$ value < 0.001; $^{****}p$ value < 0.0001

Table 12 Logistic regression models of health outcomes if being an international immigrant sequentially adjusted by SDH

Health outcome	**Model 1 Crude OR of being migrant**			**Model 2 Adjusted OR by demographics**			**Model 3 Adjusted OR by demographics + SES**			**Model 4 Adjusted OR by demographics + SES +access to health care**			**Model 5 Adjusted OR by demographics + SES +access to health care psychosocial**		
	OR	**[C195%]**	**p**	**OR**	**[C195%]**	**p**	**OR**	**[C195%1**	**p**	**OR**	**[C195%]**	**p**	**OR**	**[C195%]**	**p**
Negative Self-perceived health	**0.66***	**[0.45-0.96]**	**0.031**	0.90	[0.62-1.33]	0.638	1 .10	[0.71-1.60]	0.752	1.1	[0.71-1.64]	0.716	1.36	[0.81-2.28]	0.252
Chronic morbidity	**0.30****	**[0.26-0.35]**	**< 0.000**	**0.43****	**[0.36-0.51]**	**< 0.000**	**0.50****	**[0.42-0.61]**	**<0.000**	**0.54****	**[0.45-0.67]**	**<0.000**	**0.61****	**[0.44-0.841**	**0.003**
Disability	**0.45****	**[0.34-0.60]**	**< 0.000**	**0.66****	**[0.50-0.87]**	**0.004**	0.80	[0.57-1.05]	0.103	0.80	[0.58-1.08]	0.138	0.94	[0.55-1.62]	0.835
Activity limitations	**0.44****	**[0.25-0.80]**	**0.007**	0.80	[0.46-1.53]	0.560	1 .10	[0.49-2.50]	0.812	1.2	[0.51-2.70]	0.719	2.1 7	[0.82-5.76]	0.121

C/ confidence Interval; *p value<0.05; **p value<0.01; ***p value<0.001; ****p value<0.0001

evidence-based migration policies. These practical implications could be useful tools for encouraging collabora- tive alliances and policy making at regional level in Latin American region.

Conclusions

The present study revealed an unadjusted advantage on health status among international migrants residing in Chile compared to the local population. Conversely, whena SDH approach was applied for adjustment, the healthy migrant effect disappeared for almost all health outcomesin our study. Being an international migrant remained protective for chronic morbidities, which might reflect the health gap from the advanced epidemiological transition experienced in Chile where NCDs represent the main public health issues. These findings bring attention to the needof further research on health disparities between international migrants and locals, while considering the diverse exposures during the migration process that could dissolve this health advantage over time. Our findings highlight the need to deepen the HME by cause-specific morbid- ity, particularly chronic conditions and their risks factors.This knowledge could be useful for health care practition-ers and policy makers to develop a more comprehensive understanding of how variables like unemployment, affiliation to the health system and psychosocial factors may shape migrants' health over time. It could be relevant for both policy and practice at health system level in Chile and more broadly in the Latin American region, especially for the purpose of "leaving no one behind in health protection".

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Authors' contributions
All authors contributed to the design, interpretation of results and drafted themanuscript. All authors read and approved the final manuscript.

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Availability of data and materials
The dataset analyzed during the current study is available in the Social Observatory website of the Ministry of Social Development http://observator io.ministeriodesarrollosocial.gob.cl/encuesta-casen-2017.
All data generated during this study are included in this published article.

Declarations

Ethics approval and consent to participate
The investigation was conducted in accordance with ethical guidelines and regulations in compliance with the Declaration of Helsinki and local data protection law. This study is part of the Fondecyt Regular project 1201461 which was approved by the Ethics Committee of The Faculty of Medicine of The Universidad del Desarrollo, as well as the Ethics Committee of the Serviciode Salud Metropolitano Sur-Oriente. Specifically, this study performed a secondary analysis of The CASEN survey. The data base of the survey has pub-lic and free access provided for academic research by the Ministry of Social Development upon request on the website (http://observatorio.ministerio desarrollosocial.gob.cl/). All analyses were performed with anonymized data following ethical standards in research.

Consent for publication
Not Applicable.

Competing interests
The authors report no competing interest.

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References

1. Segal U. Globalization, migration, and ethnicity. Public Health. 2019;172:135–42.
2. Razum O. Migrant mortality, healthy migrant effect. In: Kirch W, editor. Encyclopedia of public health. Dordrecht: Springer, Netherlands; 2008. p.932–5.
3. Krämer A, Fischer F. Refugee health: public health theory and disease dynamics. In: Krämer A, Fischer F, editors. Refugee migration and health:challenges for Germany and Europe. Switzerland: Springer InternationalPublishing; 2019. p. 3–18.
4. Hamilton TG. The healthy immigrant (migrant) effect: in search of a betternative-born comparison group. Soc Sci Res. 2015;54:353–65.
5. Spallek J, Zeeb H, Razum O. What do we have to know from migrants' past exposures to understand their health status? A life course approach.Emerg Themes Epidemiol. 2011;8(1):6.
6. Zavaleta-Abad RA, Campos-Uscanga Y. Health effects after migration and the mediating role of acculturation and family cohesion. Univ Salud. 2019;21(3):261–9.
7. Domnich A, Panatto D, Gasparini R, Amicizia D. The "Healthy immigrant" effect: does it exist in Europe today? Ital J Public Health. 2012;9(3):e7532.
8. Hombrados-Mendieta I, Millán-Franco M, Gómez-Jacinto L, Gonzalez- Castro F, Martos-Méndez MJ, García-Cid A. Positive influences of social support on sense of community, life satisfaction and the health of immi-grants in Spain. Front Psychol. 2019;10:2555.
9. United Nations Department of Economic and Social Affairs. International migration 2020 highlights. 2021 [cited 14 Sept 2021]. Available from: https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/undesa_pd_2020_international_migration_highlights.pdf.
10. Cerrutti M, Parrado E. Intraregional migration in South America: trendsand a research agenda. Annu Rev Sociol. 2015;41:399–421.
11. Instituto Nacional de Estadísticas. Estimación de personas extranjeras residentes habituales en Chile al 31 de diciembre de 2020. 2021 [cited 15Sept 2021]. Available from: https://www.extranjeria.gob.cl/media/2021/08/Estimaci%C3%B3n-poblaci%C3%B3n-extranjeraen-Chile-2020-regio nes-y-comunas-metodolog%C3%ADa.pdf.
12. Cabieses B, Tunstall H, Pickett K. Understanding the socioeconomic statusof international immigrants in Chile through hierarchical cluster analysis: a population-based study. Int Migr. 2015;53(2):303–20.
13. Wickramage K, Vearey J, Zwi AB, Robinson C, Knipper M. Migrationand health: a global public health research priority. BMC Public Health. 2018;18(1):1–9.
14. Cabieses B. Investigación en migración y salud en Chile: Avanzando. RevMed Chile. 2016;144(8):1093–4.

15. Castañeda H, Holmes SM, Madrigal DS, Young M-ED, Beyeler N, QuesadaJ. Immigration as a social determinant of health. Ann Rev Public health.2015;36:375–92.
16. Cabieses B, Pickett KE, Tunstall H. Comparing sociodemographic factors associated with disability between immigrants and the Chilean-born: arethere different stories to tell? Int J Environ Res. 2012;9(12):4403–32.
17. Cabieses B, Tunstall H, Pickett K. Testing the Latino paradox in Latin America: a population-based study of intra-regional immigrants in Chile.Rev Med Chile. 2013;141:1255–65.
18. Agar Corbinos L, Delgado I, Oyarte M, Cabieses B. Salud Y Migración: Análisis Descriptivo Comparativo De Los Egresos Hospitalarios De La Población Extranjera Y Chilena. Oasis. 2017;25:95–112.
19. Betancour MC, Pérez-González C. Caracterización de las consultas de la población migrante adulta en un servicio de urgencia público del área norte de Santiago de Chile durante 2018. Rev Salud Publica.2020;22(6):1–8.
20. Contreras JO, Carroza Escobar MB, Quiroz-Carreño J, Díaz Navarrete M, Araya BM. Maternal and perinatal outcomes of peruvian pregnant
women in Chile: exploring the healthy immigrant effect. Rev Peru MedExp y Salud Publica. 2021;37:654–61.
21. Feller C, Alvarado P, Doña C, García I. Actividad física y deporte en la población migrante en Chile. Cuad Med Soc (Chile). 2018;58(4):1–13.
22. World Health Organization. Social determinants of health. 2021 [cited 10Sept 2021]. Available from: https://www.who.int/health-topics/social- determinants-of-health#tab tab_1.
23. Thomas F. Rights and deservingness. In: Thomas F, editor. Handbook of migration and health. Cheltenham: Edward Elgar Publishing; 2016. p. 95–158.
24. Chang CD. Social determinants of health and health disparities amongimmigrants and their children. Curr Probl Pediatr Adolesc Health Care.2019;49(1):23–30.
25. Cabieses B, Oyarte M. Health access to immigrants: identifying gaps forsocial protection in health. Rev Saude Publica. 2020;54:20.
26. Riosmena F, Kuhn R, Jochem WC. Explaining the immigrant health advan-tage: self-selection and protection in health-related factors among five major national-origin immigrant groups in the United States. Demogra- phy. 2017;54(1):175–200.
27. Ministerio de Desarrollo Social y Familia. Manual del investigador Guía práctica para el uso y análisis de información Encuesta CASEN 2017. 2017[cited 10 sept 2021]. Available from: http://observatorio.ministeriodesar rollosocial.gob.cl/storage/docs/casen/2017/Manual_del_Investigador_ Casen_2017.pdf.
28. European Statistical Office (EUROSTAT). Health variables of EU-SILC. 2020 [cited 10 Sept 2021]. Available from: https://ec.europa.eu/eurostat/ cache/metadata/en/hlth_silc_01_esms.htm.
29. Eriksson I, Undén A-L, Elofsson S. Self-rated health. Comparisons between three different measures. Results from a population study. Int J Epidemiol.2001;30(2):326–33.
30. Cabieses B, Cookson R, Espinoza M, Santorelli G, Delgado I. Did socioeco-nomic inequality in self-reported health in Chile fall after the equity- based healthcare reform of 2005? A concentration index decompositionanalysis. PLoS One. 2015;10(9):e0138227–e.
31. Villalobos DP. Panorama de la dependencia en Chile: avances y desafíos.Rev Med Chile. 2019;147(1):83–90.
32. Thomas K, Nilsson E, Festin K, Henriksson P, Lowén M, Löf M, et al. Associations of psychosocial factors with multiple health behaviors: a population-based study of middle-aged men and women. Int J EnvironRes. 2020;17(4):1239.
33. Vincens N, Emmelin M, Stafström M. Social capital, income inequality andthe social gradient in self-rated health in Latin America: a fixed effects analysis. Soc Sci Med. 2018;196:115–22.
34. Fernández-Niño JA, Vásquez-Rodríguez AB, Flórez-García VA, Rojas-BoteroML, Luna-Orozco K, Navarro-Lechuga E, et al. Modos de vida y estado de salud de migrantes en un asentamiento de Barranquilla, 2018. Rev Salud Publica. 2018;20:530–8.
35. Mendoza W, Miranda JJ, Mendoza W, Miranda JJ. La inmigración ven- ezolana en el Perú: desafíos y oportunidades desde la perspectiva de lasalud. Rev Peru Med Exp Salud Publica. 2019;36:497–503.
36. Oyarte M, Delgado I, Pedrero V, Agar L, Cabieses B. Hospitalizaciones por cáncer en migrantes internacionales y población local en Chile. RevSaude Publica. 2018;52:36.
37. Farré L. New evidence on the healthy immigrant effect. J Popul Econ.2016;29:365–94.
38. Lee S, O'Neill AH, Ihara ES, Chae DH. Change in self-reported health statusamong immigrants in the United States: associations with measures of acculturation. PLoS One. 2013;8(10):e76494.
39. Ministerio de Salud de Chile. Encuesta Nacional de Salud 2016-2017 Primeros resultados. 2017 [cited 25 Oct 2021]. Available from: https:// www.minsal.cl/wp-content/uploads/2017/11/ENS-2016-17_PRIMEROS-RESULTADOS.pdf.
40. Porras FM. El panorama epidemiológico. RChSP. 2017;21(2):107–10.
41. Bambs C, Bravo-Sagua R, Margozzini P, Lavandero S. Science and healthpolicies to tackle chronic diseases in Chile. Trends Endocrinol Metab. 2020;31(2):67–70.
42. Organización Panamericana de la Salud: OPS/OMS. Indicadores básicos2019 Tendencias de la salud en las Américas. 2019 [cited 25 Oct 2021]. Available from: https://iris.paho.org/bitstream/handle/10665.2/51543/ 9789275321287_spa.pdf?sequence 7&isAllowed y
43. Markides KS, Rote S. The healthy immigrant effect and aging inthe United States and other western countries. Gerontologist. 2019;59(2):205–14.
44. Loi S, Hale JM. Migrant health convergence and the role of material depri-vation. Demogr Res. 2019;40:933–62.
45. Levchenko Y. Aging into disadvantage: disability crossover among Mexi-can immigrants in America. Soc Sci Med. 2021;285:114290.
46. Zhou Q. Changing disability status of immigrants in Australia-three cases.RDS. 2017;13(2):2–17.
47. Lubbers M, Gijsberts M. Changes in self-rated health right after immigra-tion: a panel study of economic, social, cultural, and emotional explana-tions of self-rated health among immigrants in the Netherlands. Front Sociol. 2019;4:45.
48. Lu Y, Denier N, Wang JS-H, Kaushal N. Unhealthy assimilation or persistenthealth advantage? A longitudinal analysis of immigrant health in the United States. Soc Sci Med. 2017;195:105–14.
49. Abraído-Lanza AF, Mendoza-Grey S, Flórez KR. A commentary on theLatin American paradox. JAMA Netw Open. 2020;3(2):e1921165–e.
50. Luthra R, Nandi A, Benzeval M. Unravelling the 'immigrant health paradox': ethnic maintenance, discrimination, and health behaviorsof the foreign born and their children in England. J Ethn Migr Stud. 2020;46(5):980–1001.
51. Bilecen B, Vacca R. The isolation paradox: a comparative study of social support and health across migrant generations in the US. Soc Sci Med.2021;283:114204.
52. Yang PQ, Hwang SH. Explaining immigrant health service utilization: a theoretical framework. SAGE Open. 2016;6(2):2158244016648137.

4. Chapter 3 Primary data collection analysis on cardiovascular health outcomes

This chapter represents the third sub-study of the dissertation and contains the results from the primary data collection performed during COVID-19 pandemic, in which cardiovascular diseases and risks factors were studied. A community-based survey comprised by sections of social determinants of health was analyzed following the statistical methods of the previous chapter (other methodological details can be found in Annex 1) to answer the following question: **is there a healthy migrant effect on cardiovascular diseases and cardiovascular risk factors in Chile, and how does this effect vary according to social determinants of health?** The main hypothesis of the study was:

H 1.0 due to the healthy migrant effect, there is a lower proportion of cardiovascular disease and cardiovascular risk factors in international migrants compared to the Chilean local population (crude or unadjusted comparison). Further hypotheses to devolve into the influence of social determinants of health were also proposed: H 1.1. the healthy migrant effect disappears after adjusting for demographic determinants (sex, age, ethnicity) and is attenuated after sequentially adjusting by socioeconomic determinants (educational level, income, occupational participation); H1.2. The healthy migrant effect is attenuated after adjusting by access to health care determinants (insurance and access barriers); H.1.3. The healthy migrant effect is attenuated after adjusting by psychosocial determinants (stress, discrimination, social capital, and social support).

The proposed general objective when conducting this study was to analyze the existence of the healthy migrant effect on cardiovascular diseases and cardiovascular risk factors among international migrant population vs. Chilean local population, and the associated social determinants (demographic, socioeconomic, access to health care, psychosocial, and migratory related factors.).

As part of the doctoral dissertation were conducted specific objectives to test de hypothesis and delve into the cardiovascular health of international migrants including: i) the description of above-mentioned social determinants of health in international migrant population residing in Chile; ii) comparison of the crude cardiovascular outcomes between the international migrant population and Chilean population; iii) analysis of each set of social determinants association with cardiovascular outcomes in both populations; iv) analysis of the healthy migrant effect on cardiovascular health outcomes adjusted by each set of social determinants of health (demographic, socioeconomic, access to health care, psychosocial.).

4.1. Methodological Annex of primary data collection

4.1.2. Context of the study

This study was embedded in a wider project Fondecyt Regular No. 1201461 entitled *"Living and health trajectories of international migrants to Chile: how do they compare to the locals and what are their costs related to the healthcare system?"* whose principal investigator is

Dr. Baltica Cabieses, PhD, supervisor of this dissertation. The present study was part of the second objective of the Fondecyt project (sub-study 2) which consist in a longitudinal community survey with a follow-up at 12 months from baseline participation. However, the source of data for this study was the baseline participation of the community survey. The sub-study 2 aimed to measure social conditions, access to health care and health outcomes including chronic diseases. Although, the instrument of the Fondecyt project was not exclusively designed for cardiovascular research, under the heading of chronic conditions there were questions for cardiovascular diseases and its risk factors.

4.1.3. Type of study and study design

This is a quantitative observational analytical cross-sectional study. As above-mentioned the study was performed with baseline data collected during 2021-2022. Before data collection, the instrument was designed by the research team of the Fondecyt project based on questions from the CASEN 2017 survey, ENS 2017 and scales aimed for migrants. The instrument was reviewed and piloted by researchers and collaborators of the project. In addition, the process of recruiting and training the interviewers was be carried out by researchers involved in design and piloting the instrument. The study was carried out in 3 boroughs of Metropolitan areas of Santiago de Chile during the coronavirus diseases 2019 (COVID-19) pandemic. The communes La Pintana, La Granja and San Ramón are characterized by high rates of multidimensional poverty and social vulnerability (219). During the pandemic the boroughs reached high infection and mortality rates due to COVID-19 (105). Participants were recruited through institutional and community approaches during lockdowns and gradual easing of mobility restrictions, which will be detailed in further sections. The survey was conducted by a trained interviewer to an adult who voluntary provided data on him/herself and members of the household. The survey was carried out during 40-60 min with an individual semi-structured interview mode through WhatsApp video-call or in person if the sanitary situation allowed it. Before data collection, participants were informed of the purpose of the study, data protection and voluntary participation. In compliance with ethical guidelines of the principles of the Declaration of Helsinki, the informant consent was signed by the participant. The Fondecyt Regular project was approved by the Ethics Committee of the Faculty of Medicine of The Universidad del Desarrollo and the Ethics Committee of the Servicio de Salud Metropolitano Sur Oriente.

4.1.4. Study population

This study included international migrants residing in La Pintana, La Granja and San Ramón, as well as Chileans residing in these boroughs as a control group. The universe of international migrants was made up of all international migrants residing in La Pintana (n=2.935), La Granja (n= 3.587) and San Ramón (n=2.742). These boroughs were selected due to their association with Padre Hurtado Hospital, which is adjoint with the Faculty of Medicine of the Universidad del Desarrollo. The latter favored the viability of the study, since it supported institutional recruitment during lockdowns, thanks to the agreements with borough's health departments. The sample calculation from the Fondecyt project proposal was used. The sample was estimated for categorical variables with maximum uncertainty, with an expected proportion of 50%, confidence level of 95% and precision of 3% (epidat

4.1). The viable sample size was n=1.650 international migrants and n=1.650 Chileans as control group, that is n=550 migrants and n=550 Chileans per commune. Following the inclusion criteria: 1) commune resident; 2) over 18 years of age; 3) be an international migrant and 4) speak Spanish or Creole; as exclusion criteria 1) pregnancy, to avoid the influence of pregnancy on cardiovascular events and risks factors, since pregnancy-associated diagnoses were not comparable to the chronic conditions under study. In addition, self-report did not allow to confirm if the health condition had an acute onset or was underdiagnosed (220).

The study followed a non-probabilistic sampling since migrant population represent a "hard to reach population" with whom access, and trust challenges are faced (215). The lack of data of their geographical distribution, constant mobility of this population limited a probabilistic sampling (216). Since the traditional sampling methods for general populations from "Western, Educated, Industrialized, Rich and Democratic Societies" are not applicable for international migrants residing in these boroughs (217). The respondent-driven sampling was chosen given that is aimed at hidden population, this is a rigorous non-probabilistic method in which unbiased estimates are produced from a sample of referrals (221). This method meets conditions such as being supported by migrants, avoid exposure to being identified, and it generates trust for participation (216). The initial recruitment consisted of "seeds" selection which are the initial participants of the survey, chosen for convenience according to the access to contact them as well as the diversity and size of their social network. These first recruits were informed about the purpose of the study, ethical considerations and inclusion criteria so that they could invite 3 people among their close contacts (221). Despite the "seeds" were selected intentionally, the method has been considered a pseudo-random sampling, since each participant recruits randomly 3 potential participants from their social network, acting as quotas that might reduce the risk of differential recruitment (221). Evidence suggest that after approximately six "waves" of selection, the resulting sample will be randomly selected and will have stable characteristics. Thus, reaching a balance not influenced by the initial intentional selection of the "seeds" (222).

The initial recruitment to select the "seeds" of the respondent driven sampling follow these strategies: i) the migrant referent from the Padre Hurtado Hospital (in charge of giving orientation to migrants of the boroughs) provided a random list of 60 migrants who have attended the hospital in the last year (10 women and 10 men per commune); ii) in parallel, migrants organization from each commune were contacted, providing a list of 10 people residing in each borough (5 women and 5 men per commune). Both mechanisms initiated the intentional sampling process and followed a snowball strategy, where first participants were asked to provide 3 quotas of new potential participants, following recommendations of sex, age and country of origin distribution if possible. During the recruitment process we aimed to obtain similar proportions of men and women, age groups and main countries of origin, according to the available national estimations at that time (INE 2020) (Table 13.):

Table 13. Distribution of sex, country of origin and expected age in the sample of international migrants.

	Proportion of international migrants INE 2020	n in sample

Sex		
Women	48.8%	792
Men	51.2%	858
Country of Origin (Top 4)		
1. Venezuela	30.5%	512
2. Peru	15.8%	264
3. Haiti	12.5%	215
4. Colombia	10.8%	182
Others	30.4%	477
Age		
18-29 years	33.3%	545
30-39 years	29.7%	495
40-64 years	24.2%	396
>65 years	2.8%	50
Efforts were made to complete the remaining 164 participants with people over 65 years of age		

4.1.5. International migrant recruitment

There were diverse strategies adjusted to the sanitary situation during COVID-19 pandemic (March 2021-november 2022). During lockdown the recruitment was carried out mainly remotely, first contacting the people of the above-mentioned lists. We continued with other strategies specific to the community dynamics and institutional context of each commune. Noteworthy, the recruitment was constant over time and the strategies were adapted to reach population regardless of their migratory status, time of residence and health insurance. All the strategies were translated into Creole to provide detailed information of the project to Haitian migrants. As well as, included information of migrant organizations and institutional support to counteract mistrust, stigmatizing discourses during elections, uncertainty and among others, impacting their willingness to participate.

Recruitment strategies were performed as follows: i) migrant and pro-migrant organizations: migrant leaders were contacted to support the dissemination of the project remotely; ii) snowball: following the respondent driven principles, participant that were recruited from other sources referred another potential participants that were further contacted by recruited of the study; iii) COVID-19 vaccination campaigns and primary health care centers: considering the mobility restrictions and agreements with the borough's health departments, this strategy allowed face-to-face recruitment and surveys. Different health facilities located in high migrant concentration areas were reached a context of mutual trust; iv) community recruitment: when mobility restrictions were reduced, diverse settings such as common pots, free fairs, public transportation, among others were visited for recruitment purposes. After lockdowns this strategy led to a better understanding of the borough's dynamics, since neighborhood councils were supporting the strategy which was coupled with community recruiters residing in the commune; v) pro-migrant organization events: in order to provide a safe environment for recruitment regardless of the administrative status, the strategy was executed when diverse guidance was provided by the organizations (migratory regularization, social integration, health education); vi) institutional referrals: besides the first

referrals for the respondent driven "seeds", social workers and advisors from the migrant support offices provided referrals to be contacted by the study recruiters. This strategy led us reach migrants that were asking for institutional support due to their social vulnerability regardless of the migratory status. In addition, recruiters were also placed in these locations to share posters and detailed information to potential participants going to the offices of community development.

4.1.6. National population recruitment

The control group comprised by Chileans was recruited through some shared strategies with migrant population and other specific approaches for local population, including: i) snowball: following the respond driven principles, first seeds representing community leaders were asked to refer potential participants. In addition, participants from other sources were also encouraged to refer people from their networks ii) social network posting: digital posters were shared on institutional social networks of each borough and disseminated by other institutional-related networks. As well as Facebook groups for sales, community councils and community leaders. iii) vaccination campaign and primary health care facilities: this strategy was initially piloted and implemented among national population when mobility was restricted. The strategy which was shared with migrant population was adapted to the differences among these populations; iv) community recruitment: collaborative approaches implemented during the sociosanitary crises such as common pots and neighborhood meetings led to recruit locals from diverse focal points. Overall, these strategies allowed to diversify the sample and reach both populations during COVID-19, however there are limitations and risk of bias detailed in the fifth chapter of the dissertation.

4.2.1. Data collection

The survey was conducted as a personal interview by trained interviewers in person or virtually. When the survey was face-to-face, it was in a private place without environmental disturbances, at a time agreed with the participant. Virtual surveys were carried out on a secure video-call platform (e.g., Whatsapp, zoom), using visual aids to guide the interviewee and resemble the face-to-face situation. Previous studies have implemented remote data collection in migrant population (138, 163, 223), thus the modality has been positioned as a way to continue research in the context of COVID-19 pandemic (224). Internet-mediated research modalities stand out for being useful and versatile tools for members of the so-called "hard to reach populations", since video-calls allow real time communication during flexible schedules and places preferred by the participant (225). As ethical compensation, each participant was compensated with $4,000 Chilean pesos to cover the time spent.

4.2.2. Study variables

The main outcomes of the study were the prevalence cardiovascular diseases and its risks factors. Since the study stands in the social determinants of health perspective, these represent the main explanatory variables for stratified analysis and adjustments (further detailed in subsequent sections).

4.2.3. Dependent variables

Self-report of cardiovascular diseases: i) acute myocardial infarction; ii) cerebrovascular accident. Self-reported cardiovascular risk factors: i) type 2 diabetes mellitus; ii) hypertension; iii) obesity; iv) dyslipidemia; v) alcohol consumption; vi) tobacco use; vii) low physical activity; viii) low fruit and vegetable consumption (Table 14.).

4.2.4. Independent variables

The explanatory variables were mainly made up of social determinants of health: i) demographic determinants (sex, age, ethnicity); ii) socioeconomic determinants (educational level, occupational participation, income); iii) access to health care determinants (affiliation and barriers in accessing the health care); iv) psychosocial determinants (discrimination, stress, social capital and social support); v) migratory-related determinants (country of origin, time of residence). (Table 14.)

4.2.5. Instrument

The questionnaire was design by researchers of the Fondecyt project, this instrument was aimed to evaluate the social conditions and health outcomes of Chilean and migrant population. Its design was based on the Chilean National Socioeconomic Characterization Survey (CASEN 2017), the health national survey (NHS) called Encuesta Nacional de Salud (ENS 2017) and complementary scales to delve into international migrants. The questionnaire was not restricted to cardiovascular research since it was embedded in a wider project, however, it provides data to test the hypothesis on healthy migrant effect. As well as, included items to characterize the sample from the social determinants of health perspective and self-reported data of cardiovascular disease and risk factors. The instrument contained five sections: i) personal and demographic information of the household informant and the family group; ii) migration process; iii) health outcomes; iv) psychosocial dimension; v) health access and use applicable for insured peopled and those who were not yet. The survey was available in Spanish and Creole, the latter was conducted by a member of the research team that was fluent in Creole. Sections and items considered in this study are detailed below, including design or adaptation when needed:

> Section I: included *demographic determinants* sex (women/men), age (continuous and categorized: 18-29, 30-49, 50-64, >65 years old) and ethnicity background (yes/no). The latter was determined by self-reported aboriginal ethnicity belonging to which the participant identifies. *Socioeconomic determinants* were made up of 3 variables: educational level, occupational participation and income. To determine the educational level, the participant selected between none, primary, secondary, technical and university. While the income was quantitatively measured with the self-reported average household income. In turn, the income was categorized into four categories: below $400.000 which is the national minimum wage, followed by 400.000-700.000, 700.000-1.000.000 and more than 1.000.000.000. Occupational participation was determined according to whether they were employed, unemployed or inactive (e.g., housewife or student). *Access to health care* was measured

according to the type of insurance as none, public system, private system and other. People affiliated to the public system were asked to specify the FONASA group (A, B, C, D, don't' know). In addition, self-report of barriers in accessing to the health care (yes/no) were asked, and barriers were classified as: don't know where to consult, unavailable appointment, geographical barrier, had an appointment but was not attended, was not treated respectfully and other. (Table 14.).

Section II included *migratory-related determinants* in which the date of arrival was asked and categorized as 0-5 years, 4-6 years, 7-9 years, 11-20 years and over 20 years. The country of origin was asked according to the intraregional pattern and categorized as Peru, Colombia, Venezuela, Ecuador, Haiti, Bolivia, Dominican Republic and other. In addition, the visa of arrival was asked and categorized as tourist visa, democratic responsibility visa, labor opportunities visa, family reunification visa, non-authorized entry and other. Lastly the current migratory status was asked according to the type of visas available in 2021 (permanent residence, labor visa, temporary visa, tourist visa, pending visa, irregular and other. (Table 14.).

Section III included cardiovascular diseases and risk factors collected through self-report of previous medical diagnosis or treatment for the condition. This method has been previously used in international migrant literature (160, 164, 177, 226-228). This section was based on self-report questions of population surveys that include self-report of treatment (CASEN) and diagnosis (NHS). Additionally, the household informant provides data of cardiovascular outcomes of another closer adult (e.g., partner) living in the household (Table 14.).

a) Cardiovascular diseases: previous history of diagnosis or treatment for acute myocardial infarction (yes/no), cerebrovascular accident (yes/no).
b) Cardiovascular risk factors: previous history of diagnosis or treatment for hypertension (yes/no), type II diabetes mellitus (yes/no), dyslipidemia (yes/no), obesity (yes/no).
c) Behavioral risk factors: low physical activity was determined by answering yes/no to moderate or high intensity physical activity for at least 30 minutes, more than 3 times per week. Tobacco and alcohol consumption were determined by current consumption within the last month (yes/no). Moreover, in this section participants were asked to specify time, frequency, dose and reasons for consumption these details could be explored in further analysis of behavioral risk in depth. Low fruit and vegetable intake queried by the number of daily servings of fruits and vegetables during a typical week. The intake was categorized if they consume less than 5 servings per day and equal or more than 5 servings per day (yes/no).

Table 14. Design methodology for cardiovascular diseases and cardiovascular risk factors questions.

CVD variables	Variable operationalized	Question in the Fondecyt survey	Comparable to population-based surveys

Acute myocardial infarction (yes/no)	Dichotomous variable 1=Yes 0=No	Combined question diagnosis or having received treatment Based on: ENS: cardiovascular module (d1_F1 and d3) CASEN: health module (s28)	CASEN 2017 Have been in medical treatment for the past 12 months: Question s28 answer option 5 ENS 2017 Medical diagnosis d1_F1 or having received treatment for AMI d3
Cerebrovascular accident (CVA) (yes/no)	Dichotomous variable 1=Yes 0=No	Combined question diagnosis or having received treatment Based on: ENS: cardiovascular module (d4 and d6). CASEN: health module (s28)	CASEN 2017 Have been in medical treatment for the past 12 months: Question s28 answer option 17 ENS 2017 Medical diagnosis d4 or having received treatment for stroke d6.
CVRF variables		**Question design in international migrant survey**	**Comparable to population-based surveys**
Hypertension (HTN) (yes/no)	Dichotomous variable 1=Yes 0=No	Combined question diagnosis or having received treatment Based on: ENS: module XVI (h2 and h4) CASEN: health module (s28)	CASEN 2017 Have been in medical treatment for the past 12 months: Question s28 answer option 1 ENS 2017 Medical diagnosis h2 or having received treatment for AMI h4
Diabetes mellitus (T2DM) (yes/no)	Dichotomous variable 1=Yes 0=No	Combined question diagnosis or having received treatment Based on: ENS: module XVII (di3 and di5) CASEN: health module (s28)	CASEN 2017 Have been in medical treatment for the past 12 months: Question s28 answer option 3 ENS 2017 Medical diagnosis di3 or having received treatment for DM di5.
Dyslipidemia (DLD) (yes/no)	Dichotomous variable 1=Yes 0=No	Combined question diagnosis or having received treatment Based on: ENS: module XVIII (dis2 and dis4)	ENS 2017 Medical diagnosis dis2 Having received dis4 treatment.
Obesity (yes/no)	Dichotomous variable 1=Yes 0=No	Self-report nutritional status* Based on: ENS: module XI (n3)	ENS 2017 Self-report of nutritional status n3. Has a doctor, nurse, or other health professional ever told you that you are overweight? *Anthropometric measurements were not used to keep

			consistency with self-report methodology
Tobacco consumption (yes/no)	Dichotomous variable 1=Yes 0=No	Asking for current consumption and daily doses Based on: ENS: module XIV smoking (ta3 and ta4)	ENS 2017 current consumption ta3 daily consumption ta4 (for future analysis)
Alcohol consumption (yes/no)	Dichotomous variable 1=Yes 0=No	Asking for current consumption and average amount of consumption Based on: ENS: module VII (m7p6 and m7p4)	ENS 2017 Current consumption last 7 days m7p6 Average amount of consumption m7p4 (for future analysis)
Low fruits and vegetable intake (yes/no)	Dichotomous variable 1=Yes 0=No	It is evaluated by daily consumption of fruits and vegetables and classified with world health recommendation >5 servings or ≥ 5 servings Based on: ENS: module XII fruits (die6, die7) and vegetables (die8, die9)	ENS 2017 fruit consumption typical week die6 and servings on one of those days die7 fruit consumption typical week die8 and servings on one of those days die9
Low Physical activity (yes/no)	Dichotomous variable 1=Yes 0=No	moderate or intense physical activity at least 3 times a week for 30 minutes Based on ENS: module IV sports or PA practice for 30 minutes (a17)	ENS 2017 Practice of sport or physical activity for 30 minutes: question a17 answer option 1 (3 times a week)

Section IV Psychosocial dimensions: this section was designed from items of the CASEN 2017 and 2016-2017 National Health Survey (ENS) (Table 15.)

a) Social support defined as the perception of value, affection and care from others (229) was measured through the social support scale "Enhancing Recovery In Coronary Heart Disease patients ENRICHD Social Support Instrument" (ESSI) (230). This tool has been used in diverse populations, including young people with heart conditions (231), women with cardiovascular disease (232), patients with type 2 diabetes mellitus (233) and other chronic diseases (234). In addition, there is evidence using the instrument in studies exploring cardiovascular diseases and risk factors among international migrant population (169, 235-237). Its selection is also based on the reliability reported for the scale, with an intraclass correlation coefficient of 0.94, and

Crobach's alpha of 0.88 (238). The original scale is made up of 7 questions, the first 6 can be answered on a scale of 1 never, 2 almost never, 3 sometimes, 4 most of the time, 5 all the time; while the seventh question asks if he is married or cohabiting, which can be answered with yes/no. This study included items related to being listened to, feeling confident for advice, perception of esteem, affection, close contact and having people to share with. Considering the score of 1 to 5 for each item, a new variable dichotomized was created in which having below 3 points in all items (sometimes, almost never, never) was considered not having social support (no) and having equal or more than 4 points in all items (most of the time and all the time) was considered as having social support (yes) since it indicated a constant availability of support over time.

b) Social capital defined as reciprocal interactions based on trust (239) was measured through belonging to organized groups. The question was derived from CASEN 17 module R of identities and participation (r6) and asked if participant belongs to neighborhood councils, recreative groups, religious organization or go to church, artistic groups, cultural groups, young youth groups, among others over the last 12 months. The variable was dichotomized as yes or no according to the participation in one or more of these groups.

a) Discrimination: according to module R (CASEN 2017) of identities and participation, the question asked for having experienced discrimination in the past 12 months and further dichotomized (yes/no). In addition, participants specified the type of discrimination they experienced (r9 of CASEN 2017) including socioeconomic, gender, place of residence, age, sexual orientation, tattoos, physical appearance, skin color, religion, politic ideology, place in which they study, being indigenous, have a disability and being migrant.

b) Stress: a question from the National Health Survey of module XX was included, asking stress frequency during the last year (ps7_F1) and categorized as never, sometimes, several times and permanently. In addition, it was further dichotomized (yes/no).

Table 15. Independent variables of social determinants of health.

Social determinants of health		
Variable	**variable type**	**response scale**
Sex	dichotomous variable	1=Women 2=Men
Age	Continuous variable	Years old
	Categorical variable	1=18-29 years old 2=30-49 years old 3=50-64 years old 4=over 65 years old

	Dichotomous variable	In case of aboriginal background 1=Yes 0=No	
Educational level	Categorical variable	1=None 2=Primary 3=Secondary 4=Technical 5=University	
Average monthly household income	Continuous variable	Chilean pesos	
	Categorical variable	1= <400.000 2=400.000-700.000 3=700.000-1.000.000 4=>1.000.000	
Occupation	Categorical variable	1=Employee 2=Unemployed 3=inactive (student/housewife)	
Social support	Dichotomous variable	1=Having social support 0=Not having social support	
Social capital	Dichotomous variable	1=Having social capital 0=Not having social capital	
Discrimination	dichotomous variable	<u>Experience discrimination or unfair treatment</u> 1=Yes 0=No	
	Categorical variable	<u>Type of Discrimination</u> 1=Socioeconomic level=1 2=Gender =2 3=Marital status=3 4= physical appearance =4 5=Ethnicity =5	6=Age 7=Ideology 8=Place of Residence site 9=Health condition or disability 10= Being migrant
Stress	Categorical variable	Yes=1 No= 1	
		0=Never 1=Sometimes 2=Several times 3=Permanently	
Migration process	Categorical variable	<u>Country of origin</u> 1=Peru 2=Columbia 3=Venezuela 4=Ecuador	5= Haiti 6=Bolivia 7=Dominican Republic 8=Other

	Categorical variable	Time of residence 1= 0-5 years 2=6-10 years 3=11-20 years 4=over 20 years

4.3. Data analysis

The data analysis was structured to test the health migrant effect hypothesis from crude prevalence and adjusted analysis. In addition, each specific objective proposed in the dissertation was explored. After the exploratory check of the database, as well as performing cleaning procedures to eliminate erratic data, recode variables, restructuring and creating a data set for both migrant and Chilean population a descriptive analysis was carried out (specific objective 1). In which measures of central tendency of continuous variables and proportions for categorical variables were presented. Specifically, a description of the sample from the social determinants of health was performed, that is reporting demographic, socioeconomic, access to health care, psychosocial and migratory-related factors.

Regarding the objective 2, the unadjusted prevalence as proportions of CVD and CVRF was estimated in each population, stratified by social determinants of health and compared to test the crude healthy migrant effect. The Pearson's chi-square test was used to test independence between migration status (migrant versus Chilean) and these cardiovascular health status outcomes. The following specific objective 3 in which the association of social determinants of health with health outcomes was analyzed through multivariate logistic regression. The model estimated the probability (odds, OR) of reporting cardiovascular outcomes (CVD, CVRF) adjusted by each set of social determinants of health in migrants and locals, separately. Multivariate logistic regression adjusted by sex an age was performed to analyze the association between migratory-related factors and CVD/CVRF.

The adjusted estimation of the healthy migrant effect on cardiovascular outcomes was performed through multivariate logistic regressions (having/not having each CVD and FRCV). The dependent variables were cardiovascular diseases and cardiovascular risk factors, while the main independent variable was "being a migrant" (reference: Chilean born). The models of multivariate logistic regression were sequentially adjusted by each set of social determinants of health as follows: i) model 1 crude odds ratio (OR) of having CVD/CVRF if being migrants; ii) model 2 OR of having CVD/CVRF adjusted by demographics; iii) model 3 OR of having CVD/CVRF adjusted by demographics and socioeconomics; iv) model 4 OR of having CVD/CVRF adjusted by demographics, socioeconomics and access to health care; v) model 5 OR of having CVD/CVRF adjusted by demographics, socioeconomics, access to health care and psychosocial factors. Noteworthy, the adjusted healthy migrant effect estimation was performed for each cardiovascular disease, metabolic and behavioral risk factor. When the unadjusted prevalence was not supporting the crude healthy migrant effect (as of low physical activity and low fruits and vegetable intake) the adjusted model was not performed.

4.4. Ethical considerations

The Fondecyt regular project was approved by the Ethics Committee of the Faculty of Medicine of The Universidad del Desarrollo and the Ethics Committee of the Servicio de Salud Metropolitano Sur Oriente. This study adhered to the principles of the Declaration of Helsinki.

- Non-maleficence: we avoid dangerous situations or risks derived from the study (e.g., compliance to sanitary protocols during COVID-19 pandemic) by not exposing the participants to contagion, injury, threatens of their privacy, dignity or physical, mental and moral integrity. To safeguard the confidentiality and safeguard the data, documents will be kept in locked drawers in the Universidad del Desarrollo. Data collected was uploaded to Red-cap platform and data spreadsheet are protected, in addition, each participant was coded with a unique identifier. Personal data will only be accessed with the authorization of the Fondecyt principal investigator, for specific purposes that justify it, such as follow-up after the baseline participation.
- Beneficence: Although participants did not receive direct benefits during their participation. The information provided will serve to detect risk factors and cardiovascular diseases among migrant population, as well as the social determinants of health influencing these health outcomes. The identification of specific cardiovascular health needs could be useful for scientific reports and recommendations to the health authority. Additionally, the evidence is useful for timely health planning and input for decision and policy makers.
- Autonomy: The voluntary nature of the participation was safeguarded before, during and after collecting the data. During inform consent, sufficient information was provided regarding the purpose of the study, potential benefits to the international migrant community, and possible risks with strategies to reduce it. This informed consent was applied to those who had the capacity to consent, without any type of influence or additional expectations to motivate them to participate. Throughout the research process, participants had the right to withdraw at any time without prejudice.
- Justice: Efforts were made to maintain equitable conditions for all participants, since the instrument, measurements and application conditions were the same for all groups. In addition, the selection of the participants was based on strategies that allowed participation of diverse participant's profiles. If the inclusion criteria were not met, the decision was scientifically based, without prejudice or discrimination. On the other hand, as this project considers the study of the social determinants of health, this approach allowed to detect factors favoring inequity in health. Taken together, the evidence from this study might be useful for future research and health interventions to reduce inequities among migrant population.

4.4.1. Potential risks

This study had minimal risks that might be associated with safeguarding the data collected in protection of the participant's privacy. Regarding data collection, interviewers were constantly trained and monitored to safeguard the data and be respectful of the attitudes and cultural preferences of the participant. In addition, during collection and storing the data,

there were verification rounds to avoid losses and inconsistencies. Privacy-related risk and confidentiality of the data, were managed through strategies such as using unique identifiers, keep physical documents locked limited at maximum unauthorized access or disclosure. The databases were encrypted, requiring passwords to process and share it. On the other hand, when the analysis was carried out, the communication of the results was made protecting confidentiality, without providing any detail that allows the identification of any participant, (e.g., avoiding tracking or exposing it by answers declared in the questionnaire such as migratory status).

4.4.2. Compensations

Considering the time invested by the participant and potential cost of mobilization, financial compensation was provided. The principal investigators of the Fondecyt project deposited a compensation of $4.000 Chilean pesos to the participant's bank account. In case the participant did not have a bank account, they referred the account of a closer contact of their social network.

4.5. Results of primary data collection analysis

4.5.1. Characteristics of the sample by social determinants of health

The total sample comprise 6.626 individuals (n=3.234 Chileans and n=3.302 international migrants) similarly distributed in San Ramón, La Granja and La Pintana (33.38%, 33.20% and 33.41%, respectively). Of them, the majority were women in both groups, respectively. The mean age of the sample was 37.28 ± 15.44 years old. Among Chileans, the mean age was 40.78±16.86 years old, while migrants were 33.53±12.74 years old. Regarding marital status, both groups were mostly single (55.33% Chileans; 54.08% migrants) and ethnic aboriginal belonging was reported by 7.40% of the sample, mainly among local population (11.15% Chileans; 3.8% migrants).

The educational level of the sample was predominantly secondary level 53.96%. Noteworthy, 0.24% and 0.18% of Chileans and migrants reported not having formal education. Moreover, the distribution across educational levels was similar in both groups mainly secondary level 51.56% Chileans vs. 56.37% migrants, followed by University 21.51% Chileans vs. 22.48% migrants. The total sample had an average household income of $521.098±473862 Chilean pesos CLP (635.74 USD, 1 USD=813.74 CLP). Among migrants the average household income was signifincantly lower with $419.965±454.619 Chilean pesos (512.36 USD) than Chileans with an average household income of $617.208±417.838 Chilean pesos (752.99 USD) ($p<0.001$). The average per capita income of the total sample was 274314,5±278.227 Chilean pesos (335.66 USD), among migrants, the per capita income was significantly lower with 264.356±264.170 Chilean pesos (322.51 USD) compared to 284.111±291.106 Chilean pesos (346.62 USD) of Chilean population ($p<0.001$). Among Chileans households, 35.31% had an income below $400.000 CLP, whereas 54.71% of migrant's households did. The majority of participants were employed (54.13%), particularly 47.98% of Chileans were employed which contrast with 60.74% of migrants.

Regarding the access to health care 8.60% of the total sample was uninsured; the percentage of uninsured population was higher in international migrants compared to locals. Among those insured, the majority was affiliated to the public health system, mainly FONASA A. Access barriers were reported by almost half of the total sample, 58.12% of Chileans and 41.18% of migrants experienced barriers, mainly no obtaining an appointment.

Furthermore, characterization of psychosocial determinants revealed a high report of stress in both study populations. Self-perceived discrimination was reported by 45.24% of Chileans whose main cause was their place of residence. Considering the low socioeconomic status of the boroughs under study, these results might be in accordance with the latest national discrimination consult in which people in poverty were the second most discriminated in the country, preceded by indigenous (further mentioned in the discussion section) (93). Among migrants 28.57% reported self-perceived discrimination, mainly for being immigrant. Having social support that is the perception of being valued and cared from others or not (yes/no) was reported by most of Chileans and migrants. However, social capital which represent having or not (yes/no) reciprocal interactions based on trust was reported in a lower percentage among migrants compared to locals.

Among the migrant sample, migration-related factors confirmed an intraregional south-south migration pattern where Venezuela was the main country of origin (48.22%), followed by Peru (14.92%), Haiti (15.44%) and Colombia (11.42%). Time of residence in the country was 3.96±4.42 years, thus the majority were recent migrants residing for up to 5 years only (71.88%). Conversely, more than 15% of the migrant sample in this study had resided for over 10 years in Chile. There was a predominance tourist visa during entry (61.45%) and entering through unauthorized entry points. Only a small proportion of migrant study participants reported being a refugee or asylum seeker (4.35%). Even though 27.35% had a permanent residence, over 50% did not have a visa to display at the moment of the interview, either because it was being processed or because they had an irregular administrative status (Table 16.)

Table 16. Characteristics of participants by social determinants of health

	Total		**Chilean**		**Migrants**		
Social deteminants of health	**n=6.626**		**n=3.324**		**n=3.302**		**P value**
	n	**%**	**n/mean**	**%**	**n/mean**	**%**	
Sex							
Male	2.458	41.44	1206	39.37	1252	43.65	0.001
Female	3.473	58.56	1857	60.63	1616	56.35	0.001
Agec ategories							
18-29	1.522	27.53	695	24.12	827	26.26	0.000
30-49	2.782	50.33	1238	42.97	1.544	46.77	0.000
50-64	915	16.55	683	23.71	232	2.58	0.000
>65	309	5.59	265	9.2	44	10.01	0.000
Ethnicity							
Yes	480	7.4	354	11.15	126	3.8	0.000
No	6.008	92.6	2960	93.26	3048	91.97	0.000
MaritalStatus							
Single	3.698	55.71	1908	57.33	1.790	54.08	0.000
Married	1.782	26.85	922	27.7	860	25.98	0.000
Cohabitant	610	9.19	72	2.16	538	16.25	0.000

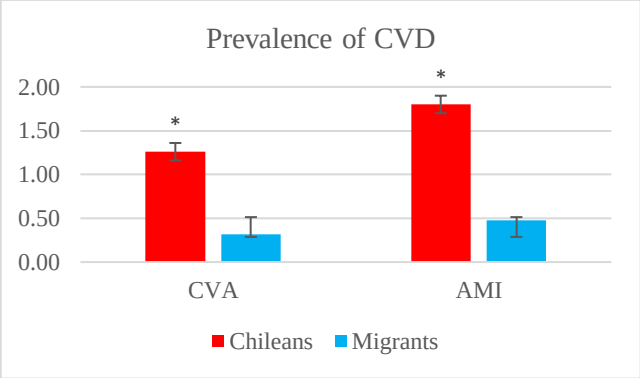
Separated/divorced/annulled	426	6.42	334	10.04	92	2.78	0.000
Widow	122	1.84	92	2.76	30	0.91	0.000
Educationa llevel							
None	14	0.21	8	0.24	6	0.18	0.000
Primary	612	9.22	342	10.28	270	8.16	0.000
HighSchool	3.582,00	53.96	1.716,00	51.56	1.866	56.37	0.000
Technical	970	14.61	546	16.41	424	12.81	0.000
University	1.46	21.99	716	21.51	744	22.48	0.000
Home income							
<400000	3.086	42.78	1.274	35.31	1.812	54.71	0.000
400.000-700.000	1.862	25.81	1.066	29.55	796	24.03	0.000
700.000-1.000.000	794	11.01	480	13.3	314	9.48	0.000
>1.000.000	1.472	20.4	788	21.84	390	11.78	0.000
Occupation							
Employed	3203	54.13	1470	47.98	1733	60.74	0.000
Unemployed	885	14.96	440	14.36	445	15.6	0.000
Inactive	1829	30.91	1154	37.66	675	23.66	0.000
Accesstohealthcare							
None	526	8.60	210	6.54	316	10.88	0.000
Public system	05.06	82.73	2.694	83.87	2.366	81.47	0.000
Private system	252	4.12	204	6.35	48	1.65	0.000
Others	278	4.55	104	3.24	174	5.99	0.000
Acccessbarriers							
Yes	3.29	49.65	1.926	58.12	1.364	41.18	0.000
No	3.336	50.35	1.388	41.88	1.948	58.82	0.000
Stress							
Yes	5.768	87.26	3.072	92.75	2.696	81.75	0.000
No	842	12.74	240	7.25	602	18.25	0.000
Discrimination							
Yes	2.358	36.97	1.454	45.24	904	28.57	0.000
No	4020	63.03	1760	54.76	2260	71.43	0.000
Socialsupport							
Yes	5.89	88.97	3.096	93.37	2.794	84.56	0.000
No	730	11.03	220	6.63	510	15.44	0.000
Socialcapital							
Yes	1.588	24.38	982	30.14	606	18.61	0.000
No	4.926	75.62	2.276	69.86	2650	81.39	0.000
Country of origin							
Peru					494	14.92	
Colombia					378	11.42	
Venezuela					1.596	48.22	
Ecuador					100	3.02	
Haiti					478	14.44	
Bolivia					106	3.20	
Dominican Republic					74	2.24	
Other					84	2.54	
Timeofresidenceyears							
0-5 years					2.592	71.88	
6-10 years					438	12.15	
11-20 years					202	5.60	
>20 years					374	10.37	

4.5.2. Crude prevalence of self-reported cardiovascular diseases stratified by SDH

<u>Main results</u>: unadjusted prevalence of all self reported cardiovascular diseases under study supported a healthy migrant effect since migrants had lower prevalence when compared to locals. Stratified analysis showed the highest prevalence in people over 65 years, with ethnical aboriginal background in comparison to younger age categories. Acute myocardial infarction was more prevalent in males and cerebrovascular disease in women. Among migrants with low socioeconomic status, lack of insurance and psychosocial resources the highest prevalence of cerebrovascular disease was found compared to those having high sociecionomic status, insurance, and resources.

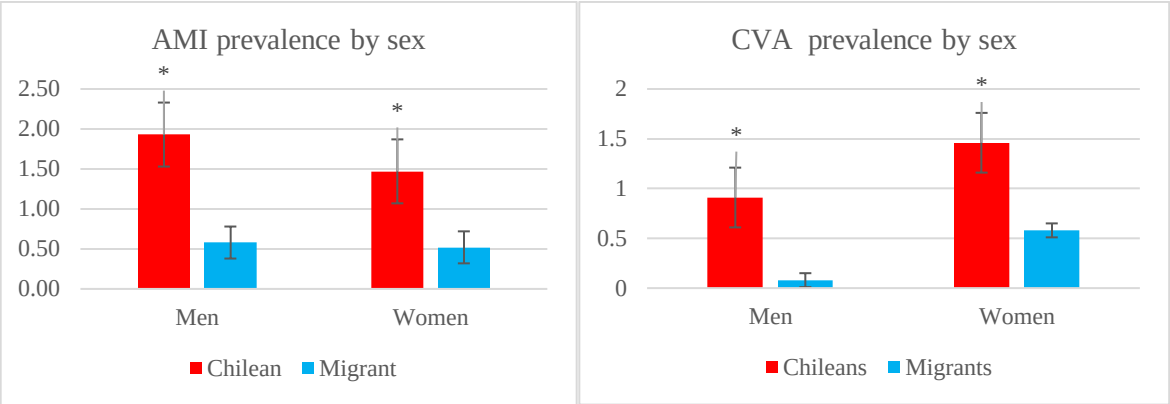
The crude prevalence (Figure 3.) of self-reported acute myocardial infarction (1.80% Chileans vs. 0.48% migrants; p<0.001) (Annex 1. Table 1) and cerebrovascular accident (CVA) (1.26% Chileans vs. 0.32% migrants; p=<0.001) (Annex 1. Table 25.) was significantly lower in immigrant population compared to Chilean population. Stratified results by sex differed (Figure 4.), as myocardial infarction showed higher prevalence in males for both populations, while cerebrovascular accident was higher among women. Stratified data also revealed higher prevalence of both outcomes among individuals over 65 years compared to those at earlier ages (Figure 5.), widows and unemployed individuals from both populations. Particularly, self-reported AMI was more prevalent in locals and migrants with an ethnic aboriginal background, among those affiliated to *other* type of health insurance, those reporting barriers in accessing health care, and those reporting experiences of discrimination. Among migrants only, the percentage of self-reported CVA was higher in those reporting an ethnic aboriginal background, nonformal education, and an income below $400.000 Chilean pesos, lack of health insurance and low social capital, which, altogether, represented a social vulnerability condition. This vulnerability refers to the structural and socioeconomic forces as a result of rooted inequities that could impact individual's health (94).

Figure 3. Crude prevalence of self-reported cardiovascular disease in migrant population compared to locals.



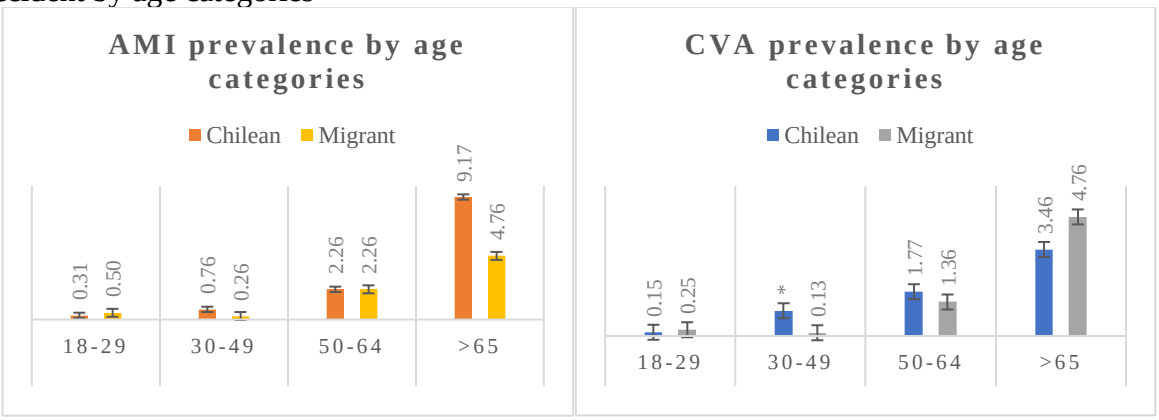
*Compared prevalence of cerebrovascular disease (CVA) and acute myocardial infarction (AMI) was lower in migrant population vs. locals; *p*<0.0001.

Figure 4. Sex differences in prevalence of self-reported acute myocardial infarction and cerebral vascular accident.



*Right figure: compared prevalence of cerebrovascular disease (CVA) stratified by sex show lower prevalence among men and women migrants vs. locals of each sex group. Left figure: Similarly, there were significant lower prevalence of acute myocardial infarction (AMI) in migrants of both sexes vs. locals of each sex group; *p*<0.001.

Figure 5. Prevalence of self-reported acute myocardial infarction and cerebral vascular accident by age categories



Both figures show a higher prevalence of cardiovascular diseases in participants over 65 years of both populations. Specifically, acute myocardial infarction (AMI) and cerebrovascular accident (CVA), respectively.

When comparing the prevalence of these self-reported outcomes between Chileans and migrants for each SDH category, there were significant differences in self-reported AMI prevalence by socioeconomic determinants such as lower educational level (5.72% Chileans vs. 0.40% migrants; p<0.001), lower income level measured as below the minimum wage <$400.000 (2.33% Chileans vs. 0.47% migrants; p<0.001), unemployment (3.69% Chileans vs. 0.68% migrants; p=0.003), and type of access to the health care (affiliation to the public health system 1.90% Chileans vs. 0.41% migrants p<0.001).

Whereas in self-reported CVA differences between Chileans and migrants for each SDH category were mainly found in those aged 30-49 years old (1.01% Chileans vs. 0.13% migrants; p=0.002), with secondary educational level (1.23% Chileans vs. 0.23% migrants; p=0.000), lower income level (1.52% Chileans vs. 0.36% migrants; p=0.001), employed

(1.01% Chileans vs. 0.18% migrants; p=0.002), and affiliated to the public health system (1.32% Chileans vs. 0.36% migrants; p<0.001). In addition, those experiencing stress (1.26% Chileans vs. 0.32% migrants; p<0.001) and discrimination (1.43% Chileans vs. 0.12% migrants; p=0.001) also had higher prevalence of self-reported CVA in both study populations

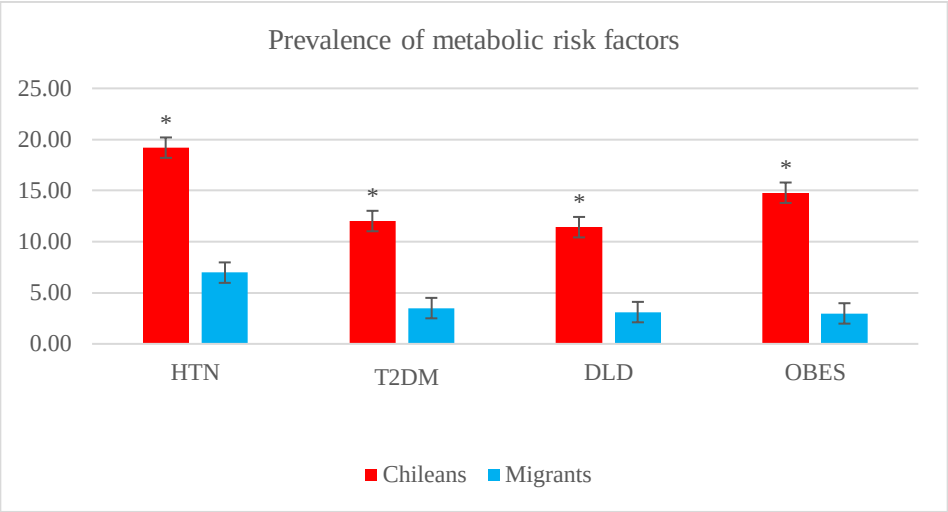
4.5.3. Crude prevalence of self-reported metabolic risks factors stratified by SDH

Main results: the unadjusted analysis revealed a healthy migrant effect, since prevalence of hypertension, type II diabetes mellitus, dyslipidemia and obesity were lower in migrants vs. locals. Stratified analysis showed that metabolic risk factors were prevalent, among women and people with aboriginal ethnic background. In addition, prevalence of metabolic factors differed across socioeconomic levels and psychosocial resources. However, some metabolic factors were more prevalent among those affiliated to the public health system, experienced barriers, stress and discrimination.

Metabolic risks factors such as hypertension (HTN) (19.20% Chileans vs. 6.97% migrants; $p<0.001$), type II diabetes mellitus (T2DM) (12.02% Chileans vs. 3.50% migrants; $p<0.001$), dyslipidemia (DLD) (11.42% Chileans vs. 3.11% migrants; $p<0.001$) and obesity (OBES) (14.79% Chileans vs. 2.98% migrants; $p<0.001$) were significantly lower in international migrants compared to the native-born population (Figure 6.). In both populations, all these health outcomes were more prevalent among women (Figure 7.), those unemployed and those with an ethnic aboriginal background (crude prevalence of Chilean population can be found in Annex 1. Table 26, and prevalence of migrant population in Annex 1. Table 27.). Self-reported HTN and T2DM was more prevalent among widow and those living in the highest income group (>$1.000.000) Particularly, there was a higher prevalence of self-reported HTN, T2DM and DLD among migrants and locals with lower educational level, whereas OBES was higher among those with superior educational level. The latter unexpected result could be related to the modality in which obesity was measured. Since self-report was used, people with more educational level might be aware of their risk and have a better understanding of parameters to identify obesity and get medical confirmation (95).

Regarding access to health care, T2DM and OBES was mainly self-reported in those affiliated to the public health system, as well as OBES and DLD in those experiencing barriers in accessing health care. The percentage of people of both groups self-reporting HTN DLD and OBES was higher among people affirming that they have social capital, that is counting with reciprocal interactions based on trust. However, self-reported DLD and OBES was higher in Chileans and migrants experiencing stress and discrimination (Annex 2. Table 26 and Table 27.).

Figure 6. Crude prevalence of self-reported metabolic risks factors in migrant population compared to locals.



*The prevalence of hypertension (HTN), type 2 diabetes mellitus (T2DM), dyslipidemia (DLD) and obesity (OBES) were significantly lower among migrant population compared to Chilean local population; *p<0.001.*

Self-reported HTN, T2DM, DLD and OBES (Figure 8.) was more prevalent in migrants aged 50-64 years old, while HTN, T2DM, DLD were prevalent among Chileans over 65 years. Noteworthy, OBES was more present at earlier ages in Chilean population (30-49 years old). Self-reported HTN and DLD was higher in Chileans with public insurance, whereas these metabolic risk factors were more prevalent among migrants with private insurance. Contrary to the greater T2DM and OBES prevalence among Chileans reporting not having social capital and social support, respectively. These risk factors were more prevalent in migrants affirming that they have these psychosocial resources than those who don't have it.

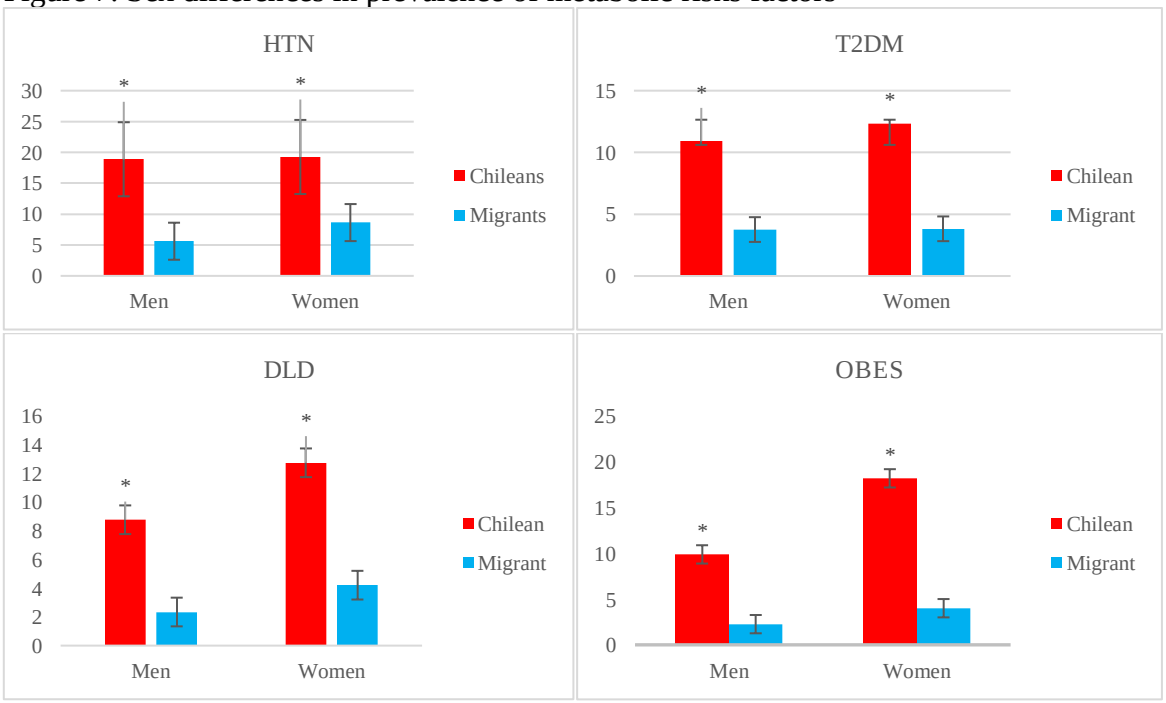
On the other hand, the comparison between groups revealed differences in those aged 30-49 years old for self-reported HTN (13.63% Chileans vs. 5.94% migrants; p<0.001), T2DM (8.45% Chileans vs. 3.43% migrants; p<0.001), DLD (10.96% Chileans vs. 2.57% migrants; p<0.001) and OBES (17.28% Chileans vs. 3.43% migrants; p<0.001). Among migrant and Chileans reporting ethnic aboriginal background there were significant differences in self-reported HTN (21.47% Chileans vs. 9.24% migrants; p=0.003), T2DM (14.29% Chileans vs. 5.88% migrants; p=0.019), DLD (13.44% Chileans vs. 3.36% migrants; p=0.001) and OBES (18.57% Chileans vs. 4.20% migrants; p<0.001).

Moreover, across categories of educational, income and occupational levels there were significant differences in all metabolic risk factors between both groups. Particularly, there were significant differences in all risk factors among those who reported being uninsured in health care (HTN 17.46 Chileans vs. 4.36% migrants; p<0.001; T2DM 10.43% Chileans vs. 3.01% migrants; p<0.001; DLD 8.90% Chileans vs. 1.68% migrants; p<0.001; OBES 11.52% Chileans vs. 1.01% migrants; p<0.001). In addition, there were differences in self-reported HTN (19.14% Chileans vs. 7.29% migrants; p<0.001), T2DM (12.41% Chileans vs. 3.68 migrants; p<0.001), and OBES (16.41% Chileans vs. 3.67% migrants; p<0.001) among those experiencing barriers to accessing health care. The latter reveals that even when migrants report barriers limiting their health access, they had significantly lower prevalence of HTN, T2DM, OBES than locals that also face these difficulties, which might be interpreted

with caution according to the factors influencing this access (further discussed in the following chapter).

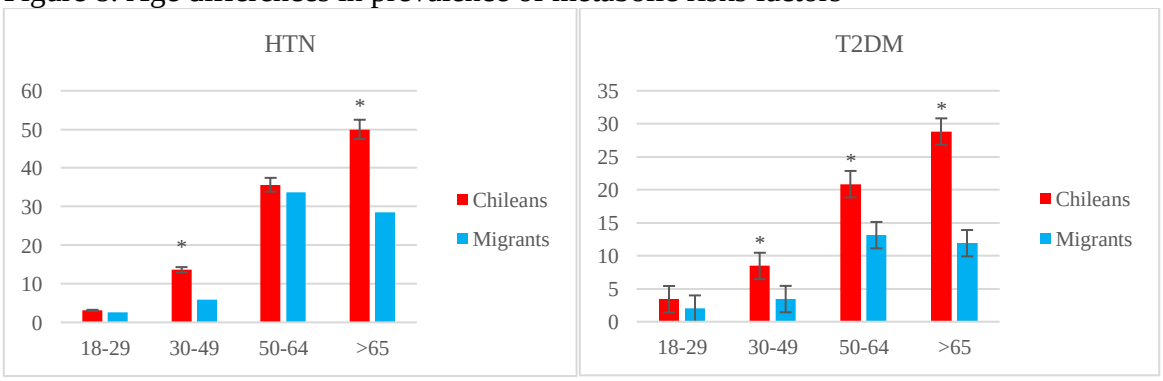
Furthermore, migrants reported significantly lower prevalence of metabolic risks factors across all psychosocial factors than local population. For example, those reporting discriminatory experiences including HTN (17.62% Chileans vs. 7.21% migrants; p<0.001), T2DM (10.43% Chileans vs. 4.18% migrants; p<0.001), and DLD (11.04% Chileans vs. 3.59% migrants; p<0.001).

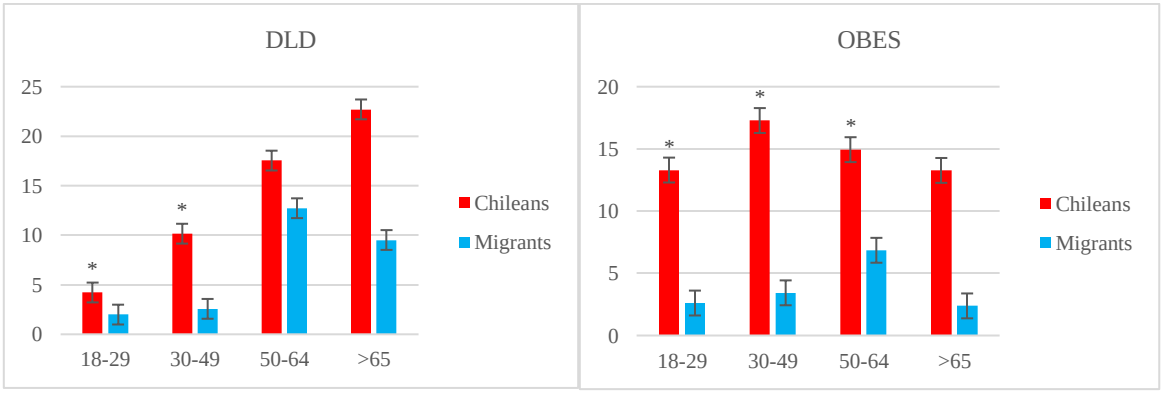
Figure 7. Sex differences in prevalence of metabolic risks factors



The prevalence of hypertension (HTN), type 2 diabetes mellitus (T2DM), dyslipidemia (DLD) and obesity (OBES) were significantly lower in both men and women migrants compared to locals of each sex group; * p<0.001.

Figure 8. Age differences in prevalence of metabolic risks factors





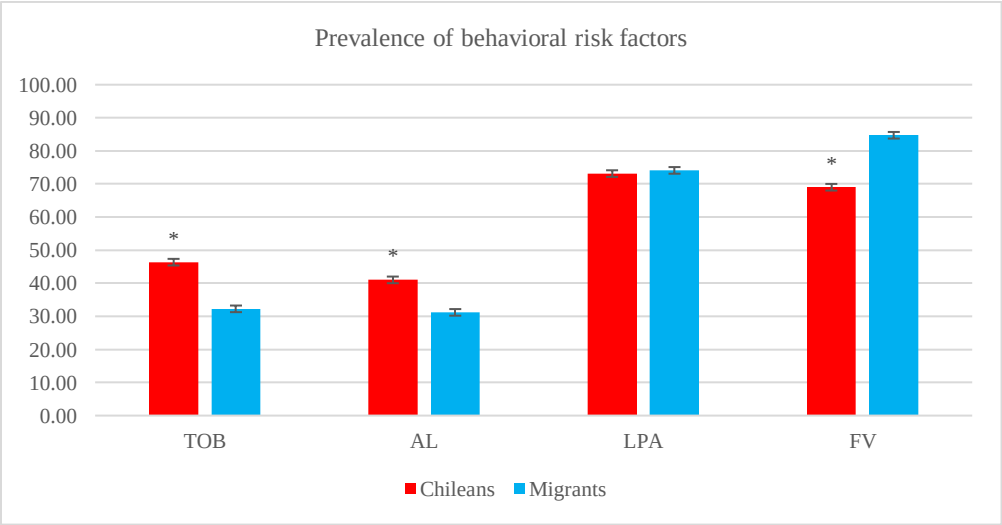
Right superior panel: prevalence of hypertension (HTN) was significantly lower in migrants aged 30-49 years and those over 65 years old when compared to local population. Left superior panel: prevalence of type 2 diabetes mellitus (T2DM) was significantly lower among migrants over 30 years old in comparison to locals of these age groups. Right inferior panel: dyslipidemia (DLD) was significantly lower in migrants from 18 to 49 years old compared to Chileans of the same age categories. Left inferior panel: obesity (OBES) was significantly lower in migrants from 18 to 64 years old compared to locals of these age groups; * p<0.001.

4.5.4. Crude prevalence of self-reported behavioral risks factors stratified by SDH

Main results: a migrant's health advantage was found in tobacco and alcohol consumption when compared to locals. The remaining behavioral factors did not support the healthy migrant effect since physical inactivity was similar in both groups, but low fruit and vegetable consumption was significantly higher in migrants than local population.

The crude prevalence of self-reported tobacco (TOB) (46.36% Chileans vs. 35.26% migrants; p<0.001) and alcohol consumption (ALC) (41.01% Chileans vs. 31.19%; p<0.001) was lower among migrants compared to locals (Figure 9.). However, low fruits and vegetables intake (FV) (69.01% Chileans vs. 84.72% migrants; p<0.001) was significantly higher among migrants. Meanwhile, prevalence of low physical activity (LPA) (73.14% Chileans vs. 74.10% migrants; p=0.552) was similar in both groups (crude prevalence of TOB, ALC, LPA of Chilean and migrant population can be found in Annex 1. Table 28. and prevalence of FV in Annex 1. Table 29.). Prevalence of these behavioral risk differed by sex, for instance ALC was more prevalent in men compared to women of both migrant and local population. Whereas self-reported TOB and FV were more prevalent in Chilean women, and TOB was higher among migrant men and LPA was similarly distributed in both sexes. In addition, prevalence of self-reported ALC and FV was higher among those reporting ethnic aboriginal identity. Particularly, self-reported ALC was higher in people of both groups reporting the higher educational level and income. Regarding occupational conditions, self-reported TOB and ALC were more prevalent among employed migrants and locals, but FV was higher in those unemployed.

Figure 9. Crude prevalence of self-reported behavioral risks factors in migrant population compared to locals.



*The prevalence of tobacco (TOB) and alcohol (ALC) consumption was significantly lower among migrant population. Whereas low physical activity (LPA) was similar in both Chilean and local population. The prevalence of low fruits and vegetable consumption (FV) was significantly higher among migrants compared to local population; *p<0.001.*

Noteworthy, self-reported ALC and TOB consumption was higher among migrants and locals reporting barriers to accessing the health care. On the other hand, data of psychosocial resources revealed higher self-reported LPA among those reporting stress that those who don't. Whereas all behavioral risks factors were more prevalent in those who report not having social capital. In contrast ALC consumption was more prevalent among participants who claim to have social support. However, LPA and FV was more prevalent in individuals that don't have social support of both groups. Furthermore, self-reported TOB and FV was prevalent in Chileans aged 30-49 years, but ALC was prevalent at earlier ages (20-29 years old). Prevalence of self-reported TOB consumption was similarly distributed across ages groups, whereas self-reported ALC was mainly prevalent among those aged 30-49 years old.

Interestingly, LPA prevalence was similar in Chileans over 20 years, especially among migrants up to 64 years old. In addition, self-reported current TOB consumption was more prevalent in migrants with ethnic aboriginal background. For their part, self-reported TOB and LPA were more prevalent among Chileans with lower educational level. However, among migrants TOB was more prevalent at higher education level, but FV was higher among migrants that reported no formal education. In addition, LPA was prevalent among unemployed migrants. Psychosocial factors showed a higher prevalence of self-reported TOB and ALC in Chileans reporting stress and discrimination than those who don't. On the other hand, migrants reported higher self-reported TOB and ALC consumption when lacking social support and discrimination, respectively.

Comparisons between Chileans and migrants revealed significantly higher consumption of TOB (54.94% Chileans vs. 34.02% migrants; $p<0.001$) and ALC (43.18% Chileans vs. 32.46% migrants; $p<0.001$), at 30-49 years old. As mentioned above, there were differences between study populations in LPA particularly among those over 65 years (72.63% Chileans

vs. 45.45% migrants; p=0.022) and in those self-identified with an ethnicity background (72.32% Chileans vs. 58.06% migrants; p=0.040).

Self-reported FV intake was more prevalent in migrants reporting any ethnic aboriginal background (84.75% Chileans vs. 93.65% migrants; p=0.009). Significant higher prevalence of self-reported TOB and ALC consumption were found among Chileans compared to migrants (TOB: 49.32% Chileans vs. 36.48% migrants; p=0.001; ALC: 46.60% Chileans vs. 35.80% migrants; p<0.001). Nevertheless, a higher prevalence of self-reported FV intake was found in unemployed migrants (76.65% Chileans vs. 85.57% migrants; p<0.001). Similarly, uninsured migrants showed higher prevalence of self-reported FV intake (67.62% Chileans vs. 84.81% migrants; p<0.001). When facing stress (46.44% Chileans vs. 35.71% migrants; p=0.001) and self-perceived discrimination 47.83% Chileans vs. 34.58% migrants 0.014), Chileans reported significantly higher TOB consumption. Additionally, when migrants lacked psychosocial resources such as social support (78.18% Chileans vs. 89.80% migrants; p<0.001) and social capital (76.45% Chileans vs. 86.04% migrants; p<0.001) they would report prevalence of LPA compared to the native-born.

4.5.5. Crude prevalence of self-reported CVD and its risks factors stratified by migration-related determinants

Main results: migrants of the main countries of origin did not self-report the highest cardiovascular diseases prevalence. The highest prevalence of AMI was reported at a time of residence over 20 years, while CVA was more prevalent at 0-5 years. Dominican Republic was the leading country for HTN and LPA prevalence and migrants from Ecuador self-reported the highest prevalence for T2DM and FV. Behavioral risk factors such as TOB and LPA were prevalent among migrants from Venezuela. Metabolic and behavioral risk factors are prevalent at times of residence over 10 years.

Cardiovascular diseases were mostly prevalent among migrants from *other* countries of the region (1.27%), followed by Ecuador (AMI: 1.06%) and Colombia (CVA: 0.87%), respectively. In addition, self-reported AMI was more prevalent among those living over 20 years in Chile (1.41%), but CVA was more prevalent among recent migrants (0.37%). Regarding self-reported cardiovascular risk factors, the country of origin with the highest crude prevalence of HTN (15.15%), ALC (43.24%) and LPA (83.78%) was Dominican Republic. While migrants from Ecuador showed the highest crude prevalence of T2DM (11.70%) and FV (92.00%). Migrants from other countries of origin were the most affected by OBES (6.33%) and DLD (7.69%) conditions.

The country of origin with the highest prevalence of self-reported TOB was Bolivia (50.00%), followed by Haiti (40.00%) and Venezuela (3.46%). In addition, Venezuela was the second country with the highest prevalence of LPA (77.96%). Migrants residing 6-10 years showed the highest prevalence of HTN (9.11%) and ALC (33.96%). In contrasts migrants residing over 20 years were mostly affected by T2DM (7.04%), OBES (7.14%), LPA (82.05%) and DLD (5.80%). Moreover, self-reported FV intake was more prevalent in those with a time of residence ranging from 11 to 20 years (94.06%). However, this

behavioral risk factor was less prevalent among those staying more than 20 years (17.65%). Remarkably, the highest prevalence of TOB consumption was found among recent migrants (37.87%) followed by those with the longest time of residence (35.71%).

4.5.6. SDH associated with CVD and its risks factors in Chilean population

Main results: Age was positively associated with cardiovascular diseases, as well as low educational level and unemployment. In addition, age, being women and having a ethnic aboriginal background were positively associated with metabolic risk factors.

The association between self-reported health outcomes and each set of SDH in locals revealed that age was associated with self-reporting cardiovascular diseases (OR: 1.06; 95%CI:1.04-1.07), specifically 7% increased odds of AMI (OR: 1.07; 95%CI:1.05-1.10). Meanwhile, being widow was associated with higher chances of CVD (OR: 2.76; 95% CI:1.16-6.60), where the odds of having AMI was 3.41 time higher in widowers (OR: 3.41; 95%CI:1.22-9.55) (Table 17.).

After adjusting by demographic factors including sex, age and ethnicity, lower levels of education (OR 2.44; 95%CI:1.05-5.65) and unemployment (OR:3.20; 95%CI:1.02-9.98) were associated with increased risk of self-reported cardiovascular diseases in Chileans.

The study of the association between self-reported CVD risks factors and SDH in Chileans (Table 18.) was mainly focused on metabolic factors that were self-reported from previous medical confirmation or disease treatment. Age was associated with self-reported HTN (OR: 1.06; 95%CI: 1.05-1.07) and T2DM (OR: 1.04; 95%CI:1.03-1.05), whereas being women was associated with higher odds of DLD (OR: 1.03; 95%CI: 1.02-1.04) and OBES (OR: 2.11; 95%CI: 1.67-2.68). Those reporting any ethnic aboriginal background had a higher risk of HTN (OR: 1.46; 95%CI: 1.06-2.01), T2DM (OR: 1.50; 95%CI:1.05-2.16) and OBES (OR: 1.39; 95%CI: 1.01-1.91). In addition, reporting being married was associated with a higher risk of all metabolic factors (HTN: OR: 1.99; 95%CI: 1.59-2.51; T2DM OR: 1.50; 95%CI:1.15-1.97; DLP: OR: 1.99; 95%CI: 1.51-2.61; OBES: OR: 1.35; 95%CI: 1.06-1.72).

After adjusting by demographics (sex, age and ethnicity), reporting an income over $1.000.000 increased by 52% the odds of HTN (OR: 1.52; 95%CI: 1.10-2.09), as well as higher chances of OBES (OR: 1.43; 95%CI: 1.03-1.98) and DLD (OR: 1.56; 95%CI: 1.06-2.27). and OBES (OR: 1.43; 95%CI: 1.03-1.98). Among the latter conditions, HTN and OBES were also positively associated with occupational status, that is, being inactive (OR: 1.38; 95%CI: 1.05-1.80) or unemployed (OR: 1.69; 95%CI: 1.25-2.28).

When analyzing access to the health system, experiencing barriers increased the odds of DLD (OR: 1.31; 95%CI: 1.00-1.70) and OBES (OR: 1.45; 95%CI: 1.14-1.82). Psychosocial factors such as discrimination impacted self-reported obesity risk in a positive, significant direction (OR 1.63; 95%CI: 1.29-2.07). Additionally, social capital was associated with increased odd of self-reported OBES (OR: 1.34; 95%CI: 1.05-1.71), as it also was observed for self-reported DLD (OR: 1.46; 95%CI: 1.10-1.92).

Table 17. SDH associated with cardiovascular disease in Chilean population.

Social determinant of health	**IAM**			ECV		
	OR	**[CI 95%]**	**P value**	**OR**	**[CI 95%]**	**P value**
Sex (ref=male)	0.76	[0.41-1.40]	0.382	1.04	[0.64-1.69]	0.871
Age	**1.07**	**[1.05-1.10]**	**0.000**	**1.00**	**[1.04-1.07]**	**0.000**
Aboriginal ethnicity (ref=no)	1.71	[0.70-4.19]	0.239	1.00	[0.45-2.24]	0.991
Marital Status ref=Single						
Married	1.42	[0.71-2.84]	0.319	1.36	[0.82-2.27]	0.237
Cohabitant	4.04	[0.85-19.12]	0.078	1.83	[0.42-8.06]	0.425
Separated/divorced/annulled	1.00	[0.32-3.08]	0.996	0.38	[0.11-1.27]	0.116
Widow	**3.40**	**[1.22-9.55]**	**0.019**	**2.7**	**[1.16-6.60]**	**0.022**
GOF test			0.356			0.466
Educational level (ref=none)						
Primary	**3.2**	**[1.02-9.98]**	**0.045**	**2.44**	**[1.05-5.65]**	**0.037**
Secondary	1.41	[0.50-3.96]	0.515	1.23	[0.60-2.55]	0.570
Technical	0.83	[0.21-3.21]	0.788	0.76	[0.28-2.00]	0.573
University	1	-	-	1	-	-
Home Income categories (<400.00 lower income)						
40**0.00** -70**0.00**	0.86	[0.41-1.80]	0.702	0.73	[0.40-1.32]	0.297
70**0.00** -1.00**0.00**	1.39	[0.54-3.49]	0.490	1.08	[0.51-2.31]	0.836
>1.00**0.00**	0.68	[0.21-2.10]	0.500	1.02	[0.49-2.13]	0.959
Occupation (ref=employed)						
Unemployed	2.01	[0.90-4.46]	0.087	**2.08**	**[1.13-3.83]**	**0.019**
Inactive	1.40	[0.56-3.45]	0.463	1.10	[0.57-2.12]	0.773
GOF test			0.329			0.291
Access to healthcare (ref=none)						
Public health system affiliation	3.83	[0.49-29.90]	0.200	6.51	[0.87-48.54]	0.068
Private health system affiliation	2.01	[0.11-36.31]	0.636	7.30	[0.75-70.70]	0.086
Others	2.26	[0.12-40.01]	0.577	4.78	[0.40-56.91]	0.215
Access barriers (ref=no)	1.53	[0.78-2.98]	0.208	1.31	[0.79-2.16]	0.295
GOF test			0.484			**0.046**
Stress (ref=no)	0.74	[0.27-2.00]	0.549	0.81	[0.36-1.78]	0.593
Discrimination (ref=no)	1.84	[0.91-3.73]	0.089	1.41	[0.84-2.39]	0.194
Social support (ref=no)	0.72	[0.23-2.17]	0.558	1.46	[0.51-4.21]	0.483
Social capital (ref=no)	1.31	[0.65-2.62]	0.444	1.09	[0.64-1.85]	0.753
GOF test			0.090			0.002

AMI: acute myorcardial infarction; CVA: cerebrovascular accident. CI confidence Interval.

Table 18. SDH associated with cardiovascular risks factors in Chilean population.

Social determinant of health	**HTA**			**DM**			**Dyslipidemia**			**Obesity**		
	OR	**[CI 95%]**	**P value**	**OR**	**[CI95%]**	**P value**	**OR**	**[CI95%]**	**P value**	**OR**	**[CI95%]**	**P value**
Sex (ref=male)	01.09	[0.88-1.34]	0.454	1.21	[0.94-1.56]	0.133	**1.64**	**[1.26-2.14]**	**0.000**	**2.10**	**[1.67-2.68]**	**0.000**
Age	**1.00**	**[1.05-1.07]**	**0.000**	**1.04**	**[1.03-1.05]**	**0.000**	**1.03**	**[1.02-1.04]**	**0.000**	1.00	[1.00-1.01]	0.194
Aboriginal ethnicity (ref=no)	**1.40**	**[1.06-2.01]**	**0.021**	**1.50**	**[1.05-2.16]**	**0.027**	**1.47**	**[1.02-2.12]**	**0.041**	**1.30**	**[1.01-1.91]**	**0.046**
Marital Status ref=Single												
Married	**1.90**	**[1.59-2.51]**	**0.000**	**1.50**	**[1.15-1.97]**	**0.003**	**1.90**	**[1.51-2.61]**	**0.000**	**1.35**	**[1.06-1.72]**	**0.017**
Cohabitant	1.02	[0.44-2.36]	0.969	1.00	[0.39-2.58]	0.998	**2.65**	**[1.29-5.43]**	**0.008**	**1.90**	**[1.06-3.65]**	**0.033**
Separated/divorced/annulled	**1.60**	**[1.17-2.36]**	**0.005**	1.29	[0.86-1.96]	0.222	1.48	[0.97-2.26]	0.071	01.09	[0.74-1.61]	0.649
Widow	**2.63**	**[1.51-4.59]**	**0.001**	1.42	[0.74-2.73]	0.294	1.61	[0.83-3.13]	0.157	0.53	[0.22-1.26]	0.149
GOF test			0.140			**0.001**			0.697			0.497
Educational level (ref=none)												
Primary	0.59	[0.10-3.43]	0.556	0.57	[0.10-3.38]	0.535	0.50	[0.08-2.91]	0.442	0.74	[0.08-6.78]	0.792
Secondary	0.57	[0.09-3.31]	0.536	0.41	[0.07-2.43]	0.330	0.42	[0.07-2.40]	0.329	0.75	[0.08-6.75]	0.798
Technical	0.41	[0.06-2.3]	0.319	0.38	[0.06-2.29]	0.294	0.31	[0.05-1.82]	0.195	0.74	[0.08-6.71]	0.789
University	0.46	[0.07-2.69]	0.390	0.32	[0.05-1.90]	0.209	0.28	[0.04-1.70]	0.170	0.73	[0.08-6.65]	0.784
Home Income categories (<400.00 lower income)												
40**0.00** -70**0.00**	1.03	[0.79-1.33]	0.824	1.18	[0.87-1.58]	0.279	1.28	[0.94-1.72]	0.115	1.25	[0.96-1.61]	0.098
70**0.00** -1.00**0.00**	**1.43**	**[1.03-1.97]**	**0.032**	1.27	[0.86-1.86]	0.226	**1.48**	**[1.00-2.17]**	**0.049**	1.07	[0.75-1.51]	0.695
>1.00**0.00**	**1.52**	**[1.10-2.09]**	**0.011**	1.25	[0.85-1.82]	0.247	**1.50**	**[1.06-2.27]**	**0.021**	**1.43**	**[1.03-1.98]**	**0.031**
Occupation (ref=employed)												
Unemployed	1.10	[0.81-1.49]	0.530	1.11	[0.78-1.57]	0.543	1.13	[0.79-1.61]	0.486	**1.60**	**[1.25-2.28]**	**0.001**
Inactive	**1.38**	**[1.05-1.80]**	**0.017**	1.06	[0.77-1.43]	0.724	0.90	[0.66-1.21]	0.473	1.08	[0.83-1.39]	0.544
GOF test			**0.011**			**0.050**			0.872			0.564
Access to healthcare (ref=none)												
Public health system affiliation	1.25	[0.78-1.98]	0.342	1.23	[0.71-2.10]	0.452	1.39	[0.77-2.48]	0.269	1.33	[0.81-2.18]	0.253
Private health system affiliation	0.96	[0.49-1.87]	0.901	0.57	[0.23-1.36]	0.204	1.18	[0.52-2.65]	0.696	1.26	[0.64-2.48]	0.495
Others	1.23	[0.92-1.42]	0.593	0.67	[0.24-1.82]	0.428	1.04	[0.38-2.78]	0.936	0.84	[0.34-2.04]	0.706
Access barriers (ref=no)	1.15	[0.92-1.42]	0.221	1.16	[0.90-1.49]	0.244	**1.30**	**[1.00-1.70]**	**0.043**	**1.45**	**[1.14-1.82]**	**0.002**
GOF test			0.054			**0.142**			0.600			0.074
Stress (ref=no)	1.35	[0.89-2.02]	0.155	1.20	[0.75-1.92]	0.442	**2.20**	**[1.21-4.03]**	**0.010**	1.57	[0.92-2.67]	0.097
Discrimination (ref=no)	1.02	[0.81-1.28]	0.853	0.78	[0.59-1.01]	0.067	1.21	[0.91-1.58]	0.174	**1.63**	**[1.29-2.07]**	**0.000**
Social support (ref=no)	1.36	[0.86-2.13]	0.180	1.37	[0.80-2.32]	0.248	0.88	[0.53-1.43]	0.605	0.83	[0.54-1.29]	0.408
Social capital (ref=no)	0.91	[0.71-1.15]	0.438	0.90	[0.67-1.18]	0.446	**1.40**	**[1.10-1.92]**	**0.007**	**1.34**	**[1.05-1.71]**	**0.019**
GOF test			0.074			0.036			0.088			0.507

HTN: hypertension; T2DM: type 2 diabetes mellitus; DLD: dyslipidemia; OBES: obesity. CI confidence Interval.

4.5.7. SDH associated with self-reported CVD and its risks factors in migrant population

Main results: analysis revealed a positive association of age and having *other* type of insurance with cardiovascular diseases. Being women increased the odds of having metabolic risk factors such as HTN, DLD and OBES. The odds of self-reporting HTN, T2DM and DLD increase among those with public insurance compared to uninsured migrants.

Age was associated with a higher risk of cardiovascular diseases in migrant population (OR: 1.84; 95%CI: 1.02-3.28). Unexpectedly, after adjusting by demographic factors lower educational level was associated with 72% less odds of CVD (OR: 0.28; 95%CI:0.00-0.78) but university level was associated with 97% reduced odds (OR: 0.03; 95%CI:0.00-0.65). The odds of having AMI was 10.38 times higher in those with *other* type of health insurance (OR 10.38; 95%CI: 1.01-105.79) (Table 19.).

In regard to self-reported metabolic factors (Table 20.) among migrants, female sex was associated with increased odds of HTN (OR: 1.72; 95%CI: 1.23-2.40), DLD (OR: 2.13; 95%CI: 1.26-3.60) and OBES (OR: 2.23; 95%CI:1.32-3.75). Likewise, the odds of having HTN (OR: 1.08; 95%CI: 1.07-1.09), T2DM (OR: 1.06; 95%CI: 1.04-1.08) and DLD (OR: 1.05; 95%CI: 1.03-1.07) were associated with increments across age. Additionally, ethnic background also revealed a significant positive association with dyslipidemia. Marital status was associated with metabolic risks factors; for instance, being divorced (OR: 2.05; 95%CI: 1.00-4.18) and widow (OR: 3.08; 95%CI: 1.02-9.26) were associated with higher odds of HTN. While being married (OR: 1.61; 95%CI: 1.01-2.58) was associated with higher odds of self-reported T2DM and OBES was associated with higher odds of being Cohabitant (OR: 2.56; 95%CI: 1.44-4.54).

Analysis related to health care access revealed 2.37 times higher odds of self-reported HTN among those with public insurance compared to no insurance (OR: 2.37; 95%CI: 1.16-4.83) as well as T2DM (OR: 2.89; 95%CI: 1.01-8.24) and DLD (OR: 6.70; 95%CI: 1.27-35.22). Among psychosocial factors, a significant association was only found in self-reported DLD, in which its odds were significantly increased by having social capital (OR: 1.84; 95%CI: 1.02-3.28).

Table 19. SDH associated with cardiovascular disease in migrant population.

Social determinant of health	**IAM**			ECV		
OR	**OR**	**[CI 95%]**	**P value**	**OR**	**[CI 95%]**	**P value**
Total						
Sex (ref=male)	1.19	[0.38-3.68]	0.768	1.68	[0.64-4.41]	0.295
Age	**1.00**	**[1.01-1.10]**	**0.008**	**1.05**	**[1.02-1.09]**	**0.001**
Aboriginal ethnicity (ref=no)	1.55	[0.20-12.29]	0.678	0.94	[0.12-7.23]	0.951
Marital Status ref=Single						
Married	1.33	[0.40-4.44]	0.640	0.75	[0.26-2.19]	0.599
Cohabitant	0.52	[0.06-4.37]	0.549	0.58	[0.13-2.63]	0.477
Separated/divorced/annulled	1.79	[0.20-16.04]	0.602	02.04	[0.42-9.92]	0.376
Widow	1	-		2.48	[0.27-22.49]	0.419
GOF test			0.173			0.280
Educational level (ref=none)						
Primary	1.95	[0.11-32.61]	0.643	**0.28**	**[0.00-0.78]**	**0.035**
Secondary	3.47	[0.42-28.17]	0.245	0.86	[0.01-1.31]	0.077

Technical	6.73	[0.67-67.14]	0.104	0.18	[0.01-3.04]	0.234
University	1		-	**0.03**	**[0.00-0.65]**	**0.025**
Home Income categories (<400.00 lower income)						
40**0.00** -70**0.00**	0.57	[0.11-2.81]	0.492	0.61	[0.17-2.25]	0.462
70**0.00** -1.00**0.00**	0.56	[0.06-4.86]	0.596	0.94	[0.20-4.48]	0.940
>1.00**0.00**	1.45	[0.36-5.87]	0.599	0.89	[0.26-3.01]	0.856
Occupation (ref=employed)						
Unemployed	1.56	[0.37-6.52]	0.540	2.20	[0.73-6-64]	0.162
Inactive	1.29	[0.27-6.08]	0.745	1.67	[0.511-5.48]	0.395
GOF test			0.257			0.493
Access to healthcare (ref=none)						
Public health system affiliation	1.18	[0.13-9.96]	0.879	1.14	[0.25-5.28]	0.863
Private health system affiliation	1	-	-	1	-	-
Others	**10.38**	**[1.01-105.79]**	**0.048**	5.94	[0.98-36.22]	0.053
Access barriers (ref=no)	0.52	[0.13-1.96]	0.336	0.53	[0.19-1.51]	0.235
GOF test			0.060			0.385
Stress (ref=no)	0.41		0.175	0.98	[0.31-3.13]	0.977
Discrimination (ref=no)	2.56		0.140	1.28	[0.46-3.55]	0.642
Social support (ref=no)	-		-	4.47	[0.57-34.70]	0.152
Social capital (ref=no)	0.91		0.887	1.04	[0.33-3.28]	0.942
GOF test			0.054			0.691

AMI: acute myorcardial infarction; CVD: cardiovascular disease. CI confidence Interval.

Table 20. SDH associated with cardiovascular risks factor in migrant population.

Social determinant of health	**HTA**			**DM**			**Dyslipidemia**			**Obesity**		
OR	**OR**	**[CI95%]**	**P value**	**OR**	**[CI95%]**	**P value**	**OR**	**[CI95%]**	**P value**	**OR**	**[CI95%]**	**P value**
Total												
Sex (ref=male)	**1.72**	**[1.23-2.40]**	**0.002**	1.00	[0.66-1.52]	0.990	**2.13**	**[1.26-3.60]**	**0.005**	**2.23**	**[1.32-3.75]**	**0.003**
Age	**1.08**	**[1.07-1.09]**	**0.000**	**1.00**	**[1.04-1.08]**	**0.000**	**1.05**	**[1.03-1.07]**	**0.000**	**1.03**	**[1.01-1.05]**	**0.002**
Ethnicity (ref=no)	1.16	[0.58-2.31]	0.677	1.54	[0.68-3.47]	0.300	1.08	[0.38-3.06]	0.887	1.47	[0.58-3.77]	0.419
Marital Status ref=Single												
Married	1.39	[0.97-2.00]	0.073	**1.60**	**[1.01-2.58]**	**0.046**	1.18	[0.67-2.06]	0.566	1.43	[0.81-2.54]	0.218
Cohabitant	1.33	[0.84-2.10]	0.224	1.50	[0.84-2.68]	0.171	1.66	[0.89-3.08]	0.108	**2.50**	**[1.44-4.54]**	**0.001**
Separated/divorced/annulled	**2.05**	**[1.00-4.18]**	**0.049**	1.15	[0.38-3.45]	0.804	1.45	[0.48-4.40]	0.507	1.53	[0.44-5.29]	0.504
Widow	**3.08**	**[1.02-9.26]**	**0.045**	2.67	[0.69-10.33]	0.153	0.83	[0.10-6.74]	0.859	1	-	
GOF test			**0.001**			0.322			**0.020**			0.512
Educational level (ref=none)												
Primary	1	-	-	1	-	-	1.93	[0.83-4.44]	0.122	0.80	[0.30-2.11]	0.655
Secondary	0.95	[0.52-1.74]	0.872	1.40	[0.65-3.00]	0.391	1.32	[0.69-2.51]	0.395	0.93	[0.51-1.67]	0.811
Technical	1.15	[0.77-1.71]	0.484	1.53	[0.88-2.64]	0.124	1.19	[0.48-2.95]	0.705	1.29	[0.59-2.75]	0.520
University	1.21	[0.68-2.14]	0.507	0.54	[0.19-1.49]	0.238	1	-	-	1	-	-
Home Income categories (<400.00 lower income)												
40**0.00** -70**0.00**	1.17	[0.78-1.72]	0.439	1.39	[0.86-2.25]	0.178	1.63	[0.95-2.80]	0.076	1.58	[.92-2.69]	0.092
70**0.00** -1.00**0.00**	1.16	[0.68-1.94]	0.582	0.49	[0.20-1.18]	0.112	0.72	[0.27-1.90]	0.508	1.24	[0.57-2.68]	0.588
>1.00**0.00**	1.12	[0.69-1.80]	0.650	1.19	[0.64-2.20]	0.576	1.07	[0.51-2.23]	0.847	0.88	[0.38-2.02]	0.766
Occupation (ref=employed)												
Unemployed	1.34	[0.88-2.00]	0.164	1.27	[0.73-2.19]	0.389	1.67	[0.89-3.09]	0.106	1.22	[0.65-2.28]	0.523
Inactive	0.78	[0.48-1.22]	0.280	1.16	[0.64-2.08]	0.624	**1.9**	**[1.04-3.47]**	**0.036**	1.05	[0.56-1.92]	0.885
GOF test			**0.000**			0.265			0.077			0.323
Access to healthcare (ref=none)												
Public health system affiliation	**2.37**	**[1.16-4.83]**	**0.018**	**2.80**	**[1.01-8.24]**	**0.047**	3.96	[0.93-16.69]	0.061	2.14	[0.65-7.04]	0.211
Private health system affiliation	3.43	[0.88-13.29]	0.075	2.58	[0.24-26.63]	0.426	5.55	[0.45-68.04]	0.180	2.23	[0.21-23.43]	0.504
Others	1.54	[0.57-4.14]	0.394	2.10	[0.52-8.38]	0.294	**6.70**	**[1.27-35.22]**	**0.025**	3.84	[0.93-15.74]	0.062
Access barriers (ref=no)	1.23	[0.87-1.72]	0.242	1.29	[0.83-2.00]	0.256	1.15	[0.68-1.93]	0.596	1.51	[0.91-2.49]	0.105
GOF test			**0.00**3			0.842			0.056			0.476
Stress (ref=no)	0.92	[0.59-1.42]	0.720	1.06	[0.57-1.92]	0.859	1.35	[0.63-2.84]	0.433	2.01	[0.83-4.79]	0.117
Discrimination (ref=no)	0.88	[0.59-1.29]	0.509	1.21	[0.74-1.97]	0.437	1.06	[0.59-1.88]	0.853	1.22	[0.69-2.13]	0.480
Social support (ref=no)	0.96	[0.58-1.56]	0.856	0.60	[0.33-1.06]	0.082	0.79	[0.40-1.54]	0.494	1.58	[0.69-3.58]	0.275
Social capital (ref=no)	1.25	[0.83-1.86]	0.282	1.62	[0.98-2.68]	0.059	**1.84**	**[1.02-3.28]**	**0.041**	1.36	[0.74-2.47]	0.321
GOF test			0.009			0.747			0.482			0.406

HTN: hypertension; T2DM: type 2 diabetes mellitus; DLD: dyslipidemia; OBES: obesity. CI confidence Interval.

4.5.8. Healthy migrant effect (HME) in self-reported cardiovascular health by SDH

Analysis of the healthy migrant effect was performed following logistic regression techniques, in which I sequentially adjusted for each set of SDH. In every model, migratory status (being a migrant, ref=Chilean) was the main independent variable.

Main result: crude analysis (model 1) showed that being migrant was protective for cardiovascular diseases and cardiovascular risk factors. However, after adjusting by demographic factors (model 2) this advantage was vanished on self-reported AMI. Whereas being migrant remained protective for self-reported CVA after adjustment for demographic (model 2) and socioeconomic (model 3) factors. However, this advantage lost significance after adjusting by access to health care factors (model 4).

Crude analyzes of metabolic risk factors (model 1), AL and TOB consumption were in favor of the healthy migrant effect. After sequentially adjusting by each set of SDH, the protective effect of being migrant was confirmed.

Initial crude analysis (Model 1) was in favor of a healthy migrant effect for self-reported cardiovascular diseases. Hence, being an international migrant was associated with 73% and 75% lower odds of AMI (OR: 0.27; 95%CI: 0.15-0.47; p<0.001) and CVA (OR: 0.25; 95%CI: 0.13-0.5; p<0.001), respectively. After adjusting by demographics (model 2), the advantage in self-reported AMI was no longer significant, but the advantage remained significant for CVA (OR: 0.43; 95%CI:0. 20-0.94; p=0.034). Lower odds of CVA among migrants compared to locals remained significant after adjusting by socioeconomic factors (model 3), showing a 61% of reduced odds (OR: 0,39; 95%CI:0,18-0,86; p=0,019. However, the subsequent model (model 4) adjusting by type of access to health care proven that the healthy migrant effect for CVA disappeared, as being a migrant lost statistical significance in this final adjusted model (Table 21.).

Regarding self-reported cardiovascular risks factors, the healthy migrant effect was evidenced in the crude or unadjusted model (model 1), which resulted in 68% lower odds of HTN (0.32; 95%CI:0.27-0.37; p<0.001) and 73% of T2DM (OR: 0.27; 95%CI:0.21-0.33; p<0.001). Similarly, being migrant was associated with 75% lower odds of DLD (OR: 0.25; 95%CI:0.20-0.31; p<0.001) and 82% of OBES (OR: 0.18; 95%CI:0.14-0.22; p<0.001). This advantage was also revealed for tobacco (OR: 0.63; 95%CI:0.50-0.80; p<0.001) and alcohol consumption (OR: 0.65; 95%CI:0.57-0.75; p<0.001).

Across all models sequentially adjusted by demographics (model 2), socioeconomics (model 3), access to health care (model 4) and psychosocial factors (model 5), the healthy migrant advantage remains significant for all risk factors, which could to some extent influence the healthy migrant effect found in self-reported cardiovascular diseases like CVA, even after adjusting by socioeconomic factors. Specifically, being an international migrant was associated with 26% less odds of self-reported HTN (OR: 0.74; 95%CI: 0.59-0.93; p=0.008), 48% less odds of T2DM (OR: 0.52; 95%CI: 0.39-0.70; p<0.001), as well as 61% reduced odds of DLD (OR: 0.39; 95%CI: 0.28-0.54; p<0.001) and 79% less odds of OBES (OR: 0.21;

95%CI: 0.15-0.28; p<0.001). In addition, being a migrant was significantly associated with 53% and 40% lower odds of TOB and ALC, respectively (TOB OR: 0.47; 95%CI: 0.35-0.64; p<0.001; ALC OR: 0.60; 95%CI: 0.50-0.73; p<0.001).

4.5.9. Migratory-related determinants of health associated with cardiovascular health outcomes

Main results: there were not significant associations between migratory-related factors and cardiovascular events. HTN was positively associated with a time of residence of 6-10 years and being Dominican. Whereas there was negative association in which being Venezuelan reduced the odds of T2DM

After adjustment for sex and age, there were not significant association between migratory-related factors and cardiovascular diseases (data not shown). However, analysis of metabolic factors (Table 7.) yielded in significant positive associations of HTN with time of residence from 6 to 10 years (OR: 1.91; 95%CI: 1.21-3.02; p=0.005). As well as countries of origin were associated with increased odds of this metabolic factor, mainly Dominican Republic (OR:5.11; 95%CI: 2.09-12.48; p<0.001), followed by Ecuador, Venezuela, and Colombia. In contrast Venezuela was negatively associated with T2DM (OR: 0.67; 95%CI:0.34-1.32; p=0.024) but Ecuador increased the risk (OR: 2.61; 95%CI: 1.11-6.12; p=0.027).

Regarding behavioral factors (Table 8.), the odds of ALC consumption were significantly reduced among those from Haiti (OR: 0.54; 95%CI: 0.33-0.88; p=0.014), while being from Bolivia was positively associated with higher odds of ALC consumption (OR: 2.16; 95%CI 1.13-4.13; p=0.020). For its part, recent migration was significantly associated with higher odds of FV intake (OR: 1.78; 95%CI: 1.24.2.54; p=0.001) and being born in Venezuela (OR: 1.67; 95%CI 1.16-2.40; p=0.006) and Ecuador (OR: 2.42; 95%CI 1.00-5.88; p=0.049) were also positively associated with increased dietary risk.

Table 21. Healthy migrant effect analysis by SDH adjustment.

Health outcome	**Model 1 Crude OR of being migrant**			**Model 2 Adjusted OR by demographics**			**Model 3 Adjusted OR by demographics + SES**			**Model 4 Adjusted OR by demographics + SES +access to health care**			**Model 5 Adjusted OR by demographics + SES +access to health care +psychosocial**		
	OR	**[CI95%]**	***p value***	**OR**	**[CI95%]**	***p value***	**OR**	**[CI95%]**	***p value***	**OR**	**[CI95%]**	***p value***	**OR**	**[CI95%]**	***p value***
AMI	**0.27**	**[0.15-0.47]**	**0.000**	0.64	[0.32-1.26]	0.196	0.65	[0.32-1.31]	0.228	0.82	[0.39-1.70]	0.593	0.99	[0.46-2.11]	0.978
CVA	**0.25**	**[0.13-0.51]**	**0.000**	**0.43**	**[0.20-0.94]**	**0.034**	**0.30**	**[0.18-0.86]**	**0.019**	0.46	[0.20-1.03]	0.058	0.41	[0.21-1.08]	0.077
HTN	**0.32**	**[0.27-0.37]**	**0.000**	**0.50**	**[0.48-0.72]**	**0.000**	**0.60**	**[0.49-0.74]**	**0.000**	**0.70**	**[0.56-0.87]**	**0.001**	**0.74**	**[0.59-0.93]**	**0.008**
T2DM	**0.27**	**[0.21-0.33]**	**0.000**	**0.40**	**[0.35-0.59]**	**0.000**	**0.40**	**[0.36-0.60]**	**0.000**	**0.52**	**[0.40-0.69]**	**0.000**	**0.52**	**[0.39-0.70]**	**0.000**
DLD	**0.25**	**[0.20-0.31]**	**0.000**	**0.30**	**[0.23-0.40]**	**0.000**	**0.30**	**[0.23-0.41]**	**0.000**	**0.34**	**[0.25-0.47]**	**0.000**	**0.30**	**[0.28-0.54]**	**0.000**
OBES	**0.18**	**[0.14-0.22]**	**0.000**	**0.10**	**[0.12-0.21]**	**0.000**	**0.10**	**[0.12-0.21]**	**0.000**	**0.10**	**[0.14-0.25]**	**0.000**	**0.20**	**[0.15-0.28]**	**0.000**
TOB	**0.63**	**[0.50-0.80]**	**0.000**	**0.60**	**[0.47-0.77]**	**0.000**	**0.54**	**[0.42-0.71]**	**0.000**	**0.50**	**[0.38-0.67]**	**0.000**	**0.47**	**[0.35-0.64]**	**0.000**
AL	**0.65**	**[0.57-0.75]**	**0.000**	**0.50**	**[0.50-0.69]**	**0.000**	**0.60**	**[0.51-0.71]**	**0.000**	**0.50**	**[0.49-0.70]**	**0.000**	**0.60**	**[0.50-0.73]**	**0.000**
LPA	1.05	[0.90-1.23]	0.531	1.16	[0.98-1.37]	0.090	1.12	[0.93-1.33]	0.227	1.13	[0.93-1.37]	0.209	1.06	[0.86-1.30]	0.604
FV	**2.40**	**[2.21-2.80]**	**0.000**	**1.90**	**[1.71-2.31]**	**0.000**	**1.97**	**[1.69-2.30]**	**0.000**	**1.23**	**[1.64-2.28]**	**0.000**	**1.94**	**[1.63-2.32]**	**0.000**

AMI: acute myorcardial infarction; CVA: cerebrovascular accident; HTN: hypertension; T2DM: type 2 diabetes mellitus; DLD: dyslipidemia; OBES: obesity; TOB: tobacco consumption; ALC: Alcohol consumption; LPA: lower physical activity; FV: low fruits and vegetables. CI confidence Interval.

Table 22. Migratory-related determinants of health associated metabolic risk factors.

Social Determinant of Health	**HTA**			**DM**			**Dyslipidemia**			**Obesity**		
Adjusted sex + age	**OR**	**[CI95%]**	**P value**	**OR**	**[CI95%]**	**P value**	**OR**	**[CI95%]**	**P value**	**OR**	**[CI95%]**	**P value**
Time of residence												
6-1o years	**1.91**	**[1.21-3.02]**	**0.005**	1.01	[0.54-1.88]	0.970	1.60	[0.81-3.18]	0.173	1.23	[0.61-2.44]	0.554
11-20 years	1.09	[0.11-2.21]	795	1.09	[0.50-2.37]	0.818	1.57	[0.64-3.85]	0.322	0.96	[0.36-2.52]	0.937
>20 years	1.15	[0.41-3.22]	779	1.78	[0.63-5.03]	0.270	1.84	[0.61-5.54]	0.275	1.82	[0.60-5.44]	0.284
Country of origin												
Colombia	**2.22**	**[1.15-4.29]**	**0.017**	0.75	[0.33-1.73]	0.509	1.41	[0.61-3.28]	0.413	0.96	[0.40-2.32]	0.941
Venezuela	**2.14**	**[1.17-3.89]**	**0.013**	**0.67**	**[0.34-1.32]**	**0.024**	1.54	[0.74-3.21]	0.240	1.17	[0.57-0.2.38]	0.660
Ecuador	**3.45**	**[1.54-7.75]**	**0.003**	**2.61**	**[1.11-6.12]**	**0.027**	1.72	[0.58-5.07]	0.318	0.96	[0.26- 3.48]	0.957
Haití	1.36	[0.64-2.91]	0.414	0.97	[0.43-2.20]	0.956	0.34	[0.09-1.25]	0.107	0.28	[0.07-1.02]	0.055
Bolivia	1.45	[0.54-3.93]	0.457	1.14	[0.36-3.56]	0.820	1	-	-	02.03	[0.73-5.59]	0.169
Rep Dominicana	**5.11**	**[2.09-12.48]**	**0.000**	2.09	[0.71-6.15]	0.180	0.55	[0.07-4.35]	0.574	0.54	[0.06-4.30]	0.567
Other country	2.11	[0.87-5.09]	0.095	1.24	[0.45-3.40]	0.667	2.21	[0.79-6.14]	0.128	1.83	[0.62-5.38]	0.271
GOF test			0.017			0.900			0.336			0.571

HTN: hypertension; T2DM: type 2 diabetes mellitus; DLD: dyslipidemia; OBES: obesity.

Table 23. Migratory-related determinants of health associated behavioral risk factors.

Social Determinant of Health	**Tobacco**			**Alcohol**			**Low physical activity**			**Low fruits and vegetable intake**		
adjusted sex + age	**OR**	**[CI95%]**	**P value**	**OR**	**[CI95%]**	**P value**	**OR**	**[CI95%]**	**P value**	**OR**	**[CI95%]**	**P value**
Time of residence												
6-1o Years	0.67	[0.26-1.73]	0.416	1.23	[0.87-1.75]	0.230	0.97	[0.68-1.38]	0.875	**1.78**	**[1.24-2.54]**	**0.001**
11-20 Years	0.77	[0.29-2.04]	0.614	1.02	[0.59-1.74]	0.936	1.09	[0.64-1.88]	0.729	3.93	[1.91-8.08]	1.915
>20 Years	1.27	[0.37-4.36]	0.698	1.16	[0.55-2.46]	0.681	1.58	[0.66-3.73]	0.296	1.15	[0.53-2.50]	0.530
Country of origin												
Colombia	1.39	[0.57-3.34]	0.460	1.44	[0.91-2.29]	0.118	1.52	[0.94-2.48]	0.087	1.49	[0.94-2.38]	0.089
Venezuela	2.00	[0.95-4.20]	0.064	1.44	[0.91-2.12]	0.066	1.41	[0.95-2.09]	0.083	**1.67**	**[1.16-2.40]**	**0.006**
Ecuador	1.41	[0.39-5.02]	0.592	1.32	[0.66-2.64]	0.426	0.58	[0.30-1.12]	0.110	**2.42***	**[1.00-5.88]**	**0.049**
Haiti	1.54	[0.35-6.62]	0.559	**0.54**	**[0.33-0.88]**	**0.014**	0.71	[0.46-1.09]	0.124	**0.49**	**[0.33-0.73]**	**0.000**
Bolivia	3.28	[0.99-10.85]	0.051	**2.16**	**[1.13-4.13]**	**0.020**	0.94	[0.47-1.85]	0.863	1.03	[0.53-2.00]	0.917
Rep Dominicana	0.92	[0.09-9.36]	0.946	1.97	[0.93-4.15]	0.073	2.25	[0.88-5.76]	0.090	**0.43**	**[0.22-0.83]**	**0.012**
Other country	**3.17**	**[1.14-8.83]**	**0.027**	1.68	[0.81-3.47]	0.156	1.07	0.50-2.30]	0.853	1.90	[0.77-4.63]	0.158
GOF test			0.838			0.017			0.318			0.398

CI confidence Interval.

Table 24. Synthesis of main findings by social determinants of health.

SHD	*Category of SDH*	↑ *prevalence in both groups*	↑ *prevalence in Chileans*	↑ *prevalence Migrants*	*OR Associated*	*OR Associated*
Sex	*Male*	AMI	AMI	TOB		
	Women	CVA	FV		DLD, OBES	HTN, DLD, OBES
	20-29 years	TOB, LPA	ALC			
	30-49 years	HTA, T2DM, DLD, OBES, LPA	TOB, FV	ALC		
	50-54 years	LPA		HTN, T2DM, DLD,		
Age	*>65 years*	AMI CVA	HTN, T2DM, DLD, LPA			
	Continuous				CVD, AMI, HTA	CVD, HTA, T2DM,
Ethnicity	*Yes*	AMI		ACV		DLD
	Widow				CVD, AMI	HTA
Marital status	*Married*				HTA, T2DM, DLD,	T2DM
	Divorced					HTA
	Cohabitant					OBES
Educational level	*None education*			ACV, FV		
	Low level	HTN, T2DM, DLD	TOB, LPA		CVD	Low risk CVD
	High level	OBES, ALC		TOB		Lower risk CVD
Income level	*Low level*			ACV		
	High level	HTA, T2DM, ALC			HTA, DLD, OBES	
Occupational	*Employed*	TOB		ALC		
	Unemployed	AMI, ACV HTN, T2DM, DLD,		FV	CVD, HTA	
	Inactive				HTA	
	None insurance			HTA, T2DM, DLD,		
	Public insurance	T2DM, OBES	HTA, DLD			
Access to health care	*Private insurance*			HTA, DLD		
	Other insurance					AMI higher risk
	Access barriers	AMI, OBES, DLD TOB, ALC		HTA, T2DM, OBES	DLD, OBES	
	Discrimination	AMI, DLD, OBES	TOB	ALC	OBES	
	Stress	DLD, OBES, LPA	TOB ALC			
	Having Social	HTA, DLD, OBES		T2DM, OBES	DLD, OBES	DLD
Psychosocial	*Low social capital*	LPA, FV, ALC	T2DM, OBES, TOB, LPA			
	Having social support			OBES, T2DM		
	Low social support	LPA FV	T2DM, OBES	TOB		

AMI: acute myocardial infarction; CVA: cerebral vascular accident; HTN: hypertension; T2DM: diabetes mellitus type II; DLD: dyslipidemia; TOB: tobacco consumption; ALC: alcohol consumption; LPA: low physical activity; FV: low fruits and vegetables intake.

5. Chapter 4 Discussion

The body of evidence described in the first chapter of this dissertation reveals the complexity of migrant's health, since cardiovascular outcomes differ across diagnosis or behavioral risks factors, countries of origin and destination studied. The healthy migrant effect might apply for some health outcomes, while there is also evidence either against the effect, mixed or neutral. Therefore, the existence of the health advantage is not consistent throughout the recent literature which has been mainly carried out in North America and Europe. Local literature has previously suggested the healthy migrant effect in both crude and adjusted analyzes considering demographic and socioeconomic factors from population-based data. Given the lack of recent evidence exploring the effect, a secondary analysis of CASEN 2017 was performed to comprehensively explore the migrant's health. This analysis comprising the second chapter of this dissertation revealed a crude advantage on self-reported health, disability, daily life limitations and chronic diseases. In addition, an adjusted analysis from the social determinants of health was implemented, these determinants represent the social conditions (family, work, community, health systems, among other) in which people are developed during their life cycle. This approach considered demographic (e.g. sex, age, ethnicity) , socioeconomic (educational level employment participation, income) , health care access (type of affiliation), psychosocial (social capital, social support) and migratory-related factors (country of origin, time of residence). After adjustment by each set of SDH, the healthy migrant effect remained significant suggesting that being migrant was protective for these health outcomes in that time. The study shed light of health gaps between migrants and Chilean population, probably due to the epidemiological transition in Chile. This transition went away from infectious diseases to increased burden of non-communicable diseases. Despite this was also occurring in other countries of the region, the advanced transition could lead to this gap, however, migrants still experiencing exposures that might contribute to health risks at long-term.

The evidence of healthy migrant effect remains inconclusive and scarce within the region. Our local approach from population-based data revealed a health advantage on chronic diseases. Although the above-mentioned secondary analysis confirmed an advantage of being migrant, the analysis of specific health conditions and its risk factors were limited. Therefore, it was necessary to evaluate the existence of the effect on leading causes of death in Chile, where high prevalence and disease burden has been described in general population. Particularly, in the absence of evidence of cardiovascular disease prevalence and SDH associated factors among migrant population in Chile, the third phase of this dissertation from the primary data collected deepend in this **this knowledge gap from the research question Is there a healthy migrant effect on cardiovascular diseases and cardiovascular risks factors in Chile, and how this effect varies according to social determinants of health?** The main hypothesis was due to the healthy migrant effect, there is a lower proportion of cardiovascular diseases and risks factors in international migrants compared to local Chilean population. This analysis is relevant for public health purposes since it allows the detection of cardiovascular-related health needs and risks factors among international migrants. Moreover, it provides evidence of diverse exposures faced during migration process towards timely and tailored prevention interventions. In addition, this

evidence is useful for policy making that takes into account the diversity of migrant population throughout the region.

The primary data collection to test the hypothesis was performed during COVID-19 pandemic in boroughs of Metropolitan Region. Specifically, the southeast communes La Pintana, La Granja and San Ramón which are considered socially vulnerable. According to the vulnerability paradigm there are structural, socioeconomic and cultural forces influencing risk processes as a result of inequalities rooted in societies (94). From a health perspective this vulnerability is related to the individual's social conditions impacting their agency and access to resources towards their health protection (96). This study gives insights of the social determinants of health to which both Chilean and local population are exposed during the sociosanitary crises. The following section discuss cardiovascular outcomes (cardiovascular diseases, metabolic risks factors and behavioral risks factors separately) in the light of the current national reference to contextualize the Chilean situation, although statistical comparisons were only made between migrants and Chileans included in the primary data analysis. In addition, the healthy migrant effect results are discussed with possible explanations that could be deepened in future reports. As well as main findings of social determinants of health significantly associated to the studied outcomes are discussed.

5.2. Interpretation of primary data findings on social determinants of health

In this cross-sectional study the sample was mainly comprised by women as often found in health care research of international literature (97). Among migrant population, the proportion of women and age distributions is in accordance with national data reporting a steady increase of migrant women in the past 3 years and migrants at working age, predominantly 30-34 years (6). Despite both groups in this study reside in vulnerable boroughs, migrants tend to report higher educational level and employment participation. Migration is globally related to labor either as a driving factor or needed for social and health integration (98). Concerning the higher educational level and labor participation but lower income than locals, a secondary analysis of the Chilean National Socioeconomic Characterization Survey (CASEN 2020) provides possible rationale for this phenomenon. The study revealed that poverty was not explained by less access to the labor market, informal labor or recent migratory fluxes. Conversely, it was explained by reduced access to social protection and institutional support networks (99) which mostly rely on a valid identification of residence permission that could be expired or pending during COVID-19 pandemic (100). In addition, it is worth to mention that poverty increased in migrant population during the pandemic, going from 10.9% in 2017 to 17% in 2020 (99).

Regarding the access to the health care, the proportion of uninsured migrants is similar to current national estimations (11%) (101, 102). However, Chileans in our sample reported higher insurance levels compared to the national reference (4% national reference vs. 6.54 Chileans participants). According to data from CASEN 2020 survey, there is an income gradient for insurance status in both migrants and locals. In addition, lack of insurance among Chilean population increased two percent points from 2017 to 2020 CASEN survey (101). Thus, the local participants of this study might reflect the impact of low socioeconomic level on health system affiliation. Among migrants, reduced access has been previously reported mainly among recent migrants from emerging countries such as Venezuela, Colombia and

Haiti (36) that in turn represent some of the predominant nationalities of this study. Although it is expected that general population with higher educational level is more prone to being affiliated than those with lower levels, this may not be true to migrants in a vulnerable situation (e.g. irregular status, low income) (101). Furthermore, the report of barriers to health care access was lower in migrant participants compared to locals, which could be related to the migratory factors of the sample. The access and use of health system increase with time of residence, therefore recent migrants that are often younger and healthier than locals don't have the same health care needs, health care-seeking and support networks. In addition, experience with health systems either in countries of origin, transit or previous destinations, as well as their migratory status might influence their approach to the Chilean system (36). Noteworthy, data from national reports reveals that the majority of involuntary reasons -i.e., beyond their control- were mostly related to the impact of COVID-19 pandemic in health system and its associated barriers (101).

Analysis of psychosocial factors revealed a high report of stress in both groups, which is potentially expected during COVID-19 pandemic and the resulted sociosanitary crises. The literature describe higher stress in women, young people and those residing in areas where COVID -19 had more impact, among others (103). Particularly, evidence from Latin-American countries, highlights the increased report of stress and other symptoms of mood disorders in general population of Chile (104). Additionally, vulnerable boroughs in Santiago de Chile were the most affected by COVID-19 infection and mortality rates, besides the exacerbated inequalities (105, 106). Moreover, discriminatory experiences were informed by both populations, but Chileans at a greater extent. In local population this could be explained by their low socioeconomic status, since people in poverty represent the second most discriminated group in Chile, after people with ethnic background, whereas Latin-American migrants represent the fifth most discriminated group. Thus, unfair treatment among local participants could be attributed to their economic vulnerability which is sharpened in indigenous participants (93). Unfair treatment faced by migrants could be derived from the intersection of their immigration status, ethnicity and low income, and possibly reinforced with discourses associating migrants as a threat for COVID-19 infection (107, 108). Discrimination is part of the psychosocial stressors impacting minorities, which along with cumulative exposures of life events increases mental and physical health risks (109).

Migrants have different psychosocial resources availability, for instance recent migrants are developing social capital and support in the host country (110). However, this process might be hindered by mobility restrictions during COVID-19 pandemic and sociosanitary crises. According to data from CASEN 2020, the report of social capital measured by organized groups belonging and participation was similar to our findings, where over 28% of locals and 17% of migrants had social capital, respectively (111). Therefore, this showed the challenging time of social integration that were facing migrant population. Similarly, social support was also lower in migrant population compared to locals, but over 80% of migrants in our sample have social support. Even though mobility restrictions and current crises might affect this resource, migrants could also be benefited from the support of their migrants peers and those in the distance in their home country (112).

The intraregional south-south pattern described in Chile (6) was confirmed in our sample which was mainly comprised by recent migrants. Similarly, the majority of participants in CASEN 2020 arrived in 2015 or after, and this distribution differ by country of origin. While Venezuela, Haiti and Colombia were the emerging nationalities, other border countries such as Peru and Bolivia represent a migrant settled population (111). Furthermore, the migratory status of the participants entails diverse challenges, since the majority did not have a visa, some had an application pending or were in an administrative irregular status. This phenomenon could be explained by the modes of entry into Chile including tourist visa and unauthorized entry points (113). During COVID-19 pandemic the land borders and mobility restrictions throughout the country increased irregular entry. As well as the administrative barriers imposed difficulties in regularization process during this period, particularly among Venezuelan migrants (114). Considering the social determinants of health described in the sample and their migratory status, the overall situation indicates that some are facing vulnerability. Specifically, vulnerable migrants are at higher risk of harm, abuse, exploitation and not fully enjoyment of their human rights than other populations. These risks might interact with each other and also with protective factors (e.g., psychosocial resources, literacy, access to health care) modulating their potential susceptibility during migratory process (115).

5.3. Interpretation of primary data findings on self-reported cardiovascular diseases

Self-report of cardiovascular diseases in both Chileans and migrants was lower than the current national reference (National Health Survey 2016-2017) of 3.3% for acute myocardial infarction and 2,6 for cerebrovascular accident, respectively (116). These differences may reflect the trend of reduction in cardiovascular disease over the years as a result of preventive strategies and public health policies progressively implemented. However, during COVID-19 pandemic there was an increment in cardiovascular unexpressed demands, evidenced in reduced activated guarantees covered by the Explicit Health Guarantees plan (AUGE-GES). As well as reductions in the incidence rates of cardiovascular emergencies (13% for AMI and 20% for CVA) suggesting that major events were not timely treated (117). Particularly, data from the cardiovascular mortality during the pandemic in Chile, revealed a reduction that could be derived from COVID-19 competitive mortality, changes in cardiovascular risk factors and environmental exposures during quarantines (118).

Results of the present study revealed a crude health advantage for cardiovascular diseases, which have been previously suggested in Chile. Literature from the hospital discharges in 2012 reported lower percentage of circulatory system diseases in migrants compared to locals (7.6% in Chileans vs. 4.4% in migrants). In addition, the overall rate of hospital discharges was also lower in migrants with 22.4 hospital discharges per one thousand inhabitants compared to 97.4 hospital discharges per one thousand inhabitants. Even though this data favors a health advantage, the authors pointed out that migrants were younger, as well as migrant population might have less access to health care and diseases might be under-registered (119). Similarly, a recent study from hospital discharges in 2018 supports a lower proportion of circulatory system, since 8.47% Chilean patients were diagnosed compared to 3.50% migrant patients. Additionally, the percentage of overall consultations demanding urgency attention was lower in migrant (36,85%) than locals, counting with less severity and mild prognosis (102). Adjusted analysis had been only performed on chronic conditions as a

whole, these findings support a healthy migrant effect among Latin-American migrants when compared to Chilean population. However, the effect disappeared at a length of residence over 20 years and after adjusting by socioeconomic status (23). Meanwhile, recent evidence from CASEN 2017 described in this dissertation, revealed that being migrant conferred protection for chronic conditions even after adjusting by demographics, socioeconomic, access to health care and psychosocial determinants (120). Therefore, these studies including cardiovascular diseases within other health conditions are a starting point for exploring a possible cardiovascular advantage among migrants residing in Chile. Meanwhile the international literature have supported the health advantage in cardiovascular events (121, 122) coronary artery disease (71, 123, 124) and cerebrovascular disease (125) in migrants from South American, Mexico, Cuba, Dominican Republic and Asia. For example, evidence from Hispanic and Chinese migrants living in EE.UU described a lower incidence of cardiovascular events, mainly in young recent migrants (121). Conversely, there is also evidence against it among Asians and Afro-descendants for IAM and CVA, respectively (126, 127); which reinforces the complexity of migrant's cardiovascular health depending on specific causes, migrants' subgroups and countries studied.

Findings on adjusted analysis revealed that the healthy migrant effect in AMI disappeared after adjusting by demographic factors (sex, age, ethnicity), spotting the influence of social and biologic characteristics involved in social categorizations and subsequent inequities (128). For instance, male sex has been described as a determinant of cardiovascular disease since morbidity and mortality of AMI is higher in men than women due to the lack hormonal protection provided by estrogens before menopause (129). Accordingly, international evidence reported acute coronary disease in male migrants from Latin-America, Africa, Europe and Asia residing in EE.UU (130, 131). In turn, the predictive value of male sex for cardiovascular events in migrants has been reported for emergency admissions in Italia (132). Meanwhile, the age is itself a traditional cardiovascular risk factor influencing physiological process and cumulative effect of risks factors over time (133) that was positively associated to cardiovascular diseases in both population of the present study. Worldwide, it has been estimated that major events accounts for 25% of all deaths in the age group of 65-84 years old, which raises to 30% among elders over 85 years. Similarly, in this study the highest prevalence of cardiovascular diseases was self-reported by participants over 65 years of age but was also at younger ages. Evidence have also reported cardiac events at earlier ages in Asian migrants from 35 years and older (134), besides migrants from the former Soviet Union under 55 years of age (135). Furthermore, ethnicity implies both genetic and cultural aspects that might influence cardiovascular disease risk (136). In this study it was observed a higher prevalence of cardiovascular disease and risks factors among participants with ethnic aboriginal background than those without it. Literature have described a high prevalence of metabolic risks factors in people with Hispanic ethnicity, making CVD the leading cause of death in this group. Likewise, afro-descendants are also affected by these risks factors, mainly by hypertension which is the major risk factor for ischemic heart events (137). Specifically, these events have been reported in migrants from Central America and Caribbean (130), South Asia (126) and Middle east (138).

The healthy migrant effect in CVA persisted after adjusting by demographics and was modulated by socioeconomic factors. It is worth to mention that in general population low socioeconomic status is associated with cardiovascular risk, since 60% of CVD can be

explained by these factors and accounts for twice as many deaths from CVD compared to the highest socioeconomic status (139). Furthermore, the modulated advantage disappeared after the adjustment by access to health care, highlighting its relevance on the cardiovascular health of migrants located in Chile. Health access denotes the ability to approach and use the health care system when needed, involving both dimensions of availability and effective utilization (140). According to national data, a higher proportion of migrants are uninsured (11%) and have higher percentage of non-consultation than Chilean population (36, 101). Particularly, previous population-based analysis informed that migrants had 7.5% higher odds of being uninsured. While data during early COVID-19 pandemic revealed the lack of insurance and low guidance of how to navigate the health system, mainly among recent migrants (141). Health care utilization could be determined by specific migratory-related factors such as migratory status, context of migration and structural factors in the destination country (e.g., migratory and health policies). For example, irregular administrative status might influence medical consultation due to fear of deportation or lack of knowledge of their health rights and available health services in the destination country (110).

Barriers in accessing to health care could be either at personal-level (e.g.: financial, knowledge, time), system level (e.g. human/financial resources, health policies) and community level (e.g. availability of interpreters). Migrants might have differential health care needs according to their self-perceived health, health seeking behaviors -which represent individual's actions to restore their health in face of health problem perceived by themselves- and previous experiences with the health system (e.g., mistrust) favoring the use of other types of attention including traditional medicine (36, 110, 142) . On the other hand, their income might determine their ability and willingness to pay, which could also be influenced by the cost of medical coverage, knowledge of coverage for migrant population and proper implementation of health policies by medical providers when is out of cost. To the latter organizational barrier it might be added the management of health resources, waiting lists, referral system among others (142). In Chile, migrants have reported institutional discrimination derived from national policies and procedures that structurally promote inequities. Specifically, from the health system which are coupled with barriers to navigate an unknown system. In addition to geographical, time and communicational barriers (143, 144). Whereas health care workers have informed the challenges of proper attention giving the lack of clarity on legal regulations of services to which migrants are entitled, lack of interpreters and intercultural competence, mainly for hospital care (145). International literature has described the impact of time of residence and migratory status on health care access. Migrants with a time of residence over 10 years and regular migratory status might have lower cardiovascular risk and severity than those uninsured migrants with irregular administrative status. Since the status does not allow them to be benefited from preventive services and timely treatment (146). Therefore, migrants of our sample have some characteristics that might increase their susceptibility and vanish possible health advantages (e.g., recently arrived, uninsured, unaware of their rights, face institutional and administrative barriers) even if they are younger and healthier at arrival.

Regarding the association of social determinants and cardiovascular disease, our findings revealed that high educational level conferred protection for this health outcome. Among migrants, university education was associated with 97% less odd of CVD. This protective factor influence health literacy which help risks understanding and facilitates healthy choices

(95). The inverse association of CVD and educational level has been previously reported, where lower educational levels increased cardiovascular risk and mortality when compared with tertiary level (147). Specifically, in migrants low educational level had a negative impact by increasing the prevalence of cerebrovascular accident (148) and cardiovascular disease related mortality (149). On the other hand, affiliation to other types of insurance was positively associated with AMI by increasing 10.38 times the odds of the disease. This finding could be interpreted from the preference of some migrants by alternative pathways of care such as transnational access at border countries, traditional medicine, religious non-medical care, pharmacy consultation and self-medication (110, 150). These preferences might be related to health system enrollment difficulties in Chile, even though migrants are entitled regardless of their migratory status. These difficulties have been reported mainly among migrants in irregular administrative status who have been denied affiliation to the public system for not being able to provide all required documents (101, 151). As previously mentioned, migrants could face fear of deportation and lack of knowledge of theirs rights and avoid contact with the formal care pathways, as well as not knowing where to seek medical attention (141, 144).

5.4. Interpretation of primary data findings on self-reported cardiovascular risks factors

Self-report of metabolic risk factors in this study differed from the national health survey estimations, specifically hypertension (27.6% NHS vs. 19.2% Chileans vs. 7.0% migrants), dyslipidemia (27.8% NHS vs. 11.4% Chileans vs. 3.1% migrants) and obesity (31.2% NHS vs. 14.8% Chileans vs. 3.0%). The highest prevalence among these risks factors was found in hypertension, which reached almost 20% in Chileans and 7% in migrants. Differences with the national reference from 2017 might be explained by the sustained decline of hypertension and other metabolic risk factors rates over time due to the national chronic disease program, as well as the Global Hearts initiative supported by the Pan-American Organization. These programs have been implemented in primary health care towards timely treatment and control of the disease (152, 153). However, the above mentioned impact of COVID-19 on the health system (117) could had influenced the access to screening and diagnostic confirmation possibly affecting participants' awareness of the disease. Meanwhile, prevalence of type II diabetes mellitus in Chilean participants was similar to the current national estimation (12.3% NHS) which indicates a different data trend during the pandemic. Anecdotal evidence from medical practice in Chile have reported increases in disease consultations possibly related to low physical activity and unhealthy diet (e.g., ultra-processed food, low fruit and vegetables intake) during quarantines (154). In addition, it has been documented a diabetogenic effect or decompensation of asymptomatic T2DM derived from changes in glucose metabolism after COVID-19 infection (155). The impact of the pandemic either on lifestyles, access to services and infection induced cardiovascular risks factors could be further studied in Chile for future health planning and public health responses.

The healthy migrant effect in all metabolic risk factors persisted after adjusting by demographic, socioeconomic, access to health care and psychosocial factors. Although national evidence remains scarce, the available data from hospital discharges reporting lower circulatory system rates compared to locals, also described lower rates of endocrine,

nutritional and metabolic diseases (2.9% Chileans vs. 1.8% migrants) (119). International literature in the region have reported lower prevalence of diabetes and hypertension among Venezuelans migrants compared to local population in Peru and Colombia, respectively (122, 156). At the same time, literature from North America have described lower prevalence of hypertension and obesity leading to fewer cardiovascular events in migrants from Latin America and Caribbean, Europe, Africa and Asia than local population (130, 157, 158). Similarly, a study of Latin American migrants described an advantage for T2DM mainly among Cubans and South Americans. In addition, the latter group along with Mexicans had lower HTN prevalence than native-born (71). In relation to Mexican migrants, data have indicate a possible positive selection due to their lower blood pressure levels, abdominal obesity and metabolic syndrome when comparing with non-migrant counterparts (159). On the other hand data from afro-descendants migrants showed an advantage in HTN, T2DM and OBES, particularly, they also had lower rates of cerebrovascular accidents (72, 125). Furthermore, results against the healthy migrant effect were also found among Hispanic migrants residing in North America, including dyslipidemia (160, 161) and hypertension (161) and type II diabetes mellitus (162), obesity (157). Likewise, opposite findings to the advantage on metabolic risk factors have also been reported among migrants from Africa (127, 163, 164) and Asia (138, 165-167), which might be in accordance with the high cardiovascular risk described in groups with this ethnic background (e.g. high prevalence of hypertension in afro-descendants and metabolic syndrome in south Asians (137, 168).

Demographic factors were the main social determinants of health associated with metabolic risks factors in migrant population. For instance, being women was positively associated with having hypertension, dyslipidemia and obesity. Accordingly, previous international evidence from afro-descendant and south Asian women has reported that they had at least three cardiovascular risks factors (169-171). In addition, among overweight and obese Hispanic women, pre-diabetes and diabetes represent a major challenge since is commonly underdiagnosed and uncontrolled probably due to barriers to screening (172). Little evidence is available in the region and does not specify prevalence by sex or test its association. However, a study in Colombia reported that hypertension and dyslipidemia were prevalent among Venezuelan migrants, most of which were women (62). Noteworthy, women are not sufficiently represented in clinical research, but at the same time cardiovascular disease is the leading cause of death in women of general population (173). Therefore, desegregated data in the region still a pending issue, reinforcing the need of research and public responses towards cardiovascular health of migrant women. Similar to the above-mentioned association of age with cardiovascular disease, this factor was also positively associated with hypertension, diabetes and dyslipidemia in migrant population. Literature have describe the early onset of T2DM in migrants from South Asia and Africa aged 31 to 41 years old (174), as well as hypertension and dyslipidemia among migrants of diverse origins in their 40s (175). Meanwhile, Latin-American migrants between 45 to 64 years were most affected by HTN, T2DM, dyslipidemia and obesity in comparison to their younger peers (176). Moreover, as expected there is also evidence reporting HTN and T2DM prevalence increases with age (177).

Reporting an ethnical aboriginal background was positively associated with dyslipidemia, which is line with previous evidence of South American native population who also tended to metabolic syndrome. High lipid levels could be explained by the Western influence on

their habits as well as its interaction with biological, environmental and socioeconomic factors within these communities (178). Previous research studying migrants with Hispanic ethnicity have reported a higher likelihood of having elevated triglycerides, cholesterol and low high-density lipoprotein coupled with obesity than non-Hispanics (160). Likewise, predictors of CVD including dyslipidemia have been found in a greater extent in both Hispanic and afro-descendants when compared to other ethnicities such as whites and Asians residing in EE.UU (179). Unexpectedly, having social capital was positively associated with dyslipidemia in the migrant sample of the present study. Social networks could influence behaviors either reinforcing healthy habits or acquiring risky behaviors (180), however it is expected a protective effect of having social capital on cardiovascular disease (181). The association could be explained by the interaction with the host society that is part of the migrant's new social capital and the adoption of their behavioral patterns (182) and diverse exposures in the receiving country (e.g. life conditions, environmental factors). Another, explanation is related to the positive effect of social networks on timely screening. It has been found that migrants might be encouraged to use preventive services, for example by their neighbors (180). Furthermore, the type of insurance was associated with metabolic factors, specifically the public health insurance significantly increased the odds of having HTN and T2DM. Previous research revealed that timely diagnosis of both risks factors has been associated with being insured which increases the chances of be benefitted by screening and diagnosis confirmation (72). In addition, periodic access to preventive services could be due to the lack of administrative and culturally related barriers, improving the awareness and understanding of cardiovascular risks (160). However, the impact of COVID-19 pandemic in the Chilean public health system might also influence these findings, either by detection among risks groups when infected (e.g., incidental finding) or a consequence of the reduction of some preventive services and continuity of treatment that give rise to symptomatic hypertension and type II diabetes mellitus.

In the present study, migratory factors were also associated with metabolic risks factors among the migrant population. The time of residence from 6 to10 years increased the odds of having hypertension, this time might favor the integration with the host society, as well as progressively show the cumulative impact of migration process on migrant's health (183). It has been proposed that health care needs and cardiovascular events increase with time of residence, particularly acquiring more risks factors (121, 180, 184). Our study revealed the highest crude prevalence of AMI among migrants residing over 20 years but time of residence was not significantly associated in the adjusted model. Previous literature have reported an association of hypertension coupled with sedentarism and overweight with a time of residence over 5 years (185). Meanwhile, those residing more than 10 years revealed a 40% higher incidence of cardiovascular events (158). However, there is also evidence that found no significant association of residence duration on hypertension prevalence (186).

Some countries of origin were positively associated with higher chances of hypertension and type II diabetes mellitus. Dominican Republic showed the highest chances of HTN, followed by Ecuador, Colombia and Venezuela. The country of origin might represent previous exposures including life conditions, access to health care and epidemiological profile of the migrant's home country (187). Previous evidence of Latin American and Caribbean countries estimated a hypertension prevalence of 40.4% (188), meanwhile current regional estimations report an age standardized prevalence of 35.4% among people aged 30-79 years. Specifically,

Dominican Republic has been classified as one of the countries with the highest prevalence (49.1%). Although, current estimations of Ecuador (27.2%) and Colombia (31.0%) are below those from Venezuela (39.4%) (189), the odds of having hypertension were lower in Venezuelan migrants than the other associated nationalities. Likewise, Venezuelan migrants showed an inverse association with T2DM, but existing estimations reported a country prevalence of 41.4%. These finding might be derived from the lack of insurance and barriers in accessing to the Chilean health care system, mainly among recent migrants with irregular administrative status (101). Additionally, Venezuelan migrants could also be unaware of their cardiovascular risks factors as a consequence of the impact of sociopolitical crises on health care functioning (e.g., shortage of financial and human resources), which impaired their access to preventive care in Venezuela (190). On the other hand, Ecuador was associated with increased odds of having T2DM in the migrant's sample. Accordingly, regional estimations have reported a country prevalence of 26.6% (189), representing the second cause of death after cardiovascular diseases. Moreover, it has been found an association between T2DM and low socioeconomic status among Ecuadorians (191). Thus, migrants from Ecuador whose migration drivers included socioeconomic reasons but remain at vulnerable boroughs in Chile could be at higher DM2 risk.

5.5. Interpretation of primary data findings on self-reported behavioral risks factors

Among the behavioral risk factors, the prevalence of current tobacco consumption was higher in Chilean participants in comparison to National estimates. In the National Health Survey 2016-2017 the prevalence of current consumption was 32.5% representing a substantial reduction over time, which contrast with the prevalence of 46.36% found in our Chilean sample (116). Meanwhile the National Service for prevention and rehabilitation of drugs and alcohol consumption (SENDA) informed a significant reduction of consumption estimates in the last years, going from 35.2% in 2018 to 32.5% in 2020, besides a monthly consumption of 28.6% in 2020 (192). Anecdotical reports of Chilean specialist in addictions suggest increases of both tobacco and alcohol consumption to cope with mental health during lockdowns and uncertain times. In addition, the consumption could also be influenced by the spread false information of nicotine properties for combating COVID-19 infection (193). It has been postulated that tobacco use might increase when people experience high levels of stress due to mobility restrictions, isolation and confinement, mainly among people of low socioeconomic status (194). Therefore, the socioeconomic composition of our sample, duration of lockdowns, high levels of stress and interruption of mental health services (e.g., continuity of care for anxiety and depression, substance use treatment), during pandemic could lead to increased consumption in vulnerable boroughs. This makes imperative to study in depth the patterns of consumption during and after pandemic and explore the need for adjusting public health strategies to counteract possible changes on trends. Although the prevalence of alcohol consumption among Chilean participants was similar to the monthly consumption from the national reference (44.3% SENDA vs. 41.0% Chilean sample) it is worth to consider the above-mentioned potential impact of quarantines and the existing sociosanitary crises on the consumption. However, restrictions on alcohol availability and financial resources could have limited its consumption in Chile. For example, buying alcohol was forbidden during lockdowns as well as people was not able to drink alcohol in social settings or might have difficulties to pay it (194).

In this study, the prevalence of insufficient physical activity was lower in comparison to the current national reference (73.1% Chileans; 74.1% migrants vs. 86.7% NHS). In contrast, a lower proportion of local population reported the recommended intake of fruits and vegetables (69.01%) compared to the NHS reference, that in turn was similar to the migrant's report (85% NHS vs. 84.7% migrants) (116). These results could be influenced by the health promotion initiatives during the pandemic (e.g., healthy life at home from choose to live healthy program) which encourages healthy habits both to prevent the infection and better cope the lockdowns. However, considering the health education focused on avoiding tobacco, sedentarism and unhealthy diet could lead to biased responses by social desirability. Since recent research showed that reporting less risky behaviors have been significantly associated with this type of bias, probably for seeking approval or not giving a negative self-image (195). Mobility restrictions during COVID-19 pandemic increased physical inactivity levels as locations and schedule for exercise were limited. In addition, doing physical activity at home was challenging since the space available and knowledge for safe practice might had been insufficient (196). According to the latest survey of physical activity and sports 2021 by the Sports ministry of Chile, inactivity was found in 64.3% of the national sample and half of them reported that their activity decreased compared to pre-pandemic levels, mainly among women. Particularly, low socioeconomic status and LPA during lockdowns influenced this outcome (197). Meanwhile, fruits and vegetable intake during pandemic has been determined by changes on dietary preferences (e.g., unhealthy comfort food to cope mental health) and its limited access, including less availability, increased prices coupled with the impact of the sociosanitary crises on financial sources. In Chile the literature have reported a significant reduction in adherence to the dietary guidelines, which was found in a sample of middle-high socioeconomic status, suggesting a possible higher reduction in vulnerable boroughs (198).

The healthy migrant effect was found in tobacco and alcohol consumption after adjusting sequentially by the social determinants of health. International evidence has reported lower tobacco consumption in migrants from Latin-America including Mexicans and Dominicans, as well as migrants from Africa and Asia when compared to locals (70, 123, 134, 158, 199, 200). Moreover, a healthy advantage on alcohol consumption have been found among migrants from Asia (201, 202). Conversely, there is also evidence against this healthier pattern, for instance Hispanic migrants residing in North America reported tobacco consumption when more acculturated by language preference, then adopting the habits of host society (162) Noteworthy, there is also data showing better habits in Mexican migrants residing in EE.UU when compared with their non-migrants counterparts (203); which might support the explanatory model for healthy migrant effect of better health habits held during all migration process (including pre-migratory phase, transit, and arrival and integration phase) (19). Thus, lower prevalence of these behavioral risk factors could partially explain the advantage seen in metabolic risks factors among the migrant population of the present study, as well as the advantage in chronic diseases from CASEN 2017 analyses. Since tobacco consumption is the main behavioral factor associated to cardiovascular disease due to the oxidative stress inducing endothelial damage and inflammation with systemic effects (204, 205). While alcohol has been associated with progressive alteration of cardiovascular function and structure, besides increasing metabolic risk (206).

The remaining behavioral risks factors in our study did not support the healthy migrant effect, particularly low fruit and vegetables consumption was higher in the migrant sample compared to locals. This unhealthy pattern could be explained by the food insecurity faced by migrants during COVID-19, mainly among those with low income and limited access to high-quality diet. Literature on Latin-American migrants highlights the influence of supply chain disruptions on food availability, especially among migrants of vulnerable boroughs. On the other hand food accessibility could be challenging due to income reductions, fear contagion and migratory status, since the latter might determine the eligibility to government assistance for financial protection strategies (207). In Chile, the access to financial aids was determined by migratory status which grants a valid identification card to apply for government assistance, thus income reductions during the pandemic might impact migrant's consumption (100). Even though other type of social benefits such as food boxes were also broadly distributed to migrant population, this boxes mainly contained non-perishable food high in carbohydrates (208). Migrants in our study came from countries that might have high availability of fruits and vegetables (e.g., Peru, Colombia, Venezuela), despite they could have had a previous habit of consumption, during the pandemic they experienced more accessibility restrictions. In addition, previous evidence studying the food quality of migrants residing in Chile revealed that migrants had a poor-quality consumption compared to their non-migrant counterparts and host population in Chile. Although migrants showed a lower consumption of vegetables, they had a similar fruit consumption when compared to Chileans which could be related to the adoption of dietary patters of the host society and financial limitations (209). In our study, self-report of low physical activity did not reveal a healthy migrant effect, as this behavioral risk factor was similar in both migrant and Chilean population. In contrast, previous literature has suggested a health advantage for physical activity compared to locals, mostly practicing collective sports and doing active transportation (210). Therefore, migrants whose activity relies in group activities at public spaces were affected by mobility restrictions during the pandemic.

The analysis of migratory determinants associated to behavioral risks factors revealed that being born in Bolivia was positively associated with alcohol consumption. According to regional reference the alcohol per capita consumption reaches 3.91% exceeding the reports of Venezuela, Ecuador and Haiti (211). Research on determinants of alcohol consumption in Bolivia suggest the rooted dynamic of traditional festivities coupled with consumption. Particularly, parents are the main promoters and providers of alcohol in family settings. In addition, population in poverty have shown increased consumption despite their financial limitations, it has been suggested that these limitations might be mitigated at expenses of not covering their basic needs (212). Conversely, being Haitian was inversely associated with alcohol consumption which is in line with regional reports, since Haiti is the second country with the lowest consumption (3.02% per capita consumption) preceded by Guatemala (211). Previous research has proposed the influence of religion, migrants who gives a high importance to religion practices tend to consume less, as well as migrants take care of their self-image displaying better habits to maintain a good reputation in the host society (213). Haitian migrants in Chile face challenges for integration including precarious jobs and life conditions, besides poor access to social protection from the government (214). This socioeconomic disadvantage could influence accessibility restrictions among Haitian migrants with the behavioral risk factor. Lastly, the association of time of residence was only found for low fruits and vegetables intake, specifically, a length of 0-5 years increased the

odds of this risk factor. Considering the difficulties imposed by the COVID-19 pandemic on food accessibility and sociosanitary crises, recent migrants might be overcoming financial restrains, lack of institutional support and fear of contagion (207). In consequence, recent arrival which could be coupled with irregular migratory status or visa pending might imply a lack of resources impacting the dietary patterns of recent migrants.

5.6. Limitations and risk of bias of the primary data study

The current study has diverse limitations risk of bias that might influence the above discussed results. Firstly, a probabilistic sampling was not feasible since migrants represent a "hard to reach population" (215) due to identification, access, motivation and trust issues (216). The lack of data of geographical distribution and frequent mobility of this population limited the existence of a sampling frame and the subsequent representativity of the sample. Therefore, in migrant's research is not always applicable the traditional sampling methods described for general population or participants from "Western, Educated, Industrialized, Rich and Democratic Societies"(217). In consequence we used a community-based approach in which the sampling was flexible to migrant's characteristics and their context. The respond-driven sampling which is a referral chain system led the recruitment of migrant population during COVID-19 pandemic, while Chileans comprised the time-place control group. We acknowledge that a non-probabilistic method limited the external validity of the study restricting the generalizability of the data.

During complete lockdowns recruitment relies on referrals from health care providers and face-to-face recruitment in allowed places such as healthcare facilities (e.g., primary health care, vaccination sites) complemented with remote strategies build upon trust given by the study. These methods might lead to sampling bias, during lockdowns people seeking for health care attention were more likely to be selected than others that might not have insurance or avoided contact with medical institutions. The uninsured people seeking health care attention or COVID-19 vaccination might be aware of their cardiovascular diseases, as well as metabolic risks factors, since they have access to screening and diagnosis of these diseases and could be actively protecting themselves. In addition, the target of the initial vaccination campaign were people with chronic diseases and elders that might have cardiovascular risk factors, representing a gateway for migrants with longer time of residence, with more access to services and older than the average age of migrant collective. This risk of bias might increase the report of the health outcomes under study, leading to its overestimation. However, the strategy also excluded people with severe diseases or risk of dying, those with mobility impairments, bedridden patients, institutionalized people, among others staying indoors or not being able to interact remotely, introducing prevalence bias (Neyman bias) modulating this estimation. Additionally, we couldn't know if there were migrants who returned to their countries of origin to be treated given the severity of their condition. Likewise, first strategies under pandemic restrictions resulted in recruitments process influenced by migratory status, as migrants arriving through not authorized entrances or having a pending visa were not reachable. Those migrants who crossed the region and were able to arrive to Santiago, might be healthier or younger to face that physical challenge. Hence, not being included could have maintained a higher prevalence given by the settled migrant group.

After lockdowns, other strategies involved community-based recruitment (e.g., free markets, outside the subway and other concurred places), migration advisory closed events and migrant support offices of the communes. These strategies allowed us to understand the dynamic within the commune while building trust and diversifying the sample. Despite the efforts to balance the sample distribution following the reference of current national statistic, the majority of the sample was comprised by women and people at higher educational level. This might introduce sampling bias favoring the report of cardiovascular risk factors since women and people at higher educational levels tend to display better health literacy than male and people with low educational attainment, respectively (218). On the other hand, these complementary strategies might not fully represent migrants living under extreme poverty, living in camps or homelessness, leading to the underestimation of cardiovascular conditions by not including people with high social vulnerability and at greater risk of diseases. Although we reached people that used to be hidden from institutional settings due to their migratory status, lack of insurance, lack of knowledge (e.g., health rights, how to navigate the health system and health-related cost) these characteristics might influence cardiovascular report. Considering the nature of self-report and the lack of biomedical confirmation including clinical and biochemical measures, information bias emerges in these particular groups. Probably because they were not benefited by preventive services and were unaware of their current medical status. Therefore, causing an underestimation of the health outcomes requiring clinical confirmation not previously detected either in the host country or in the country of origin. Especially among migrant from countries facing socioeconomic and health system crises. However, we did not collect information of pre-migratory and transit phases to better understand its influence on self-report. Additionally, a recall bias might also produce underestimations of self-reported conditions that were not confirmed with clinical records or clinical measurements during the study.

Although interviewers were continuously trained and monitored, there might be information bias due to possible systematic differences in the way they were applying the survey. Besides considering the survey mode either video-call or face-to-face, whose influence on the data should be further studied. These differences impact participant's responses leading to underestimations by not informing cardiovascular conditions or submitting inconsistent responses, that did not allow us to use the data. In addition, mistrust or discomfort may arise when people were providing personal or sensitive information, thus the role of interviewers in building trust and recalling ethical protection to the data was essential. Particularly, when migrants were asked to respond for sensitive questions of their experience in Chile such as migratory status, barriers in accessing to the health care system and discrimination, among others, they might avoid negative answers. This risk of social desirability bias could be increased if the interviewer was not a migrant or the survey was completed face-to-face. The social desirability bias might also be introduced when self-reporting cardiovascular risk factors, mainly the behavioral factors during COVID-19 pandemic. As mentioned above, health education reinforced the importance of healthy lifestyles to prevent contagion and infection severity. Thus, participants might seek for approval or look after their image in health surveys (195), particularly if they had past history of cardiovascular event and it has been suggested reducing or quitting behavioral risks. Moreover, migrants have been blamed for bringing the infection as well as being a burden for the Chilean health system in the media (100). The latter could influence self-report by providing answers they consider more

acceptable which attenuates the prevalence of cardiovascular diseases and risks factor among this population.

The cross-sectional design of the study limited causal inferences or changes over times, as well as introduce reverse causality bias where the exposure of interest does not precede the event or health outcome. In our study self-reported measurement of cardiovascular risks factors was performed before the cardiovascular disease. Hence, participants who had a cardiovascular event know their risk and could intentionally modified it, leading to attenuations of the cardiovascular risk factors estimations. We acknowledge that a longitudinal design will allow us to reduce this risk, however we could also mitigate this bias by cross-sectional measuring cardiovascular risk factors through clinical evaluations (e.g., anthropometrics, biochemical test) among participants that were unaware of their conditions. In order to detect and confirm cases and avoid intentional modification of self-report. Another risk of bias found in our study was non-response bias favoring differences in the characteristics of those that were more likely to answer the survey. We tried to ameliorate this bias by follow-up on contact with the potential participant, inquiring into rejection reasons and making retries outlining the relevance of the study during the second or third contact. However, there were groups that lacked time to complete the survey, were not agreed to share personal information and others thought they would be exposed given the sociopolitical situation. Additionally, non-response bias at question level could also happen, reinforcing differences between those who responded the question to those who did not. This could be carefully analyzed in deep for further analysis, while also detecting the questions that might be adjusted for future studies.

We acknowledged that the instrument of the study was not designed exclusively for cardiovascular research. It was framed in a larger project exploring migrant's trajectories of their life conditions, access to the health system and health outcomes. Thus, we did an approximation in agreement with the extension of other sections and some aspects couldn't be explored in its total depth. However, this study considers social determinants of all sections (e.g., demographic, socioeconomic, health care access, psychosocial and migratory-related factors) to provide data of diverse exposures of both populations. Some behavioral risk factors were not fully evaluated, that is applying complete scales to classify risky consumption due to survey extension and study scope. In addition, variables were measured dichotomously or were dichotomized following the methodology of published CASEN 2017 analysis included in this dissertation. We acknowledged the limitations of these approach, considering only two values might misemploy data for more completeness (Annex 1. Table 7. missing values). However, we covert to binary variable those that were already categorical variables, since continuous variables (e.g., age, income) were categorized. This report comprises a portion of the possible approaches and analyses as a starting point for future research. Additionally, given the nature of a primary data collection, procedures were not previously standardized as other population-based surveys such as CASEN 2017 or NHS 2016-2017, but we based the instrument design and variables operationalization on these references. This process also included adjusting a large data set for both Chilean and migrant population for better perform the analysis. Thus, this first approach is perfectible for more complex and comprehensive analysis including other available data in the survey.

5.7. Study strengths and Usefulness of the study

The knowledge of the borough's territory and its community derived from agreements with relevant institutional and community actors, led to diverse recruitment strategies. Although external validity of the study was limited, we implemented rigorous procedures favoring internal validity to replicate the reality of migrant population residing in La Pintana, La Granja and San Ramón. We continuously evaluated the strategies to reach a similar demographic distribution according to the national references and the latest surveys (CASEN 2020). Our strategies have managed to develop trust in research, identified migrant's focal points and included participants with diverse profiles during COVID-19 pandemic. We created safe spaces not influenced by migratory status or fear of contagion through alliances with pro-immigrant organizations and primary health care providers. Thus, our strategies were continuously adapted in accordance with the sociosanitary crises, considering the epidemiological situation of the boroughs, ongoing political campaigns and anti-migration speeches, among others. These adaptations also resulted from participants' and interviewers' feedback. This study promotes intersectoral collaboration including academia, health teams, decision makers of the boroughs and community leaders. The latter was accomplished by interdisciplinary teamwork which defined goals, detected challenges, opportunities and needs during the study. As well as implemented study protocols that were continuously updated when needed, training and monitoring interviewers to adapt to changing circumstances. These strategies and learned lessons could be replicated in "hard to reach" population studies, particularly among population residing in vulnerable boroughs during challenging crises. The study was compliant with ethical standards including confidentiality, safeguard data, adapted inform consent to remote data collection and ethical compensation. Specifically, ethical considerations of data protection motivated the participation during uncertainty and mistrust times. Overall, this study represents a process of adaptation and innovation in research during the pandemic and to the best of our knowledge this is the first study analyzing cardiovascular health of migrants residing in Chile from a SDH perspective.

The process of recruitment provides evidence of the impact of COVID-19 on migrant population and required adaptations in our strategies. For instance, migratory fluxes such as the return of Haitian migrants to their country of origin or to another destination country. As well as recent migration mainly of Venezuelans and migrant's entrance through not authorized points. This study shows the social vulnerability of migrant population residing in these boroughs, evidenced by their low income, discrimination, stress, lack of support networks, lack of insurance and interaction with the Chilean health system, migratory status, among others. The present study provides data characterizing SDH of both Chilean and migrant population during the particular time frame of the COVID-19 pandemic, which gives useful information of its impact on these populations. Besides, it made visible structural disadvantages, diverse cultural interactions and epidemiological profiles including health gaps between migrants and locals and potential influences on these results. Although crude analyses supported a probable healthy migrant effect on cardiovascular outcomes, the adjusted analysis from the SDH highlighted the relevance of demographic and access to health care factors on cardiovascular diseases odds. In addition, the crude stratified data informed about the distribution of the cardiovascular diseases and risks factors per categories of SDH, showing the groups that are more affected by these conditions. Meanwhile, metabolic risks factors sustained a health advantage after adjustment probably due to the lower alcohol and tobacco consumption. However, the low fruit and vegetable consumption

and physical activity in migrant population might shape possible long-term care needs. All this evidence could be useful for better understand the exposures of migrants in Chile from the social determinants of health approach, and to identify which ones are associated to cardiovascular conditions. The usefulness of the study goes beyond the contribution to the knowledge gap, it also serves as a starting point for public health responses including health promotion and prevention transferable to migrant population care. Additionally, results of this research serve as input for health policies formulation targeting migrant population and training healthcare workers with evidence from a local and regional perspective.

5.8. Future research and projections

Future approaches should include methodological improvements to reduce the above-mentioned risks of bias. Firstly, include clinical measurements in order to confirm the estimated prevalence in the current study following procedures of the national health survey. It is worth to mention that the project in which the study has been drawn has a longitudinal design in progress, representing an opportunity for exploring causality and its related mechanisms. This is also relevant to reduce reverse causality bias avoiding intentional modifications in cardiovascular risk factors report. Besides the longitudinal design, it should be coupled with anthropometric and biochemical analysis rather than self-report. Further analysis could be implemented to study the influence of data collection modality (videocall, face-to-face) and item non-response, this would give useful data for future methodological decisions and adjustments in the survey instrument. To better understand cardiovascular risks factors in migrant population, future research might comprehensively measure these health outcomes. Therefore, proposing studies that could explore in depth the people's screening history and apply standardized methods to objectively estimate risks. Since it remains to be verified the influence of lower alcohol and tobacco consumption on healthy migrant effect found in metabolic risks factors after adjusting by SDH. This could be explored in migrant's community cohorts followed-up over time, while adapting methodological approaches to their geographical mobility.

It would be relevant to fully explore cardiovascular risk throughout the migration process, collecting data of past exposures in the country of origin, transit and destination countries. This could lead to regional surveillance initiatives that allow to timely detect cardiovascular risk and treat it in articulation with local health systems and governments. Hence, considering the intraregional migration and emerging migratory fluxes within the region it might be imperative to implement studies from a regional perspective and cardiovascular risk assessment for diverse population (e.g., socioeconomic, dietary and ethnically diverse). It is also necessary to explore treatment preferences for cardiovascular conditions among migrants, to get insights of other sources of care such as traditional medicine and non-medical practices during migration process. Future perspectives of this study include research disentangling the mechanisms behind the influence of health care access on the dissolution of migrant's health advantage on cardiovascular events. This might include structural equations to test potential relationships of variables of health care access and use during the migration process and other theoretically supported SHD. In the same line, interdisciplinary approaches could be used to better understand the influence of demographic factors by performing molecular analysis, for example whole-genome association studies to detect genetic variants in migrants with aboriginal ethnic background. On the other hand, within the

projections of this area of research is to evaluate the impact of previously implemented policies and its impact on migrant population cardiovascular health. Along with the implementation and evaluation of culturally tailored preventive interventions for migrants at different ages and social integration into host country.

5.9. Main study conclusion

The healthy migrant effect has been previously suggested in local literature. This dissertation reports a migrant's health advantaged on chronic diseases after adjusting by social determinants of health such as demographic, socioeconomic, access to health care, psychosocial and migratory-related factors, from a secondary analysis of population-based data of 2017. Afterwards, primary data collection during COVID-19 pandemic allow us to delve onto cardiovascular diseases and its risks factors from the social determinant's perspective. Findings on SDH revealed a migrant sample at productive age, employed, with higher educational level but lower income. The majority of migrants were insured in the public health system; however, a higher proportion were uninsured compared to locals. Both groups experienced stress during the sociosanitary crises, in addition migrants reported lower experiences of discrimination and reported lack of social capital than locals. Regarding the migratory-related factors, the main nationalities of the sample reflected the intra-regional pattern (Venezuela, Peru, Colombia, Haiti), the majority were recent migrants and did not have a visa either because a irregular administrative status or visa was processed.

The hypothesis of the study stating a lower proportion of cardiovascular and its risk factors in international migrants compared to the local population in Chile (crude or unadjusted comparison) was partially confirmed. The crude analysis revealed a probable healthy migrant effect in all health outcomes and metabolic risks factors. Crude analysis on behavioral factors showed lower alcohol and tobacco consumption in migrants compared to Chileans, but physical inactivity was similar in both populations. While migrants did not meet the recommended fruits and vegetables intake in a greater extent than locals. Specific analysis on healthy migrant effect sequentially adjusted by each set of SDH revealed that acute myocardial infarction advantage disappeared after adjusting by demographic factors, whereas the advantage for cerebrovascular accident was modulated by socioeconomic factors and disappeared after adjusting by access to the health care. The remaining metabolic risk and behavioral factors supported the healthy migrant effect after all adjustments. Although there were not significant associations for cardiovascular diseases and migration-related factors, the highest prevalence of acute myocardial infarction was at longer time of residence in the host country, suggesting that health advantage dissolves over time. However, cardiovascular risk factors such as hypertension was positively associated with residence duration of 6-10 years which may contribute to long-term cardiovascular susceptibility. This evidence is useful to better understand migrant's situation during COVID-19 pandemic, as well as their possible cardiovascular health needs overt time. Adjusted analysis by SDH which went beyond crude analysis and an apparent healthy migrant effect, we revealed the exposures faced by migrant population, particularly the influence of access to health care. In addition, this study represents a starting point for deepening and comprehensive analysis, besides public health responses for preventive services sensitive to migration.

6. Chapter 5 Perspective for prioritizing the cardiovascular health of international migrants in receiving health systems: the case of hypertension prevention

frontiers

Challenges in the prevention of hypertension in international migrants in Latin America: prioritizing the health of migrants in health care systems

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IR and BC contributed to the conceptualization, synthesis and interpretation of literature, IR drafted the manuscript and BC critically reviewed the manuscript and wrote the final version. IR and BC read and approved the final manuscript.

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Abstract

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Among the health priorities of international migrants, non-communicable diseases such as hypertension are of major interest due to its increasing prevalence, mainly in low- and middle-income countries. Previous evidence has reported risk of hypertension in international migrants derived from exposures during migration process, living conditions, health literacy and access to preventive services. Additionally, poorer disease control has been also found when compared to local population. Considering the deficiencies in access and use of health care services related to hypertension prevention and continuity of care. This perspective article aims to offer a Latin American perspective of the challenges faced by international migrants residing in Latin America in accessing hypertension preventive care from human rights, equity, and universal primary health care approaches. This study discusses the potential influence of migration and health policies on health care systems, as well as the barriers to health care access including non-insurance, linguistic barriers, lack of intercultural competence and personal, geographical, and financial barriers. We highlight the particular healthcare needs detected from the evidence related to hypertension among migrant communities and its implication for regional public health aims. This is in line with promoting culturally tailored interventions that considers migration process, lifestyle patterns, social vulnerability, and gender particularities in the process of hypertension prevention, diagnosis and treatment. We advocate for the development of universal, voluntary and systematical regional initiatives of screening and disease control for hypertension and other chronic conditions in Latin America.

Contribution to the field

This perspective describes diverse challenges related to hypertension prevention faced by international migrants residing in Latin American region. The manuscript contributes to the understanding of health system challenges for equitable access and the growing concern about migrant hypertension risk, poor awareness, and control. In addition, these challenges are interpreted from the perspectives of human rights, equity, and universal primary health care approaches. Furthermore, this study provides comprehensive recommendations for regional migrant-sensitive preventive services considering cultural background, gender roles, occupational demands, epidemiological situations, and contextually influencing hypertension risk factors

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Challenges in the prevention of hypertension in international migrants in Latin America: prioritizing the health of migrants in health care systems

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Abstract

Among the health priorities of international migrants, non-communicable diseases such as hypertension are of major interest due to its increasing prevalence, mainly in low- and middle-income countries. Previous evidence has reported risk of hypertension in international migrants derived from exposures during migration process, living conditions, health literacy and access to preventive services. Additionally, poorer disease control has been also found when compared to local population. Considering the deficiencies in access and use of health care services related to hypertension prevention and continuity of care. This perspective article aims to offer a Latin American perspective of the challenges faced by international migrants residing in Latin America in accessing hypertension preventive care from human rights, equity, and universal primary health care approaches. This study discusses the potential influence of migration and health policies on health care systems, as well as the barriers to health care access including non-insurance, linguistic barriers, lack of intercultural competence and personal, geographical, and financial barriers. We highlight the particular healthcare needs detected from the evidence related to hypertension among migrant communities and its implication for regional public health aims. This is in line with promoting culturally tailored interventions that considers migration process, lifestyle patterns, social vulnerability, and gender particularities in the process of hypertension prevention, diagnosis and treatment. We advocate for the development of universal, voluntary and systematical regional initiatives of screening and disease control for hypertension and other chronic conditions in Latin America.

1 Introduction

International migration is defined as *"the movement of people away from their usual residence and across an international border to a country of which they are not nationals"* (1). The current worldwide estimation reached 281 million international migrants, representing 3.6% of the world population. Specifically, in Latin America the economic and political crises, climate disasters, inequalities, labor needs, violence among others have been driving international migration (24). According to the latest data, of all migrants in the Americas 58.7 migrants are residing in North America and 14.7 migrants are residing in the Latin American and Caribbean region (1.6 million in the Caribbean; 2.3 million in Central America and 10.9 in South America) (25). Particularly, migratory flows have been mainly intraregional, following a south-south pattern, where 79% of Latin American international migrants reside in other country of the region (24). During the last decade the historical migratory fluxes have changed, sending countries became a main destinations while there was a reduction of migration to the traditional destination countries including Mexico, Argentina and Brazil (26). Current reports reveal a migratory pattern between neighboring countries and throughout the region as a result of geographical closeness and multilateral treaties favoring mobility (27). In the South American subregion, the main migrant's countries of origin are Venezuela (7.1 million people move from Venezuela and 85% of them have stayed in the region) (28) followed by Colombia, Paraguay, Bolivia and Peru. Whereas Colombia, Chile and Peru became the main receiving countries. Meanwhile, the main countries of origin of those residing in the Central America subregion are EE. UU, Nicaragua, Venezuela, Colombia and Guatemala. The main receiving countries in Central America including Costa Rica, Panama, Guatemala, Belize and Salvador represent a corridor for labor migration and transit to North America (24, 29). Similarly, the intraregional pattern was also evidenced in the Caribbean region where most migrants come from Haiti, Venezuela and Dominican Republic. Furthermore, mobility restrictions during COVID-19 have impacted the migratory flows and increased vulnerability, particularly among those in transit to their destination or returning to their country of origin (30).

The main destination countries in Latin American region have developed policies towards migrants, including Chile (Law nº 21.325 of 202), Colombia (Law nº 1.465 of 2011), Peru (Legislative Decree No. 1350 of 2017), Costa Rica (General law of migration nº 8764 of 2009) Argentina (Migration law n° 25.871 of 2003) and Mexico (Migration Law of 2017), among others. Besides the specific migratory regulations, most of these initiatives consider health care access regardless of administrative status according to the constitutionally protected human rights on the basis of equal treatment with nationals (31, 32). Although, the guarantee of equal access is not always explicit, these legal provisions promote social protection, social integration and guarantee emergency medical care at no cost. Some countries such as Chile, Mexico, Peru have policies for migrants with an irregular status and vulnerable groups. In addition, migrants staying in transit stations in Mexico are entitled to medical attention, but similar protective actions throughout the region remain scarce. Noteworthy, migrants face difficulties in the effective implementation of these policies, since migratory status continues to determine access and use of health care (31).

The health of international migrants is considered a global health priority; hence recognizing their diversity, exposures, and specific health needs is vital for health planning and service

delivery from an equity approach (9). Specifically, non-communicable diseases (NCDs) are major health concerns among migrants due to the epidemiological transition often experienced in destination countries (33). These conditions cause 41 million deaths per year worldwide, corresponding to 71% of all deaths in the general population. In addition, NCDs cause premature deaths (30-69 years of age), mainly in the population from low- and middle-income countries (13). These conditions result from genetic predisposition and cumulative risk factors (34). The migratory process increases NCDs risk since exposure begins at the country of origin depending on living, political and health system conditions. Meanwhile, travel circumstances and lack of continuity in care during transit might exacerbate susceptibility, coupled with healthcare access difficulties and behavioural changes in the destination country, which gives rise to higher health needs upon return (35). Noteworthy, late diagnosis and treatment for type II diabetes mellitus, hypertension and cancer are common problems among international migrants, besides poor control of metabolic risk factors for cardiovascular diseases, which are the most prevalent in this population (13).

Diverse efforts have been made to address migrant's health needs in Latin America including chronic diseases, as evidenced in Chile with the "AUGE-GES" (Explicit Health Guarantees plan) that prioritize prevalent conditions from which migrants can be benefited regardless insurance status. These efforts conducted by the health system show progress in the Region but like other legal provisions it should be monitored and reinforced (36). Meanwhile, it has been described challenges of accessing care when the health needs requires specific attention and treatment, that could be exacerbated by administrative and bureaucratic barriers, discrimination and lack of intercultural competence (37). Even though in Latin American countries such as Mexico, Colombia and Chile where migrants are entitled to health, there are important restrictions denying attention due to policy gaps when are being implemented (38, 39). In addition, services and health care professional's availability are expected to have an impact on migrant's health needs, since services are shared with locals without specific measures targeting migrant population. Besides, experiencing delays and restrictions for attention that influence the preference for other alternatives and types of treatments outside the health care system (36, 40, 41). Although tailored health strategies remain a pending issue in the Region, there are few examples including Colombia where health policies advocate for health workers training to prevent chronic diseases among migrants (39). In addition, the "response plan for migrant's health" prioritizes health care attention for diseases that are commonly decompensated during migration (e.g. diabetes and hypertension) that should be addressed due to their psychosocial impact (42).

Previous evidence suggests a relationship between NCDs and migration mediated by social determinants of health (SDH) (14) which are the conditions shaping the individual's life cycle through economic, political and social systems (43). Furthermore, blood pressure is one of the health parameters early influenced by the migration process and its exposures. From the SDH framework, a highly prevalent NCD such as hypertension is determined by diverse risk factors, including genetic and social determinants of the migrant's ethnic background, socioeconomic status, and access to health care, among others (44). Particularly, adopting lifestyles of the destination country and acculturative stress might impact increased blood pressure (45). At the same time, some migrant groups face greater hypertension prevalence derived from poverty, irregular status, and low level of knowledge on prevention and time of residence, mainly in countries with a high burden of chronic diseases (13, 46).

Hypertension is one of the most critical risk factors for cardiovascular disease, chronic kidney disease, and premature death. This condition is rapidly increasing in low- and middle-income countries due to population ageing, urbanization, and unhealthy behaviours (e.g., unhealthy eating patterns, sedentary lifestyles, and alcohol and tobacco consumption) (47). Globally, it is estimated that there are 1.28 billion adults with hypertension (48), and 47% of them are under treatment; however, less than half achieve disease control (49). The 2030 agenda for sustainable development goals (SDG), through target 3.4, seeks to reduce premature deaths attributable to chronic diseases, along with other targets focused on controlling risk factors and universal health coverage (50). Specific measures to reduce the chronic disease burden include prevention, early diagnosis, and timely treatment (51). In turn, blood pressure control and monitoring in the general population is an indicator of universal health coverage (52). Migrants are a target group for such measures since hypertension became highly prevalent, mainly among those from Mexico, Central America, Africa, South-East Asia and the Caribbean. Evidence reports poorer disease control in migrants compared to the local population (53, 54) and low awareness of hypertension, which might result from barriers to accessing health care (13, 55). Health insurance status also determines awareness, treatment and control of hypertension, being lower in those uninsured (56). However, access to health care is often influenced by migratory policies in the destination country, leaving behind the needs of international migrants that remain to be fully detected and addressed (45). Health disparities between the local population and within migrant groups may result from migratory status; for example, the literature suggests increased cardiovascular risk due to poor access to preventive measures in non-citizens when younger (57).

Moreover, continuity of treatment is also influenced by migratory status and migrants' characteristics since it is not merely restricted to access but to adherence and treatment response considering genetic factors, tailored stratification risk and cultural background (35, 44). Little has been discussed on the increasing hypertension burden among international migrants residing in Latin America, where glaring shortcomings in prevention should be an active part of the regional agenda. The present work aims to offer a regional perspective of the growing challenges faced by international migrants in Latin America in accessing hypertension preventive care from human rights, equity and universal primary health care approaches.

Hypertension among migrants residing in Latin America

According to recent evidence from Colombia, Peru, Chile, Argentina and Uruguay, hypertension affects over 40% of the general population, similar to reported data from a cross-sectional study of 18 countries in Latin America and Caribbean Region. Meanwhile, data from Venezuela reveals a prevalence of 60.4% and most cases were not under control which may have important implications for those migrating and health systems in destination countries. In addition evidence from afro-descendants in the region is scarce and underdiagnosis remains a challenge (58). However data from Haiti reports an age adjusted prevalence of 28.5% and early occurrence (18-30 years) (59). Control of hypertension remain low among general population in Latin America and the Caribbean region (over 35% women, 23% men with hypertension) and little awareness of the disease remains mainly among uninsured asymptomatic population.

The literature describes the complexity of this public health issue mainly from reports of Latin American migrants residing in North America. For instance, data from Mexican migrants residing in the USA reveal the significant impact of systolic hypertension and pre-hypertension on cardiovascular-related deaths, in addition to the low treatment and control rates (45). At the same time, the afro-Caribbean has shown a high prevalence of hypertension, diabetes and obesity. However, evidence of migrants residing in the Latin American region remains scarce and geographically limited (60). For example, in Chile, migrants from Haiti self-reported a low prevalence of chronic diseases; hypertension was below 10% but was the most prevalent condition. Albeit country-level data is unknown, it is expected that hypertension, preeclampsia and renal disease further affect Haitian migrants due to their African ancestry and social vulnerability (61).

Similarly, in Colombia, self-reported prevalence by 229 returning Colombians and Venezuelan migrants reached 12.5% (62). Local primary healthcare data analysis confirms that essential hypertension is a common cause for seeking medical attention (63). Whereas data from the Colombian Ministry of Health and Social Protection reported 9.938 Venezuelan migrants with hypertension out of 16.812 migrants with NCDs (64). A population-based study in Peru revealed a prevalence of 2.5% of hypertension, the second most common chronic disease among Venezuelan migrants (65). Evidence from other Andean countries describes hypertension diagnosis in young adult migrants from the South American region, either in stage I or II during the first year of their arrival to Ecuador (66).

Regarding the literature of Central America, analyses of the National Health Survey of Costa Rica showed a self-reported prevalence of 5.7%, besides risk factors including obesity, tobacco consumption and sedentarism (67). Among 392 Mexicans returning to the border of their country of origin, there was a self-reported prevalence of 4.1% diagnosed previous to return (68). According to this data, prevalence of hypertension in migrants is lower than the reported prevalence in general population of the Region (40%) (58) and worldwide (32%) (49) . This is in accordance with previous evidence describing a phenomenon called “healthy migrant effect” (HME) in which migrants show better health outcomes when compared to local population (69). Specifically, this health advantage has been shown among migrants of South American, afro-Caribbean and Mexican origin living in EE. UU, whose prevalence was lower than the native-born population (70-72). Explanatories models describe a possible positive self-selection favoring migration among healthier and younger people, as well as those better skilled and better resourced. Other explanations are focused on previous healthy habits held during migration process and the protective role of psychosocial resources (73, 74) . However, this phenomenon can result from under-registration of the disease due to lower access to the health system and return to the country of origin, among those with chronic conditions (16). The HME is particularly present in recent migrants, since those with longer time of residence who have been experiencing diverse exposures during migration, including assimilation to the host population tend to lose their health advantage over time (75).

On the other hand, during the COVID-19 pandemic, the impact of chronic comorbidities also became more visible among the migrant population in Mexico, including hypertension and other cardiovascular risk factors that could be worsened during transit and at the destination when timely and tailored care was not available (76). Therefore, hypertension is frequent

across different migration phases, even at an early age. Preventive measures seem unable to reach all migrant groups in Latin America. Hence efforts from the healthcare systems in origin, transit and destination countries systems remain insufficient. Prioritizing this growing public health concern should not rely only on comparisons with local population or prevalence that is often underreported in these countries but rather consider migratory fluxes, composition and exposures of these migrant groups.

Health system challenges for equitable preventive services

Health systems in Latin America face historical challenges to provide an equitable access while having shortage of resources and system disarticulation (77). These are characterized by diverse and heterogeneous financial sources, guarantees of access to care and providers (78). Overall Latin American systems include public subsystems for those in poverty, as well as social insurance and private subsystems for formal employees and individuals with payment capacity, respectively (79) Whereas there is also a preference for complementary private insurance among individuals with higher income (78). Generally, health benefits, regulations and the population targeted differ according to socioeconomic status. The access of populations to health care is open by a unified public model in Cuba and Costa Rica and by a public contract model in Brazil. Conversely, in most other countries in Latin America the access is segregated by a segmented model (80).

Health reforms have been proposed towards universal health systems and comprehensive primary health care in countries such as Brazil, Venezuela, Uruguay and Bolivia, based on State responsibility of ensuring health right. However, its implementation has been hindered by changes of government, as well as low public spending of total health spending, and economic crises (78). Thus, these health systems are fragmented and segmented, similar to those in Chile and Colombia whose systems have a universal health coverage approach. However, Chilean and Colombian systems are market-driven, have been gradually privatized and increased the cost of care (78). Although, valuable efforts have been progressively made to foster health coverage in Chile (explicit Health Guarantees) , Brazil (Basic Action Plan), Mexico Popular Security) and Uruguay (National Integrated Health System) (77), the health spending in the region remains low reaching $182/habitant and 3,7% of GDP leading to higher direct spending on individuals (81) and affecting their access to health services.

Preventive medicine comprises integrated actions to protect, preserve, and optimize the health and well-being of individuals and communities to prevent diseases, injuries, disorders and their associated burdens. These actions must be in accordance with the individual's needs, risks and exposures and provide a timely response for informed decision-making (82). In order to counteract hypertension in the region there are initiatives such as the model Hearts in the Americas lead by Pan-American Health Organization which supports and foster cardiovascular disease prevention and its risks factors in collaboration with the Ministries of Health (83). This technical package follows the World Health Organization guidelines and comprises healthy lifestyles counseling, hypertension treatment and cardiovascular risks assessments, while reducing specific care gaps. The initiative is being implemented in 26 countries of the region including Mexico, Costa Rica, Colombia, Peru, Chile, Argentina, Brazil etc., and have improved hypertension control. However, limitations related to underfunding and pilot's implementation remain in some local health systems (83).

The access to health systems among international migrants entails challenges derived from the disarticulation between migration policy and public health policy, as well as social, socioeconomic and structural disadvantages of the host country's health system. Despite the availability of the services, migrants may have difficulties in their ability to obtain them. Notably, during their migration process, there are dynamic and multidimensional interactions between the supply of preventive services, level of inclusion in the health system, physical and financial accessibility, information availability, acceptability of services and quality of care sensitive to migration status their specific needs. Moreover, the demand for preventive services might be influenced by the migrant's epidemiological profile, beliefs and awareness of health risks, health-seeking behaviour, previous exclusion experiences and political and social context of the origin, transit and destination countries (84).

Unfortunately, international migrants are not fully benefited from preventive services. They face critical challenges related to their differentiated health patterns, the need for tailored stratification risk and disease tools, language and cultural barriers and poor knowledge of health care services (85). In addition, healthcare access and use are often limited, particularly among recent and undocumented migrants, either for being ineligible or excluded from health programs and experiencing fear of legal consequences when seeking care (44, 46). However, the humanitarian organizations have played a key role offering complementary response to the health needs of settled migrants and those in transit throughout the Region. For instance, evidence from Colombia, describe strategies from a primary care approach that have been implemented when access is not guaranteed by migratory status or by geographical barriers, following the principles for migrant's comprehensive health care of the Council of Health Ministers of Central America. The medical attention of this model provides preventive services and continuity of care tailored for migrants, either in institutional locations or mobile services located according to the migratory fluxes. The initiative considers the difficulties in treatment adherence faced during migration process, thus permanent delivery of medication, monitoring and habit counseling is provided (86).

Barriers to accessing preventive services

In Latin American countries, barriers impact the whole population, that might be exacerbated for migrants. For instance, health system issues such as lack of coordination and financial prioritization to provide health services and low awareness of migrant's health rights could leave international migrants behind. Barriers to access to health care involve structural and individual barriers that intersect with barriers to health care utilization and social determinants of health (46, 87). Previous evidence from Mexico, Costa Rica, Chile and Colombia has described diverse interactions including migratory status and health policy gaps (39), poor knowledge of health rights and available services, as well as mistrust in medical institutions, low health literacy, not having a regular medical provider from the same gender or country of origin, among others, might hinder access to preventive services (87). From a regional perspective and considering the current intraregional migratory fluxes, the absence of coordinated preventive services and continuity of care by health systems of neighboring countries could lead to duplicate efforts, disorientation when navigating different health systems and increased health risk during transit.

Evidence from preventive services utilization reported a relationship between discrimination and screening for hypertension; particularly, afro-descendants migrants experience increased levels of discrimination, limiting their use of preventive services (60). Discrimination could be derived from cultural differences, ethnicity and language proficiency (45). This issue might decisively affect afro-Caribbean and Latin-American afro-descendant migrants at higher risk of the disease and might also get less early prevention. Thus, increasing future projections of disease burden among these vulnerable groups. In addition, a lack of knowledge and misconceptions about the disease and its cost would restrict seeking and reaching appropriate care.

On the other hand, in response to diverse barriers, some migrants seek health care in their country of origin either as a substitute or supplement to health services; some have even returned temporarily or permanently for cardiovascular disease treatment (45). The lack of preventive actions aimed at migrants poses severe challenges for public health since hypertension is often asymptomatic and causes major cardiovascular events. However, timely diagnosis and comprehensive treatment would reduce the mobile population's poor control and disease burden. Inequities in access to preventive medicine and quality health services reveal the selective nature of health coverage instead of universal health coverage throughout the region.

2 Discussion

International migrants face diverse challenges derived from their migration process, limiting their access to preventive services. Previous literature reported the impact of the structure and functioning of health systems at origin, transit and destination, in addition to the complex and multidimensional interaction including knowledge of health rights, health system and available services, migratory status, immigration and health policies, as well as financial, cultural and language barriers, among others. These factors act separately or together, producing inequities in access to preventive services and increasing migrant vulnerability (88). Within the framework of universal health coverage and initiatives towards leaving no one behind, equitable access to quality health services is proposed without financial hardship or discrimination (89, 90). Access to the health system increases the probability of using preventive services and reducing cardiovascular risk due to access to early screening, diagnosis and timely treatment (72, 91). Although insurance facilitates managing risk factors, lifestyle or dietary changes, it is necessary to optimize access to screening sources and advice on risk factors at first contact with the health systems (91).

Prevention involves diverse efforts across migrant life spans and stages of their migration process. Among the hypertension preventive methods, some engage structural factors to reduce salt intake and increase accessibility to fruits and vegetables, which could benefit the migrant population. However, specific initiatives to ensure universal health coverage and expand primary care might allow more significant contact with health services, large-scale screening programs and treatment at low cost (49). Given the persistent barriers to accessing preventive services and the lack of tailored interventions based on cultural, occupational, accessibility and contextual factors (46), it is expected poor awareness and control of hypertension in migrants residing in Latin America. Notably, the COVID-19 pandemic makes visible neglected chronic diseases in vulnerable populations along with the effects of vertical health systems, level fragmentation and selective exclusion. Although intersectoral

actions of migration experts, civil society engagement and regional agreements to protect health rights have been proposed, it is still pending to reinforce NCDs prevention on the regional agenda.

In understanding health system challenges for equitable access and the growing concern of migrant hypertension risk, poor awareness and control, we call for the design, implementation and evaluation of evidence-based preventive services in Latin America considering the sociosanitary impact of the COVID-19 pandemic. Among migrant groups, some are particularly vulnerable, including those with irregular status, low socioeconomic status and limited access to services. Thus, detecting health care needs and hypertension drivers of diverse migrant groups is critical. Determining health risks upon arrival at transit and destination countries must be regionally coordinated and addressed with intercultural competence. These services may include community-based behavioural interventions adapted to cultural background, gender roles, occupational demands, epidemiological situations and contextual influence on hypertension risk factors (46). In addition, the information provided must facilitate communication and improve knowledge of health rights, the country's health system and available services to empower migrant groups (45). The latter requires training of health care teams to provide migrant-sensitive services and risk factors management of people on the move.

Gender disparities in hypertension prevalence (e.g. higher in men vs pre-menopausal women), disease awareness, socioeconomic status, lifestyles and health-seeking behaviours require differential approaches (46, 92). Similarly, there are critical ethnicity-related distinctions in prevalence, control and mortality (e.g., higher prevalence in afro-descendant migrants), making specific risk stratification tools imperative for diverse populations (44). Therefore, preventive actions should be in accordance with gender, ethnicity, acculturation level and NCD profiles of migrants residing in Latin America. Additionally, children and adolescent migrants are susceptible to developing risk factors resulting from early exposure to the migration process and lifestyles of the host society. For instance, evidence suggested the association of migration at earlier ages with cardiovascular risk, creating the need for early prevention focused on these groups (45).

A regional initiative of universal, voluntary and systematic preventive services for hypertension and other chronic diseases should agree with local policies. At the same time, policy adequacy is needed towards migrant-inclusive approaches, promote universal health coverage and reduce disparities to prevent further cardiovascular events (57). Data registry disaggregated by migratory status, gender, and ethnicity, among others, is suggested. To comprehensively study hypertension trends and disparities leading to tailored preventive programs. Furthermore, developing interoperable and secure regional surveillance platforms might help support decision-making. These efforts may implement intersectoral approaches, including members of the migrant and host community, health providers, labour, transport and other relevant sectors for public health benefit (45).

3 Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

4 Author Contributions

IR and BC contributed to the conceptualization, synthesis and interpretation of literature, IR drafted the manuscript and BC critically reviewed the manuscript and wrote the final version. IR and BC read and approved the final manuscript.

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7 References

1. OIM. Términos Fundamentales Sobre Migración (2021). Available online at: https://www.iom.int/es/terminos-fundamentales-sobre-migracion#migracion. (accessed September 10, 2022).

2. OIM. Tendencias Recientes De La Migración En Las Américas (2022). Available online at:: https://rosanjose.iom.int/sites/g/files/tmzbdl1446/files/documents/tendencias-recientes-de-la-migracion-en-las-americas_sp.pdf. (accessed September 10, 2022).

3. Migration Data Portal . Total Number of International Migrants at Mid-Year 2020 (2021). Available online at: https://www.migrationdataportal.org/international-data?i=stock_abs_&t=2020&m=1. (accessed March 3, 2023).

4. BID. Flujos Migratorios En América Latina Y El Caribe (2021). Available online at: https://publications.iadb.org/publications/spanish/document/Flujos-migratorios-en-America-Latina-y-el-Caribe-estadisticas-de-permisos-para-los-migrantes.pdf. (accessed March 3, 2023).

5. IOM. América Del Sur Estrategia Regional 2020-2024 (2021). Available online at: https://publications.iom.int/es/node/2821. (accessed March 3, 2023).

6. BID. La opinión pública respecto de la migración en América Latina y el Caribe (2023). Available online at: Https://Publications.Iadb.Org/Publications/Spanish/Viewer/La-Opinion-Publica-Hacia-La-Migracion-En-America-Latina-Y-El-Caribe.Pdf. (accessed March 3, 2023)

7. IOM. Centroamérica, Norteamérica Y El Caribe – Estrategia Regional 2020-2024. (2021). Available online at: https://publications.iom.int/es/node/2698. (accessed March 3, 2023)

8. IOM. Covid-19 and the State of Global Mobility in 2020 (2021). Available online at https://publications.iom.int/es/node/2662. (accessed March 3, 2023).

9. Larenas-Rosa D. Políticas Migratorias Y Protección De La Salud De La Población Migrante: Una Aproximación Al Escenario Normativo De América Latina. *SALUD Y MIGRACIONES*:21.

10. BID. Regímenes De Política Migratoria En América Latina Y El Caribe (2022). Available online at: http://167.71.166.66/bitstream/handle/123456789/607/Regimenes-de-politica-migratoria-en-America-Latina-y-el-Caribe-inmigracion-libre-movilidad-regional-refugio-y-nacionalidad.pdf?sequence=1&isAllowed=y. (accessed March 3, 2023)

11. Wickramage K, Vearey J, Zwi AB, Robinson C, Knipper M. Migration and Health: A Global Public Health Research Priority. *BMC Public Health* (2018) 18(1):1-9.

12. Castelli F, Tomasoni LR, El Hamad I. Migration and Chronic Noncommunicable Diseases: Is the Paradigm Shifting? *J Cardiovasc Med* (2014) 15(9):693-5.

13. Organization WH. World Report on the Health of Refugees and Migrants. (2022).

14. Organization WH. Noncommunicable Diseases (2021). Available online at: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases. (accessed September 10, 2022).

15. IOM. Non-Communicable Diseases and Migration (2017). Available online at: https://www.iom.int/sites/g/files/tmzbdl486/files/our_work/DMM/Migration-Health/mhd_infosheet_ncds_10.09.2018.pdf. (accessed September 10, 2022).

16. Oyarte M, Cabieses B, Rada I, Blukacz A, Espinoza M, Mezones-Holguin E. Unequal Access and Use of Health Care Services among Settled Immigrants, Recent Immigrants, and Locals: A Comparative Analysis of a Nationally Representative Survey in Chile. *International Journal of Environmental Research and Public Health* (2022) 20(1):741.

17. Nicolao J. *Regional Migrants in Bahía Blanca, Argentina: Challenges in Social Rights Access*. Estudios fronterizos(2019).doi: 10.21670/ref.1903024.

18. Aith FMA, Forsyth C, Shikanai-Yasuda MA. *Chagas Disease and Healthcare Rights in the Bolivian Immigrant Community of São Paulo, Brazil*. Tropical Medicine and Infectious Disease(2020).doi: 10.3390/tropicalmed5020062.

19. Bojorquez-Chapela I, Flórez-García V, Calderón-Villarreal A, Fernández-Niño JA. *Health Policies for International Migrants: A Comparison between Mexico and Colombia*. Health Policy OPEN(2020). p. 100003.doi: 10.1016/j.hpopen.2020.100003.

20. Cabieses B, Chepo M, Obach A, Espinoza M. *Towards Universal Coverage for International Migrants in Chile: Accessibility and Acceptability Indicators from a Multi-Methods Study*. Medical Research Archives(2019).doi: 10.18103/mra.v7i1.1889.

21. Fouratt CE, Voorend K. *Esquivando Al Estado. Prácticas Privadas En El Uso De Los Servicios De Salud Entre Inmigrantes Nicaragüenses En Costa Rica*. Anuario de Estudios Centroamericanos(2019). p. 373-403.doi: 10.15517.

22. Restrepo J. Plan De Respuesta Del Sector Salud Al Fenómeno Migratorio. *Bogotá: Ministerio de Salud* (2018).

23. Davies AA, Blake C, Dhavan P. Social Determinants and Risk Factors for Non-Communicable Diseases (Ncds) in South Asian Migrant Populations in Europe. *Asia Europe Journal* (2011) 8(4):461-73.

24. WHO. Social Determinants of Health (2021). Available online at: https://www.who.int/health-topics/social-determinants-of-health#tab=tab_1. (accessed September 10, 2022).

25. Saeed A, Dixon D, Yang E. Racial Disparities in Hypertension Prevalence and Management. A Crisis Control. *American College of Cardiology* (2020).

26. Rosenthal T, Touyz RM, Oparil S. Migrating Populations and Health: Risk Factors for Cardiovascular Disease and Metabolic Syndrome. *Curr Hypertens Rep* (2022):1-16.

27. Ali SH, Islam NS, Commodore-Mensah Y, Yi SS. Implementing Hypertension Management Interventions in Immigrant Communities in the Us: A Narrative Review of Recent Developments and Suggestions for Programmatic Efforts. *Curr Hypertens Rep* (2021) 23(1):1-10.

28. Mills KT, Stefanescu A, He J. The Global Epidemiology of Hypertension. *Nature Reviews Nephrology* (2020) 16(4):223-37.

29. Organization WH. Hypertension (2021). Available online at https://www.who.int/news-room/fact-sheets/detail/hypertension. (accessed September 10, 2022).

30. Zhou B, Carrillo-Larco RM, Danaei G, Riley LM, Paciorek CJ, Stevens GA, et al. Worldwide Trends in Hypertension Prevalence and Progress in Treatment and Control from 1990 to 2019: A Pooled Analysis of 1201 Population-Representative Studies with 104 Million Participants. *The Lancet* (2021) 398(10304):957-80.

31. Singh Thakur J, Nangia R, Singh S. Progress and Challenges in Achieving Noncommunicable Diseases Targets for the Sustainable Development Goals. *FASEB BioAdvances* (2021) 3(8):563-8.

32. Bennett JE, Kontis V, Mathers CD, Guillot M, Rehm J, Chalkidou K, et al. Ncd Countdown 2030: Pathways to Achieving Sustainable Development Goal Target 3.4. *The Lancet* (2020) 396(10255):918-34.

33. Kruk ME, Gage AD, Arsenault C, Jordan K, Leslie HH, Roder-DeWan S, et al. High-Quality Health Systems in the Sustainable Development Goals Era: Time for a Revolution. *The Lancet global health* (2018) 6(11):e1196-e252.

34. Payton C, Kimball S, Ahrenholz NC, Wieland ML. Preventive Care and Management of Chronic Diseases in Immigrant Adults. *Prim Care* (2021) 48(1):83-97.

35. Agyemang C, van den Born B-J. Non-Communicable Diseases in Migrants: An Expert Review. *J Travel Med* (2019) 26(2):tay107.

36. OPS. Salud De Los Migrantes Internacionales - Estado De Salud: Enfermedades No Transmisibles (2022). Available online at: https://www.paho.org/es/documentos/salud-migrantes-internacionales-estado-salud-enfermedades-no-transmisibles. (accessed September 10, 2022).

37. Sorlie PD, Allison MA, Avilés-Santa ML, Cai J, Daviglus ML, Howard AG, et al. Prevalence of Hypertension, Awareness, Treatment, and Control in the Hispanic Community Health Study/Study of Latinos. *Am J Hypertens* (2014) 27(6):793-800.

38. Guadamuz JS, Durazo-Arvizu RA, Daviglus ML, Calip GS, Nutescu EA, Qato DM. Citizenship Status and the Prevalence, Treatment, and Control of Cardiovascular Disease Risk Factors among Adults in the United States, 2011–2016. *Circ Cardiovasc Qual Outcomes* (2020) 13(3):e006215.

39. Camafort M, Alcocer L, Coca A, Lopez-Lopez J, López-Jaramillo P, Ponte-Negretti C, et al. Latin-American Ambulatory Blood Pressure Registry (Mapa-Latam): An Urgent Need. *Revista Clínica Española (English Edition)* (2021) 221(9):547-52.

40. Metz M, Pierre JL, Yan LD, Rouzier V, St-Preux S, Exantus S, et al. Hypertension Continuum of Care: Blood Pressure Screening, Diagnosis, Treatment, and Control in a Population-Based Cohort in Haiti. *The Journal of Clinical Hypertension* (2022) 24(3):246-54.

41. Rosenthal T. The Effect of Migration on Hypertension and Other Cardiovascular Risk Factors: A Review. *J Am Soc Hypertens* (2014) 8(3):171-91.

42. Leiva M, Correa ME, Ardiles L, Krall P. La Inmigración Haitiana En Chile: Un Desafío Para Los Programas De Salud Cardiovascular Y Renal. *Revista médica de Chile* (2018) 146(11):1361-2.

43. Fernández-Niño JA, Vásquez-Rodríguez AB, Flórez-García VA, Rojas-Botero ML, Luna-Orozco K, Navarro-Lechuga E, et al. Modos De Vida Y Estado De Salud De Migrantes En Un Asentamiento De Barranquilla, 2018. *Revista de Salud Pública* (2018) 20:530-8.

44. Ibarra JMM, Cano JRM, Álvarez ETM, Enríquez SXG. Perfil Epidemiológico De Los Migrantes Venezolanos Atendidos En Rumichaca, 2018. *Dilemas contemporáneos: Educación, Política y Valores* (2020).

45. Cubillos A, Ardón N. Realidades En La Salud De Las Poblaciones Migrantes: El Caso De Los Migrantes Venezolanos En El Contexto Colombiano. *JOSÉ KOECHLIN/JOAQUÍN EGUREN* (2018):97.

46. Bernabe-Ortiz A, Carrillo-Larco RM. Multimorbidity and Disability among Venezuelan Migrants: A Population-Based Survey in Peru. *Journal of immigrant and minority health* (2022) 24(5):1206-13.

47. Silva Y, Inciarte L, Rodríguez P. Prevalencia De Hipertensión Arterial En Adultos Jóvenes Inmigrantes. *Metro Ciencia* (2021) 29(suppl 2)):36-7.

48. Herring A, Bonilla R. Inmigrantes Nicaragüenses En Costa Rica: Estado Y Utilización De Servicios De Salud. *Población y Salud en Mesoamérica* (2009).

49. Sanchez-Nuñez FM, Fernández-Ortega MA, Dávila-Mendoza R, Ponce-Rosas ER, Luna-Téllez Y, Meléndez-Álvarez S. Factores De Riesgo a La Salud Durante El Proceso Migratorio En México. *Revista Cubana de Medicina General Integral* (2020) 36(4).

50. Razum O. Migrant Mortality, Healthy Migrant Effectmigrant Mortality, Healthy Migrant Effect. In: Kirch W, editor. *Encyclopedia of Public Health*. Dordrecht: Springer Netherlands (2008). p. 932-5.

51. Bacon E, Riosmena F, Rogers RG. Does the Hispanic Health Advantage Extend to Better Management of Hypertension? The Role of Socioeconomic Status, Sociobehavioral Factors, and Health Care Access. *Biodemography Soc Biol* (2017) 63(3):262-77.

52. Garcia C, Garcia MA, Ailshire JA. Sociocultural Variability in the Latino Population: Age Patterns and Differences in Morbidity among Older Us Adults. *Demographic research* (2018) 38:1605.

53. Commodore-Mensah Y, Matthie N, Wells J, Dunbar SB, Himmelfarb CD, Cooper LA, et al. African Americans, African Immigrants, and Afro-Caribbeans Differ in Social Determinants of Hypertension and Diabetes: Evidence from the National Health Interview Survey. *Journal of racial and ethnic health disparities* (2018) 5(5):995-1002.

54. Zavaleta-Abad RA, Campos-Uscanga Y. Health Effects after Migration and the Mediating Role of Acculturation and Family Cohesion. *Universidad y Salud* (2019) 21(3):261-9.

55. Hamilton TG. The Healthy Immigrant (Migrant) Effect: In Search of a Better Native-Born Comparison Group. *Soc Sci Res* (2015) 54:353-65.

56. Riosmena F, Kuhn R, Jochem WC. Explaining the Immigrant Health Advantage: Self-Selection and Protection in Health-Related Factors among Five Major National-Origin Immigrant Groups in the United States. *Demography* (2017) 54(1):175-200.

57. Lu Y, Denier N, Wang JS-H, Kaushal N. Unhealthy Assimilation or Persistent Health Advantage? A Longitudinal Analysis of Immigrant Health in the United States. *Soc Sci Med* (2017) 195:105-14. doi: https://doi.org/10.1016/j.socscimed.2017.11.019.

58. Neira Orjuela F. Características Sociodemográficas Y De Salud De Los Mexicanos Y Los Migrantes Con Enfermedad Por Coronavirus (Covid-19) En México. *Notas de Población* (2021).

59. Cecchini S. Protección Social Universal En América Latina Y El Caribe. Textos Seleccionados 2006-2019. (2019).

60. Giovanella L, Vega R, Tejerina-Silva H, Acosta-Ramirez N, Parada-Lezcano M, Ríos G, et al. ¿ Es La Atención Primaria De Salud Integral Parte De La Respuesta a La Pandemia De Covid-19 En Latinoamérica? *Trabalho, Educação e Saúde* (2020) 19.

61. Abramo L, Cecchini S, Ullmann H. Enfrentar Las Desigualdades En Salud En América Latina: El Rol De La Protección Social. *Ciência & Saúde Coletiva* (2020) 25(5):1587-98.

62. Frenk J, Gómez-Dantés O. Health Systems in Latin America: The Search for Universal Health Coverage. *Arch Med Res* (2018) 49(2):79-83. doi: https://doi.org/10.1016/j.arcmed.2018.06.002.

63. Conill EM. Sistemas Universais Para a América Latina: Jovens E Antigas Inovações Nos Serviços De Saúde. *Revista Brasileira em Promoção da Saúde* (2018) 31(4).

64. Miettinen OS. Reflections on Preventive Medicine. *Prev Med* (2014) 67:313-5.

65. Campbell NRC, Paccot Burnens M, Whelton PK, Angell SY, Jaffe MG, Cohn J, et al. [2021 World Health Organization Guideline on Pharmacological Treatment of Hypertension: Policy Implications for the Region of the Americasdiretrizes De 2021 Da Organização Mundial Da Saúde Sobre O Tratamento Medicamentoso Da Hipertensão Arterial: Repercussões Para as Políticas Na Região Das Américas]. *Rev Panam Salud Publica* (2022) 46:e54. Epub 2022/05/17. doi: 10.26633/rpsp.2022.54.

66. Levesque J-F, Harris MF, Russell G. Patient-Centred Access to Health Care: Conceptualising Access at the Interface of Health Systems and Populations. *International journal for equity in health* (2013) 12(1):1-9.

67. Martin Y, Collet T-H, Bodenmann P, Blum MR, Zimmerli L, Gaspoz J-M, et al. The Lower Quality of Preventive Care among Forced Migrants in a Country with Universal Healthcare Coverage. *Prev Med* (2014) 59:19-24.

68. Gallego ÁC, Moreno B, López JA, Bernal OA. Situación De Salud En Población Migrante Atendida Por La Cruz Roja Colombiana, 2020. *Revista Avances en Salud* (2021) 5(2).

69. OPS. Salud De Los Migrantes Internacionales. Sistemas De Salud: Acceso a La Atención Médica. (2022).

70. O'Donnell CA, Burns N, Mair FS, Dowrick C, Clissmann C, van den Muijsenbergh M, et al. Reducing the Health Care Burden for Marginalised Migrants: The Potential Role for Primary Care in Europe. *Health Policy* (2016) 120(5):495-508.

71. Richter S, Vallianatos H, Green J, Obuekwe C. *Intersection of Migration and Access to Health Care: Experiences and Perceptions of Female Economic Migrants in Canada*. International Journal of Environmental Research and Public Health(2020).doi: 10.3390/ijerph17103682.

72. Odoch WD, Senkubuge F, Hongoro C. How Has Sustainable Development Goals Declaration Influenced Health Financing Reforms for Universal Health Coverage at the Country Level? A Scoping Review of Literature. *Globalization and health* (2021) 17(1):1-13.

73. Alcalá HE, Albert SL, Roby DH, Beckerman J, Champagne P, Brookmeyer R, et al. Access to Care and Cardiovascular Disease Prevention: A Cross-Sectional Study in 2 Latino Communities. *Medicine* (2015) 94(34).

74. Reckelhoff JF. Gender Differences in Hypertension. *Curr Opin Nephrol Hypertens* (2018) 27(3):176-81.

7. Annex 1.

Table 25. Unadjusted global and stratified prevalence of self-reported cardiovascular diseases by SDH factors

	Acute myocardial infarction					**Cerebrovascular accident**				
	Chilean		**Migrants**			**Chilean**		**Migrants**		
Social determinants of health	**n=3.005**		**n=3.094**			**n=3.012**		**n=3.093**		
	%	95%IC	**%**	95%IC	P value	**%**	95%IC	**%**	95%IC	P value
Total	1.8%	[1.38-2.34]	0.48%	[0.29-0.80]	**0.000**	**1.26%**	**[0.91-1.72]**	**0.32%**	**[0.17-0.59]**	**0.000**
Sex										
Male	1.93%	[1.26-2.94]	0.58%	[0.28-1.22]	**0.004**	**0.91%**	**[0.49-1.69]**	**0.08%**	**[0.01-0.59]**	**0.005**
Female	1.47%	[1.00-2.16]	0.52%	[0.26-1.03]	**0.008**	**1.46%**	**[0.99-2.15]**	**0.58%**	**[0.30-1.11]**	**0.015**
Age categories										
18-29	0.31%	[0.08-1.23]	0.54%	[0.18-1.32]	0.698	0.15%	[0.02-1.09]	0.25%	[0.06-0.98]	1.000
30-49	0.76%	[0.39-1.45]	0.26%	[0.98-0.70]	0.091	1.01%	[0.57-1.76]	**0.13%**	**[0.03-0.52]**	**0.002**
50-64	2.26%	[1.34-3.78]	2.26%	[0.94-5.34]	1.000	1.77%	[0.98-3.17]	1.36%	[0.43-4.14]	1.000
>65	9.17%	[6.04-13.68]	4.76%	[1.14-17.76]	0.547	3.46%	[1.73-6.79]	4.76%	[1.14-17.76]	0.655
Ethnicity										
Yes	2.25%	[1.07-4.66]	0.84%	[0.12-5.83]	0.454	0.96%	[0.31-2.95]	0.84%	[0.11-5.83]	1.000
No	1.75%	[1.31-2.32]	0.42%	[0.24-0.74]	**0.000**	**1.30%**	**[0.93-1.80]**	**0.28%**	**[0.14-0.56]**	**0.000**
Marital Status										
Single	1.11%	[0.71-17.39]	0.37%	[0.17-0.83]	**0.015**	**1.05%**	**[0.66-1.66]**	**0.31%**	**[0.12-0.74]**	**0.011**
Married	2.48%	[1.64-3.74]	0.71%	[0.32-1.58]	**0.004**	**1.80%**	**[1.10-2.91]**	**0.12%**	**[0.01-0.84]**	**0.000**
Cohabitant	2.86%	[0.70-10.96]	0.37%	[0.09-1.48]	0.068	0.00%	[-]	0.19%	[0.02-1.31]	1.000
Separated/divorced/annulled	1.50%	[0.56-3.95]	1.23%	[0.17-8.47]	1.000	0.37%	[0.05-2.63]	2.47%	[0.60-9.52]	0.136
Widow	9.21%	[4.40-18.27]	0.00%		0.188	3.95%	[1.25-11.72]	4.00%	[0.50-25.50]	1.000
Educational level										
None	0%	-	0%	-	-	0%	-	16.67%	[1.18-76.96]	0.462
Primary	0.76%	[0.32-1.82]	0.14%	[0.02-1.01]	0.113	3.01%	[1.56-5.69]	**0.40%**	**[0.05-2.79]**	**0.020**
Secondary	1.40%	[0.67-2.91]	0.76%	[0.24-2.34]	0.526	1.23%	[0.78-1.91]	**0.23%**	**[0.086-1.61]**	**0.000**
Technical	1.62%	[1.09-2.38]	0.57%	[0.31-1.06]	**0.006**	**0.60%**	**[0.19-1.84]**	0.51%	[0.12-2.01]	0.611
University	5.72%	[3.58-9.03]	0.40%	[0.06-2.79]	**0.000**	**1.07%**	**[0.50-2.22]**	0.28%	[0.07-1.13]	0.074
Home Income categories										
<400000	2.33%	[1.59-3.39]	0.47%	[0.24-0.95]	**0.000**	**1.52%**	**[0.94-2.42]**	**0.36%**	**[0.15-0.79]**	**0.001**
400.000-700.000	1.64%	[1.01-2.66]	0.40%	[0.13-1.23]	**0.018**	**0.82%**	**[0.41-1.63]**	0.27%	[0.06-1.05]	0.201
700.000-1.000.000	1.58%	[0.76-3.29]	0.33%	[0.05-2.34]	0.152	1.13%	[0.46-2.68]	0.33%	[0.04-2.34]	0.410
>1.000.000	01.06%	[0.44-2.54]	0.85%	[0.27-2.59]	1.000	1.69%	[0.84-3.35]	0.28%	[0.03-1.98]	0.086
Occupation										
Employed	01.01%	[0.59-1.69]	0.41%	[0.19-0.86]	**0.050**	**1.01%**	**[0.59-1.69]**	**0.18%**	**[0.05-0.54]**	**0.002**
Unemployed	3.69%	[2.23-6.03]	0.68%	[0.22-2.10]	**0.003**	**2.19%**	**[1.14-4.16]**	0.68	[0.21-2.10]	0.082

Inactive	1.71%	[1.07-2.74]	0.50%	[0.16-1.55]	**0.038**	**1.20%**	**[0.68-2.10]**	0.67%	[0.25-1.77]	0.437
Access to health care										
None	01.05%	[0.26-4.12]	0.34%	[0.05-2.36]	0.564	0.00%	[-]	0.67%	[0.16-2.65]	0.522
Public system	1.90%	[1.43-2.53]	0.41%	[0.21-0.78]	**0.000**	**1.32%**	**[0.93-1.85]**	**0.36%**	**[0.18-0.72]**	**0.000**
Private system	0.52%	[0.07-3.63]	0%		1.000	1.56%	[0.50-4.76]	0.00%	[-]	1.000
Others	02.02%	[0.49-7.84]	2.38%	[0.89-6.21]	1.000	2.02%	[0.49-7.84]	0.00%	[-]	0.138
Access barriers										
Yes	1.79%	[1.26-2.53]	0.40%	[0.17-0.96]	**0.000**	**1.27%**	**[0.83-1.91]**	**0.24%**	**[0.07-0.74]**	**0.002**
No	1.83%	[1.22-2.73]	0.54%	[0.29-1.01]	**0.001**	**1.27%**	**[0.77-0.20]**	**0.38%**	**[0.18-0.79]**	**0.009**
Stress										
Yes	1.62%	[1.21-2.17]	0.44%	[0.24-0.79]	**0.000**	**1.26%**	**[0.90-1.74]**	**0.32%**	**[0.15-0.63]**	**0.000**
No	04.09%	[2.13-7.70]	0.71%	[0.27-1.88]	**0.002**	**1.36%**	**[0.43-4.14]**	0.35%	[0.08-1.41]	0.139
Discrimination										
Yes	1.95%	[1.33-2.86]	0.60%	[0.25-1.43]	**0.000**	**1.43%**	**[0.91-2.22]**	**0.12%**	**[0.01-0.84]**	**0.001**
No	1.60%	[1.08-2.35]	0.47%	[0.25-0.87]	**0.001**	**1.08%**	**[0.67-1.73]**	**0.42%**	**[0.22-0.81]**	**0.027**
Social support										
Yes	1.72%	[1.29-2.27]	0.57%	[0.35-0.95]	**0.000**	**1.25%**	**[0.89-1.73]**	**0.34**	**[0.17-0.66]**	**0.000**
No	3.00%	[1.35-6.55]	0%		**0.001**	**1.49%**	**[0.47-0.45]**	**0.21%**	**[0.02-1.47]**	**0.080**
Social capital										
Yes	2.21%	[1.43-3.41]	0.87%	[0.36-2.08]	0.062	1.43%	[0.83-2.45]	**0.17%**	**[0.02-1.23]**	**0.013**
No	1.62%	[1.15-2.27]	0.40%	[0.22-0.75]	**0.000**	**1.23%**	**[0.82-1.80]**	**0.36%**	**[0.18-0.69]**	**0.001**

CI confidence Interval

Table 26. Crude prevalence of self-reported metabolic risks factors in Chilean population

	HTA			**DM**			**DLD**			**OBES**		
Social determinants of health	**n=2.995**			**n=2.978**			**n=2.977**			n=2.988		
	%	95%IC	P Value	**%**	95%IC	P Value	**%**	95%IC	P Value	**%**	95%IC	P Value
Total	**19.20%**	**[17.82-20.64]**	**0.000**	**12.02%**	**[10.90-13.2]**	**0.000**	**11.42%**	**[10.32-2.61]**	**0.000**	**14.79%**	**[13.56-16.11]**	**0.000**
Sex												
Male	**18.8**	**[12.67-21.33]**	**0.000**	**10.91%**	**[9.18-12.90]**	**0.000**	**8.77%**	**[7.21-10.61]**	**0.000**	**9.88%**	**[8.23-11.81]**	**0.000**
Female	**19.26%**	**[17.48-21.24]**	**0.000**	**12.35%**	**[10.86-14.01]**	**0.000**	**12.74%**	**[11.23-14.40]**	**0.000**	**18.19%**	**[16.43-20.10]**	**0.000**
Age Categories												
18-29	3.10%	[2.00-4.75]]	0.630	3.41%	[2.25-5.12]	0.100	**4.22%**	**[2.90-6.08]**	**0.018**	**13.30%**	**[10.88-16.17]**	**0.000**
30-49	**13.63%**	**[11.78-15.71]**	**0.000**	**8.45%**	**[6.98-10.19]**	**0.000**	**10.16%**	**[8.56-12.02]**	**0.000**	**17.28%**	**[15.24-19.55]**	**0.000**
50-64	35.66%	[31.96-93.52]	0.620	**20.85%**	**[17.80-24.27]**	**0.012**	17.54%	[14.71-20.77]	0.110	**14.94%**	**[12.33-17.98]**	**0.002**
>65	**50.00%**	**[43.56-56.43]**	**0.012**	28.82%	[23.29-35.05]	0.022	22.71%	[17.71-28.61]	0.062	13.27%	[9.42-18.38]	0.061
Ethnicity												
Yes	**21.47%**	**[17.25-26.39]**	**0.003**	**14.29%**	**[10.79-18.67]**	**0.010**	**13.44%**	**[10.04-17.76]**	**0.001**	**18.57%**	**[14.59-23.33]**	**0.000**
No	**18.92%**	**[17.47-20.44]**	**0.000**	**11.72%**	**[10.55-12.99]**	**0.000**	**11.23%**	**[10.08-12.48]**	**0.000**	**14.40%**	**[13.12-15.78]**	**0.000**
Marital Status												
Single	**12.60%**	**[11.09-14.26]**	**0.000**	**09.07%**	**[7.79-10.53]**	**0.000**	**7.97%**	**[6.77-9.35]**	**0.000**	**13.36%**	**[11.82-15.06]**	**0.000**
Married	**28.70%**	**[25.81-31.77]**	**0.000**	**16.34%**	**[14.03-18.94]**	**0.000**	**16.59%**	**[14.26-19.20]**	**0.000**	**17.33%**	**[14.97-19.99]**	**0.000**
Cohabitant	13.04%	[6.84-23.43]	0.360	**10.14%**	**[4.84-20.01]**	**0.020**	**15.94%**	**[8.95-26.77]**	**0.000**	**21.43%**	**[13.24-32.78]**	**0.000**
Separated/divorced/annulle	24.53%	[19.70-30.09]	0.130	**14.07%**	**[10.35-18.84]**	**0.030**	**13.21%**	**[9.62-17.86]**	**0.044**	**15.04%**	**[11.21-19.88]**	**0.000**

Widow	42.86	[32.16-54.26]	0.360	23.29%	[14.87-34.52]	0.267	18.67	[11.28-29.29]	0.107	10.53%	[5.29-19.85]	0.195
Educational level												
None	42.86%	[10.37-82.93]	0.120	28.57%	[4.91-75.60]	0.269	28.57%	[4.91-75.60]	0.318	14.29%	[0.12-0.70]	0.538
Primary	**28.86%**	**[23.97-34.28]**	**0.000**	**18.84%**	**[14.73-23.75]**	**0.000**	**16.55%**	**[12.72-21.25]**	**0.000**	**14.63%**	**[0.11-0.19]**	**0.000**
Secondary	**20.74%**	**[18.78-22.84]**	**0.000**	**12.22%**	**[10.67-13.96]**	**0.000**	**12.39%**	**[10.82-14.13]**	**0.000**	**14.98%**	**[0.13-0.17]**	**0.000**
Technical	**14.86%**	**[11.99-18.27]**	**0.000**	**11.27%**	**[8.76-14.36]**	**0.000**	**10.10%**	**[7.73-13.09]**	**0.000**	**15.40%**	**[0.13-0.19]**	**0.000**
University	**14.22%**	**[11.74-17.11]**	**0.000**	**8.90%**	**[6.93-11.34]**	**0.000**	**7.66%**	**[5.84-9.96]**	**0.000**	**13.96%**	**[0.12-0.17]**	**0.000**
Home income categories												
<400000	**18.15%**	**[15.99-20.52]**	**0.000**	**11.15%**	**[9.42-13.14]**	**0.000**	**10.31%**	**[8.65-12.24]**	**0.000**	**13.72%**	**[11.81-15.88]**	**0.000**
400.000-700.000	**18.13%**	**[15.52-20.67]**	**0.000**	**12.51%**	**[10.56-14.75]**	**0.000**	**11.69%**	**[9.80-13.87]**	**0.000**	**15.43%**	**[13.29-17.85]**	**0.000**
700.000-1.000.000	**20.45%**	**[16.93-24.49]**	**0.002**	**12.27%**	**[9.48-15.72]**	**0.000**	**12.33%**	**[9.53-15.79]**	**0.000**	**13.24%**	**[10.37-16.76]**	**0.000**
>1.000.000	**22.72%**	**[19.14-26.73]**	**0.003**	**12.85%**	**[10.09-16.20]**	**0.000**	**15.69%**	**[9.95-16.04]**	**0.000**	**17.45%**	**[14.27-21.16]**	**0.000**
Occupation												
Employed	**17.07%**	**[15.16-19.14]**	**0.000**	**10.96%**	**[9.41-12.73]**	**0.000**	**10.63%**	**[9.10-12.37]**	**0.000**	**12.76%**	**[11.10-14.63]**	**0.000**
Unemployed	**22.85%**	**[19.01-27.19]**	**0.000**	**14.25%**	**[11.17-18.00]**	**0.000**	**13.12%**	**[10.15-16.78]**	**0.000**	**19.46%**	**[15.88-23.61]**	**0.000**
Inactive	**20.48%**	**[18.08-23.09]**	**0.000**	**11.91%**	**[10.03-14.07]**	**0.000**	**11.21%**	**[9.38-13.33]**	**0.000**	**16.15%**	**[13.98-18.57]**	**0.000**
Access to healthcare												
None	**17.46%**	**[12.66-23.58]**	**0.000**	**11.11%**	**[7.33-16.48]**	**0.000**	**8.90%**	**[5.58-13.88]**	**0.000**	**11.52%**	**[7.69-16.91]**	**0.000**
Public health system	**19.70%**	**[18.16-21.33]**	**0.000**	**12.58%**	**[11.31-13.97]**	**0.000**	**11.79%**	**[10.55-13.13]**	**0.000**	**15.12%**	**[13.75-16.61]**	**0.000**
Private health system	13.54%	[9.36-19.18]	0.808	5.79%	[3.22-10.18]	0.471	7.81%	[4.74-12.59]	0.740	11.98%	[8.07-17.42]	0.055
Others	**17.35%**	**[11.00-26.27]**	**0.005**	08.08%	[4.05-15.45]	0.078	8.14%	[3.41-14.35]	0.240	8.16%	[4.10-15.60]	0.181
Access barriers												
Yes	**19.14%**	**[17.35-21.06]**	**0.000**	**12.41%**	**[10.92-14.05]**	**0.000**	**12.14%**	**[10.67-13.76]**	**0.000**	**16.41%**	**[14.73-18.23]**	**0.000**
No	**19.06%**	**[16.98-21.32]**	**0.000**	**11.29%**	**[9.64-13.16]**	**0.000**	**10.14%**	**[8.58-11.94]**	**0.000**	**12.31%**	**[10.60-14.25]**	**0.000**
Stress												
Yes	**18.86%**	**[17.44-20.35]**	**0.000**	**11.94%**	**[10.77-13.20]**	**0.000**	**11.65%**	**[10.50-12.90]**	**0.000**	**15.13%**	**[13.84-16.52]**	**0.000**
No	**23.04%**	**[17.89-29.14]**	**0.000**	**12.39%**	**[8.61-17.49]**	**0.000**	**7.76%**	**[4.86-12.16]**	**0.002**	**9.55%**	**[6.29-14.23]**	**0.000**
Discrimination												
Yes	**17.62%**	**[15.66-19.77]**	**0.000**	**10.43%**	**[8.89-12.19]**	**0.000**	**11.94%**	**[10.29-13.80]**	**0.000**	**18.05%**	**[16.07-20.22]**	**0.000**
No	**20.23%**	**[18.30-22.29]**	**0.000**	**13.32%**	**[11.71-15.10]**	**0.000**	**10.55%**	**[9.11-12.17]**	**0.000**	**11.50%**	**[10.01-13.19]**	**0.000**
Social support												
Yes	**19.17%**	**[17.74-20.67]**	**0.000**	**12.16%**	**[10.99-13.43]**	**0.000**	**11.16%**	**[10.03-12.38]**	**0.000**	**14.31%**	**[13.06-15.66]**	**0.000**
No	**18.69%**	**[13.82-24.76]**	**0.000**	**9.64%**	**[6.21-14.66]**	**0.002**	**14.14%**	**[9.92-19.75]**	**0.000**	**20.20%**	**[15.15-26.41]**	**0.000**
Social capital												
Yes	**19.82%**	**[17.34-22.55]**	**0.000**	**12.04%**	**[10.06-14.34]**	**0.000**	**14.70%**	**[12.52-17.18]**	**0.000**	**18.16%**	**[15.76-20.83]**	**0.000**
No	**18.76%**	**[17.11-20.51]**	**0.000**	**12.11%**	**[10.75-13.60]**	**0.000**	**9.85%**	**[8.62-11.22]**	**0.000**	**13.05%**	**[11.65-14.59]**	**0.000**

HTN: hypertension; T2DM: type 2 diabetes mellitus; DLD: dyslipidemia; OBES: obesity. CI confidence Interval.

Table 27. Crude prevalence of self-reported metabolic risks factors in migrant population

	HTN			**DM**			**DLD**			**OBES**		
Social determinants of health	**n=3.086**		P	**n=3.090**		P Value	**n=3.086**		P Value	n=3.089		P
	%	95%IC	Value	**%**	95%IC	migrants	**%**	95%IC	migrants	**%**	95%IC	Value
Total	**6.97%**	**[6.12-7.92]**	**0.000**	**3.5%**	**[2.90-4.20]**	**0.000**	**3.11%**	**[2.55-3.78]**	**0.000**	**2.98%**	**[2.43-3.64]**	**0.000**
Sex												
Male	**5.61%**	**[4.43-7.07]**	**0.000**	**3.76%**	**[2.81-4.99]**	**0.000**	**2.34%**	**[1.62-3.37]**	**0.000**	**2.26%**	**[1.55-3.27]**	**0.000**
Female	**8.83%**	**[7.5-10.34]**	**0.000**	**3.82%**	**[2.97-4.90]**	**0.000**	**4.21%**	**[3.31-5.33]**	**0.000**	**4.00%**	**[3.20-5.19]**	**0.000**
Age categories												
18-29	2.61%	[1.70-3.97]	0.630	1.99%	[1.21-3.21]	0.100	**1.99%**	**[1.22-3.22]**	**0.018**	**2.61%**	**[1.70-3.97]**	**0.000**

30-49	**5.94%**	**[4.85-7.24]**	**0.000**	**3.43%**	**[2.62-4.47]**	**0.000**	**2.57%**	**[1.88-3.50]**	**0.000**	**3.43%**	**[2.62-4.48]**	**0.000**
50-64	33.64%	[27.67-40.17]	0.620	**13.12%**	**[9.25-18.27]**	**0.012**	12.73%	[8.91-17.84]	0.110	**6.85%**	**[4.16-11.08]**	0.002
>65	**28.57%**	**[16.71-44.36]**	**0.012**	**11.9%**	**[4.90-26.13]**	**0.022**	9.52%	[3.51-23.33]	0.062	2.38%	[0.32-15.85]	0.061
Ethnicity												
Yes	**9.24%**	**[5.16-16.00]**	**0.003**	**5.88%**	**[2.80-11.90]**	**0.019**	**3.36%**	**[1.25-8.69]**	**0.001**	**4.20%**	**[1.74-9.78]**	**0.000**
No	**6.79%**	**[5.92-7.77]**	**0.000**	**3.44%**	**[2.83-4.18]**	**0.000**	**2.60%**	**[2.07-3.25]**	**0.000**	**2.53%**	**[2.01-3.18]**	**0.000**
Marital Status												
Single	**5.47%**	**[4.46-6.69]**	**0.000**	**2.54%**	**[1.87-3.43]**	**0.000**	**2.30%**	**[1.67-3.16]**	**0.000**	**2.11%**	**[1.51-2.95]**	**0.000**
Married	**8.94%**	**[7.18-11.07]**	**0.000**	**4.78%**	**[3.52-6.45]**	**0.000**	**3.93%**	**[2.80-5.48]**	**0.000**	**3.33%**	**[2.31-4.79]**	**0.000**
Cohabitant	5.81%	[4.10-8.14]	0.360	**3.74%**	**[2.42-5.72]**	**0.026**	**3.94%**	**[2.58-5.97]**	**0.000**	**5.04%**	**[3.47-7.25]**	**0.000**
Separated/divorced/annulled	16.25%	[9.59-26.18]	0.130	**4.94%**	**[1.83-12.59]**	**0.030**	**4.94%**	**[1.83-12.59]**	**0.044**	**3.75%**	**[1.19-11.17]**	**0.006**
Widow	32.00%	[16.26-53.27]	0.360	12.00%	[3.68-32.69]	0.267	4.00	[0.50-25.50]	0.107	0.00%	-	0.195
Educational level												
None	0.00%	[0-0]	0.120	0%	--	0.269	0.00%	[-]	0.318	0.00%	-	0.538
Primary	**9.56%**	**[6.47-13.89]**	**0.000**	**5.58%**	**[3.32-9.21]**	**0.000**	**5.22%**	**[3.04-8.80]**	**0.000**	**2.38%**	**[1.07-5.22]**	**0.000**
Secondary	**6.57%**	**[5.49-7.83]**	**0.000**	**3.91%**	**[3.09-4.93]**	**0.000**	**2.70%**	**[2.03-3.58]**	**0.000**	**2.70%**	**[2.04-3.56]**	**0.000**
Technical	**7.38%**	**[5.17-10.42]**	**0.000**	**1.78%**	**[0.00-.036]**	**0.000**	**3.55%**	**[2.11-5.91]**	**0.000**	**4.07%**	**[2.51-6.55]**	**0.000**
University	**6.85%**	**[5.19-8.97]**	**0.000**	**2.71%**	**[0.01-0.04]**	**0.000**	**3.14%**	**[2.07-4.73]**	**0.000**	**3.29%**	**[2.20-4.91]**	**0.000**
Home Income categories												
<400000	**6.35%**	**[5.27-7.61]**	**0.000**	**3.26%**	**[2.51-4.22]**	**0.000**	**2.61%**	**[1.94-3.49]**	**0.000**	**2.31%**	**[1.69-3.15]**	**0.000**
400.00 -700.00	**6.65%**	**[5.07-8.67]**	**0.001**	**4.13%**	**[2.91-5.82]**	**0.000**	**4.01%**	**[2.81-5.67]**	**0.000**	**4.14%**	**[2.93-5.84]**	**0.000**
700.00 -1.000.00	**9.49%**	**[6.62-13.42]**	**0.002**	**2.00%**	**[0.89-4.39]**	**0.000**	**3.02%**	**[1.57-5.71]**	**0.000**	**3.34%**	**[1.80-6.12]**	**0.000**
>1.000.00	**8.47%**	**[5.98-11.87]**	**0.003**	**4.51%**	**[2.77-7.24]**	**0.000**	**3.66%**	**[2.13-6.21]**	**0.000**	**3.38%**	**[1.93-5.87]**	**0.000**
Occupation												
Employed	**6.81%**	**[5.70-8.11]**	**0.000**	**3.48%**	**[2.70-4.47]**	**0.000**	**2.37%**	**[1.74-3.21]**	**0.000**	**2.9%**	**[2.20-3.82]**	**0.000**
Unemployed	**11.24%**	**[8.59-14.57]**	**0.000**	**5.28%**	**[3.52-7.82]**	**0.000**	**5.49%**	**[3.70-8.07]**	**0.000**	**5.05%**	**[3.34-7.55]**	**0.000**
Inactive	**6.22%**	**[4.53-23.09]**	**0.000**	**3.52%**	**[2.30-5.34]**	**0.000**	**4.52%**	**[3.11-6.51]**	**0.000**	**3.18%**	**[2.04-4.94]**	**0.000**
Access to healthcare												
None	**4.36%**	**[2.54-7.38]**	**0.000**	02.01%	[0.90-4.42]	**0.000**	**1.68%**	**[0.69-3.99]**	**0.000**	**1.01%**	**[0.32-3.09]**	**0.000**
Public health system affiliation	**7.76%**	**[6.71-8.95]**	**0.000**	3.99%	[3.24-4.89]	**0.000**	**3.13%**	**[2.48-3.94]**	**0.000**	**3.26%**	**[2.60-4.09]**	**0.000**
Private health system affiliation	11.11%	[4.58-24.53]	0.808	2.22%	[0.29-14.85]	0.471	4.44%	[1.07-16.65]	0.740	2.22%	[0.30-14.86]	0.055
Others	**5.99%**	**[3.23-10.81]**	**0.005**	2.98%	[1.23-6.99]	0.078	3.57%	[1.60-7.76]	0.240	4.17%	[1.99-8.52]	0.181
Access barriers												
Yes	**7.29%**	**[5.96-8.86]**	**0.000**	**3.68%**	**[2.76-4.87]**	**0.000**	**3.92%**	**[2.97-5.15]**	**0.000**	**3.67%**	**[2.76-4.87]**	**0.000**
No	**6.75%**	**[5.68-7.99]**	**0.000**	**3.37%**	**[2.63-4.29]**	**0.000**	**2.56%**	**[1.92-3.39]**	**0.000**	**2.59%**	**[1.88-3.33]**	**0.000**
Stress												
Yes	**6.88%**	**[5.95-7.94]**	**0.000**	**3.50%**	**[2.84-4.29]**	**0.000**	**3.26%**	**[2.63-4.03]**	**0.000**	**3.26%**	**[2.63-4.03]**	**0.000**
No	**7.49%**	**[5.57-9.98]**	**0.000**	**3.55%**	**[2.30-5.44]**	**0.000**	**2.49%**	**[1.47-4.16]**	**0.002**	**1.78%**	**[0.96-3.29]**	**0.000**
Discrimination												
Yes	**7.21%**	**[5.63-9.18]**	**0.000**	**4.18%**	**[3.01-5.77]**	**0.000**	**3.59%**	**[2.52-5.09]**	**0.000**	**3.83%**	**[2.72-5.37]**	**0.000**
No	**7.01%**	**[6.00-8.17]**	**0.000**	**3.20%**	**[2.53-4.04]**	**0.000**	**3.01%**	**[2.36-3.83]**	**0.000**	**2.73%**	**[2.12-3.52]**	**0.000**
Social support												
Yes	**6.84%**	**[5.92-7.87]**	**0.000**	**3.30%**	**[2.67-4.05]**	**0.000**	**3.07%**	**[2.47-3.81]**	**0.000**	**3.11%**	**[2.51-3.85]**	**0.000**
No	**7.76%**	**[5.66-10.53]**	**0.000**	**4.61%**	**[3.05-6.91]**	**0.002**	**3.35%**	**[2.06-5.41]**	**0.000**	**2.30%**	**[1.28-4.11]**	**0.000**
Social capital												
Yes	**9.09%**	**[6.98-11.74]**	**0.000**	**4.72%**	**[3.25-6.80]**	**0.000**	**5.44%**	**[3.84-7.63]**	**0.000**	**5.06%**	**[3.54-7.19]**	**0.000**
No	**6.57%**	**[5.56-7.62]**	**0.000**	**3.24%**	**[2.60-4.01]**	**0.000**	**2.63%**	**[2.07-3.34]**	**0.000**	**2.51%**	**[1.96-3.21]**	**0.000**

HTN: hypertension; T2DM: type 2 diabetes mellitus; DLD: dyslipidemia; OBES: obesity. CI confidence Interval

Table 28. Crude prevalence of tobacco, alcohol and low physical activity in Chilean and migrant population

Social Determinant of Health	Tobacco					Alcohol					Low physical activity				
	Chileans		Migrants			Chileans		Migrants			Chileans		Migrants		
Total	**4**	**[43.42-49.32]**	**35.26**	**[30.60-40.21]**	**0.000**	**41.01%**	**[38.66-43.39]**	**31.19%**	**[28.96-33.50]**	**0.000**	73.14%	[70.95-75.21]	74.10%	[71.90-76.18]	0.552
Sex															
Male	4	[36.96-48.26]	45.00	[36.89-53.37]	0.670	**53.09%**	**[48.38-57.74]**	**46.15%**	**[41.66-50.70]**	**0.039**	61.87%	[57.21-66.31]	63.50%	[59.05-67.72]	0.632
Female	**4**	**[44.32-51.22]**	**29.59**	**[24.12-35.69]**	**0.000**	**36.70%**	**[34.04-39.44]**	**25.00%**	**[22.56-27.60]**	**0.000**	77.16%	[74.72-79.42]	75.51%	[76.02-80.79]	0.458
Age categories															
18-29	3	[33.62-44.46]	37.50	[28.64-47.27]	0.810	**45.47%**	**[41.08-49.93]**	**30.60%**	**[26.75-34.74]**	**0.000**	**67.49%**	**[63.18-71.51]**	**74.13%**	**[70.17-77.72]**	**0.022**
30-49	**5**	**[50.65-59.15]**	**35.02**	**[28.93-41.64]**	**0.000**	**43.18%**	**[39.66-46.76]**	**32.83%**	**[29.87-35.92]**	**0.000**	75.17%	[71.94-78.13]	74.89%	[72.00-77.57]	0.910
50-64	4	[35.91-49.38]	34.00	[22.04-48.41]	0.340	31.82%	[26.99-37.06]	23.91%	[17.47-31.80]	0.096	76.97%	[72.09-81.21]	72.86%	[64.83-79.62]	0.348
>65	2	[11.28-32.94]	22.22	[4.30-64.47]	1.000	34.74%	[25.76-44.94]	23.81%	[9.69-47.64]	0.444	**72.63%**	**[62.69-80.73]**	**45.45%**	**[25.48-66.99]**	**0.022**
Ethnicity															
Yes	3	[27.11-44.54]	40.00	[17.71-67.36]	0.780	47.46%	[40.15-54.86]	45.00%	[32.74-57.89]	0.767	**72.32%**	**[62.21-78.44]**	**58.06%**	**[45.28-69.84]**	**0.040**
No	**4**	**[44.59-50.84]**	**34.53**	**[29.79-28.59]**	**0.000**	**40.16%**	**[37.68-42.68]**	**23.99%**	**[27.73-32.33]**	**0.000**	73.18%	[70.85-75.37]	76.20%	[73.99-78.27]	0.590
Marital Status															
Single	**4**	**[43.06-50.82]**	**33.33**	**[27.37-39.87]**	**0.000**	**45.54%**	**[42.39-48.72]**	**30.30%**	**[27.32-33.44]**	**0.000**	**70.55%**	**[67.56-73.35]**	**76.14%**	**[73.20-78.85]**	**0.007**
Married	4	[38.81-50.14]	39.47	[29.00-51.00]	0.520	35.79%	[31.53-40.28]	29.95%	[25.72-34.55]	0.072	**77.01%**	**[19.36-27.06]**	**70.64%**	**[66.08-74.82]**	**0.038**
Cohabitant	4	[27.43-63.58]	37.74	[25.55-51.69]	0.640	38.89%	[34.12-56.02]	36.05%	[30.39-42.11]	0.854	72.22%	[54.98-84.69]	73.26%	[67.49-78.32]	1.000
Separated/divorced	4	[40.07-58.25]	37.50	[20.05-58.93]	0.370	35.33%	[28.40-42.92]	30.43%	[18.66-45.48]	0.601	74.25%	[67.03-80.35]	76.09%	[61.33-86.45]	0.851
Widow	4	[25.48-64.34]	25.00	[46.11-69.67]	0.430	21.74%	[11.91-36.33]	35.71%	[14.27-64.95]	0.309	84.78%	[70.90-92.71]	60.00%	[32.63-82.28]	0.067
Educational level															
None	0	-	0.00%	[-]		25.00%	[0.83-92.93]	33.33%	[0.25-98.98]	0.714	50.00%	[3.98-96.01]	66.67%	[1.01-99.74]	0.629
Primary	4	[34.81-52.78]	32.50	[19.56-48.79]	0.150	32.75%	[26.09-40.18]	31.78	[24.27-40.38]	0.480	76.61%	[69.62-82.38]	76.52%	[68.45-83.02]	0.546
Secondary	**5**	**[46.62-54.74]**	**36.41**	**[30.24-43.05]**	**0.000**	**38.23%**	**[35.02-41.53]**	**27.60%**	**[24.79-30.59]**	**0.000**	75.87%	[72.89-78.62]	77.39%	[74.57-79.98]	0.242
Technical	**4**	**[40.71-55.07]**	**26.92**	**[16.43-40.83]**	**0.005**	**45.05%**	**[39.22-51.02]**	**35.96**	**[29.61-42.83]**	**0.029**	70.70%	[64.99-75.81]	70.59%	[63.93-76.46]	0.529
University	3	[28.91-41.71]	40.00	[29.06-52.03]	0.270	**48.74%**	**[43.56-53.93]**	**37.50%**	**[32.57-42.69]**	**0.002**	67.04%	[61.98-71.72]	66.76%	[61.67-71.48]	0.500
Home Income categories															
<400000	4	[42.90-52.53]	40.11	[33.10-47.54]	0.110	**34.12%**	**[30.52-37.90]**	**25.43%**	**[22.65-28.41]**	**0.000**	75.20%	[71.68-78.40]	74.04%	[71.03-76.82]	0.633
400.00 -700.00	**4**	**[41.08-51.43]**	**30.28**	**[22.31-39.62]**	**0.004**	**44.47%**	**[40.28-48.72]**	**35.94%**	**[31.27-40.87]**	**0.010**	72.05%	[68.07-75.69]	73.45%	[68.82-77.62]	0.654
700.00 -1.000.00	4	[33.83-49.08]	41.86	[27.84-57.32]	1.000	47.08%	[40.81-53.44]	44.67%	[36.84-52.75]	0.677	71.25%	[65.17-76.64]	70.59%	[62.82-77.31]	0.910
>1.000.00	**4**	**[43.38-54.65]**	**33.70**	**[24.69-44.05]**	**0.012**	46.14%	[41.57-50.75]	40.71%	[35.14-45.40]	0.099	73.79%	[68.53-77.63]	69.89%	[64.87-74.46]	0.235
Occupation															
Employed	**4**	**[45.00-53.64]**	**36.48**	**[30.51-42.88]**	**0.001**	**46.60%**	**[43.04-50.18]**	**35.80%**	**[32.80-38.90]**	**0.000**	71.56%	[68.21-74.68]	72.94%	[70.04-75.66]	0.549
Unemployed	4	[40.05-55.24]	33.77	[23.98-45.17]	0.051	39.67%	[33.66-45.99]	31.60%	[26.62-37.03]	0.059	72.84%	[66.87-78.08]	76.87%	[71.80-81.26]	0.321
Inactive	4	[37.58-47.04]	32.86	[22.74-44.84]	0.150	**35.27%**	**[31.73-38.96]**	**18.31%**	**[14.56-22.77]**	**0.000**	75.00%	[71.57-78.13]	75.29%	[70.43-79.57]	0.939
Access to healthcare															
None	4	[35.61-58.98]	36.36	[21.47-54.42]	0.395	37.14%	[28.36-46.86]	26.14%	[19.74-33.73]	0.074	71.43%	[61.96-79.32]	74.03%	[66.46-80.38]	0.671
Public health	**4**	**[44.04-50.55]**	**33.70**	**[28.29-39.57]**	**0.000**	**40.34%**	**[37.74-42.99]**	**29.61%**	**[27.03-32.32]**	**0.000**	75.98%	[75.59-77.22]	74.54%	[71.94-76.98]	0.817
Private health	3	[24.20-47.25]	28.57	[4.91-75.60]	1.000	55.88%	[46.02-65.29]	45.93%	[26.60-66.38]	0.495	67.65%	[57.87-76.08]	70.83%	[48.95-86.01]	0.813
Others	3	[20.05-58.93]	33.33	[13.37-61.81]	1.000	46.15%	[32.90-59.97]	42.86%	[32.60-53.76]	0.726	50.00%	[36.42-63.57]	66.28%	[55.53-75.57]	0.073
Access barriers															
Yes	**4**	**[45.27-53.01]**	**35.53**	**[29.12-42.50]**	**0.001**	**41.12%**	**[38.04-44.26]**	**34.90%**	**[31.34-38.62]**	**0.013**	74.35%	[71.49-77.01]	73.19%	[69.68-76.43]	0.606
No	4	[38.02-47.12]	34.97	[28.37-42.20]	0.900	**40.98%**	**[37.36-44.69]**	**28.59%**	**[25.78-31.56]**	**0.000**	71.47%	[67.98-74.71]	74.74%	[71.87-77.40]	0.142
Stress															
Yes	**4**	**[43.39-49.50]**	**35.71**	**[30.64-41.12]**	**0.001**	**41.56%**	**[39.11-44.05]**	**30.60%**	**[28.16-33.16]**	**0.000**	73.31%	[71.03-75.46]	75.00%	[72.58-77.26]	0.324
No	4	[32.96-56.22]	37.76	[21.76-46.03]	0.206	34.71%	[26.17-43.17]	33.80%	[28.53-39.49]	1.000	72.50%	[63.75-79.80]	70.45%	[64.92-75.42]	0.721
Discrimination															
Yes	**4**	**[43.50-52.19]**	**34.58**	**[26.10-44.16]**	**0.014**	**40.30%**	**[36.78-43.91]**	**33.64%**	**[29.32-38.25]**	**0.024**	70.84%	[67.42-74.03]	70.48%	[66.01-74.58]	0.894
No	**4**	**[41.59-49.86]**	**35.00**	**[29.41-41.02]**	**0.004**	**41.64%**	**[38.41-44.93]**	**30.55%**	**[27.90-33.34]**	**0.000**	75.45%	[72.49-78.18]	76.33%	[73.73-78.74]	0.673
Social support															

Yes	**4**	**[42.55-48.69]**	**33.96**	**[28.94-39.36]**	**0.000**	**41.44%**	**[39.00-43.91]**	**32.76%**	**[30.30-32.32]**	**0.000**	72.80%	[70.52-74.96]	73.82%	[71.41-76.09]	0.557
No	5	[44.48-35.85]	41.94	[30.15-54.71]	0.132	**35.45%**	**[27.00-44.91]**	**22.40%**	**[17.63-28.01]**	**0.013**	76.09%	[70.38-85.75]	75.60%	[69.86-80.54]	0.502
Social capital															
Yes	4	[35.96-46.98]	29.82	[19.22-43.15]	0.107	**37.27%**	**[33.09-41.64]**	**27.87%**	**[22.97-33.36]**	**0.008**	**70.06%**	**[68.84-73.95]**	**62.24%**	**[56.54-67.62]**	**0.028**
No	**4**	**[45.10-52.17]**	**36.14**	**[31.04-41.56]**	**0.000**	**42.57%**	**[39.71-45.46]**	**32.09%**	**[29.59-34.69]**	**0.000**	74.52%	[71.90-76.96]	77.02%	[74.65-79.23]	0.155

Table 29. Crude prevalence of low fruit and vegetable intake

Low fruit and vegetables intake					
Social Determinant	**Chileans**		**Migrants**		
Total	**69.01%**	**[67.48-70.50]**	**84.72%**	**[83.45-85.90]**	**0.000**
Sex					
Male	**76.78%**	**[74.31-79.08]**	**85.78%**	**[83.37-87.61]**	**0.000**
Female	**76.58%**	**[74.59-78.44]**	**89.57%**	**[84.81-88.15]**	**0.000**
Age categories					
18-29	**76.69%**	**[73.39-76.69]**	**84.16%**	**[81.05-86.49]**	**0.000**
30-49	**78.35%**	**[75.96-80.56]**	**85.82%**	**[83.98-87.47]**	**0.000**
50-64	**73.79%**	**[70.35-76.95]**	**93.53%**	**[78.52-96.07]**	**0.000**
>65	**71.32%**	**[65.55-76.46]**	**86.36%**	**[72.31-93.88]**	**0.042**
Ethnicity					
Yes	**84.75%**	**[80.59-88.13]**	**93.65%**	**[87.74-96.81]**	**0.009**
No	**73.51%**	**[71.89-75.07]**	**84.84%**	**[83.52-86.07]**	**0.000**
Marital Status					
Single	**76.73%**	**[74.77-78.57]**	**83.91%**	**[82.13-85.54]**	**0.000**
Married	**73.54%**	**[70.58-76.28]**	**84.42%**	**[81.83-86.69]**	**0.000**
Cohabitant	**69.44%**	**[57.70-79.10]**	**87.36%**	**[84.26-89.91]**	**0.000**
Separated/divorced/annulled	**73.05%**	**[68.02-77.55]**	**86.96%**	**[78.28-92.49]**	**0.006**
Widow	**58.70%**	**[48.27-68.39]**	**93.33%**	**[75.80-98.42]**	**0.000**
Educational level					
None	**50.00%**	**[15.81-84.18]**	**100.00%**	**[-]**	**0.070**
Primary	**80.70%**	**[76.15-84.55]**	**91.11%**	**[87.05-93.98]**	**0.000**
Secondary	**74.94%**	**[72.83-76.93]**	**83.07%**	**[81.29-84.70]**	**0.000**
Technical	**75.09%**	**[71.28-78.54]**	**88.68%**	**[85.28-91.36]**	**0.000**
University	**71.79%**	**[68.37-74.96]**	**84.41%**	**[81.61-86.84]**	**0.000**
Home Income categories					
<400000	**76.92%**	**[74.52-79.15]**	**86.53%**	**[84.88-88.03]**	**0.000**
40**0.00** -70**0.00**	**72.23%**	**[69.46-74.84]**	**80.65%**	**[77.75-83.25]**	**0.000**
70**0.00** -1.00**0.00**	**75.83%**	**[71.78-79.46]**	**87.26%**	**[83.07-90.52]**	**0.000**
>1.00**0.00**	**42.26%**	**[54.91-60.52]**	**21.01%**	**[75.84-81.82]**	**0.000**
Occupation					
Employed	**76.65%**	**[73.38-77.77]**	**85.57%**	**[83.83-87.15]**	**0.000**
Unemployed	**78.64%**	**[74.54-82.22]**	**89.66%**	**[86.46-92.17]**	**0.000**
Inactive	**77.12%**	**[74.60-79.45]**	**86.07%**	**[83.24-88.49]**	**0.000**
Access to healthcare					
None	**67.62%**	**[60.95-73.63]**	**84.81%**	**[80.39-88.37]**	**0.000**
Public health system	**75.43%**	**[73.76-77.01]**	**84.45%**	**[82.92-85.85]**	**0.000**
Private health system	**70.59%**	**[63.93-76.46]**	**87.50%**	**[74.42-94.39]**	**0.017**
Others	**71.15%**	**[61.62-79.11]**	**82.76%**	**[76.35-87.70]**	**0.025**
Access barriers					

Yes	**75.49%**	**[73.52-77.36]**	**82.55%**	**[80.44-84.47]**	**0.000**
No	**73.92%**	**[71.54-76.16]**	**86.24%**	**[84.63-87.70]**	**0.000**
Stress					
Yes	**75.52%**	**[73.96-77.00]**	**83.90%**	**[82.46-85.24]**	**0.000**
No	**65.00%**	**[58.72-70.79]**	**88.70%**	**[85.91-91.00]**	**0.000**
Discrimination					
Yes	**73.45%**	**[71.11-75.66]**	**78.76%**	**[75.96-81.30]**	**0.004**
No	**76.14%**	**[74.08-78.07]**	**88.41%**	**[87.01-89.66]**	**0.000**
Social support					
Yes	**74.55%**	**[72.98-76.05]**	**83.82%**	**[82.40-85.14]**	**0.000**
No	**78.18%**	**[72.20-83.17]**	**89.80%**	**[86.85-92.15]**	**0.000**
Social capital					
Yes	**71.69%**	**[68.78-74.42]**	**82.18%**	**[78.91-85.02]**	**0.000**
No	**76.45%**	**[74.66-78.14]**	**86.04%**	**[84.66-87.30]**	**0.000**

CI confidence Interval.

Table 30. Missing values per varibles in migrant and Chilean population

Variables	**Missing values migrants**		**Null values Chileans**	
	n	%	n	%
Demographics				
sexo_informante	1	0,06	0	0,00
etnia_informante	69	4,17	7	0,42
Socioeconomics				
nivel_educativo_informante	1	0,06	0	0,00
ocupacion_informante	3	0,97	0	0,00
ocupacion_integrante1	2	0,12	0	0,00
Access to health care				
afiliacion_salud_informante	6	0,36	7	0,42
sistema_afiliacion_salud_informante	153	9,24	139	8,35
barrera_acceso_salud_informante	0	0,00	7	0,42
barrera_idioma_informante	0	0,00	0	0,00
barrera_donde_consultar_informante	0	0,00	3	0,18
barrera_hora_informante	0	0,00	3	0,18
barrera_geografica_informante	0	0,00	3	0,18
barrera_no_atencion_informante	0	0,00	3	0,18
barrera_respeto_informante	0	0,00	3	0,18
barrera_otra_informante	0	0,00	3	0,18
Psychosocial				
estres_informante	7	0,42	8	0,48
discriminacion_socioeconomico_informante	16	0,97	9	0,54

discriminacion_genero_informante	16	0,97	9	0,54
discriminacion_civil_informante	18	1,09	9	0,54
discriminacion_ropa_informante	16	0,97	10	0,60
discriminacion_color_informante	17	1,03	9	0,54
discriminacion_migrante_informante	18	1,09	0	0,00
discriminacion_edad_informante	22	1,33	9	0,54
discriminacion_orientacion_informante	22	1,33	16	0,96
discriminacion_tatuajes_informante	19	1,15	11	0,66
discriminacion_fisico_informante	17	1,03	9	0,54
discriminacion_religion_informante	18	1,09	7	0,42
discriminacion_politica_informante	16	0,97	9	0,54
discriminacion_sindicato_informante	19	1,15	9	0,54
discriminacion_residencia_informante	16	0,97	8	0,48
discriminacion_estudio_informante	17	1,03	11	0,66
discriminacion_indigena_informante	24	1,45	14	0,84
discriminacion_discapacidad_informante	20	1,21	12	0,72
discriminacion_otro_informante	33	1,99	15	0,90
no_discriminacion_informante	32	1,93	36	2,16
juntas_vecinos_informante	10	0,60	8	0,48
club_recreativo_informante	10	0,60	8	0,48
organizacion_religiosa_informante	10	0,60	7	0,42
organizacion_artistico_informante	12	0,72	10	0,60
juvenil_estudiantil_informante	13	0,79	10	0,60
grupo_adulto_mayor_informante	12	0,72	11	0,66
grupo_voluntariado_informante	15	0,91	10	0,60
autoayuda_salud_informante	16	0,97	7	0,42
agrupacion_ideologica_informante	14	0,85	8	0,48
organizacion_indigena_informante	14	0,85	7	0,42
centro_apoderados_informante	13	0,79	9	0,54
centro_madres_informante	17	1,03	8	0,48
organizaciones_diversidad_informante	18	1,09	8	0,48
otro_grupo_informante	26	1,57	10	0,60
apoyo_escucha_informante	6	0,36	6	0,36
apoyo_consejo_informante	5	0,30	6	0,36
apoyo_afecto_informante	5	0,30	6	0,36
apoyo_cercano_informante	4	0,24	6	0,36
apoyo_grupo_informante	6	0,36	7	0,42
Migratory				

pais_origen_informante	1	0,06	Not applicable	Not applicable
otro_ pais_origen_informante	41	2,54	Not applicable	Not applicable
refugio_asilo_informante	71	4,29	Not applicable	Not applicable
visa_ingreso_informante	45	2,72	Not applicable	Not applicable
estatus_migratorio_informante	39	2,36	Not applicable	Not applicable
estatus_migratorio_integrante1	320	19,32	Not applicable	Not applicable
Cardiovascular diseases				
infarto_informante	6	0,54	8	1,20
infarto_integrante1	108	7,37	232	15,08
acv_informante	6	0,54	7	0,96
acv_integrante1	108	7,43	300	18,81
Cardiovascular risks factors				
hipertension_informante	7	0,85	31	1,86
hipertension_integrante1	107	7,67	232	15,08
diabetes_informante	6	0,85	6	2,88
diabetes_integrante1	108	7,37	233	15,08
hiperlipidemia_informante	6	0,79	5	2,40
hiperlipidemia_integrante1	108	7,55	235	15,63
obesidad_informante	5	0,79	5	0,84
obesidad_integrante1	108	7,43	236	15,32
tabaco_vida_informante	58	3,50	0	0,00
tabaco_actual_informante	16	0,97	0	0,00
alcohol_actual_informante	56	3,38	1	0,06
actividad_fisica_informante	42	2,54	0	0,00
porcion_fruta_informante	4	0,24	0	0,00
porcion_verduras_informante	6	0,36	0	0,00

8. References

1. OIM. Términos Fundamentales Sobre Migración (2021). Available from: https://www.iom.int/es/terminos-fundamentales-sobre-migracion#migracion.
2. Castelli F. Drivers of Migration: Why Do People Move? *J Travel Med* (2018) 25(1):tay040.
3. Segal U. Globalization, Migration, and Ethnicity. *Public Health* (2019) 172:135-42.
4. OIM. World Migration Report 2022: Chapter 2 (2021). Available from: https://publications.iom.int/es/node/3171.
5. Cerrutti M, Parrado E. Intraregional Migration in South America: Trends and a Research Agenda. *Annu Rev Sociol* (2015) 41:399-421.
6. INE. Estimación De Personas Extranjeras Residentes Habituales En Chile Al 31 De Diciembre De 2020 (2021). Available from: https://www.extranjeria.gob.cl/media/2021/08/Estimaci%C3%B3n-poblaci%C3%B3n-extranjera-en-Chile-2020-regiones-y-comunas-metodolog%C3%ADa.pdf.
7. Familia MdDSy. Inmigrantes Síntesis De Resultados Casen 2017. (2018).
8. Zimmerman C, Kiss L, Hossain M. Migration and Health: A Framework for 21st Century Policy-Making. *PLoS Med* (2011) 8(5).
9. Wickramage K, Vearey J, Zwi AB, Robinson C, Knipper M. Migration and Health: A Global Public Health Research Priority. *BMC Public Health* (2018) 18(1):1-9.
10. World Health Organization. 62nd World Health Assembly. March 16 , 2019. Commission on Social Determinants, (2019).
11. Castañeda H, Holmes SM, Madrigal DS, Young M-ED, Beyeler N, Quesada J. Immigration as a Social Determinant of Health. *Annu Rev Public Health* (2015) 36:375-92.
12. Davies AA, Basten A, Frattini C. Migration: A Social Determinant of the Health of Migrants. *Eurohealth* (2009) 16(1):10-2.
13. Organization WH. World Report on the Health of Refugees and Migrants. (2022).
14. Davies AA, Blake C, Dhavan P. Social Determinants and Risk Factors for Non-Communicable Diseases (Ncds) in South Asian Migrant Populations in Europe. *Asia Europe Journal* (2011) 8(4):461-73.
15. Kirch W. *Encyclopedia of Public Health: Volume 1: A-H Volume 2: I-Z*: Springer Science & Business Media (2008).
16. Riosmena F, Kuhn R, Jochem WC. Explaining the Immigrant Health Advantage: Self-Selection and Protection in Health-Related Factors among Five Major National-Origin Immigrant Groups in the United States. *Demography* (2017) 54(1):175-200.
17. Markides KS, Rote S. The Healthy Immigrant Effect and Aging in the United States and Other Western Countries. *The Gerontologist* (2019) 59(2):205-14.
18. Krämer A, Fischer F. *Refugee Migration and Health: Challenges for Germany and Europe*: Springer (2018).
19. Spallek J, Zeeb H, Razum O. What Do We Have to Know from Migrants' Past Exposures to Understand Their Health Status? A Life Course Approach. *Emerging themes in epidemiology* (2011) 8(1):6.
20. Domnich A, Panatto D, Gasparini R, Amicizia D. The "Healthy Immigrant" Effect: Does It Exist in Europe Today? *Italian Journal of Public Health* (2012) 9(3).
21. Troncoso-Pantoja C, Martínez-Sanguinetti MA, Ulloa N, Celis-Morales C. La Mayoría De Las Enfermedades Cardiovasculares Se Atribuyen a Factores De Riesgo Que

Podrían Ser Modificados Con Cambios De Los Estilos De Vida. *Revista médica de Chile* (2020) 148(1):126-8.
22. Cabieses B, Pickett KE, Tunstall H. Comparing Sociodemographic Factors Associated with Disability between Immigrants and the Chilean-Born: Are There Different Stories to Tell? *International journal of environmental research and public health* (2012) 9(12):4403-32.
23. Cabieses B, Tunstall H, Pickett K. Testing the Latino Paradox in Latin America: A Population-Based Study of Intra-Regional Immigrants in Chile. (2013).
24. OIM. Tendencias Recientes De La Migración En Las Américas (2022). Available from: https://rosanjose.iom.int/sites/g/files/tmzbdl1446/files/documents/tendencias-recientes-de-la-migracion-en-las-americas_sp.pdf.
25. Migration Data Portal. Total Number of International Migrants at Mid-Year 2020 (2021). Available from: https://www.migrationdataportal.org/international-data?i=stock_abs_&t=2020&m=1.
26. BID. Flujos Migratorios En América Latina Y El Caribe (2021). Available from: https://publications.iadb.org/publications/spanish/document/Flujos-migratorios-en-America-Latina-y-el-Caribe-estadisticas-de-permisos-para-los-migrantes.pdf.
27. IOM. América Del Sur Estrategia Regional 2020-2024 (2021). Available from: https://publications.iom.int/es/node/2821.
28. BID. Https://Publications.Iadb.Org/Publications/Spanish/Viewer/La-Opinion-Publica-Hacia-La-Migracion-En-America-Latina-Y-El-Caribe.Pdf. (2023).
29. IOM. Centroamérica, Norteamérica Y El Caribe – Estrategia Regional 2020-2024. (2021).
30. IOM. Covid-19 and the State of Global Mobility in 2020 (2021). Available from: https://publications.iom.int/es/node/2662.
31. Larenas-Rosa D. Políticas Migratorias Y Protección De La Salud De La Población Migrante: Una Aproximación Al Escenario Normativo De América Latina. *SALUD Y MIGRACIONES*:21.
32. BID. Regímenes De Política Migratoria En América Latina Y El Caribe (2022). Available from: http://167.71.166.66/bitstream/handle/123456789/607/Regimenes-de-politica-migratoria-en-America-Latina-y-el-Caribe-inmigracion-libre-movilidad-regional-refugio-y-nacionalidad.pdf?sequence=1&isAllowed=y.
33. Castelli F, Tomasoni LR, El Hamad I. Migration and Chronic Noncommunicable Diseases: Is the Paradigm Shifting? *J Cardiovasc Med* (2014) 15(9):693-5.
34. WHO. Noncommunicable Diseases (2021). Available from: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases.
35. IOM. Non-Communicable Diseases and Migration (2017). Available from: https://www.iom.int/sites/g/files/tmzbdl486/files/our_work/DMM/Migration-Health/mhd_infosheet_ncds_10.09.2018.pdf.
36. Oyarte M, Cabieses B, Rada I, Blukacz A, Espinoza M, Mezones-Holguin E. Unequal Access and Use of Health Care Services among Settled Immigrants, Recent Immigrants, and Locals: A Comparative Analysis of a Nationally Representative Survey in Chile. *International Journal of Environmental Research and Public Health* (2022) 20(1):741.
37. Nicolao J. *Regional Migrants in Bahía Blanca, Argentina: Challenges in Social Rights Access*. Estudios fronterizos(2019).doi: 10.21670/ref.1903024.

38. Aith FMA, Forsyth C, Shikanai-Yasuda MA. *Chagas Disease and Healthcare Rights in the Bolivian Immigrant Community of São Paulo, Brazil*. Tropical Medicine and Infectious Disease(2020).doi: 10.3390/tropicalmed5020062.
39. Bojorquez-Chapela I, Flórez-García V, Calderón-Villarreal A, Fernández-Niño JA. *Health Policies for International Migrants: A Comparison between Mexico and Colombia*. Health Policy OPEN(2020). p. 100003.doi: 10.1016/j.hpopen.2020.100003.
40. Cabieses B, Chepo M, Obach A, Espinoza M. *Towards Universal Coverage for International Migrants in Chile: Accessibility and Acceptability Indicators from a Multi-Methods Study*. Medical Research Archives(2019).doi: 10.18103/mra.v7i1.1889.
41. Fouratt CE, Voorend K. *Esquivando Al Estado. Prácticas Privadas En El Uso De Los Servicios De Salud Entre Inmigrantes Nicaragüenses En Costa Rica*. Anuario de Estudios Centroamericanos(2019). p. 373-403.doi: 10.15517.
42. Restrepo J. Plan De Respuesta Del Sector Salud Al Fenómeno Migratorio. *Bogotá: Ministerio de Salud* (2018).
43. WHO. Social Determinants of Health (2021). Available from: https://www.who.int/health-topics/social-determinants-of-health#tab=tab_1.
44. Saeed A, Dixon D, Yang E. Racial Disparities in Hypertension Prevalence and Management. A Crisis Control. *American College of Cardiology* (2020).
45. Rosenthal T, Touyz RM, Oparil S. Migrating Populations and Health: Risk Factors for Cardiovascular Disease and Metabolic Syndrome. *Curr Hypertens Rep* (2022):1-16.
46. Ali SH, Islam NS, Commodore-Mensah Y, Yi SS. Implementing Hypertension Management Interventions in Immigrant Communities in the Us: A Narrative Review of Recent Developments and Suggestions for Programmatic Efforts. *Curr Hypertens Rep* (2021) 23(1):1-10.
47. Mills KT, Stefanescu A, He J. The Global Epidemiology of Hypertension. *Nature Reviews Nephrology* (2020) 16(4):223-37.
48. WHO. Hypertension (2021). Available from: https://www.who.int/news-room/fact-sheets/detail/hypertension.
49. Zhou B, Carrillo-Larco RM, Danaei G, Riley LM, Paciorek CJ, Stevens GA, et al. Worldwide Trends in Hypertension Prevalence and Progress in Treatment and Control from 1990 to 2019: A Pooled Analysis of 1201 Population-Representative Studies with 104 Million Participants. *The Lancet* (2021) 398(10304):957-80.
50. Singh Thakur J, Nangia R, Singh S. Progress and Challenges in Achieving Noncommunicable Diseases Targets for the Sustainable Development Goals. *FASEB BioAdvances* (2021) 3(8):563-8.
51. Bennett JE, Kontis V, Mathers CD, Guillot M, Rehm J, Chalkidou K, et al. Ncd Countdown 2030: Pathways to Achieving Sustainable Development Goal Target 3.4. *The Lancet* (2020) 396(10255):918-34.
52. Kruk ME, Gage AD, Arsenault C, Jordan K, Leslie HH, Roder-DeWan S, et al. High-Quality Health Systems in the Sustainable Development Goals Era: Time for a Revolution. *The Lancet global health* (2018) 6(11):e1196-e252.
53. Payton C, Kimball S, Ahrenholz NC, Wieland ML. Preventive Care and Management of Chronic Diseases in Immigrant Adults. *Prim Care* (2021) 48(1):83-97.
54. Agyemang C, van den Born B-J. Non-Communicable Diseases in Migrants: An Expert Review. *J Travel Med* (2019) 26(2):tay107.

55. OPS. Salud De Los Migrantes Internacionales - Estado De Salud: Enfermedades No Transmisibles (2022). Available from: https://www.paho.org/es/documentos/salud-migrantes-internacionales-estado-salud-enfermedades-no-transmisibles.
56. Sorlie PD, Allison MA, Avilés-Santa ML, Cai J, Daviglus ML, Howard AG, et al. Prevalence of Hypertension, Awareness, Treatment, and Control in the Hispanic Community Health Study/Study of Latinos. *Am J Hypertens* (2014) 27(6):793-800.
57. Guadamuz JS, Durazo-Arvizu RA, Daviglus ML, Calip GS, Nutescu EA, Qato DM. Citizenship Status and the Prevalence, Treatment, and Control of Cardiovascular Disease Risk Factors among Adults in the United States, 2011–2016. *Circ Cardiovasc Qual Outcomes* (2020) 13(3):e006215.
58. Camafort M, Alcocer L, Coca A, Lopez-Lopez J, López-Jaramillo P, Ponte-Negretti C, et al. Latin-American Ambulatory Blood Pressure Registry (Mapa-Latam): An Urgent Need. *Revista Clínica Española (English Edition)* (2021) 221(9):547-52.
59. Metz M, Pierre JL, Yan LD, Rouzier V, St-Preux S, Exantus S, et al. Hypertension Continuum of Care: Blood Pressure Screening, Diagnosis, Treatment, and Control in a Population-Based Cohort in Haiti. *The Journal of Clinical Hypertension* (2022) 24(3):246-54.
60. Rosenthal T. The Effect of Migration on Hypertension and Other Cardiovascular Risk Factors: A Review. *J Am Soc Hypertens* (2014) 8(3):171-91.
61. Leiva M, Correa ME, Ardiles L, Krall P. La Inmigración Haitiana En Chile: Un Desafío Para Los Programas De Salud Cardiovascular Y Renal. *Revista médica de Chile* (2018) 146(11):1361-2.
62. Fernández-Niño JA, Vásquez-Rodríguez AB, Flórez-García VA, Rojas-Botero ML, Luna-Orozco K, Navarro-Lechuga E, et al. Modos De Vida Y Estado De Salud De Migrantes En Un Asentamiento De Barranquilla, 2018. *Revista de Salud Pública* (2018) 20:530-8.
63. Ibarra JMM, Cano JRM, Álvarez ETM, Enríquez SXG. Perfil Epidemiológico De Los Migrantes Venezolanos Atendidos En Rumichaca, 2018. *Dilemas contemporáneos: Educación, Política y Valores* (2020).
64. Cubillos A, Ardón N. Realidades En La Salud De Las Poblaciones Migrantes: El Caso De Los Migrantes Venezolanos En El Contexto Colombiano. *JOSÉ KOECHLIN/JOAQUÍN EGUREN* (2018):97.
65. Bernabe-Ortiz A, Carrillo-Larco RM. Multimorbidity and Disability among Venezuelan Migrants: A Population-Based Survey in Peru. *Journal of immigrant and minority health* (2022) 24(5):1206-13.
66. Silva Y, Inciarte L, Rodríguez P. Prevalencia De Hipertensión Arterial En Adultos Jóvenes Inmigrantes. *Metro Ciencia* (2021) 29(suppl 2)):36-7.
67. Herring A, Bonilla R. Inmigrantes Nicaragüenses En Costa Rica: Estado Y Utilización De Servicios De Salud. *Población y Salud en Mesoamérica* (2009).
68. Sanchez-Nuñez FM, Fernández-Ortega MA, Dávila-Mendoza R, Ponce-Rosas ER, Luna-Téllez Y, Meléndez-Álvarez S. Factores De Riesgo a La Salud Durante El Proceso Migratorio En México. *Revista Cubana de Medicina General Integral* (2020) 36(4).
69. Razum O. Migrant Mortality, Healthy Migrant Effectmigrant Mortality, Healthy Migrant Effect. In: Kirch W, editor. *Encyclopedia of Public Health*. Dordrecht: Springer Netherlands (2008). p. 932-5.
70. Bacon E, Riosmena F, Rogers RG. Does the Hispanic Health Advantage Extend to Better Management of Hypertension? The Role of Socioeconomic Status, Sociobehavioral Factors, and Health Care Access. *Biodemography Soc Biol* (2017) 63(3):262-77.

71. Garcia C, Garcia MA, Ailshire JA. Sociocultural Variability in the Latino Population: Age Patterns and Differences in Morbidity among Older Us Adults. *Demographic research* (2018) 38:1605.
72. Commodore-Mensah Y, Matthie N, Wells J, Dunbar SB, Himmelfarb CD, Cooper LA, et al. African Americans, African Immigrants, and Afro-Caribbeans Differ in Social Determinants of Hypertension and Diabetes: Evidence from the National Health Interview Survey. *Journal of racial and ethnic health disparities* (2018) 5(5):995-1002.
73. Zavaleta-Abad RA, Campos-Uscanga Y. Health Effects after Migration and the Mediating Role of Acculturation and Family Cohesion. *Universidad y Salud* (2019) 21(3):261-9.
74. Hamilton TG. The Healthy Immigrant (Migrant) Effect: In Search of a Better Native-Born Comparison Group. *Soc Sci Res* (2015) 54:353-65.
75. Lu Y, Denier N, Wang JS-H, Kaushal N. Unhealthy Assimilation or Persistent Health Advantage? A Longitudinal Analysis of Immigrant Health in the United States. *Soc Sci Med* (2017) 195:105-14. doi: https://doi.org/10.1016/j.socscimed.2017.11.019.
76. Neira Orjuela F. Características Sociodemográficas Y De Salud De Los Mexicanos Y Los Migrantes Con Enfermedad Por Coronavirus (Covid-19) En México. *Notas de Población* (2021).
77. Cecchini S. Protección Social Universal En América Latina Y El Caribe. Textos Seleccionados 2006-2019. (2019).
78. Giovanella L, Vega R, Tejerina-Silva H, Acosta-Ramirez N, Parada-Lezcano M, Ríos G, et al. ¿ Es La Atención Primaria De Salud Integral Parte De La Respuesta a La Pandemia De Covid-19 En Latinoamérica? *Trabalho, Educação e Saúde* (2020) 19.
79. Abramo L, Cecchini S, Ullmann H. Enfrentar Las Desigualdades En Salud En América Latina: El Rol De La Protección Social. *Ciência & Saúde Coletiva* (2020) 25(5):1587-98.
80. Frenk J, Gómez-Dantés O. Health Systems in Latin America: The Search for Universal Health Coverage. *Arch Med Res* (2018) 49(2):79-83. doi: https://doi.org/10.1016/j.arcmed.2018.06.002.
81. Conill EM. Sistemas Universais Para a América Latina: Jovens E Antigas Inovações Nos Serviços De Saúde. *Revista Brasileira em Promoção da Saúde* (2018) 31(4).
82. Miettinen OS. Reflections on Preventive Medicine. *Prev Med* (2014) 67:313-5.
83. Campbell NRC, Paccot Burnens M, Whelton PK, Angell SY, Jaffe MG, Cohn J, et al. [2021 World Health Organization Guideline on Pharmacological Treatment of Hypertension: Policy Implications for the Region of the Americasdiretrizes De 2021 Da Organização Mundial Da Saúde Sobre O Tratamento Medicamentoso Da Hipertensão Arterial: Repercussões Para as Políticas Na Região Das Américas]. *Rev Panam Salud Publica* (2022) 46:e54. Epub 2022/05/17. doi: 10.26633/rpsp.2022.54.
84. Levesque J-F, Harris MF, Russell G. Patient-Centred Access to Health Care: Conceptualising Access at the Interface of Health Systems and Populations. *International journal for equity in health* (2013) 12(1):1-9.
85. Martin Y, Collet T-H, Bodenmann P, Blum MR, Zimmerli L, Gaspoz J-M, et al. The Lower Quality of Preventive Care among Forced Migrants in a Country with Universal Healthcare Coverage. *Prev Med* (2014) 59:19-24.
86. Gallego ÁC, Moreno B, López JA, Bernal OA. Situación De Salud En Población Migrante Atendida Por La Cruz Roja Colombiana, 2020. *Revista Avances en Salud* (2021) 5(2).

87. OPS. Salud De Los Migrantes Internacionales. Sistemas De Salud: Acceso a La Atención Médica. (2022).
88. O'Donnell CA, Burns N, Mair FS, Dowrick C, Clissmann C, van den Muijsenbergh M, et al. Reducing the Health Care Burden for Marginalised Migrants: The Potential Role for Primary Care in Europe. *Health Policy* (2016) 120(5):495-508.
89. Richter S, Vallianatos H, Green J, Obuekwe C. *Intersection of Migration and Access to Health Care: Experiences and Perceptions of Female Economic Migrants in Canada*. International Journal of Environmental Research and Public Health(2020).doi: 10.3390/ijerph17103682.
90. Odoch WD, Senkubuge F, Hongoro C. How Has Sustainable Development Goals Declaration Influenced Health Financing Reforms for Universal Health Coverage at the Country Level? A Scoping Review of Literature. *Globalization and health* (2021) 17(1):1-13.
91. Alcalá HE, Albert SL, Roby DH, Beckerman J, Champagne P, Brookmeyer R, et al. Access to Care and Cardiovascular Disease Prevention: A Cross-Sectional Study in 2 Latino Communities. *Medicine* (2015) 94(34).
92. Reckelhoff JF. Gender Differences in Hypertension. *Curr Opin Nephrol Hypertens* (2018) 27(3):176-81.
93. Públicas CUP. Segunda Consulta Nacional De Discriminación. (2021).
94. Thomas DS, Phillips BD, Fothergill A, Blinn-Pike L. *Social Vulnerability to Disasters*: CRC press (2009).
95. Nielsen SS, Hempler NF, Krasnik A. Issues to Consider When Measuring and Applying Socioeconomic Position Quantitatively in Immigrant Health Research. *International journal of environmental research and public health* (2013) 10(12):6354-65.
96. Cabieses B, Bernales M, Obach A, Pedrero V. Vulnerabilidad Social Y Su Efecto En Salud En Chile: Desde La Comprensión Del Fenómeno Hacia La Implementación De Soluciones. *Vulnerabilidad Social Y Su Efecto En Salud En Chile: Desde La Comprensión Del Fenómeno Hacia La Implementación De Soluciones*. (2016). p. 485-.
97. Glass DC, Kelsall HL, Slegers C, Forbes AB, Loff B, Zion D, et al. A Telephone Survey of Factors Affecting Willingness to Participate in Health Research Surveys. *BMC Public Health* (2015) 15:1017. Epub 2015/10/07. doi: 10.1186/s12889-015-2350-9.
98. Stefoni C, Bonhomme M. Una Vida En Chile Y Seguir Siendo Extranjeros. *Si somos americanos* (2014) 14(2):81-101.
99. Migrantes SJd. Casen Y Migración: Una Caracterización De La Pobreza, El Trabajo Y La Seguridad Social En La Población Migrante (2021) [Mayo 26 2022]. Available from: https://www.migracionenchile.cl/wp-content/uploads/2021/10/Informe-CASEN_compressed-2.pdf.
100. Rada I, Cabieses B. Reporte Situacional: El Caso De Migrantes Internacionales En Chile Durante La Pandemia De Covid-19 [Junio 3 2022]. Available from: https://migrationhealth.org/wp-content/uploads/2021/08/Lancet-Migration-Situational-brief-on-Chile-02-ES.pdf.
101. SJM. Avances Y Brechas En El Acceso a Salud De La Población Migrante Residente En Chile. (2022).
102. Correa-Betancour M, Pérez-González C. Caracterización De Las Consultas De La Población Migrante Adulta En Un Servicio De Urgencia Público Del Área Norte De Santiago De Chile Durante 2018. *Revista de Salud Pública* (2023) 22:658-65.

103. Kowal M, Coll-Martín T, Ikizer G, Rasmussen J, Eichel K, Studzińska A, et al. Who Is the Most Stressed During the Covid-19 Pandemic? Data from 26 Countries and Areas. *Applied Psychology: Health and Well-Being* (2020) 12(4):946-66.
104. Palomera-Chávez A, Herrero M, Carrasco Tápias NE, Juárez-Rodríguez P, Barrales Díaz CR, Hernández-Rivas MI, et al. Impacto Psicológico De La Pandemia Covid-19 En Cinco Países De Latinoamérica. *Revista Latinoamericana de Psicología* (2021) 53:83-93.
105. Mena GE, Martinez PP, Mahmud AS, Marquet PA, Buckee CO, Santillana M. Socioeconomic Status Determines Covid-19 Incidence and Related Mortality in Santiago, Chile. *Science* (2021) 372(6545).
106. Bilal U, Alfaro T, Vives A. Covid-19 and the Worsening of Health Inequities in Santiago, Chile. *Int J Epidemiol* (2021).
107. Freier LF, Vera Espinoza M. Covid-19 and Immigrants' Increased Exclusion: The Politics of Immigrant Integration in Chile and Peru. *Frontiers in Human Dynamics* (2021):6.
108. Jara-Labarthé V, Cisneros Puebla CA. Migrants in Chile: Social Crisis and the Pandemic (or Sailing over Troubled Water…). *Qualitative Social Work* (2021) 20(1-2):284-8.
109. Cuevas AG, Ong AD, Carvalho K, Ho T, Chan SWC, Allen JD, et al. Discrimination and Systemic Inflammation: A Critical Review and Synthesis. *Brain, behavior, and immunity* (2020) 89:465-79.
110. Yang PQ, Hwang SH. Explaining Immigrant Health Service Utilization: A Theoretical Framework. *SAGE Open* (2016) 6(2):2158244016648137. doi: 10.1177/2158244016648137.
111. CASEN. Inmigrantes Casen En Pandemia 2020 (Revisado Noviembre 2022) (2022). Available from: http://observatorio.ministeriodesarrollosocial.gob.cl/encuesta-casen-en-pandemia-2020.
112. Babuç ZT. A Relational Sociological Analysis on the Impact of Covid-19 Pandemic Lockdown on Syrian Migrants' Lives in Turkey: The Case of Mersin Province. *Journal of International Migration and Integration* (2022) 23(4):1645-66.
113. UNHCR. Update North of Chile, March 2022. (2022).
114. Stefoni C, Contreras D. Situación Migratoria En Chile: Tendencias Y Respuestas De Política En El Período 2000-2021. (2022).
115. OIM. The Determinants of Migrant Vulnerability Part 1 (2019). Available from: https://www.iom.int/sites/g/files/tmzbdl486/files/our_work/DMM/MPA/1-part1-thedomv.pdf.
116. MINSAL. Encuesta Nacional De Salud 2016-2017 (2017). Available from: https://www.minsal.cl/wp-content/uploads/2017/11/ENS-2016-17_PRIMEROS-RESULTADOS.pdf.
117. Siches I, Vega J, Chomalí M, Yarza B, Estay R, Goyenechea M, et al. El Impacto De Covid-19 En El Sistema De Salud Y Propuestas Para La Reactivación. *Colegio Médico de Chile: Santiago, Chile* (2020):48.
118. Chang S-W, Zitko P, Passi-Solar Á, Danaei G, Margozzini P. Changes in Cardiovascular Mortality in Chile During the Covid-19 Pandemic. *Heart* (2022) 108(21):1716-21.
119. Agar Corbinos L, Delgado I, Oyarte M, Cabieses B. Salud Y Migración: Análisis Descriptivo Comparativo De Los Egresos Hospitalarios De La Población Extranjera Y Chilena (Health and Migration: A Comparative Descriptive Analysis of Hospital Discharges in the Foreign and Chilean Populations). (2017).

120. Rada I, Oyarte M, Cabieses B. A Comparative Analysis of Health Status of International Migrants and Local Population in Chile: A Population-Based, Cross-Sectional Analysis from a Social Determinants of Health Perspective. *BMC Public Health* (2022) 22(1):1329. doi: 10.1186/s12889-022-13709-5.
121. Lê-Scherban F, Albrecht SS, Bertoni A, Kandula N, Mehta N, Roux AVD. Immigrant Status and Cardiovascular Risk over Time: Results from the Multi-Ethnic Study of Atherosclerosis. *Ann Epidemiol* (2016) 26(6):429-35. e1.
122. Fernández-Niño JA, Rojas-Botero ML, Bojorquez-Chapela I, Giraldo-Gartner V, Sobczyk RA, luis Acosta-Reyes J, et al. Situación De Salud De Gestantes Migrantes Venezolanas En El Caribe Colombiano: Primer Reporte Para Una Respuesta Rápida En Salud Pública. *Salud UIS* (2019) 51(3):208-19.
123. Tamez M, Ríos-Bedoya CF, Rodríguez-Orengo JF, Tucker KL, Mattei J. Sociodemographic and Lifestyle Factors, and Health Conditions of Dominican Adults Living in Puerto Rico. *Journal of immigrant and minority health* (2018) 20(5):1085-93.
124. Sharifi F, Shah BR. Cardiovascular Risk Factors and Events in Iranian Immigrants Versus Other Immigrants from the Middle East. *Journal of immigrant and minority health* (2019) 21(4):788-92.
125. Wirth LS, Tobo BB, Hinyard L, Vaughn MG. Foreign-Born Blacks No Different from Whites for Odds of Stroke. *J Epidemiol Community Health* (2017) 71(8):786-93.
126. Fedeli U, Cestari L, Ferroni E, Avossa F, Saugo M, Modesti PA. Ethnic Inequalities in Acute Myocardial Infarction Hospitalization Rates among Young and Middle-Aged Adults in Northern Italy: High Risk for South Asians. *Intern Emerg Med* (2018) 13(2):177-82.
127. Fedeli U, Avossa F, Ferroni E, Schievano E, Bilato C, Modesti PA, et al. Diverging Patterns of Cardiovascular Diseases across Immigrant Groups in Northern Italy. *Int J Cardiol* (2018) 254:362-7.
128. Solar O, Irwin A. A Conceptual Framework for Action on the Social Determinants of Health. WHO Document Production Services, (2010).
129. O'Neil A, Scovelle AJ, Milner AJ, Kavanagh A. Gender/Sex as a Social Determinant of Cardiovascular Risk. *Circulation* (2018) 137(8):854-64.
130. Fang J, Yuan K, Gindi RM, Ward BW, Ayala C, Loustalot F. Association of Birthplace and Coronary Heart Disease and Stroke among Us Adults: National Health Interview Survey, 2006 to 2014. *Journal of the American Heart Association* (2018) 7(7):e008153.
131. Van Oeffelen AA, Vaartjes I, Stronks K, Bots ML, Agyemang C. Sex Disparities in Acute Myocardial Infarction Incidence: Do Ethnic Minority Groups Differ from the Majority Population? *European journal of preventive cardiology* (2015) 22(2):180-8.
132. Russo V, Santarelli S, Magrini L, Moscatelli P, Altomonte F, Cremonesi G, et al. Multicentre Italian Analysis on Cardiovascular Diseases: Impact of Immigrants' Referral to Emergency Department. *J Cardiovasc Med* (2017) 18(3):136-43.
133. Dhingra R, Vasan RS. Age as a Risk Factor. *Medical Clinics* (2012) 96(1):87-91.
134. Cainzos-Achirica M, Vela E, Cleries M, Bilal U, Mauri J, Pueyo MJ, et al. Cardiovascular Risk Factors and Disease among Non-European Immigrants Living in Catalonia. *Heart* (2019) 105(15):1168-74.
135. Reuven Y, Shvartzman P, Dreiher J. Cardiovascular Disease and Hospital Admissions in African Immigrants and Former Soviet Union Immigrants: A Retrospective Cohort Study. *Int J Cardiol* (2019) 296:172-6.

136. Muncan B. Cardiovascular Disease in Racial/Ethnic Minority Populations: Illness Burden and Overview of Community-Based Interventions. *Public Health Rev* (2018) 39(1):1-11.
137. Bays HE. Ten Things to Know About Ten Cardiovascular Disease Risk Factors ("Aspc Top Ten–2020"). *American Journal of Preventive Cardiology* (2020):100003.
138. Raza Q, Nicolaou M, Dijkshoorn H, Seidell JC. Comparison of General Health Status, Myocardial Infarction, Obesity, Diabetes, and Fruit and Vegetable Intake between Immigrant Pakistani Population in the Netherlands and the Local Amsterdam Population. *Ethn Health* (2017) 22(6):551-64.
139. Mensah GA. Socioeconomic Status and Heart Health—Time to Tackle the Gradient. *JAMA Cardiology* (2020).
140. Cabieses B, Bird P. Glossary of Access to Health Care and Related Concepts for Low- and Middle-Income Countries (Lmics): A Critical Review of International Literature. *Int J Health Serv* (2014) 44(4):845-61.
141. Cabieses B, Blukacz A. Reforzar El Acceso a La Salud En El Contexto De Covid-19 En Migrantes Recién Llegados a Chile. *Revista Chilena de Salud Pública* (2020) 24(2):166-.
142. Gulliford M, Figueroa-Munoz J, Morgan M, Hughes D, Gibson B, Beech R, et al. What Does' Access to Health Care'mean? *J Health Serv Res Policy* (2002) 7(3):186-8.
143. Vega CVZ, Campos MCG. Discriminación Y Exclusión Hacia Migrantes En El Sistema De Salud Chileno. Una Revisión Sistematizada. *Salud & Sociedad* (2019) 10(2):188-204.
144. Martínez CL, Pino BDA, García AFB, Acevedo VAB, Silva DRC, Ojeda IAM. Acceso Y Conocimiento De Inmigrantes Haitianos Sobre La Atención Primaria De Salud Chilena. *Benessere Revista de Enfermería* (2020) 5(1).
145. Bernales M, Cabieses B, McIntyre AM, Chepo M. Challenges in Primary Health Care for International Migrants: The Case of Chile. *Aten Primaria* (2017) 49(6):370-1.
146. Sadarangani TR, Trinh-Shevrin C, Chyun D, Yu G, Kovner C. Cardiovascular Risk in Middle-Aged and Older Immigrants: Exploring Residency Period and Health Insurance Coverage. *J Nurs Scholarsh* (2019) 51(3):326-36.
147. Schultz WM, Kelli HM, Lisko JC, Varghese T, Shen J, Sandesara P, et al. Socioeconomic Status and Cardiovascular Outcomes: Challenges and Interventions. *Circulation* (2018) 137(20):2166-78.
148. Lo CC, Adame JL, Cheng TC. Explaining Chronic Illness and Self-Rated Health among Immigrants of Five Hispanic Ethnicities. *Journal of Racial and Ethnic Health Disparities* (2020) 7(1):177-91.
149. Okrainec K, Bell CM, Hollands S, Booth GL. Risk of Cardiovascular Events and Mortality among a Population-Based Cohort of Immigrants and Long-Term Residents with Diabetes: Are All Immigrants Healthier and If So, for How Long? *Am Heart J* (2015) 170(1):123-32.
150. Pierola MD, Rodríguez Chatruc M, editors. Migrants in Latin America: Disparities in Health Status and in Access to Healthcare. 2020: Inter-American Development Bank.
151. Bernales M, Cabieses B, McIntyre AM, Chepo M. Desafíos En La Atención Sanitaria De Migrantes Internacionales En Chile. *Rev Peru Med Exp Salud Publica* (2017) 34:167-75.
152. Passi-Solar Á, Margozzini P, Mindell JS, Ruiz M, Valencia-Hernandez CA, Scholes S. Hypertension Care Cascade in Chile: A Serial Cross-Sectional Study of National Health Surveys 2003-2010-2017. *BMC Public Health* (2020) 20(1):1-11.

153. OPS. Chile, Donde Las Medidas Contra La Hipertensión Salvan Vidas (2021). Available from: https://www.paho.org/es/noticias/25-8-2021-chile-donde-medidas-contra-hipertension-salvan-vidas.
154. La Tercera. Más De Medio Millón De Nuevos Diabéticos En Chile: Médicos Advierten Explosiva Alza Por La Pandemia (2022). Available from: https://www.latercera.com/que-pasa/noticia/mas-de-medio-millon-de-nuevos-diabeticos-en-chile-medicos-advierten-explosiva-alza-por-la-pandemia/BWOORKT6LJABRO2EYIJJX2UG6M/.
155. Rubino F, McIntyre R, Chai Z, Amiel S, Alberti G, Bornstein S, et al. New-Onset Diabetes and Covid-19: Evidence from a Global Clinical Registry. (2023).
156. Mendoza W, Miranda JJ, Mendoza W, Miranda JJ. *La Inmigración Venezolana En El Perú: Desafíos Y Oportunidades Desde La Perspectiva De La Salud*. Rev Peru Med Exp Salud Publica(2019). p. 497-503.doi: 10.17843/rpmesp.2019.363.4729.
157. Di Giuseppe G, Chu A, Tu JV, Shanmugasegaram S, Liu P, Lee DS. Incidence of Heart Failure among Immigrants to Ontario, Canada: A Canheart Immigrant Study. *J Card Fail* (2019) 25(6):425-35.
158. Tu JV, Chu A, Rezai MR, Guo H, Maclagan LC, Austin PC, et al. Incidence of Major Cardiovascular Events in Immigrants to Ontario, Canada: The Canheart Immigrant Study. *Circulation* (2015) 132(16):1549-59.
159. Beltrán-Sánchez H, Palloni A, Riosmena F, Wong R. Ses Gradients among Mexicans in the United States and in Mexico: A New Twist to the Hispanic Paradox? *Demography* (2016) 53(5):1555-81.
160. Cohn T, Miller A, Fogg L, Braun LT, Coke L. Impact of Individual and Neighborhood Factors on Cardiovascular Risk in White Hispanic and Non-Hispanic Women and Men. *Res Nurs Health* (2017) 40(2):120-31.
161. Essilfie G, Shavelle DM, Tun H, Platt K, Kobayashi R, Mehra A, et al. Association of Elevated Triglycerides and Acute Myocardial Infarction in Young Hispanics. *Cardiovasc Revasc Med* (2016) 17(8):510-4.
162. Nokes B, Sim Y, Gibson B, Byreddy S, Labiner DM, Coull B, et al. Assessment of Stroke Risk in Southern Arizona, the Pairing of Acculturation and Stroke Risk Factor Development. *Journal of immigrant and minority health* (2015) 17(2):513-8.
163. Snijder MB, Galenkamp H, Prins M, Derks EM, Peters RJ, Zwinderman AH, et al. Cohort Profile: The Healthy Life in an Urban Setting (Helius) Study in Amsterdam, the Netherlands. *BMJ open* (2017) 7(12).
164. Marshall GN, Schell TL, Wong EC, Berthold SM, Hambarsoomian K, Elliott MN, et al. Diabetes and Cardiovascular Disease Risk in Cambodian Refugees. *Journal of immigrant and minority health* (2016) 18(1):110-7.
165. Modesti PA, Castellani S, Calabrese M, Malandrino D, Zhao D. Comparison of Type 2 Diabetes Prevalence in Chinese Migrants Vs Caucasians and New Perspectives for Screening of Cerebrovascular Disease in Chinese: A Proof of Concept Study. *Diabetes Res Clin Pract* (2017) 130:196-203.
166. Minneboo M, Lachman S, Snijder M, Vehmeijer J, Jørstad H, Peters R. Risk Factor Control in Secondary Prevention of Cardiovascular Disease: Results from the Multi-Ethnic Helius Study. *Neth Heart J* (2017) 25(4):250-7.
167. Gupta S, Aroni R, Lockwood S, Jayasuriya I, Teede H. South Asians and Anglo Australians with Heart Disease in Australia. *Aust Health Rev* (2015) 39(5):568-76.

168. Mahadevan M, Bose M, Gawron KM, Blumberg R, editors. Metabolic Syndrome and Chronic Disease Risk in South Asian Immigrants: A Review of Prevalence, Factors, and Interventions. *Healthcare*; 2023: MDPI.
169. Commodore-Mensah Y, Sampah M, Berko C, Cudjoe J, Abu-Bonsrah N, Obisesan O, et al. The Afro-Cardiac Study: Cardiovascular Disease Risk and Acculturation in West African Immigrants in the United States: Rationale and Study Design. *Journal of immigrant and minority health* (2016) 18(6):1301-8.
170. Fernandez R, Rolley JX, Rajaratnam R, Sundar S, Patel NC, Davidson PM. Risk Factors for Coronary Heart Disease among Asian Indians Living in Australia. *J Transcult Nurs* (2015) 26(1):57-63.
171. de Back TR, Bodewes AJ, Brewster LM, Kunst AE. Cardiovascular Health and Related Health Care Use of Moluccan-Dutch Immigrants. *PLoS One* (2015) 10(9).
172. Lindberg NM, Vega-López S, LeBlanc ES, Leo MC, Stevens VJ, Gille S, et al. High Prevalence of Undiagnosed Hyperglycemia in Low-Income Overweight and Obese Hispanic Women in Oregon. *Journal of racial and ethnic health disparities* (2019) 6(4):799-805.
173. Humphries K, Izadnegadar M, Sedlak T, Saw J, Johnston N, Schenck-Gustafsson K, et al. Sex Differences in Cardiovascular Disease–Impact on Care and Outcomes. *Front Neuroendocrinol* (2017) 46:46.
174. Snijder MB, Agyemang C, Peters RJ, Stronks K, Ujcic-Voortman JK, van Valkengoed IG. Case Finding and Medical Treatment of Type 2 Diabetes among Different Ethnic Minority Groups: The Helius Study. *Journal of diabetes research* (2017) 2017.
175. Gany F, Bari S, Gill P, Ramirez J, Ayash C, Loeb R, et al. Step on It! Workplace Cardiovascular Risk Assessment of New York City Yellow Taxi Drivers. *Journal of immigrant and minority health* (2016) 18(1):118-34.
176. López-Cevallos DF, Escutia G, González-Peña Y, Garside LI. Cardiovascular Disease Risk Factors among Latino Farmworkers in Oregon. *Ann Epidemiol* (2019) 40:8-12. e1.
177. Sewali B, Harcourt N, Everson-Rose SA, Leduc RE, Osman S, Allen ML, et al. Prevalence of Cardiovascular Risk Factors across Six African Immigrant Groups in Minnesota. *BMC Public Health* (2015) 15(1):411.
178. Ingaramo RA. Obesity, Diabetes, and Other Cardiovascular Risk Factors in Native Populations of South America. *Curr Hypertens Rep* (2016) 18(1):9.
179. Statistics NCfH. Health, United States, 2015: With Special Feature on Racial and Ethnic Health Disparities. (2016).
180. Havranek EP, Mujahid MS, Barr DA, Blair IV, Cohen MS, Cruz-Flores S, et al. Social Determinants of Risk and Outcomes for Cardiovascular Disease: A Scientific Statement from the American Heart Association. *Circulation* (2015) 132(9):873-98.
181. Choi M, Mesa-Frias M, Nüesch E, Hargreaves J, Prieto-Merino D, Bowling A, et al. Social Capital, Mortality, Cardiovascular Events and Cancer: A Systematic Review of Prospective Studies. *Int J Epidemiol* (2014) 43(6):1895-920.
182. Klöfvermark J, Hjern A, Juárez SP. Acculturation or Unequal Assimilation? Smoking During Pregnancy and Duration of Residence among Migrants in Sweden. *SSM-population health* (2019) 8:100416.
183. Hombrados-Mendieta I, Millán-Franco M, Gómez-Jacinto L, Gonzalez-Castro F, Martos-Méndez MJ, García-Cid A. Positive Influences of Social Support on Sense of Community, Life Satisfaction and the Health of Immigrants in Spain. *Front Psychol* (2019) 10.

184. Commodore-Mensah Y, Ukonu N, Cooper LA, Agyemang C, Himmelfarb CD. The Association between Acculturation and Cardiovascular Disease Risk in Ghanaian and Nigerian-Born African Immigrants in the United States: The Afro-Cardiac Study. *Journal of immigrant and minority health* (2018) 20(5):1137-46.
185. Obiang-Obounou BW. The Length of Residence Is Associated with Cardiovascular Disease Risk Factors among Foreign-English Teachers in Korea. *Behavioral Sciences* (2018) 8(1):2.
186. Shah SM, Loney T, Sheek-Hussein M, El Sadig M, Al Dhaheri S, El Barazi I, et al. Hypertension Prevalence, Awareness, Treatment, and Control, in Male South Asian Immigrants in the United Arab Emirates: A Cross-Sectional Study. *BMC Cardiovasc Disord* (2015) 15(1):30.
187. Gushulak BD, MacPherson DW. Health Aspects of the Pre-Departure Phase of Migration. *PLoS Med* (2011) 8(5).
188. Barbosa EC, Ramirez A, Beaney T, Kobeissi E, Lopez-Jaramillo P, Hernánez-Hernández R, et al. May Measurement Month 2017: Latin America. *J Hypertens* (2020) 38(6):1183-8.
189. OPS. Enlace: Portal De Datos Sobre Enfermedades No Transmisibles, Salud Mental, Y Causas Externas Hipertension (2019). Available from: https://www.paho.org/es/enlace/hipertension.
190. Roa AC. Sistema De Salud En Venezuela:¿ Un Paciente Sin Remedio? *Cad Saude Publica* (2018) 34:e00058517.
191. Calahorrano AZ, Fernández E. Diabetes Mellitus Tipo 2 En El Ecuador: Revisión Epidemiológica. *Mediciencias UTA* (2018) 2(4):3-9.
192. SENDA. Décimo Cuarto Estudio Nacional De Drogas En Población General De Chile, 2020 (2021). Available from: https://www.senda.gob.cl/wp-content/uploads/2022/01/Estudio-PG2020.pdf.
193. Clinica las Condes. Consumo De Tabaco Y Alcohol Aumenta Durante La Cuarentena (2020). Available from: https://www.clinicalascondes.cl/BLOG/Listado/coronavirus/consumo-tabaco-cuarentena.
194. Arancibia M, Rojo A. Covid-19 Y Consumo De Sustancias: Revisión Narrativa De La Evidencia Disponible. *Rev Chil Neuropsiquiatr* (2021) 59(2):142-51.
195. Teh WL, Abdin E, PV A, Siva Kumar FD, Roystonn K, Wang P, et al. Measuring Social Desirability Bias in a Multi-Ethnic Cohort Sample: Its Relationship with Self-Reported Physical Activity, Dietary Habits, and Factor Structure. *BMC Public Health* (2023) 23(1):1-10.
196. Ramos MR, Jiménez MdLM. Cambios En Los Estilos De Vida Durante El Confinamiento Por Covid-19. *CIENCIA ergo-sum* (2021) 28(4).
197. Ministerio del Deporte de Chile. Aplicación De Encuesta Nacional De Hábitos De Actividad Física Y Deporte Para La Población De 5 Años Y Más (2021). Available from: https://biblioteca.digital.gob.cl/bitstream/handle/123456789/3872/45159_informe_ejecutivo_enhaf_2021.pdf?sequence=1&isAllowed=y.
198. Pye C, Sutherland S, Martín PS. Consumo De Frutas, Verduras Y Legumbres En Adultos De Santiago Oriente, Chile:¿ Ha Influido El Confinamiento Por Covid-19? *Revista chilena de nutrición* (2021) 48(3):374-80.
199. Ford ND, Narayan KV, Mehta NK. Diabetes among Us-and Foreign-Born Blacks in the USA. *Ethn Health* (2016) 21(1):71-84.

200. Kuerban A. Healthy Migrant Effect on Smoking Behavior among Asian Immigrants in the United States. *Journal of immigrant and minority health* (2016) 18(1):94-101.
201. Parackal S, Stewart J, Ho E. Exploring Reasons for Ethnic Disparities in Diet-and Lifestyle-Related Chronic Disease for Asian Sub-Groups in New Zealand: A Scoping Exercise. *Ethn Health* (2017) 22(4):333-47.
202. El Masri A, Kolt GS, Astell-Burt T, George ES. Lifestyle Behaviours of Lebanese-Australians: Cross-Sectional Findings from the 45 and up Study. *PLoS One* (2017) 12(7):e0181217.
203. Fleischer NL, Ro A, Bostean G. Smoking Selectivity among Mexican Immigrants to the United States Using Binational Data, 1999–2012. *Prev Med* (2017) 97:26-32.
204. McEvoy JW, Blaha MJ, DeFilippis AP, Lima JA, Bluemke DA, Hundley WG, et al. Cigarette Smoking and Cardiovascular Events: Role of Inflammation and Subclinical Atherosclerosis from the Multiethnic Study of Atherosclerosis. *Arteriosclerosis, thrombosis, and vascular biology* (2015) 35(3):700-9.
205. Yusuf S, Joseph P, Rangarajan S, Islam S, Mente A, Hystad P, et al. Modifiable Risk Factors, Cardiovascular Disease, and Mortality in 155 722 Individuals from 21 High-Income, Middle-Income, and Low-Income Countries (Pure): A Prospective Cohort Study. *The Lancet* (2020) 395(10226):795-808.
206. Fernández-Solà J. Cardiovascular Risks and Benefits of Moderate and Heavy Alcohol Consumption. *Nature Reviews Cardiology* (2015) 12(10):576-87.
207. Payán DD, Perez-Lua F, Goldman-Mellor S, Young M-EDT. Rural Household Food Insecurity among Latino Immigrants During the Covid-19 Pandemic. *Nutrients* (2022) 14(13):2772.
208. Gobierno de Chile. Presidente Piñera Pone En Marcha Plan "Alimentos Para Chile" Para 2,5 Millones De Hogares: "Comprendemos La Necesidad Y Urgencia De Este Programa" (2020). Available from: https://prensa.presidencia.cl/comunicado.aspx?id=151457.
209. Hun N, Urzúa A, López Espinoza A, Mora A, Rodríguez Martínez T, López Á, et al. Calidad Global De La Alimentación En La Poblacion Migrante Residente En Chile. *Nutr Hosp* (2021) 38(6):1232-7.
210. Feller C, Alvarado P, Doña C, García I. Actividad Física Y Deporte En La Población Migrante En Chile. *Cuad Méd Soc (Chile)* (2018) 58(4).
211. OPS. Enlace: Data Portal on Noncommunicable Diseases, Mental Health, and External Causes Alcohol Consumption. (2019).
212. Miranda JMG. Determinantes Del Consumo De Alcohol: Una Aproximación Empírica Para Bolivia–2017. *Cuadernos del CIMBAGE* (2019) 2(21):145-72.
213. Marcelin LH, Vivian J, DiClemente R, Shultz J, Page JB. Trends in Alcohol, Drug and Cigarette Use among Haitian Youth in Miami-Dade County, Florida. *J Ethn Subst Abuse* (2005) 4(1):105-31.
214. Stang Alva F, Lara Edwards A, Andrade Moreno M. Retórica Humanitaria Y Expulsabilidad: Migrantes Haitianos Y Gobernabilidad Migratoria En Chile. *Si somos americanos* (2020) 20(1):176-201.
215. Shaghaghi A, Bhopal RS, Sheikh A. Approaches to Recruiting 'Hard-to-Reach'populations into Research: A Review of the Literature. *Health promotion perspectives* (2011) 1(2):86.

216. Tyldum G. Surveying Migrant Populations with Respondent-Driven Sampling. Experiences from Surveys of East-West Migration in Europe. *International Journal of Social Research Methodology* (2020):1-13.
217. Faugier J, Sargeant M. Sampling Hard to Reach Populations. *Journal of advanced nursing* (1997) 26(4):790-7.
218. Stormacq C, Van den Broucke S, Wosinski J. Does Health Literacy Mediate the Relationship between Socioeconomic Status and Health Disparities? Integrative Review. *Health promotion international* (2019) 34(5):e1-e17.
219. BCN. Reportes Comunales | 2020 (2020). Available from: https://www.bcn.cl/siit/reportescomunales/comunal.html?unidad=Comunales&anno=2020.
220. Al-Dahir S, Brakta F, Khalil A, Benrahla M, Jack Jr L, Kennedy K. The Impact of Acculturation on Diabetes Risk among Arab Americans in Southeastern Louisiana. *Journal of Health Care for the Poor and Underserved* (2013) 24(1):47-63.
221. Volz E, Heckathorn DD. Probability Based Estimation Theory for Respondent Driven Sampling. *Journal of official statistics* (2008) 24(1):79.
222. Organization WH. Introduction to Hiv/Aids and Sexually Transmitted Infection Surveillance: Module 4: Introduction to Respondent-Driven Sampling. (2013).
223. Obisesan O, Kuo W-H, Brunet M, Obisesan A, Akinola O, Commodore-Mensah Y. Predictors of Obesity among Nigerian Immigrants in the United States. *Journal of immigrant and minority health* (2017) 19(2):328-32.
224. Saberi P. Research in the Time of Coronavirus: Continuing Ongoing Studies in the Midst of the Covid-19 Pandemic. *AIDS and Behavior* (2020):1-4.
225. Deakin H, Wakefield K. Skype Interviewing: Reflections of Two Phd Researchers. *Qualitative research* (2014) 14(5):603-16.
226. Commodore-Mensah Y, Hill M, Allen J, Cooper LA, Blumenthal R, Agyemang C, et al. Sex Differences in Cardiovascular Disease Risk of Ghanaian-and Nigerian-Born West African Immigrants in the United States: The Afro-Cardiac Study. *Journal of the American Heart Association* (2016) 5(2):e002385.
227. Hernandez R, Carnethon M, Giachello AL, Penedo FJ, Wu D, Birnbaum-Weitzman O, et al. Structural Social Support and Cardiovascular Disease Risk Factors in Hispanic/Latino Adults with Diabetes: Results from the Hispanic Community Health Study/Study of Latinos (Hchs/Sol). *Ethn Health* (2018) 23(7):737-51.
228. Linares JD, Jackson II LR, Dawood FZ, Swett K, Benjamin EJ, Schneiderman N, et al. Prevalence of Atrial Fibrillation and Association with Clinical, Sociocultural, and Ancestral Correlates among Hispanic/Latinos: The Hispanic Community Health Study/Study of Latinos. *Heart Rhythm* (2019) 16(5):686-93.
229. Thomas K, Nilsson E, Festin K, Henriksson P, Lowén M, Löf M, et al. Associations of Psychosocial Factors with Multiple Health Behaviors: A Population-Based Study of Middle-Aged Men and Women. *International journal of environmental research and public health* (2020) 17(4):1239.
230. Mitchell PH, Powell L, Blumenthal J, Norten J, Ironson G, Pitula CR, et al. A Short Social Support Measure for Patients Recovering from Myocardial Infarction: The Enrichd Social Support Inventory. *J Cardiopulm Rehabil Prev* (2003) 23(6):398-403.
231. Bucholz EM, Strait KM, Dreyer RP, Geda M, Spatz ES, Bueno H, et al. Effect of Low Perceived Social Support on Health Outcomes in Young Patients with Acute Myocardial Infarction: Results from the Variation in Recovery: Role of Gender on Outcomes

of Young Ami Patients (Virgo) Study. *Journal of the American Heart Association* (2014) 3(5):e001252.
232. Witt D, Benson G, Campbell S, Sillah A, Berra K. Measures of Patient Activation and Social Support in a Peer-Led Support Network for Women with Cardiovascular Disease. *J Cardiopulm Rehabil Prev* (2016) 36(6):430-7.
233. Al-Amer R, Ramjan L, Glew P, Randall S, Salamonson Y. Self-Efficacy, Depression, and Self-Care Activities in Adult Jordanians with Type 2 Diabetes: The Role of Illness Perception. *Issues Ment Health Nurs* (2016) 37(10):744-55.
234. Katoh Y, Ota A, Yatsuya H, Li Y, Naito H, Fujisawa A, et al. Functional Capacity, Self-Rated Health Status, and Psychosocial Characteristics of Employed Cancer Survivors in Japan. *Fujita Medical Journal* (2017) 3(3):55-61.
235. Lagisetty PA, Wen M, Choi H, Heisler M, Kanaya AM, Kandula NR. Neighborhood Social Cohesion and Prevalence of Hypertension and Diabetes in a South Asian Population. *Journal of immigrant and minority health* (2016) 18(6):1309-16.
236. Needham BL, Mukherjee B, Bagchi P, Kim C, Mukherjea A, Kandula NR, et al. Acculturation Strategies and Symptoms of Depression: The Mediators of Atherosclerosis in South Asians Living in America (Masala) Study. *Journal of immigrant and minority health* (2018) 20(4):792-8.
237. Turkson-Ocran R-AN, Commodore-Mensah Y, Amadi OA. Impact of Social Support and Stress on Blood Pressure among West African Immigrants. (2017).
238. Vaglio J, Conard M, Poston WS, O'Keefe J, Haddock CK, House J, et al. Testing the Performance of the Enrichd Social Support Instrument in Cardiac Patients. *Health and quality of life outcomes* (2004) 2(1):1-5.
239. Vincens N, Emmelin M, Stafström M. Social Capital, Income Inequality and the Social Gradient in Self-Rated Health in Latin America: A Fixed Effects Analysis. *Soc Sci Med* (2018) 196:115-22.