

# 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

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## Research Article

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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 (HME) on health status but 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 of health (SDH).

**Methods:** We analyzed data from the Chilean National Socioeconomic Characterization Survey (CASEN, version 2017). Crude 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. The association between these outcomes and demographic, socioeconomic, access to health care, psychosocial and migratory related factors were tested using multivariate logistic regression in each population. The HME was also tested using multivariate logistic regression, sequentially adjusted for each set of SDH to obtain the odds ratio of presenting each health outcome if being an international migrant (ref=Chilean).

**Results:** International migrants had lower crude prevalence of all health indicators than Chileans. Age, unemployment and health care system affiliation were associated with health outcomes in both populations. Psychosocial determinants were both risk and protective factors. Crude analysis revealed an apparent HME in all 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 conditions, HME disappeared after adjusting by SDH, particularly unemployment, type of health system and psychosocial factors.

**Conclusions:** Testing the HME in Chile reveals 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 factors. As well as differential exposures faced during migration process that could dissolve the HME over time. Evidence from this integrative approach is useful for informed health planning and intersectoral local and regional solutions.

## Background

International migration is a complex process of voluntary or involuntary human mobility (1). Globally, in 2020 it was estimated that approximately 3.6% of world's population were international migrants (2). In Latin America, one of the main migratory flows throughout the last decades has been intraregional migration, often known as south-south migration (3). Among the countries in the region, Chile has experienced a steady increase of international migration, current estimations from the National Institute of Statistics reported 1.462.103 international migrants at the end of 2020, reaching 8% of the total population. Estimations of sex distribution described a slightly higher proportion of migrant men (50.9%), almost half of migrants were aged 25-35 years old and the majority came from countries within the region such as Venezuela, Perú, Haiti, Colombia and Bolivia (4). Previous evidence has highlighted the heterogeneity of this population, whose demographic and socioeconomic characteristics not only differ from Chilean population, but also within migrant groups (5). This variability is particularly important, since diverse exposures during migration process might have effects on health and wellbeing (6, 7). Furthermore, migration itself has been recognized as a social determinant of health, given the potential influence of certain migration circumstances on health risks (8), which makes the relationship between migration and health a public health priority (6).

The health of international migrants residing in Chile has been previously explored. Some evidence has suggested a health advantage over native population called "healthy migrant effect" (HME). This phenomenon postulates that migrants have better health outcomes (morbidity, mortality) when compared to the host population (9). Explanatory models have proposed a positive selection where migrants are self-selected when they feel capable to face the migratory process (10). For example, selection applies on those who are younger and those with labor market skills (11). Other explanation is based on healthy behaviors preserved during migration process, which could be enhanced with favorable life conditions at the destination country (12). Moreover, psychosocial resources like social support and social cohesion may be protective for positive reinforcement of healthy behaviors (13, 14), stress management and disease risk prevention (15).

In Chile, evidence from population-based studies have reported the probable existence of the HME on crude health indicators, such as disability (16, 17), illness, accidents and chronic health conditions (17). As well as hospital discharges rates, particularly, migrants had lower proportion of infectious diseases, metabolic disorders, mental health conditions and cardiorespiratory diseases, among others (18). Recent studies have also observed this advantage on emergency consultations of migrants residing in the northern area of the capital of Chile. For instance, migrants had lower hospitalization rates and were not affected by severe clinical conditions (19). Meanwhile, Peruvian mothers living in Santiago have also shown an advantage on perinatal outcomes over native Chilean mothers (20). Interestingly, migrants living in diverse cities of Chile showed a healthier behavior, since migrants reported regular physical activity, which in turn promotes their integration and increases their psychosocial resources (21).

Among the above-mentioned evidence, some authors have tested the apparent healthy migrant effect from the perspective of social determinants of health (SDH), which refers to "*the conditions in which people are born, grow, work, live and age, and the wider set of forces and systems shaping the conditions of daily life*" (22). For example, after the adjustment for socioeconomic determinants, the crude advantage seen on disability, any health problem, any chronic condition or cancer disappeared. Similarly, determinants of migration process also had an influence over time, it seems that longer residence duration in Chile dissolves the healthy migrant effect (17). Likewise, it has been 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 and diverse exposures during migration could challenge the health of international migrants, considering that some migrant groups face structural vulnerability (23). Literature describes SDH that influence the health of international migrants, including: i) economic disadvantage and poor living conditions; ii) the effect of educational level on health literacy and behavioral decisions; iii) public policies and migratory laws acting either as facilitator or limiter (24); iv) psychosocial determinants that could also promote risk according to migration circumstances and interaction with host society. The lack or imbalance of psychosocial resources such as

social support and limited social network have negative impact on health outcomes (15); v) access to health care often mediated by migratory status and sociocultural barriers (24). Noteworthy, migrant population in Chile are more likely to be uninsured and have less use of healthcare system than local population (25). International literature has suggested that lower access to healthcare might lead to the under-report of medical conditions in migrants, raising questions around its influence on HME analysis (26). Overall, the social determinants of health approach go beyond merely crude comparisons and comprehensively explores its modulation on HME.

Currently there is a paucity of evidence testing the healthy migrant effect on 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 migration process. The migrant population in Chile has changed over time while became increasingly heterogeneous, which points out the need of an update analysis of HME under the social determinants of health approach. This would help to develop a broad understanding of the complexity of migration and health, and its implications on Chilean public health. The present study aims to analyze the existence of the healthy migrant effect on self-perceived health, chronic morbidity, disability and activity limitations and its association with social determinants of health. This analysis was performed by comparing the health status of international migrants and Chilean population from population-based data. In order to contribute to the comprehensive analysis of HME we investigate the influence of demographic, socioeconomic, access to health care, psychosocial and migratory related factors. This update bring attention to the multidimensional nature of migration in the South American region and the detection of particular needs of international migrants for health planning process.

## Methods

The present investigation was a cross-sectional observational study in which a secondary analysis of the National Socioeconomic Characterization Survey (CASEN version 2017) was performed. The CASEN survey is regularly applied by the Ministry of Social Development to Chilean households and their residents; aiming to know their socioeconomic situation, multidimensional poverty and income distribution. As well as update the evidence of priority groups and detect their particular needs. This voluntary survey follows a structured interview answered by an adult who provides data of the other household members. This survey was designed with a probabilistic, stratified and multistage sampling; that is representative at each national, regional (16 regions), and urban/rural level, but excluding geographic areas with difficult access. The total sample was comprised by 70.947 households with 216.439 residents, which represented 16.843.471 Chilean population and 777.407 international migrants. The data base of CASEN survey has public access (27). This study is part of the Fondecyt Regular project 1201461 approved by the Ethics Committee of the Faculty of Medicine of The Universidad del Desarrollo and Ethics Committee of the Servicio de Salud Metropolitano Sur-Oriente. The study complied with ethical guidelines and regulations according to the principles of the Declaration of Helsinki.

### Health status

Health status was examined using the framework of the small module on health 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)

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 health that cannot be improved (29). Like previous studies (30), the variable was dichotomized as positive health for scores ranging 4-7 and negative health for scores ranging 1-3. This study focused on negative self-perceived health as indicator in order to maintain consistency with the other negative health indicators included in the analysis.

#### Chronic morbidity (CM)

based on question "have you 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 other chronic condition.

#### Disability (DIS)

Although the EU-SILC framework does not separate disability from the activity limitation variable. The CASEN survey includes a question focused 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, bathroom use, lie down or get out of bed/ get dressed).

### Social determinants of health

#### Demographic factors

age as continuous variable and categorical (<6 years, 6-14, 15-64 and >64 years). Sex (male, female). Ethnicity for those belonging or being descendant of minority groups in Chile (yes, no), marital status (single, married/cohabitant, separated/divorced/annulled, widow), area (urban, rural).

#### **Socioeconomic factors**

educational level according to the highest level achieved or current level of the household informant (categorized as university, technical, high school, primary, kinder, special education, none). Household income categorized in five quintiles of equal size sorted in ascending order according to the autonomous per capita household income (I, II, III, IV, V). Occupation defined by the occupational activity of the household informant. The variable was created from questions related to current job/occasional job/ work license/search for a job/ attending to educational center (categorized as unemployed, does not study, study, employed, and study and work).

#### **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 system do you use?". Further categorized as none, public health system affiliation, private health system affiliation, other.

#### **Psychosocial factors**

the variable social support was created from available questions that were mainly related to instrumental social support network; dichotomized yes or no according to the presence of one or more supportive behaviors from someone at home and outside. Social capital variable was created from a question of belonging and participation in diverse organizations or organized groups over the last 12 months. Dichotomized as yes or no according to the participation in one or more of these groups.

#### **Migratory related factors**

Country of origin 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 (4) (Venezuela, Perú, Haiti, Colombia, Bolivia, Argentina, Ecuador, other countries in South America and other). Time of residence 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 Chilean born population. The crude and stratified prevalence by demographic, socioeconomic, access to health care and migratory related factors were presented as proportion. The Pearson's chi-square test was used to test independence between migration and health status outcomes. Multivariate logistic regression was used to estimate the probability (odds ratio, OR) of reporting these health outcomes and adjusted by each set of SDH in international migrants and local population, separately. The association between migratory related factors and health outcomes was explored with multivariate logistic regression adjusted by sex and age. Then, the healthy migrant effect was examined using multivariate logistic regression sequentially adjusted for SDH, where NSPH, CM, DIS and AL were dependent variables and migrant status was the independent variable (reference Chilean born). In order to estimate the crude and adjusted probability of presenting these health outcomes if being international migrant. The Hosmer-Lemeshow goodness of fit test was used as post-estimation after logistic regression. Data analysis 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**

### **Crude prevalence of health outcomes**

International migrants had lower crude prevalence of NSPH (3,97% vs 5,91%), CM (9,55% vs. 25,97%), DIS (14,63% vs. 23,89%) and AL (5,56 vs. 11,52%). Regarding stratified analysis, both groups showed higher prevalence of health status outcomes among female, people over 64 years, widow, unemployed and those with public health system affiliation. The outcomes differed by geographical area, for example prevalence of CM and DIS were higher in local and migrant population living in rural areas. Whereas negative self-perceived health and AL were higher in Chileans living in rural areas but lower in migrants. Stratified analysis of socioeconomic factors showed diverse results for these health outcomes, particularly there was a gradient in self-perceived health across income quintiles of both groups. Among migrants, higher prevalence of NSPH was observed in those who were uninsured and those with 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 in the public health system (Table 1-3). 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 4).

Table 1  
Crude and stratified prevalence of health outcomes by SDH factors in immigrant population.

Social determinant of health	Negative		Chronic		Disability	
	self-perceived health		morbidity			
	%	95% CI	%	95% CI	%	95% CI
	3,97%	[2,8% - 5,7%]	9,55%	[8,3% - 10,9%]	14,63%	[13,1% - 16,3%]
<b>Sex</b>						
Female <sup>b,c</sup>	4,67%	[2,7% - 8,0%]	10,34%	[8,9% - 12,0%]	7,07%	[5,0% - 10,0%]
Male <sup>a,b,c</sup>	3,22%	[2,4% - 4,4%]	8,92%	[6,6% - 12,0%]	4,01%	[3,1% - 5,2%]
<b>Age categories</b>						
<6	1,66%	[0,5% - 5,0%]	5,00%	[2,6% - 9,5%]	6,02%	[3,8% - 9,4%]
6-14 years <sup>b</sup>	3,78%	[2,1% - 6,6%]	3,21%	[1,6% - 6,4%]	6,45%	[3,4% - 12,0%]
15-64 years <sup>b,c</sup>	3,74%	[2,4% - 5,8%]	9,09%	[7,7% - 10,8%]	4,60%	[3,2% - 6,5%]
>64 years <sup>b</sup>	13,33%	[8,8% - 19,7%]	49,88%	[41,8% - 58,0%]	29,41%	[22,3% - 37,7%]
<b>Ethnicity</b>						
Yes <sup>b,c</sup>	5,67%	[3,6% - 8,8%]	10,44%	[7,5% - 14,5%]	7,40%	[5,2% - 10,4%]
No <sup>a,b,c</sup>	3,92%	[2,7% - 5,7%]	9,63%	[8,4% - 11,1%]	5,53%	[4,2% - 7,3%]
<b>Marital Status</b>						
Single <sup>b</sup>	4,21%	[2,1% - 8,4%]	7,71%	[5,4% - 11,0%]	6,05%	[3,7% - 9,6%]
Married/cohabitant <sup>a,b,c</sup>	3,02%	[2,2% - 4,1%]	9,35%	[7,9% - 11,1%]	4,39%	[3,6% - 5,4%]
Separated/divorced/annulled <sup>b,c</sup>	7,55%	[3,8% - 14,6%]	22,55%	[15,8% - 31,1%]	6,16%	[3,4% - 10,9%]
Widow <sup>b</sup>	19,81%	[12,1% - 30,8%]	46,18%	[35,3% - 57,4%]	32,13%	[22,4% - 43,7%]
<b>Area</b>						
Urban <sup>b,c</sup>	4,02%	[2,8% - 5,8%]	9,51%	[8,2% - 11,0%]	5,56%	[4,2% - 7,3%]
Rural <sup>a,b,c</sup>	2,40%	[1,2% - 4,9%]	13,76%	[9,7% - 19,1%]	6,27%	[4,2% - 9,3%]
<b>Educational level</b>						
None <sup>b,c</sup>	3,65%	[1,8% - 7,3%]	5,60%	[3,2% - 9,6%]	8,42%	[5,2% - 13,3%]
University <sup>b,c</sup>	2,90%	[1,7% - 4,9%]	13,96%	[9,9% - 19,4%]	3,80%	[2,7% - 5,4%]
Technical <sup>a,b,c</sup>	1,68%	[1,0% - 3,0%]	7,52%	[5,2% - 10,8%]	3,56%	[2,0% - 6,1%]
High School <sup>b,c</sup>	4,73%	[2,4% - 9,3%]	7,77%	[6,5% - 9,3%]	5,91%	[3,5% - 9,9%]
Primary <sup>a,b,c</sup>	5,67%	[4,2% - 7,7%]	9,95%	[7,7% - 12,8%]	8,25%	[6,3% - 10,7%]
<b>Income quintile</b>						
I <sup>a,b,c</sup>	4,71%	[3,0% - 7,4%]	8,73%	[6,5% - 11,7%]	5,63%	[3,7% - 8,4%]
II <sup>b,c</sup>	6,01%	[4,3% - 8,4%]	8,68%	[6,9% - 10,9%]	7,68%	[5,2% - 11,2%]
III <sup>b</sup>	5,80%	[1,9% - 16,8%]	8,29%	[6,3% - 10,8%]	9,40%	[4,7% - 18,0%]
IV <sup>a,b,c</sup>	1,91%	[1,3% - 3,0%]	7,73%	[6,2% - 9,6%]	3,93%	[2,8% - 5,5%]
V <sup>b,c</sup>	3,30%	[2,0% - 5,3%]	14,10%	[10,1% - 19,3%]	3,13%	[2,1% - 4,7%]
<b>Occupation</b>						

<sup>a</sup> Negative self-perceived health, <sup>b</sup> chronic morbidity, <sup>c</sup>disability p value < 0.05 when comparing the same category between the Chilean-born and the immigrant populations (Chi-square test). Cl: confidence interval.

Social determinant of health	Negative self-perceived health		Chronic morbidity		Disability	
	%	95% CI	%	95% CI	%	95% CI
	3,97%	[2,8% - 5,7%]	9,55%	[8,3% - 10,9%]	14,63%	[13,1% - 16,3%]
Does not study	0,91%	[0,2% - 3,6%]	2,73%	[1,0% - 7,6%]	4,12%	[1,5% - 11,0%]
Unemployed <sup>bc</sup>	9,41%	[4,8% - 17,8%]	17,46%	[14,1% - 21,4%]	13,05%	[8,1% - 20,3%]
Study	3,85%	[1,1% - 12,2%]	8,53%	[5,2% - 13,8%]	4,33%	[2,5% - 7,4%]
Employed <sup>abc</sup>	2,59%	[1,9% - 3,5%]	7,37%	[6,0% - 9,0%]	3,38%	[2,7% - 4,3%]
Study or/and employed <sup>ab</sup>	0,54%	[0,1% - 2,9%]	45,35%	[13,9% - 81,0%]	1,92%	[0,5% - 6,6%]
<b>Access to healthcare</b>						
None <sup>abc</sup>	2,48%	[1,5% - 4,2%]	3,78%	[2,5% - 5,6%]	4,70%	[2,8% - 7,8%]
Public health system affiliation <sup>bc</sup>	4,36%	[2,7% - 7,0%]	9,15%	[7,8% - 10,8%]	6,48%	[4,7% - 8,9%]
Private health system affiliation <sup>c</sup>	4,10%	[2,1% - 7,9%]	18,78%	[11,1% - 29,9%]	2,95%	[1,9% - 4,5%]
Others <sup>c</sup>	2,55%	[1,0% - 6,2%]	13,67%	[7,6% - 23,3%]	3,93%	[1,7% - 8,7%]
<b>Social Support</b>						
Yes <sup>abc</sup>	4,33%	[3,2% - 5,9%]	13,54%	[10,7% - 17,1%]	4,30%	[3,3% - 5,6%]
No <sup>b</sup>	30,13%	[6,6% - 72,5%]	3,54%	[1,4% - 8,7%]	30,54%	[6,8% - 72,7%]
<b>Social capital</b>						
Yes <sup>abc</sup>	3,93%	[2,7% - 5,7%]	15,42%	[12,5% - 18,9%]	6,03%	[4,6% - 7,9%]
No <sup>abc</sup>	4,05%	[2,6% - 6,3%]	9,05%	[7,4% - 11,0%]	5,44%	[3,9% - 7,6%]

<sup>a</sup> Negative self-perceived health, <sup>b</sup>chronic morbidity, <sup>c</sup>disability p value < 0.05 when comparing the same category between the Chilean-born and the immigrant populations (Chi-square test). CI: confidence interval.

Table 2  
Crude and stratified prevalence of health outcomes by SDH factors in Chilean born population.

Negative self-perceived health		Chronic morbidity		Disability		
Social determinant of health	%	95% CI	%	95% CI	%	95% CI
Female <sup>b,c</sup>	5,91%	[5,7% - 6,1%]	25,97%	[25,6% - 26,4%]	23,89%	[23,6% - 24,2%]
Sex						
Male <sup>a,b,c</sup>	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%]	5,87%	[5,4% - 6,4%]
6-14 years <sup>b</sup>	2,61%	[2,3% - 2,9%]	8,56%	[8,1% - 9,1%]	5,10%	[4,6% - 5,6%]
15-64 years <sup>b,c</sup>	5,07%	[4,9% - 5,3%]	22,58%	[22,2% - 23,0%]	8,93%	[8,6% - 9,2%]
>64 years <sup>b</sup>	14,23%	[13,7% - 14,8%]	67,80%	[67,0% - 68,6%]	32,04%	[31,1% - 32,9%]
Ethnicity						
Yes <sup>b,c</sup>	5,69%	[5,2% - 6,2%]	21,36%	[20,5% - 22,2%]	11,24%	[10,6% - 11,9%]
No <sup>a,b,c</sup>	5,93%	[5,7% - 6,1%]	26,78%	[26,4% - 27,2%]	11,61%	[11,3% - 11,9%]
Marital Status						
Single <sup>b</sup>	3,77%	[3,6% - 4,0%]	13,57%	[13,1% - 14,0%]	8,17%	[7,9% - 8,5%]
Married/cohabitant <sup>a,b,c</sup>	7,15%	[6,9% - 7,4%]	35,04%	[34,4% - 35,7%]	12,43%	[12,0% - 12,9%]
Separated/divorced/annulled <sup>b,c</sup>	8,54%	[7,9% - 9,2%]	40,18%	[39,0% - 41,3%]	15,12%	[14,3% - 16,0%]
Widow <sup>b</sup>	14,54%	[13,7% - 15,4%]	67,53%	[66,4% - 68,7%]	35,48%	[34,2% - 36,8%]
Area						
Urban <sup>b,c</sup>	5,80%	[5,6% - 6,0%]	25,93%	[25,5% - 26,4%]	11,45%	[11,1% - 11,8%]
Rural <sup>a,b,c</sup>	6,67%	[6,3% - 7,1%]	28,31%	[27,4% - 29,2%]	12,34%	[11,7% - 13,0%]
Educational level						
None <sup>b,c</sup>	6,32%	[5,9% - 6,8%]	18,08%	[17,2% - 19,0%]	13,89%	[13,2% - 14,6%]
University <sup>b,c</sup>	2,92%	[2,7% - 3,2%]	19,89%	[19,2% - 20,6%]	6,78%	[6,3% - 7,3%]
Technical <sup>a,b,c</sup>	3,71%	[3,3% - 4,2%]	21,58%	[20,5% - 22,7%]	7,57%	[6,9% - 8,3%]
High School <sup>b,c</sup>	5,71%	[5,5% - 6,0%]	26,68%	[26,1% - 27,2%]	10,60%	[10,3% - 11,0%]
Primary <sup>a,b,c</sup>	8,30%	[8,0% - 8,6%]	33,48%	[32,8% - 34,1%]	15,74%	[15,2% - 16,3%]
Income quintile						
I <sup>a,b,c</sup>	7,89%	[7,5% - 8,3%]	27,31%	[26,6% - 28,0%]	14,24%	[13,7% - 14,8%]
II <sup>b,c</sup>	6,60%	[6,3% - 7,0%]	26,08%	[25,4% - 26,7%]	12,34%	[11,8% - 12,9%]
III <sup>b</sup>	6,08%	[5,7% - 6,5%]	26,58%	[25,8% - 27,4%]	11,92%	[11,4% - 12,5%]
IV <sup>a,b,c</sup>	5,02%	[4,7% - 5,4%]	26,45%	[25,7% - 27,2%]	10,20%	[9,7% - 10,7%]
V <sup>b,c</sup>	2,99%	[2,7% - 3,3%]	24,33%	[23,4% - 25,3%]	7,90%	[7,3% - 8,5%]
Occupation						

<sup>a</sup> Negative self-perceived health, <sup>b</sup> chronic morbidity, <sup>c</sup>disability p value < 0.05 when comparing the same category between the Chilean-born and the immigrant populations (Chi-square test). CI: confidence interval.

Negative self-perceived health		Chronic morbidity		Disability		
Does not study	2,91%	[2,4% - 3,5%]	6,59%	[5,8% - 7,5%]	5,03%	[4,4% - 5,8%]
Unemployed <sup>b,c</sup>	11,88%	[11,5% - 12,3%]	48,73%	[48,1% - 49,4%]	23,46%	[22,9% - 24,1%]
Study	2,10%	[1,9% - 2,4%]	9,49%	[8,9% - 10,2%]	5,51%	[5,1% - 6,0%]
Employed <sup>a,b,c</sup>	4,20%	[4,0% - 4,4%]	23,54%	[23,1% - 24,0%]	7,61%	[7,3% - 7,9%]
Study or/and employed <sup>a,b</sup>	2,94%	[2,2% - 3,9%]	10,76%	[9,5% - 12,2%]	5,71%	[4,6% - 7,1%]
Access to healthcare						
None <sup>a,b,c</sup>	4,98%	[4,1% - 6,1%]	13,63%	[12,3% - 15,1%]	8,01%	[6,9% - 9,2%]
Public health system affiliation <sup>b,c</sup>	6,54%	[6,3% - 6,7%]	27,77%	[27,3% - 28,2%]	12,68%	[12,4% - 13,0%]
Private health system affiliation <sup>c</sup>	2,86%	[2,5% - 3,2%]	20,68%	[19,7% - 21,7%]	6,34%	[5,8% - 6,9%]
Others <sup>c</sup>	5,66%	[4,9% - 6,6%]	28,49%	[26,4% - 30,7%]	11,22%	[9,9% - 12,6%]
Social Support						
Yes <sup>a,b,c</sup>	7,54%	[7,3% - 7,8%]	40,40%	[39,8% - 41,0%]	15,00%	[14,5% - 15,5%]
No <sup>b</sup>	14,06%	[11,8% - 16,6%]	40,92%	[36,7% - 45,3%]	20,26%	[17,4% - 23,5%]
Social capital						
Yes <sup>a,b,c</sup>	6,36%	[6,1% - 6,7%]	36,23%	[35,6% - 36,9%]	13,71%	[13,2% - 14,2%]
No <sup>a,b,c</sup>	6,41%	[6,2% - 6,6%]	26,18%	[25,7% - 26,6%]	12,05%	[11,7% - 12,4%]

<sup>a</sup> Negative self-perceived health, <sup>b</sup>chronic morbidity, <sup>c</sup>disability p value < 0.05 when comparing the same category between the Chilean-born and the immigrant populations (Chi-square test). CI: confidence interval.

Table 3  
Crude and stratified prevalence of activity limitations by SDH in immigrant and Chilean born population.

Activity limitations	Chilean born population				Migrant population
	Social determinants		%	95% CI	
	of health				
		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%]
15-64 years		2,38%	[2,3% - 2,5%]	1,47%	[0,5% - 4,1%]
>64 years		19,01%	[18,4% - 19,7%]	21,14%	[15,1% - 28,9%]
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*		24,5	[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%]
Study		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%]

\**p* value < 0,05 when comparing the same category between the Chilean-born and the immigrant populations (Chi-square test). CI: confidence interval.

Activity limitations					
Study 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%]	
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 when comparing the same category between the Chilean-born and the immigrant populations (Chi-square test). CI: confidence interval.

Table 4  
Crude and stratified prevalence of health outcomes by migratory related factors in immigrant population.

Negative self-perceived health	Chronic morbidity		Disability		Activity limitations			
	%	95% IC	%	95% IC	%	95% IC	%	95% IC
<b>Country of Origin</b>								
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 in South 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%]
<b>Time of residence</b>								
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.

## SDH associated with health outcomes

Logistic regression models for NSPH, CM and DIS adjusted by different set of SDH in migrant population are presented in Table 5. Models for Activity limitations in both populations are presented in Table 6. Age was associated with all health outcomes in both populations. 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 to the health system, particularly affiliation to private health system (OR 4,99; 95% CI: 2,70-9,25). Whereas the risk of CM was also associated with having social support (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 associated 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% CI: 1,29-8,40). Likewise, being married/cohabitant 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 migratory related factors (Table 7.), 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: 3,65-33,4)

Table 5  
Logistic regression models of health outcomes by SDH in immigrant population.

Self-perceived bad health	Chronic morbidity			Disability					
	OR	95% IC	P value	OR	95% IC	P value	OR	95% IC	P value
<b>Demographic</b>									
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/Cohabitan	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
<b>Socioeconomic</b>									
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
Study	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
Study 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
<b>Access to healthcare (ref= none)</b>									
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
<b>Psychosocial</b>									
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
<i>Cl: confidence interval; *p value &lt; 0,05</i>									

Table 6  
Logistic regression models of activity limitations by SDH in immigrant and Chilean born populations.

Activity limitations						
	Immigrant			Chilean born		
	OR	95% IC	P value	OR	95% IC	P value
<b>Demographic</b>						
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/Cohabitan	0,24*	[0,09 - 0,62]	0,003	0,42*	[0,39 - 0,45]	0,000
Separated/divorced/annulled	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	[0,37 - 1,28]	0,239	1,04	[0,96 - 1,12]	0,384
GOF test			0,000			0,000
<b>Socioeconomic</b>						
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	[0,26 - 0,34]	0,235
Primary	0,67	[0,20 - 2,30]	0,527	0,38	[0,33 - 0,43]	0,604
Income quintile (ref=I lower income level)						
II	0,71	[0,31 - 1,65]	0,434	0,93	[0,86 - 1,01]	0,083
III	4,23	[0,89 - 19,98]	0,069	0,85*	[0,77 - 0,93]	0,000
IV	0,98	[0,31 - 3,08]	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)						
Study 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
<b>Access to healthcare (ref= none)</b>						
Public health system affiliation	1,32	[0,34 - 5,18]	0,690	1,33	[0,99 - 1,79]	0,058
Private health system affiliation	1,21	[0,32 - 4,67]	0,777	0,95	[0,68 - 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	[0,80 - 1,68]	0,450

Activity limitations						
GOF test			0,445			0,000
Psychosocial						
Social support (ref=no)	<b>0,13*</b>	[ 0,05 - 0,35]	<b>0,000</b>	1,06	[0,83 - 1,35]	0,648
Social capital (ref=no)	0,72	[0,29 - 1,81]	0,484	<b>0,83*</b>	[0,76 - 0,90]	<b>0,000</b>
GOF test			0,747			0,000

Table 7  
Logistic regression models of health outcomes by migratory related factors in immigrant population.

Negative	Chronic morbidity				Disability				P value	
	OR	95% IC	P value	OR	95% IC	P value	OR	95% IC		
<i>sex + age +</i>										
<b>Country of Origin (ref = Perú)</b>										
Venezuela	2,57	[ 0,29 – 22,78]	0,395	1,91	[ 0,43 – 8,89]	0,395	-			
Haiti	<b>4,67*</b>	[ 1,31 – 16,66]	<b>0,018</b>	-			<b>2,88*</b>	[ 0,15 – 7,19]	<b>0,024</b>	
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	<b>1,42</b>	[ 0,59 – 3,42]	<b>0,420</b>	<b>0,13*</b>	[ 0,03 – 0,58]	<b>0,008</b>	
Other countries in South America	1,26	[ 0,20 – 7,85]	0,802	<b>2,09</b>	[ 0,68 – 6,01]	<b>0,200</b>	0,44	[ 0,13 – 1,49]	0,186	
Others	3,86	[ 0,45 – 32,77]	0,214	<b>1,90</b>	[ 0,66 – 5,47]	<b>0,232</b>	0,79	[ 0,31 – 2,04]	0,625	
<b>Time of residencia (ref = 2010 or later)</b>										
2009 - 2000	<b>0,25*</b>	[ 0,06 - 0,99]	<b>0,048</b>	0,63	[ 0,22 – 1,77]	0,375	<b>2,89*</b>	[ 1,04 – 8,04]	<b>0,042</b>	
1999 or before	0,45	[ 0,05 – 4,22]	0,481	1,66	[ 0,43 – 4,60]	0,324	<b>11,04*</b>	[ 3,65 – 33,4]	<b>0,000</b>	
GOF test			0,000			0,000			0,000	
<i>Cl: confidence Interval; *p value &lt; 0.05.</i>										

## CI: confidence Interval \*p value < 0.05

Diverse variables were associated with health status of Chilean population, including all demographic factors (Table 8). After adjustment for demographics, the lack of educational attainment was associated with higher risk of NSPH, CM and DIS. In addition, 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/cohabitant 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 reduced the 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 associated 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).

Table 8  
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% IC	P value	OR	95% IC	P value	OR	95% IC	P value	OR	95% IC	P value
<b>Demographic</b>												
Age	1,03*	[1,03 - 1,04]	0,000	1,06*	[1,05 - 1,06]	0,000	1,04*	[1,04 - 1,04]	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 - 1,10]	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 - 1,31]	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 - 0,58]	0,000	0,42*	[0,39 - 0,45]	0,000
Separated/divorced/annulled	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 - 0,60]	0,000
widow	0,85*	[0,77 - 0,94]	0,001	1,06	[0,99 - 1,13]	0,107	0,90*	[0,84 - 0,98]	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]	0,172	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
<b>Socioeconomic</b>												
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 - 0,34]	0,235
Primary	0,61*	[0,54 - 0,69]	0,000	0,74*	[0,66 - 0,83]	0,000	0,39*	[0,36 - 0,44]	0,000	0,38	[0,33 - 0,43]	0,604
Income quintile (ref=I lower income level)												
II	0,89*	[0,82 - 0,97]	0,005	1,00	[0,95 - 1,05]	0,913	1,00	[0,91 - 1,03]	0,310	0,93	[0,86 - 1,01]	0,083
III	0,84*	[0,78 - 0,92]	0,000	0,99	[0,94 - 1,05]	0,742	0,94	[0,88 - 1,00]	0,074	0,85*	[0,77 - 0,93]	0,000
IV	0,73*	[0,66 - 0,81]	0,000	0,97	[0,91 - 1,03]	0,270	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
Study	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 - 1,74]	0,000	0,01*	[0,01 - 0,02]	0,000
Study and work	1,61*	[1,10 - 2,37]	0,015	0,63*	[0,50 - 0,79]	0,000	2,11*	[1,56 - 2,85]	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 affiliation	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

CI: confidence Interval \*p value < 0.05.

Self-perceived bad health			Chronic morbidity			Disability			Activity limitations		
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]
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	1,21	[0,85 - 1,74]
Doesn't know	0,89	[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 - 1,68]
GOF test			0,002			0,000			0,000		0,000
<b>Psychosocial</b>											
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]
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]
GOF test			0,384			0,000			0,001		0,000
<i>Cl: confidence Interval *p value &lt; 0.05.</i>											

## Findings on Healthy Migrant effect

The odds of having each health outcomes if being an international migrant were calculated and progressively adjusted by each set of SDH (Table 9.). The crude analysis revealed a healthy migrant effect, since being an immigrant was significantly associated with lower odds of presenting all health outcomes. After adjustment for demographics, being immigrant was no longer protective for NSPH and AL. However, after adjustment for socioeconomic covariates, only the association with CM remained significant. The subsequent models showed a healthy migrant effect for CM after adjustment for access to health care and psychosocial factors. Being migrant was associated with 39% lower odds of chronic morbidity compared to Chilean population (OR: 0,61; 95% CI: 0,44-0,84; P = 0,0003).

Table 9  
Logistic regression models of health outcomes if being an international immigrant sequentially adjusted by SDH.

Model 1		Model 2		Model 3		Model 4		Model 5				
Crude OR of being migrant		Adjusted OR by demographics		Adjusted OR by demographics + SES		Adjusted OR by demographics +SES +access to health care		Adjusted OR by demographics +SES +access to health care +psychosocial				
Health outcome	OR	[IC95%]	p	OR	[IC95%]	p	OR	[IC95%]	p	OR	[IC95%]	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
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
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
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

*Cl: confidence Interval \*p value < 0.05.*

## Discussion

This study analyzed the prevalence of health outcomes of international migrants and local population, and its associated SDH. As well as the presence of the HME by comparing both populations. Results showed that migrants had lower crude prevalence across all health outcomes. In both groups age, unemployment, affiliation to the health system and psychosocial factors were associated with these outcomes. Among migrants, a time of residence over 20

years was associated with higher odds of disability. Crude models showed an apparent migrant's health advantage on NSPH, CM, DIS and AL. However, after adjustment for demographics, socioeconomics, health care affiliation and psychosocial factors, being immigrant only confers protection for chronic morbidity. Previous evidence from 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 effect did not persist for any health outcome, highlighting the influence of a 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 Venezuela had a lower self-reported prevalence of diverse chronic diseases such as hypertension, cardiovascular diseases, diabetes mellitus and cancer than local population (32). Similar to the smaller percentage of chronic conditions reported by Venezuelans in Peru (33). Data from other sources such as hospital discharges, have revealed crude lower rates of CM in migrants residing in Chile (18). Moreover, adjusted analysis on cancer hospital discharges also showed a potential advantage on this indicator (34).

The migrant's 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 the access to a healthy diet, lower environmental risks, among other exposures at the country of origin. Besides, 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 return (35). This explanation might be complementary to the "cultural buffering" of the migrant's group, whose norms reduce risky behaviors and promotes a healthy decision making (36). Although, CASEN survey does not provide information related to behavioral factors, 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 in the general population. As well as, type II diabetes mellitus, hypertension, dyslipidemia and obesity (37). Chile has experienced an epidemiological transition, where overall non-communicable disease burden has increased, reaching more than four comorbidities in the general population (38). Among countries in the Americas Region, Chile has a high rate of deaths caused by chronic diseases, which contrast with lower rates reported by the main migrant's countries of origin (39). Therefore, the advanced epidemiological transition in Chile could yield a health gap between migrants and locals, that needs to be analyzed throughout the migrant life trajectories.

Literature have suggested that HME disappears with time of residence and migrant health converge to native population, mainly in elderly (40). This deterioration results from cumulative exposures such as adoption of unhealthy behaviors from host society (e.g. smoking, alcohol consumption, greater calories intake), acculturative stress, discrimination and precarious living conditions (40, 41). Our findings show a higher crude prevalence of CM for those migrants living over 20 years in Chile. However, time of residence was not associated with CM in the partially adjusted model. Thus, the exposure to diverse factors during migration process does not seem to dissolve the advantage for chronic diseases seen in international migrants residing in Chile. As mentioned, this protection does not apply for a long-term condition such as disability that could be derived from exposure to diverse SDH. Evidence have suggested that even if migrants experienced advantages in other health outcomes, they face disability in a great extent. A cumulative disadvantage resulted 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 (42). Moreover, migrants at older ages tend to display higher disability rates than recent migrants and local population (42, 43). In the same line, it has been documented that time of residence has an inverse association with self-perceived health. While there's also evidence reporting poor health perception in recent migrants, suggesting the absence of HME in this indicator (44). Nevertheless, when examining the health perception trajectories, it could be either stable or decline over time at similar rate as locals, which contrast to the negative relationship described in cross-sectional data (45).

Regarding the psychosocial resources, previous evidence have highlighted its protective role in migrants health (13, 15). Our results showed both risk and protective associations between psychosocial factors and health outcomes. 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 migration networks (46). Depending on networks composition, migrants might be differentially exposed to healthy or risky behaviors (e.g., alcohol consumption determined by social situations, religious norms and ethnic identity) (47). Whereas, social support differs by migrant's characteristics, including migratory related factors as well as social context and types of supportive ties. Literature have described an "isolation paradox" in which migrants with poor social support were healthier than natives with similar isolation levels. The expected gradient between social support and good health is not always seen in migrant population, those with greater social support could also display poor health outcomes (48). Moreover, 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 (49), which could explain the association between CM and healthcare affiliation. Since these priority conditions are covered by the explicit health guarantees of Chilean health care system.

The present study contributes to the understanding of the healthy migrant effect by comparing international migrants and local population from population-based data. Our findings provide an insight of the influence of health access and psychosocial factors on migrant's health status, beyond the influence of socioeconomic factors already described in previous research in Chile. This new evidence shed light on health disparities between these populations and brings attention to its importance for health planning. However, the study has important limitations including the cross-sectional analysis that does not allow us to detect changes across time of residence. Estimations were based on self-reported data without medical confirmation. In addition, the CASEN survey does not provide data of behavioral and occupational risk factors to better understand prevalence of long-term conditions. Similarly, due to database limitations it was not possible to analyze other migratory variables and those analyzed were adjusted by sex and age. Furthermore, it is possible that some migrants did not report that they were born abroad or those with irregular administrative status have chosen not to participate. Therefore, migrants who experience greater social vulnerability might not be fully represented in this survey and the social determinants of health to which they were exposed, and their respective health needs could be overlooked. 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 migrant population and diverse exposures they face during migration process.

The findings of this study have practical implication towards inclusive public health responses. Since unemployment, affiliation to health system and psychosocial factors could be potentially modified by migrant-sensitive intersectoral actions. These initiatives must be based on equity and human rights perspectives to promote migrant integration. Besides the articulation of joint efforts at community and national level. For instance, foster social protection strategies regardless of immigration status to counteract socioeconomic vulnerability and poor living conditions that might result from unemployment. Furthermore, addressing barriers for healthcare affiliation, effective access and use of health care. Overall, it should be integrated with psychosocial support-based activities. These measures might involve community based-interventions, intercultural competence in health care and evidence-based migration policies. In order to protect health and wellbeing of migrants and prevent a potential health decline. These practical implications may be useful for the current migratory context in Latin America and the need of encourage collaborative alliances and policy making at regional level.

## Conclusions

The present study revealed a crude advantage on health status of International migrants residing in Chile. However, when an integrative approach was applied by adjusting for social determinants of health the healthy migrant effect disappeared for almost all outcomes. Being migrant remained protective for chronic morbidities which might reflect the health gap resulted from the advanced epidemiological transition in Chile where non-communicable diseases are main public health problems. These findings bring attention to the importance of studying health disparities between international migrants and locals, while considering the diverse exposures during migration process that could dissolve this health advantage over time. Our findings highlight the need to deepen study the HME by cause-specific morbidity, particularly, chronic conditions and its risks factors and could be useful to health care practitioners and policy makers in a more comprehensive understanding of how variables like unemployment, affiliation to the health system and psychosocial factors may shape migrants' health over time. This could be relevant to both policy and practice for health systems in Chile and more broadly in the Latin American region, especially in the purpose of "leaving no one behind in health protection".

## Abbreviations

HME: Healthy migrant effect

SDH: Social Determinants of health

NSPH: Negative Self-perceived health

CM: Chronic morbidity

DIS: Disability

AL: Activity limitations

OR: Odds ratio

CI: Confidence interval

## 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 Servicio de Salud Metropolitano Sur-Oriente. Specifically, this study performed a secondary analysis of The CASEN survey. The data base of the survey has public and free access provided for academic research by the Ministry of Social Development upon request on the website (<http://observatorio.ministeriodesarrollosocial.gob.cl/>). All analyses were performed with anonymized data following ethical standards in research.

### Consent for publication

Not Applicable.

### 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://observatorio.ministeriodesarrollosocial.gob.cl/encuesta-casen-2017>

All data generated during this study are included in this published article.

### Competing interest

The authors report no competing interest

### Funding

#### Authors' contributions

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

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