



Education as a social determinant of the health of international migrants and locals in Chile between 2013 and 2022

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ABSTRACT

Background: Education is a recognised social determinant of health and interacts with other determinants including employment and income. International migration may disrupt these interactions. Education in Chile reflects wider socioeconomic inequalities and in the last decade, it has welcomed an increasing number of migrants.

Objective: To analyse education as a social determinant of health among international migrants and locals between 2013 and 2022.

Methods: Observational cross-sectional study based on five versions of the CASEN survey. Education, employment, and income were analysed in relation to healthcare needs for both populations and logistic regression models were estimated for each year. For 2022, the interactions between education and employment were explored in relation to healthcare needs.

Results: International migrants showed a higher education level and employment rate than Chileans, and a smaller proportion reported healthcare needs. After adjusting for demographic and socioeconomic factors, locals aged 19–25 and 26–59 were more likely to report healthcare needs compared to international migrants across multiple years. The effects of education, employment, and income on healthcare needs among locals and international migrants showed fluctuating ORs without marked trends. In 2022, significant differences in healthcare needs were observed among migrants and locals based on interactions between education and employment, with non-overlapping confidence intervals particularly among unemployed, less-educated youth, middle-aged migrants with incomplete basic education, and older individuals.

Conclusions: This study provides an overview of education as a social determinant of health among international migrants and locals for the last decade and call for targeted in-depth analyses on the topic.

1. Background

A myriad of factors contributes to health outcomes in conjunction with, and beyond, biological conditions. In 2005, the World Health Organization (WHO) established the Commission on Social Determinants of Health to support countries and health systems to address the social factors leading to negative health outcomes and broader health inequities. The social determinants of health (SDoHs thereafter) are defined as “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”, including “economic policies and systems,

development agendas, social norms, social policies and political systems” (WHO Commission on Social Determinants of Health 2008).

Education, either formal or informal, is a well-established SDoH and can be understood as a lifelong process starting at birth (WHO Commission on Social Determinants of Health 2008). Existing research has found that highly educated people generally tend to display or self-report better health outcomes than their less educated counterparts (Davies et al., 2018, Hahn et al., 2015, Prus, 2011). For the purpose of this study, only formal education, defined by UNESCO (UNESCO Institute for Statistics 2012) as “institutionalized, intentional and planned through public organizations and recognized private bodies” will be

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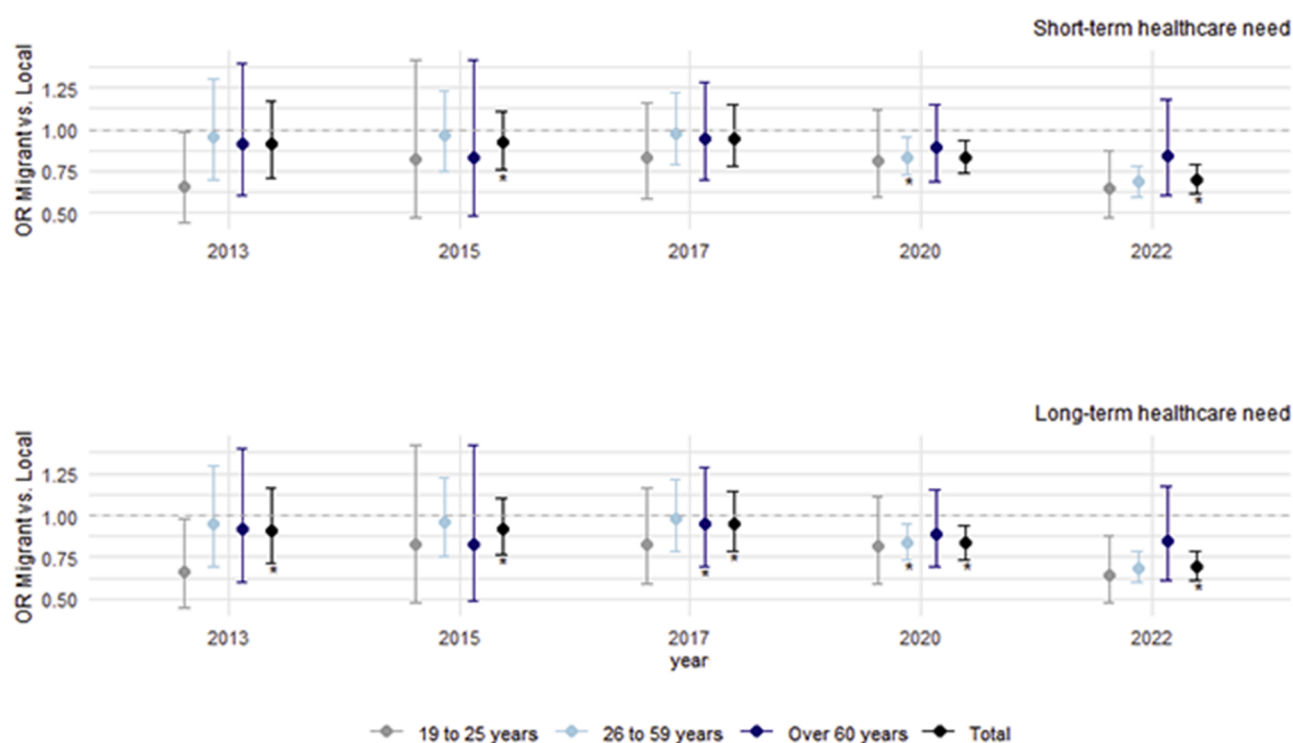
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Table 1

Population surveyed in CASEN (Sample or number of observations) and corresponding population size adjusted by expansion factors (Population sizes) by year.

Year	International migrants				Locals			
	Sample size	% of total sample	Population size	% of total population	Sample size	% of total sample	Population size	% of total population
<i>Total population</i>								
2013	3555	1.63%	354,581	2.05%	212,346	97.19%	16,689,377	96.62%
2015	4851	1.82%	465,319	2.65%	260,754	97.67%	16,970,061	96.68%
2017	6811	3.15%	777,407	4.37%	207,603	95.92%	16,843,471	94.59%
2020	8857	4.78%	1,191,601	6.10%	173,462	93.54%	17,972,203	91.95%
2022	11,894	5.88%	1,736,691	8.74%	188,785	93.35%	17,937,742	90.24%
<i>Population aged 19 and over</i>								
2013	2945	1.87%	290,479	2.31%	152,961	96.96%	12,090,302	96.30%
2015	3973	2.03%	380,379	2.95%	190,854	97.34%	12,405,443	96.22%
2017	5681	3.49%	656,104	4.90%	155,501	95.52%	12,577,190	93.95%
2020	7208	5.11%	976,850	6.62%	130,712	92.74%	13,399,680	90.86%
2022	9539	6.13%	1,422,300	9.38%	144,643	92.91%	13,549,596	89.32%

**Fig. 1.** OR of migrant vs local adjusted by employment, education, and income variables for the logistic regression model of short-term healthcare needs and long-term healthcare needs. CASEN 2013 - 2022.

OR model: Health need (short or long term) ~ migration + attendance + education + occupation + income + age + gender + area + health insurance. For all estimated logistic regression models, the "does not answer" categories for the short-term needs variable were not considered. *p-value test Hosmer-Lemeshow F-adjusted <0.05, OR Migrant vs. Local, model short-term healthcare needs (2022). 19 to 25 years: 0.6438, 26 to 59 years: 0.6851, Over 60 years: 0.8453, Total: 0.6971. OR Migrant vs. Local, model long-term healthcare needs (2022). 19 to 25

considered.

Education may determine health outcomes through different pathways, interacting with other SDOHs (Hahn and Truman, 2015, Raghupathi and Raghupathi, 2020). Most directly, educational attainment allows for better access to, and a critical understanding of, health-related information, which can promote health-seeking behaviours and lifestyles (Clouston et al., 2017, Skalamara and Hummer, 2016). However, this explanation is limited, as behaviours and lifestyles are, in turn, either promoted or constrained by other SDOHs that influence and are influenced by education (Lahelma et al., 2004). Education can be considered "the most basic component of socioeconomic status" (Telfair and Shelton, 2012), as it largely shapes employment opportunities, which will determine income, better living conditions, food security, access to quality healthcare and treatment, but also safer working conditions (Ali and Jalal, 2018, Ionescu and Cuza, 2012, Lazear, 1977,

Bhandari and Bordoloi, 2006, Reibling and Wendt, 2009, Mutisya et al., 2016, Lunau et al., 2015). There are, furthermore, variations to these mechanisms across historical and social contexts, and taking these variations into account is key to producing the evidence necessary to create intersectoral policies contributing to reducing health inequities (Zajacova and Lawrence, 2018).

One such contextual variation can be observed in the case of migration, which may disrupt these pathways, where higher levels of education do not necessarily determine better employment and higher income. As people migrate, depending on the reasons for migrating, the conditions in which they do so, and where they settle, they may face underemployment, as they access jobs that do not fully utilise their skills, education, or availability to work, leading to a lower income (Greenwood, 1999, McKee-Ryan and Harvey, 2011, Risberg and Romani, 2022). Additionally, they might be constrained to accepting

Table 2

OR of the occupation, education, and income variables for the logistic regression model of short-term healthcare needs. CASEN 2013 – 2022.

		2013		2015		2017		2020		2022	
		Mig.	Local	Mig.	Local	Mig.	Local	Mig.	Local	Mig.	Local
19 to 25 years old	Current school attendance										
	No	0.47	0.84*	1.05	0.92	0.69	0.85**	0.88	1	1.12	0.86
	Yes (Ref.)										
	Educational level										
	Below basic	0.66	0.94	0.72	0.83	0.91	1.51*	1.94	1.06	0.26	1.39
	Completed basic	1.62	1.13	0.48	0.96	0.61	0.83*	1.38	0.91	0.86	1.09
	Completed 2dary (Ref.)										
	Completed higher	7.76**	1.01	0.94	0.87**	1	0.94	1.07	1.09	0.81	1.1
	Does not answer		0.22**		2.67	0.77	1.06	0.55	0.97		0.97
	Occupation										
	Has never worked	1.87	0.8*	0.47	0.83	1.56	0.66**	1.04	0.74**	0.52	0.54**
	Unemployed	2.09	1.05	0.36*	1.05	2.09*	0.99	1.32	0.89	0.83	1.05
	Employed (Ref.)										
	Household autonomous income quintile										
	I, poorest	11.59**	0.91	0.25	0.89	0.19*	0.89	0.4	1.19	0.45	0.74*
26 to 59 years old	II	7.93**	0.75*	0.21	0.92	0.43	0.69**	0.65	1.3	0.34*	0.83
	III	6.65*	1.03	0.15**	0.92	0.81	0.87	0.27**	1.25	0.44*	0.83
	IV	23.29**	1	0.22*	0.93	0.5	0.86	0.75	1.33*	0.33*	1.01
	V, richest (Ref.)										
	Current school attendance										
	No	0.32	0.8*	0.86	0.85	0.26	0.86*	0.81	0.82**	1.03	0.72**
	Yes (Ref.)										
	Educational level										
	Does not answer	0.49	0.9	2.05	0.74	1.52	0.74	1.18	0.82	1.33	0.84
	Below basic	0.97	0.98	0.92	1.07	1.52	1.1	1.93**	1.1	1.11	1.01
	Completed basic	1.06	1.02	1.2	1.04	1.38	1.09*	1.43	1.08	0.95	0.87**
	Completed secondary	0.63	0.99	0.86	0.94	1.37	0.97	1.19	1.01	0.94	0.87**
	Completed higher (Ref.)										
	Occupation										
	Has never worked	0.45*	0.9	0.64	0.92	1.03	0.87**	0.96	1	0.9	0.64**
	Unemployed	0.99	1.07	1.25	1.1**	2.24**	1.11**	1.25	1.06	1.09	1.05
	Employed (Ref.)										
	Household autonomous income quintile										
	I, poorest	1.61	1.11	0.4**	0.92	0.49*	0.95	1.29	1.13*	0.73	0.81**
Over 60 years old	II	2.21	1.03	0.46*	0.91*	0.79	0.89*	1.22	1.02	0.69	0.8**
	III	1.64	0.94	0.47*	0.84**	1.07	0.97	1.17	1.03	0.67*	0.83**
	IV	2.16	1.01	0.53*	0.87**	0.74	0.97	1.39	1.05	0.66*	0.87*
	V, richest (Ref.)										
	Educational level										
	Does not answer		0.89	–	1.01	1	0.68*	1.24	1.03	1.21	1.28
	Below basic	0.67	1.13	1.36	1.02	0.83	1.16*	1.19	1.23**	1.64	1
	Completed basic	0.51	1.1	0.99	1.05	0.96	1.07	1.71	1.12*	1.22	0.97
	Completed secondary	0.53	0.97	1.41	0.99	0.88	1.02	1.96*	1.06	1.22	0.94
	Completed higher (Ref.)										
	Occupation										
	Has never worked	2.54	1.12	0.64	1.14*	0.78	1	0.59	1.1	1.35	1.03
	Unemployed	1.79	1.25**	0.96	1.23**	1.03	1.18**	1.08	1.2**	0.83	1.08
	Employed (Ref.)										
	Household autonomous income quintile										
	I, poorest	1.12	1.18	0.64	1.11	2.9*	0.98	1.01	1.37**	1.27	0.85*
Total	II	0.58	1.14	0.59	1.16*	1.04	0.99	1.48	1.27**	1.45	0.81**
	III	0.59	1.04	2.11	1.08	1.77	0.99	0.73	1.26**	0.62	0.84*
	IV	1.45	0.97	0.65	1.03	1.51	0.98	0.81	1.12	2.19	0.84*
	V, richest (Ref.)										
	Age										
	19 to 25 years old (Ref.)										
	26 to 59 years old	1.99*	1.07	1.17	1.04	1.43	0.96	1.07	1.11*	0.87	1.09
	Over 60 years old	3.26*	1.10	1.47	1.05	1.47	0.98	1.02*	1.10	0.88	1.07
	Attends an educational entity										
	No	0.43	0.83**	1.08	0.88*	0.33*	0.86**	0.85	0.93	1.15	0.78*
	Yes (Ref.)										
	Educational level										
	Does not answer	0.32	0.82	0.54	0.99	1.19	0.75*	0.92	0.88	1.26	1.21
	Below basic	1.37	1.08	1.34	1.09**	1.05	1.16**	1.35	1.14**	1.17	1.11*
	Completed basic	1.41	1.07	1.07	1.09**	0.97	1.08**	1.21	1.08*	0.99	1.03
	Completed 2dary (Ref.)										
	Completed higher	1.72	1.02	1.04	1.03	0.76	0.99	0.82	0.98	1.03	1.11*
	Occupation										
	Has never worked	0.91	0.91*	0.57	0.95	1.05	0.85**	0.86	0.93*	0.86	0.67**
	Unemployed	1.11	1.10**	0.91	1.12**	1.91**	1.10**	1.23	1.06*	1.00	0.97
	Employed (Ref.)										
	Household autonomous income quintile										
	I, poorest	1.68	1.11*	0.40**	0.97	0.57*	0.95	1.10	1.23**	0.74	0.82**

(continued on next page)

Table 2 (continued)

	2013		2015		2017		2020		2022	
	Mig.	Local	Mig.	Local	Mig.	Local	Mig.	Local	Mig.	Local
II	1.91	1.03	0.41**	0.98	0.76	0.90*	1.15	1.14**	0.69*	0.8**
III	1.35	0.99	0.48*	0.92*	1.10	0.97	0.95	1.13*	0.65*	0.83**
IV	2.29**	1.01	0.46**	0.93*	0.74	0.96	1.21	1.09*	0.68*	0.87*
V, richest (Ref.)										

OR model: Short-term healthcare need ~ attendance + education + occupation + income + age + gender + area + health insurance, according to life stage. For all estimated logistic regression models, the "does not answer" category for the short-term needs variable was not considered.

* p-value < 0.05

** p-value < 0.01.

P-value Hosmer-Lemeshow F-adjusted test less than 0.05 in migrant model 2013 19 to 25 years old, migrant model 2015 25 to 59 years old, migrant models 2020, 2017, 2015, 2013 over 60 years old, and local model 2022, 2020, 2017 and 2015 total adult population.

Number of observations per model. Migrants: 2013 (19 to 25 years old: 577; 26 to 59 years old: 1952; over 60 years old: 325; Total: 2862), 2015 (19 to 25 years old: 687; 26 to 59 years old: 2762; over 60 years old: 354; Total: 3806), 2017 (19 to 25 years old: 1043; 26 to 59 years old: 4046; over 60 years old: 462; Total: 5553), 2020 (19 to 25 years old: 980; 26 to 59 years old: 5589; over 60 years old: 594; Total: 7163) and 2022 (19 to 25 years old: 1392; 26 to 59 years old: 7321; over 60 years old: 647; Total: 9386). Local: 2013 (19 to 25 years old: 25,414; 26 to 59 years old: 89,448; over 60 years old: 34,748; Total: 149,610), 2015 (19 to 25 years old: 29,155; 26 to 59 years old: 109,898; over 60 years old: 47,723; Total: 186,776), 2017 (19 to 25 years old: 22,307; 26 to 59 years old: 88,902; over 60 years old: 42,562; Total: 153,771), 2020 (19 to 25 years old: 18,392; 26 to 59 years old: 74,219; over 60 years old: 37,808; Total: 130,419) and 2022 (19 to 25 years old: 18,189; 26 to 59 years old: 79,840; over 60 years old: 44,811; Total: 142,840)

more dangerous jobs (Yanar et al., 2004). From a SDoH perspective, these mechanisms may have an impact on migrants' short and long-term health needs and outcomes (Priebe et al., 2016).

Chile is a high-income, yet highly unequal country located in the Southern Cone of Latin America (GNI per Capita, Country statistical profile). Education in Chile reflects wider socioeconomic inequalities. The privatisation of part of the school system during the military dictatorship in the 1980s left it fragmented, with an underfunded and underperforming public sector used by the lower-income sectors of the population (Corvalán and García-Huidobro, 2015; Cavieres Fernández, 2014). This contributes to limited social mobility in a society marked by deep class divides (Castillo, 2016; Solís and Dalle, 2019). Furthermore, Chile, as much as the rest of Latin America, is still characterised by race and ethnic divides as a legacy from its colonial history, interacting with class inequalities (Tereucán Angulo et al., 2022).

Additionally, recent migration patterns have come into play. With the return to democracy in 1990, Chile gradually became a country of immigration within the Latin American region. While the early 2000s saw mainly migration influxes and pendular migration patterns from neighbouring Peru, who represent 24% of all residence permits since 2000, the past 10 years saw an increasing diversification of migratory flows (Datos Abiertos). For instance, the Haitian population, which represented no more than 2000 people in 2012, grew nearly tenfold to 185 721 in 2022 (Servicio Nacional de Migraciones 2024). Another key example is the Venezuelan population in Chile, which came to represent the largest community of immigrants, growing from 5748 people in 2012 to 532 715 in 2022 (Servicio Nacional de Migraciones 2024). With regards to education, according to the version of the National Socio-economic Characterization Survey (*Encuesta de Caracterización Socio-económica Nacional*, CASEN survey thereafter) conducted in 2020, international migrants in Chile have an average of 13.3 years of formal schooling, while the Chilean-born population displays an average of 11.6 years (Data Social). That same year, while 75.6% of the international migrant population was part of the workforce, only 53.7% of the Chilean-born did. Finally, with regards to income, 17% of the international migrant population faced income poverty, compared to 10.4% of the Chilean-born population (Caracterización Socioeconómica Inmigrantes).

Considering these disparities, analysing education as a social determinant of health differentiating between the migrant and Chilean-born population is relevant. The aim of this study is to analyse education as a social determinant of health among international migrants and locals between 2013 and 2022.

2. Materials and methods

2.1. Study design

An observational cross-sectional study was carried out. Five versions of the anonymous and nationally representative CASEN survey were used: 2013, 2015, 2017, 2020, and 2022. We analysed education in relation to individual health status, distinguishing between the local and international migrant populations.

2.2. Materials

The CASEN survey is a diagnostic, evaluation, and targeting tool, designed, operationalised, and managed by the Ministry of Social Development and Family. The survey was first implemented in the 1980s and has been collecting demographic and socioeconomic data in Chile periodically ever since. Its main objective is to collect data on the socioeconomic conditions of households in Chile, especially among priority groups as defined by social policies at the national level. It is widely used for policymaking and is recognised as a trustworthy reflection of the socioeconomic situation at the national level.

The data is collected by trained surveyors through structured interviews with heads of household or a household member over 18 years old acting as an informant. The sampling is probabilistic, stratified, and multistage. The survey covers topics such as household composition, education, work, income, health, identity, and housing. Please see Table 1 for detailed information on the sample sizes for each year and population group.

2.3. Variables

International migration: An international migrant is defined by the International Organization for Migration as "any person who is moving or has moved across an international border (...) away from his/her habitual place of residence" regardless of their migratory status (Migrants). According to the criteria set by the CASEN survey, anyone born outside Chile is considered an international migrant, while anyone born in Chile was considered a local. The terms international migrants in Chile and immigrants are used interchangeably in this study.

Health status: We used "being under treatment for any pathology during the year prior to the survey" (yes/ no/ does not know) as proxy for chronic or long-term healthcare needs and "having had any illness or accident in the 3 months prior to the survey" (yes/ no/ does not know) as proxy for short-term healthcare needs.

Education: We included current school attendance (yes/no),

Table 3

OR of the occupation, education, and income variables for the logistic regression model of long-term healthcare needs. CASEN 2013 - 2022.

		2013		2015		2017		2020		2022	
		Mig.	Local	Mig.	Local	Mig.	Local	Mig.	Local	Mig.	Local
19 to 25 years old	Current school attendance										
	No	0.47	0.84*	1.05	0.92	0.69	0.85**	0.88	1	1.12	0.86
	Yes (Ref.)										
	Educational level										
	Below basic	0.66	0.94	0.72	0.83	0.91	1.51*	1.94	1.06	0.26	1.39
	Completed basic	1.62	1.13	0.48	0.96	0.61	0.83*	1.38	0.91	0.86	1.09
	Completed 2dary (Ref.)										
	Completed higher	7.76**	1.01	0.94	0.87**	1	0.94	1.07	1.09	0.81	1.1
	Does not answer		0.22**		2.67	0.77	1.06	0.55	0.97		0.97
	Occupation										
	Has never worked	1.87	0.8*	0.47	0.83	1.56	0.66**	1.04	0.74**	0.52	0.54**
	Unemployed	2.09	1.05	0.36*	1.05	2.09*	0.99	1.32	0.89	0.83	1.05
	Employed (Ref.)										
	Household autonomous income quintile										
	I, poorest	11.59**	0.91	0.25	0.89	0.19*	0.89	0.4	1.19	0.45	0.74*
26 to 59 years old	II	7.93**	0.75*	0.21	0.92	0.43	0.69**	0.65	1.3	0.34*	0.83
	III	6.65*	1.03	0.15**	0.92	0.81	0.87	0.27**	1.25	0.44*	0.83
	IV	23.29**	1	0.22*	0.93	0.5	0.86	0.75	1.33*	0.33*	1.01
	V, richest (Ref.)										
	Current school attendance										
	No	0.32	0.8*	0.86	0.85	0.26	0.86*	0.81	0.82**	1.03	0.72**
	Yes (Ref.)										
	Educational level										
	Does not answer	0.49	0.9	2.05	0.74	1.52	0.74	1.18	0.82	1.33	0.84
	Below basic	0.97	0.98	0.92	1.07	1.52	1.1	1.93**	1.1	1.11	1.01
	Completed basic	1.06	1.02	1.2	1.04	1.38	1.09*	1.43	1.08	0.95	0.87**
	Completed secondary	0.63	0.99	0.86	0.94	1.37	0.97	1.19	1.01	0.94	0.87**
	Completed higher (Ref.)										
	Occupation										
	Has never worked	0.45*	0.9	0.64	0.92	1.03	0.87**	0.96	1	0.9	0.64**
	Unemployed	0.99	1.07	1.25	1.1**	2.24**	1.11**	1.25	1.06	1.09	1.05
	Employed (Ref.)										
	Household autonomous income quintile										
	I, poorest	1.61	1.11	0.4**	0.92	0.49*	0.95	1.29	1.13*	0.73	0.81**
Over 60 years old	II	2.21	1.03	0.46*	0.91*	0.79	0.89*	1.22	1.02	0.69	0.8**
	III	1.64	0.94	0.47*	0.84**	1.07	0.97	1.17	1.03	0.67*	0.83**
	IV	2.16	1.01	0.53*	0.87**	0.74	0.97	1.39	1.05	0.66*	0.87*
	V, richest (Ref.)										
	Educational level										
	Does not answer		0.89	–	1.01	1	0.68*	1.24	1.03	1.21	1.28
	Below basic	0.67	1.13	1.36	1.02	0.83	1.16*	1.19	1.23**	1.64	1
	Completed basic	0.51	1.1	0.99	1.05	0.96	1.07	1.71	1.12*	1.22	0.97
	Completed secondary	0.53	0.97	1.41	0.99	0.88	1.02	1.96*	1.06	1.22	0.94
	Completed higher (Ref.)										
	Occupation										
	Has never worked	2.54	1.12	0.64	1.14*	0.78	1	0.59	1.1	1.35	1.03
	Unemployed	1.79	1.25**	0.96	1.23**	1.03	1.18**	1.08	1.2**	0.83	1.08
	Employed (Ref.)										
	Household autonomous income quintile										
	I, poorest	1.12	1.18	0.64	1.11	2.9*	0.98	1.01	1.37**	1.27	0.85*
Total	II	0.58	1.14	0.59	1.16*	1.04	0.99	1.48	1.27**	1.45	0.81**
	III	0.59	1.04	2.11	1.08	1.77	0.99	0.73	1.26**	0.62	0.84*
	IV	1.45	0.97	0.65	1.03	1.51	0.98	0.81	1.12	2.19	0.84*
	V, richest (Ref.)										
	Age										
	19 to 25 years old (Ref.)										
	26 to 59 years old	2.19	1.28**	1.24	1.11*	1.44	1.10*	0.69	1.06	0.68*	0.98
	Over 60 years old	1.67	1.33**	1.78	1.11	1.44	1.19**	0.55	1.23**	0.57	1.05
	Attends an educational entity										
	No	0.36	0.94	1.89	0.97	0.12*	1.00	0.74	0.84**	0.74	0.88*
	Yes (Ref.)										
	Educational level										
	Does not answer	0.33	1.06	0.59	0.84	1.03	0.92	1.06	0.82*	0.69	0.77*
	Below basic	1.24	1.24**	1.01	1.25**	0.99	1.32**	1.34	1.31**	0.93	1.20**
	Completed basic	2.4*	1.15**	0.92	1.17**	0.94	1.22**	0.91	1.14**	0.97	1.11**
	Completed 2dary (Ref.)										
	Completed higher	1.49	1.01	1.37	0.98	0.79	1.03	0.99	0.95	0.94	1.05*
	Occupation										
	Has never worked	0.90	1.42**	0.96	0.39**	0.79	1.40**	1.17	1.26	0.80	1.03
	Unemployed	1.48	1.44**	1.06	1.41**	1.20	1.44**	1.31	1.33	0.72**	0.74**
	Employed (Ref.)										
	Household autonomous income quintile										
	I, poorest	1.04	1.09	2.56**	1.10**	1.07	1.08	1.10	1.25**	0.78	0.99

(continued on next page)

Table 3 (continued)

	2013		2015		2017		2020		2022	
	Mig.	Local	Mig.	Local	Mig.	Local	Mig.	Local	Mig.	Local
II	1.23	1.02	1.64	1.09*	1.21	1.07	1.13	1.18**	0.81	0.94
III	0.76	1.13*	1.45	1.03	0.99	1.06	0.79	1.12**	0.75*	0.95
IV	1.41	1.04	0.96	1.02	0.88	1.02	1.04	1.15**	0.83	0.98
V, richest (Ref.)										

OR model: Long-term healthcare need ~ attendance + education + occupation + income + age + gender + area + health insurance, according to life stage. For all estimated logistic regression models, the “does not answer” category for the long-term healthcare needs variables was not considered.

* p-value < 0.05

** p-value < 0.01

Number of observations per model. Migrants: 2013 (19 to 25 years old: 566; 26 to 59 years old: 1963; over 60 years old: 337; Total: 2,899), 2015 (19 to 25 years old: 582; 26 to 59 years old: 2818; over 60 years old: 366; Total: 3,885), 2017 (19 to 25 years old: 985; 26 to 59 years old: 4056; over 60 years old: 458; Total: 5549), 2020 19 to 25 years old: 968; 26 to 59 years old: 5532; over 60 years old: 589; Total: 7089) and 2022 (19 to 25 years old: 1404; 26 to 59 years old: 7335; over 60 years old: 647; Total: 9,386). Local: 2013 (19 to 25 years old: 25,792; 26 to 59 years old: 90,884; over 60 years old: 35,314; Total: 151,990), 2015 (19 to 25 years old: 29,666; 26 to 59 years old: 111,681; over 60 years old: 48,411; Total: 189,758), 2017 (19 to 25 years old: 22,275; 26 to 59 years old: 88,683; over 60 years old: 42,544; Total: 153,502), 2020 (19 to 25 years old: 18,175; 26 to 59 years old: 73,431; over 60 years old: 37,502; Total: 129,108) and 2022 (19 to 25 years old: 18,195; 26 to 59 years old: 79,784; over 60 years old: 44,943; Total: 142,922)

P-value Hosmer-Lemeshow F-adjusted test less than 0.05 in migrant model

referring to adults still studying at the time of the survey, and educational level (less than complete basic education/ complete basic education which may include persons who are in or have incomplete secondary education/ complete secondary education which may include persons who are in and have not yet or will not complete higher education/ complete higher technical or professional education, which may include people with a postgraduate degree/ no answer).

Employment: We used the employment variable of the survey, with the following possible answers: has never worked/ employed / unemployed.

Income: With regards to income, the household income quintile was used, being I the poorest and V the wealthiest.

Furthermore, the following variables were also included: sex (man/ woman), age (continuous and divided into intervals according to stage of the life cycle and corresponding educational and employment stage: 19 to 25, 26 to 59, and 60 or older), geographic area (urban/ rural), healthcare system (public/ private/ other including the military/ none or does not know).

2.4. Data analysis

A descriptive analysis of the migrant and local adult populations was carried out, in total and stratified by age group, for each of the year included, and according to all the variables described previously. Additionally, for each of the variables, we estimated the percentages of short- and long-term healthcare needs for each subgroup, with their respective 95% confidence intervals (See Additional File 1).

Logistic regression models were then estimated for each year using short- and long-term healthcare needs as dependent variables and education, school attendance and employment as main independent variables. The models were adjusted for all adults and by age group, with different reference categories by educational attainment for each group (in the case of the 19 to 25 age group, the reference category used was completed secondary education, and for those 26 years old and over, completed higher education was used as a reference category). All models were adjusted for sex, age, geographic area, income quintile and health status, including the Hosmer and Lemeshow test adjusted for complex samples. For 2022, the interactions between attendance, educational level and employment were explored through flow charts including the estimation of percentages of long- and short-term needs with their respective confidence intervals for each interaction. Additionally, for that same year, logistic regression models were estimated considering the interactions between attendance and employment, as well as educational level and employment. Associations between education, occupation and income quintile were assessed using Chi-square test with Rao-Scott second order correction (considering the complex

survey design). Considering that these bivariate associations may be influenced by the sample size, the strength of association was also explored using Cramér's V (appropriate for non-squared tables with more than two dimensions) for the total sample used and stratifying by age group.

For all estimated logistic regression models, the “does not answer” category for the short- and long-term healthcare needs variables was not considered.

All analyses were performed with 95% confidence and 0.05 significance. Considering the complexity of the sample structure, linearised Taylor variance estimation was used. The data was processed using STATA 17 and R softwares.

2.5. Data availability and ethics

CASEN survey datasets are free of access through the following link: <https://observatorio.ministeriodesarrollosocial.gob.cl>. This study was part of Fondecyt Regular 1,201,461, a project funded by the National Research Agency of the Chilean government and 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 (code 2020–92). The study complies with ethical guidelines and regulations established by the Declaration of Helsinki.

3. Results

3.1. Descriptive results

The descriptive results presented in the additional material show that the adult migrant population consistently reports less current school attendance than the adult Chilean population between 2013 and 2022 (4.25% vs 9.85% in 2022). With regards to educational attainment, a greater proportion of international migrants report having completed higher education across all years, however, the gap has been reduced, as the proportion of local population reporting completed higher education increased 9 percentage points between 2013 and 2022 (from 16.66% to 25.69%), while the proportion of migrants reporting completed higher education decreased for the first time between 2020 and 2022 (from 39.45% to 34.99%). While the rates of completed secondary education are very similar between migrant and local populations across all years, differences are observed among those reporting completed basic or below, to the disadvantage of the Chilean population. However, while the proportion of the Chilean population reporting below basic education has decreased between 2013 and 2022 (from 16.59% to 12.00%), the proportion of migrant population reporting below basic education showed a slight increase between 2020 and 2022 for the first time (from

Table 4

OR of the occupation, education, and income variables for the logistic regression model of long-term and short-term healthcare needs. Panel data CASEN 2013 to 2022.

		Short-term			Long-term		
		Mig.	Local	Total	Mig.	Local	Total
19 to 25 years old	Migrant						
	Yes			0.73**			0.48**
	No (Ref.)						
	Current school attendance						
	No	0.82	0.87**	0.87**	0.79	0.97	0.97
	Yes (Ref.)						
	Educational level						
	Below basic	0.71	1.14	1.13	1.28	3.10**	3.04**
	Completed basic	0.66	0.99	0.97	0.66	1.03	1.02
	Completed 2dary (Ref.)						
	Completed higher	0.96	0.96	0.96	1.15	0.96	0.96
	Does not answer	0.47*	0.88	0.86	–	1.25	1.19
	Occupation						
	Has never worked	1.05	0.71**	0.72**	0.88	1.16**	1.15**
	Unemployed	1.12	1.02	1.02	1.02	1.32**	1.31**
	Employed (Ref.)						
	Household autonomous income quintile						
	I, poorest	0.36*	0.90	0.87*	1.98	0.98	0.99
	II	0.44	0.82**	0.80**	1.42	0.91	0.91
	III	0.52	0.96	0.93	1.74	1.03	1.04
	IV	0.55	0.95	0.93	1.84	0.98	0.99
	V, richest (Ref.)						
26 to 59 years old	Migrant						
	Yes			0.93			0.64**
	No (Ref.)						
	Current school attendance						
	No	0.39	0.83**	0.81**	0.20*	0.86**	0.81**
	Yes (Ref.)						
	Educational level						
	Below basic	1.41	1.05	1.07*	1.04	1.23**	1.23**
	Completed basic	1.27	1.03	1.05	1.38	1.06*	1.07*
	Completed secondary	1.05	0.96	0.97	1.02	0.96	0.97
	Completed higher (Ref.)						
	Does not answer	1.19	0.77*	0.79*	0.56	0.85	0.84
	Occupation						
	Has never worked	0.75	0.85**	0.85**	0.85	1.42**	1.40**
	Unemployed	1.59*	1.10**	1.12**	1.28	1.40**	1.39**
	Employed (Ref.)						
	Household autonomous income quintile						
	I, poorest	0.64*	0.99	0.97	1.33	1.13**	1.14**
	II	0.76	0.94	0.93*	1.43	1.04	1.05
	III	0.84	0.92**	0.91**	1.15	1.04	1.04
	IV	0.74	0.96	0.94*	1.07	1.00	1.00
	V, richest (Ref.)						
Over 60 years old	Migrant						
	Yes			0.88			0.64**
	No (Ref.)						
	Educational level						
	Below basic	1.28	1.12**	1.13**	1.04	1.25**	1.24**
	Completed basic	1.15	1.07*	1.07*	0.99	1.22**	1.22**
	Completed secondary	1.24	1.01	1.02	0.91	1.01	1.01
	Completed higher (Ref.)						
	Does not answer	0.96	1.01	1.01	0.74	0.91	0.9
	Occupation						
	Has never worked	0.91	1.09**	1.08**	1.26	1.49**	1.48**
	Unemployed	1.13	1.21**	1.21**	1.34	1.65**	1.65**
	Employed (Ref.)						
	Household autonomous income quintile						
	I, poorest	1.10	1.11**	1.11**	1.05	1.17**	1.16**
	II	1.03	0.10**	1.09**	0.87	1.20**	1.19**
	III	0.86	1.07*	1.07*	0.79	1.16**	1.15**
	IV	1.00	1.02	1.01	0.73	1.13**	1.12**
	V, richest (Ref.)						
Total	Migrant						
	Yes			0.89*			0.6**
	No (Ref.)						
	Age						
	19 to 25 years old (Ref.)						
	26 to 59 years old	1.50*	1.03	1.95	1.57	1.14**	1.15**
	Over 60 years old	1.65	1.04	1.06	1.65	1.20**	1.22**
	Attends an educational entity						
	No	0.55	0.87**	0.85**	0.30*	0.96	0.93*
	Yes (Ref.)						

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Table 4 (continued)

	Short-term			Long-term		
	Mig.	Local	Total	Mig.	Local	Total
Educational level						
Below basic	1.33	1.11**	1.11**	1.01	1.28**	1.28**
Completed basic	1.07	1.07**	1.07**	1.25	1.18**	1.18**
Completed 2dary (Ref.)	0.94	1.02	1.01	0.99	0.99	0.99
Completed higher						
Does not answer	0.99	0.92	0.92	0.58	0.92	0.91
Occupation						
Has never worked	0.84	0.89**	0.89**	0.83	1.36**	1.35**
Unemployed	1.35*	1.11**	1.11**	1.24	1.43**	1.43**
Employed (Ref.)						
Household autonomous income quintile						
I, poorest	0.68*	0.99	0.98	1.22	1.08**	1.08**
II	0.73*	0.96	0.95	1.22	1.05*	1.05*
III	0.81	0.96	0.95*	1.03	1.06*	1.06*
IV	0.76	0.97	0.96	0.99	1.03	1.03
V, richest (Ref.)						

OR model short-term: Short-term healthcare need ~ attendance + education + occupation + income + age + gender + area + health insurance+year, according to life stage. For all estimated logistic regression models, the “does not answer” categories for the short-term healthcare needs variables were not considered.

OR model Long-term: Long-term healthcare need ~ attendance + education + occupation + income + age + gender + area + health insurance+year, according to life stage. For all estimated logistic regression models, the “does not answer” categories for the long-term healthcare needs variables were not considered.

* p-value < 0.05

** p-value < 0.01

Number of observations per model. **Short-term.** Migrants (19 to 25 years old: 2809; 26 to 59 years old: 10,268; over 60 years old: 2131; Total: 14,614), locals (19 to 25 years old: 87,930; 26 to 59 years old: 2818; over 60 years old: 195,421; Total: 556,759) and total (19 to 25 years old: 90,739; 26 to 59 years old: 321,484; over 60 years old: 197,552; Total: 571,373). **Long-term.** Migrants (19 to 25 years old: 2800; 26 to 59 years old: 10,370; over 60 years old: 2133; Total: 14,734), locals (19 to 25 years old: 88,786; 26 to 59 years old: 314,238; over 60 years old: 196,461; Total: 561,983) and total (19 to 25 years old: 91,606; 26 to 59 years old: 324,608; over 60 years old: 198,594; Total: 576,717).

Hosmer-Lemeshow F-adjusted test p-value is less than 0.05 in the long-term needs model for the total population aged 60 and over, for locals aged 60 and over, for the total surveyed population, and for the total local population. Additionally, in the short-term needs model, the p-value is less than 0.05 for the total surveyed population and the total local population.

5.04% to 5.48%).

Regarding employment, the migrant population reports consistently higher rates by about 20 percentage points than its Chilean counterpart over the years (for instance, 78.84% vs. 58.26% in 2022). With regards to household income, if in 2013, 32.08% of international migrants belonged to the richest quintile (vs 18.06% of locals), in 2022, this proportion was down to 16.60% (vs 17.06% of locals). Conversely, the proportion of international migrants belonging to intermediate quintiles II, III and IV increased between 2013 and 2022, from 16.71% to 19.36%, 16.07% to 24.90% and 23.88% to 27.10% respectively, while the proportion belonging to the least wealthy quintile only increased by a little over 1 percentage point. Among Chileans, a slight upward trend toward the poorest quintile and downward trend for the wealthiest quintile was observed between 2013 and 2022: from 18.89% to 20.30% and from 18.06% to 17.06% respectively. Finally, regarding healthcare needs, a smaller proportion of international migrants reported either short- or long-term healthcare needs than the Chilean population, consistently across all years included in this study. The descriptive results stratified by age group are available as part of Supplementary Material 1.

3.2. Logistic regression models

With regards to the association between education and health, consistent with the descriptive findings presented in the additional material, after adjusting logistic regression models for migrant vs. local status, school attendance, educational level, employment status, household income quintile, sex, age, geographical area, and healthcare system, being a migrant vs. local was found to be statistically significant for short- or long-term healthcare needs in 2022 for the 19–25 and 26–59 age groups, as well as for the total sample. This was also the case in 2020 for the 26–59 age group (total sample for short-term needs only) and in 2013 for the 19–25 age group. In each case, this was to the disadvantage of the local population, who was more likely to report long or short-term healthcare needs than international migrants (Fig. 1).

When analysing the effects of school attendance, educational level, employment, and income on short- and long-term healthcare needs among locals and international migrants separately over the years, the ORs of each of the categories of the different variables fluctuated over the period observed (with no marked upward or downward trends), and the significance of each variable and goodness of fit of the models varied by year and age range (Tables 2–3).

Specifically, for the 19–25 age group, at least one quintile level of household income was statistically significant in reference to quintile V (richest) in relation to reporting short-term health needs in both migrants and locals each year, except 2015 for locals. Except for 2013, where the adjusted Hosmer and Lemeshow test indicated possible problems with the Goodness of Fit (GOF) of the model, the lower quintiles had less odds of reporting short-term healthcare needs than the richest quintile among international migrants (in 2022 we observed between 56% and 67% less chance depending on the quintile) (OR<1). A similar situation occurred with the local population, except for 2020 where the lowest income quintiles had a higher chance of reporting short-term needs than the richest quintile, however, this was significant only for quintile IV vs. V (OR 1.33). In the case of the local population, never having worked vs being employed was significant every year, except 2015, in favour of those who had never worked (Table 2). In the case of long-term healthcare needs, the income quintile was not significant for migrants. Conversely, having completed basic education in 2022, having less than basic education in 2020 and 2015 in reference to having completed secondary education, and not attending an educational institution in reference to attending one in 2013 were statistically significant for migrants (OR 0.37, 3.34, 0.03 and 0.25 respectively). Regarding the local population, the number of factors related to reporting long-term healthcare needs was higher than among migrants (Table 3).

For migrants in the 26–59 age group, being unemployed vs employed in 2022 and 2020 and belonging to the poorest quintile vs the wealthiest in 2013 were risk factors for self-reported long-term healthcare needs,

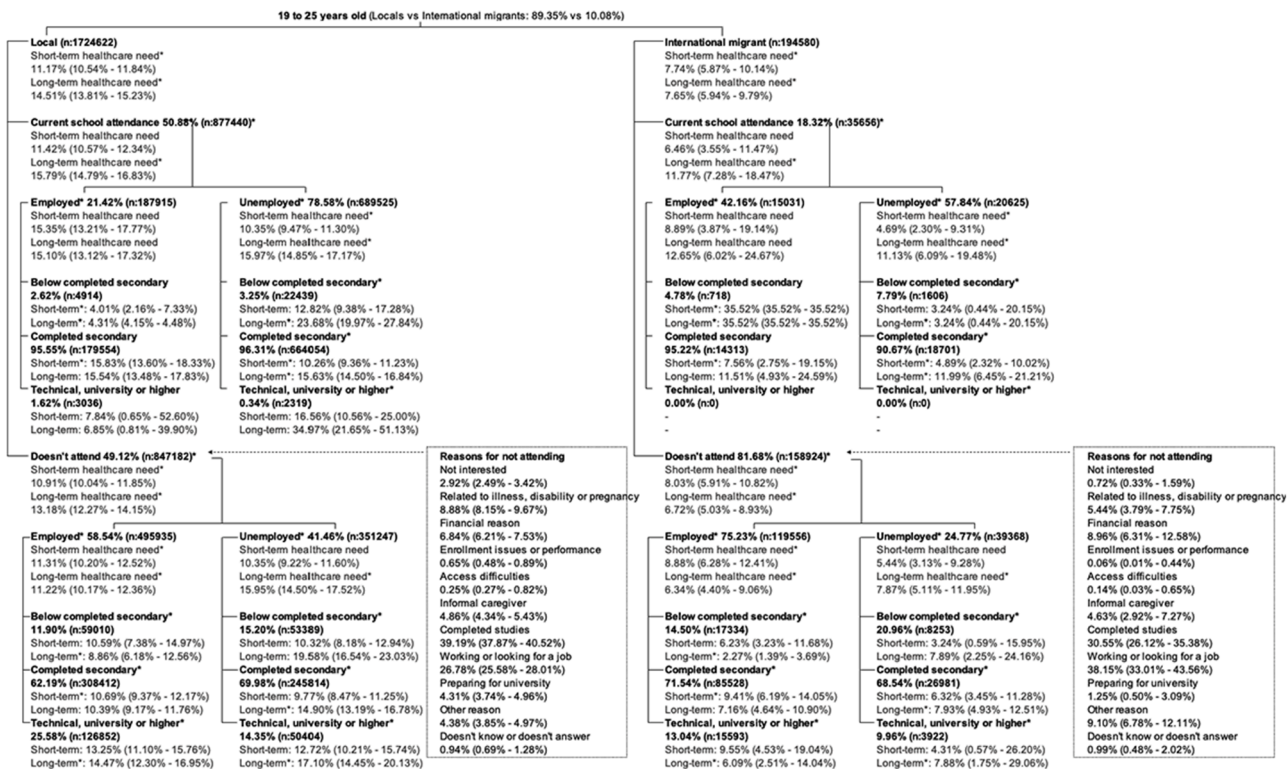


Fig. 2. Long-term needs, short-term needs, and 20/20 index according to characteristics related to education and work in the local and immigrant population aged 19 to 25. CASEN 2022.

20/20 Index → Locals 11.57, International migrants (IM) 6.25, locals who currently attend education 13.86, locals who don't attend 8.39, IM who attend 8.21, IM who don't attend 5.56, locals who attend and are employed 11.52, locals who attend and are unemployed 14.34, IM who attend and are employed 6.07, IM who attend and are unemployed 8.69, locals who don't attend and are employed 6.87, locals who don't attend and are unemployed 10.93, IM who don't attend and are employed 5.37, IM who don't attend and are unemployed 4.59. * p-value <0.05 Pearson χ^2 statistic with second-order correction of Rao and Scott (F statistic) of the migration variables with the respective indicated variable for the corresponding level. 20/20 Index (20/20 I.) is calculated as the ratio between the mean household autonomous income in the last quintile and the mean household autonomous income in the first quintile in the respective subgroups of interest (it is omitted if there are no respondents in quintiles 1 or 5). By educational level, the missing percentage corresponds to those who don't know or respond.

with 1.41 and 2.11 times more likelihood to report such needs, respectively. Among the local population, never having worked and being unemployed vs being employed (except in 2020) and incomplete basic education vs complete higher education were risk factors for reporting healthcare needs for the whole period, while the significance of the other factors analysed varied from year to year (Table 2). For short-term healthcare needs, the significance of the different variables varied from year to year, among both migrants and locals (Table 2).

Regarding older adults (60 years and older), for short-term healthcare needs, the models showed limited GOF for all years except 2022 among migrants, despite being significantly different from the null model (Table 2). Regarding long-term healthcare needs among migrants, belonging to quintile I and IV vs quintile V in 2022 (OR 0.46 and 0.41 respectively), quintile I vs quintile V in 2020 (OR 2.18), quintile III vs V (OR 0.13) in 2013 and being unemployed vs being employed also in 2013, were statistically significant (Table 3).

Finally, we combined the data from all years, and being a migrant with reference to being born in Chile, turned out to be a protective factor for long and short term needs among all age groups, except for short term needs for people aged 60 and over (Table 4).

3.3. Exploratory analysis of the interactions between school attendance or educational attainment and occupation and relation to health

We conducted an exploratory analysis of the interactions between current school attendance (19–25 age group) or educational attainment (26 to 59 and 60+ age groups) and occupation in 2022. With regards to the descriptive results, a greater proportion of locals between 19 and 25

years old reported still attending school than international migrants (50.88% vs 18.32%). Among those not currently attending school, a greater proportion of locals was unemployed, compared to international migrants (41.46% vs 24.77%) (Fig. 2). Among the 26 to 59 age group, a greater proportion of unemployed locals reported having completed higher education than international migrants (12.30% vs 9.44%) (Fig. 3). Finally, among the 60+ age group, 29.41% of the locals reported being currently employed versus 40.57% among international migrants. Additionally, a greater proportion of locals reported being retired (45.08% vs 15.77%). Regarding educational level for this age group, among both locals and international migrants, those with a completed higher education were the most represented among the employed with regards to other employment situations (Fig. 4). Please see Supplementary Material 2 for the detailed tables.

When relating these interactions to health, the confidence intervals among those reporting long- and short-term healthcare needs did not overlap in the case of some combinations between school attendance, employment, and educational attainment, for both migrants and locals (Figs. 2–4). For example, among migrants, the confidence intervals for long-term and short-term healthcare needs did not overlap between those who did not attend school, were unemployed and had less than full secondary education and those who did not attend, were employed, and had less than full secondary education in the 19–25 age group (Fig. 2). For migrants belonging to the 26–59 age group, there were differences in the short-term healthcare needs of those reporting incomplete basic education according to whether they were employed or had never worked, among others (Fig. 3). In the 60 or older age group, there were differences regarding the long-term healthcare needs of those who had

26 to 59 years old (Locals vs International migrants: 86.79% vs 11.98%)		Below basic education level* 6.97% (n:579912) →		Occupation* →	Short-term healthcare need	Long-term healthcare need	20/20 I.
		Short-term healthcare need*		Has never worked (16.39%)	13.22% (11.32% - 15.39%)*	50.78% (47.88% - 53.67%)*	10,51
		Long-term healthcare need*		Unemployed (30.87%)	20.86% (18.89% - 22.98%)*	51.79% (49.39% - 54.18%)*	13,05
		42.32% (40.92% - 43.73%)		Employed (52.74%)	16.74% (15.31% - 18.28%)*	34.15% (32.33% - 36.02%)*	5,62
		20/20 Index: 7.64					
		Completed basic* 15.67% (n:1303975) →		Occupation* →	Short-term healthcare need	Long-term healthcare need	20/20 I.
		Short-term healthcare need*		Has never worked (6.68%)	11.88% (10.04% - 14.01%)*	42.37% (39.51% - 45.27%)*	10,05
		Long-term healthcare need*		Unemployed (27.67%)	17.46% (15.97% - 19.06%)*	41.68% (39.90% - 43.47%)*	7,55
		33.31% (32.33% - 34.30%)*		Employed (65.66%)	15.04% (14.11% - 16.02%)*	28.86% (27.68% - 30.07%)*	5,92
		20/20 Index: 6.79					
		Completed secondary* 42.91% (n:3570456) →		Occupation* →	Short-term healthcare need	Long-term healthcare need	20/20 I.
		Short-term healthcare need*		Has never worked (5.02%)	10.65% (9.17% - 12.35%)*	33.97% (31.47% - 36.56%)*	15,76
		Long-term healthcare need*		Unemployed (23.78%)	16.96% (15.90% - 18.08%)*	33.39% (32.12% - 34.69%)*	10,88
		27.70% (27.06% - 28.35%)*		Employed (71.20%)	15.58% (14.83% - 16.36%)*	25.35% (24.61% - 26.11%)*	6,90
		20/20 Index: 8.40					
		Completed higher education* 34.01% (n:2830222) →		Occupation* →	Short-term healthcare need	Long-term healthcare need	20/20 I.
		Short-term healthcare need*		Has never worked (1.27%)	10.77% (7.66% - 14.93%)*	27.41% (22.98% - 32.34%)*	17,10
		Long-term healthcare need*		Unemployed (12.30%)	17.46% (15.71% - 19.36%)*	30.61% (28.53% - 32.76%)*	14,95
		27.06% (26.19% - 27.94%)*		Employed (86.43%)	18.63% (17.45% - 19.87%)*	26.55% (25.58% - 27.54%)*	10,18
		20/20 Index: 21.64					
		Below basic education level* 5.41% (n:62138) →		Occupation* →	Short-term healthcare need	Long-term healthcare need	20/20 I.
		Short-term healthcare need*		Has never worked (10.35%)	28.03% (16.95% - 42.64%)*	19.88% (9.81% - 36.15%)*	-
		Long-term healthcare need*		Unemployed (20.64%)	13.95% (7.74% - 23.87%)*	21.91% (14.35% - 31.98%)*	-
		15.98% (11.89% - 21.13%)*		Employed (69.01%)	9.01% (5.99% - 13.35%)*	13.62% (9.49% - 19.16%)*	4,43
		20/20 Index: 4.98					
		Completed basic* 12.38% (n:142175) →		Occupation* →	Short-term healthcare need	Long-term healthcare need	20/20 I.
		Short-term healthcare need*		Has never worked (4.42%)	6.46% (1.79% - 20.77%)*	25.70% (14.32% - 41.70%)*	-
		Long-term healthcare need*		Unemployed (17.77%)	10.08% (6.34% - 15.65%)*	21.17% (15.34% - 28.48%)*	14,49
		14.80% (12.37% - 17.62%)*		Employed (77.31%)	10.45% (8.14% - 13.32%)*	12.73% (10.15% - 15.85%)*	4,31
		20/20 Index: 5.58					
		Completed secondary* 41.36% (n:474895) →		Occupation* →	Short-term healthcare need	Long-term healthcare need	20/20 I.
		Short-term healthcare need*		Has never worked (3.44%)	4.06% (1.88% - 8.54%)*	10.52% (6.04% - 17.71%)*	10,63
		Long-term healthcare need*		Unemployed (15.40%)	12.01% (8.91% - 16.00%)*	19.54% (14.69% - 25.52%)*	10,53
		13.64% (12.17% - 15.27%)*		Employed (81.16%)	9.87% (8.14% - 11.93%)*	12.66% (11.11% - 14.38%)*	6,25
		20/20 Index: 6.81					
		Completed higher education* 39.52% (n:453810) →		Occupation* →	Short-term healthcare need	Long-term healthcare need	20/20 I.
		Short-term healthcare need*		Has never worked (1.88%)	9.63% (3.56% - 23.55%)*	11.69% (6.11% - 21.23%)*	20,83
		Long-term healthcare need*		Unemployed (9.44%)	11.00% (7.11% - 16.63%)*	22.86% (17.07% - 29.91%)*	10,80
		16.21% (14.00% - 18.68%)*		Employed (88.57%)	12.71% (9.98% - 16.06%)*	15.60% (13.27% - 18.24%)*	7,98
		20/20 Index: 8.72					

Fig. 3. Long-term needs, short-term needs, and 20/20 index according to characteristics related to education and work in the local and immigrant population aged 26 to 59. CASEN 2022. * p-value <0.05 Pearson χ^2 statistic with second-order correction of Rao and Scott (F statistic) of the migration variables with the respective indicated variable for the corresponding level. 20/20 Index (20/20 I.) is calculated as the ratio between the mean household autonomous income in the last quintile and the mean household autonomous income in the first quintile in the respective subgroups of interest (it is omitted if there are no respondents in quintiles 1 or 5, poorest and richest respectively).

never worked according to educational level (Fig. 4).

Finally, it is worth noting that, among the population aged 19–25, the percentage of people who did not attend school for reasons related to illness, disability or pregnancy was higher among locals (8.88%, CI95%: 8.15% - 9.67%) than among migrants (5.44%, CI95%: 3.79% - 7.75%) (Fig. 2).

4. Discussion

The present study aimed at analysing education as a SDoH among

international migrants and the Chilean population in Chile between 2013 and 2022, based on a repeated analysis of CASEN surveys. Education was conceptualised as current school attendance and educational attainment and health as short- and long-term healthcare needs (illness or accident in the last 3 months or being treated for any pathology during the last year prior).

Descriptive results found that generally, international migrants have a higher educational level than locals, although the gap has been reduced over the years mainly as a result of a constant increase of the proportion of locals reporting having completed higher education since

Locals (n:3504258)		Has never worked* 5.47% (n:191707)	Education level*	Short-term healthcare need	Long-term healthcare need	20/20 I.
		Short-term healthcare need	Below basic (37.20%)	24.65% (21.97% - 27.54%)	71.18% (68.25% - 73.95%)*	10,57
		23.46% (21.64% - 25.40%)	Completed basic (37.56%)	21.80% (19.14% - 24.73%)	70.71% (67.43% - 73.79%)*	14,43
		Long-term healthcare need*	Completed secondary (20.72%)	24.16% (20.39% - 28.38%)*	65.60% (61.01% - 69.91%)*	11,26
		69.60% (67.49% - 71.63%)	Completed higher educ. (2.92%)	22.74% (21.17% - 24.39%)*	63.89% (55.97% - 71.12%)*	32,33
		20/20 Index: 13.64				
		Inactive due to retirement* 45.08% (n:1579669)	Education level*	Short-term healthcare need	Long-term healthcare need	20/20 I.
		Short-term healthcare need*	Below basic (33.75%)	23.33% (22.21% - 24.48%)	74.31% (73.12% - 75.48%)	17,13
		23.14% (22.39% - 23.90%)	Completed basic (34.40%)	22.66% (21.46% - 23.91%)	73.64% (72.32% - 74.91%)	16,85
		Long-term healthcare need	Completed secondary (18.34%)	22.64% (20.94% - 24.43%)*	69.12% (67.14% - 71.04%)*	17,80
		72.31% (71.49% - 73.11%)	Completed higher educ. (12.17%)	24.40% (22.08% - 26.89%)*	68.19% (65.43% - 70.83%)*	21,92
		20/20 Index: 18.21				
		Unemployed* 20.04% (n:702403)	Education level*	Short-term healthcare need	Long-term healthcare need	20/20 I.
		Short-term healthcare need	Below basic (29.83%)	30.02% (28.02% - 32.10%)	73.28% (71.16% - 75.29%)*	12,63
		29.16% (27.93% - 30.42%)	Completed basic (36.69%)	29.08% (27.05% - 31.19%)	73.36% (71.40% - 75.24%)*	16,43
		Long-term healthcare need*	Completed secondary (22.89%)	27.89% (25.60% - 30.30%)*	65.49% (62.99% - 67.91%)*	17,41
		70.86% (69.62% - 72.07%)	Completed higher educ. (9.44%)	27.08% (23.40% - 31.10%)	66.24% (61.56% - 70.63%)*	20,19
		20/20 Index: 17.63				
		Employed* 29.41% (n:1030479)	Education level*	Short-term healthcare need	Long-term healthcare need	20/20 I.
		Short-term healthcare need	Below basic (19.69%)	20.06% (18.28% - 21.96%)	52.50% (50.25% - 54.75%)*	8,57
		21.74% (20.57% - 22.96%)	Completed basic (32.93%)	21.74% (20.19% - 23.37%)	54.41% (52.57% - 56.25%)*	7,89
		Long-term healthcare need*	Completed secondary (26.60%)	20.19% (18.47% - 22.01%)*	52.99% (50.81% - 55.15%)*	9,70
		54.11% (52.89% - 55.33%)	Completed higher educ. (19.74%)	25.43% (21.48% - 29.82%)*	57.26% (53.89% - 60.57%)*	13,97
		20/20 Index: 12.26				
Over 60 years old (Locals vs International migrants: 95.97% vs 2.17%)		Has never worked* 10.68% (n:8479)	Education level*	Short-term healthcare need	Long-term healthcare need	20/20 I.
		Short-term healthcare need	Below basic (18.92%)	22.13% (7.66% - 49.33%)*	24.50% (9.30% - 50.68%)*	-
		27.02% (15.71% - 42.38%)	Completed basic (21.26%)	14.53% (5.79% - 31.98%)*	56.52% (30.86% - 79.10%)*	4,84
		Long-term healthcare need*	Completed secondary (32.52%)	19.91% (9.68% - 36.58%)*	63.15% (47.24% - 76.63%)*	18,16
		59.16% (47.03% - 70.27%)	Completed higher educ. (25.90%)	45.81% (45.81% - 45.81%)*	79.42% (79.42% - 79.42%)*	-
		20/20 Index: 7.93				
		Inactive due to retirement* 15.77% (n:12520)	Education level*	Short-term healthcare need	Long-term healthcare need	20/20 I.
		Short-term healthcare need*	Below basic (16.67%)	21.18% (7.36% - 47.61%)*	65.88% (44.31% - 82.42%)*	18,75
		13.91% (8.68% - 21.54%)	Completed basic (32.89%)	18.29% (8.27% - 35.70%)*	64.23% (34.59% - 85.91%)*	16,35
		Long-term healthcare need	Completed secondary (23.41%)	2.18% (0.63% - 7.24%)*	51.28% (30.21% - 71.90%)*	16,32
		61.13% (48.70% - 72.27%)	Completed higher educ. (23.64%)	11.45% (4.41% - 26.63%)*	62.74% (43.45% - 78.67%)*	-
		20/20 Index: 15.60				
		Unemployed* 32.99% (n:26194)	Education level*	Short-term healthcare need	Long-term healthcare need	20/20 I.
		Short-term healthcare need	Below basic (15.45%)	31.07% (18.70% - 46.90%)*	42.39% (28.60% - 57.47%)*	-
		21.52% (13.73% - 32.09%)*	Completed basic (25.00%)	25.21% (13.54% - 42.04%)*	64.21% (37.76% - 84.14%)*	20,14
		Long-term healthcare need*	Completed secondary (29.77%)	23.53% (8.14% - 51.66%)*	48.48% (27.89% - 69.60%)*	9,56
		51.86% (40.52% - 63.01%)*	Completed higher educ. (29.23%)	11.68% (5.23% - 24.05%)*	48.84% (31.05% - 66.94%)*	13,63
		20/20 Index: 14.30				
		Employed* 40.57% (n:32215)	Education level*	Short-term healthcare need	Long-term healthcare need	20/20 I.
		Short-term healthcare need	Below basic (13.02%)	22.00% (10.40% - 40.67%)*	50.95% (32.19% - 69.45%)*	6,43
		20.34% (13.66% - 29.18%)*	Completed basic (19.23%)	13.66% (8.53% - 35.99%)*	39.01% (23.94% - 56.51%)*	3,66
		Long-term healthcare need*	Completed secondary (27.71%)	20.80% (10.10% - 38.05%)*	51.08% (37.86% - 64.14%)*	5,79
		40.10% (32.23% - 48.51%)*	Completed higher educ. (35.71%)	20.90% (9.45% - 40.08%)*	31.59% (19.32% - 47.12%)*	78,45
		20/20 Index: 8.95				
International migrants (n:79408)		Short-term healthcare need				
		20.43% (15.38% - 26.62%)*				
		Long-term healthcare need*				
		49.33% (42.90% - 55.78%)*				
		20/20 Index: 10.33				

Fig. 4. Long-term needs, short-term needs, and 20/20 index according to characteristics related to education and work in the local and immigrant population aged over 60. CASEN 2022.

* p-value < 0.05 Pearson χ^2 statistic with second-order correction of Rao and Scott (F statistic) of the migration variables with the respective indicated variable for the corresponding level. 20/20 Index (20/20 I.) is calculated as the ratio between the mean household autonomous income in the last quintile and the mean household autonomous income in the first quintile in the respective. subgroups of interest (it is omitted if there are no respondents in quintiles 1 or 5, poorest and richest respectively). By educational level, the missing percentage corresponds to those who don't know or didn't respond.

2013. This may be due to the significant efforts that have been made in Chile in recent years to improve access to higher education, including government-backed student loans, programmes and legal regulations to grant free access to some universities for students belonging to low-income households, and the expansion of private universities (Santelices et al., 2019, Abarca Millán, 2020, Rodríguez-Garcés, 2021). These measures may have contributed to reducing some gaps, however, concerns remain with regards to the quality of some private universities and to the actual reduction of the more acute inequities regarding

financial access to universities (Espinoza, 2017, Espinoza et al., 2024). Another potential concern, beyond access to higher education, is the quality of basic and secondary education. Although increasingly less people do not complete basic education in Chile, the quality of basic and secondary education vastly varies across the public and private sectors, and access to high quality education remains highly determined by socioeconomic factors (Mella, 2003, Torres, 2018). Highly educated international migrants, on the other hand, may leave their country of origin in search of better opportunities abroad (Villarreal, 2016).

Considering that Chile is an attractive country for its political and economic stability within Latin America and the Caribbean, where most of international migrants come from, this may explain why a greater proportion of international migrants report higher education compared to Chileans (Aldunate et al., 2019).

Regarding employment, rates are consistently and considerably higher among international migrants than locals, potentially due to more female migrants being employed than their Chilean counterparts. Although our results are not stratified by sex, this phenomenon is commonly observed, as women may migrate on their own in search of employment or migrant households may need a dual income, especially if remittances are sent to their country of origin (He and Gerber, 2020, Mizanur Rahman, 2013). Finally, concerning income, international migrants remained with a higher proportion belonging to the wealthiest quintile than the local population until 2022. Additionally, the proportion of international migrants belonging to the wealthiest income was halved between 2013 and 2022 and was redistributed among intermediate quintiles.

Across the decade examined in this study, the educational level of international migrants in Chile trended upwards until 2022, their employment rate continuously increased except in 2022, while their representation among the wealthiest quartile continuously decreased, coming to be 50% of what it was in 2013. Chileans, on the other hand, increased their participation in higher education, while generally maintaining their employment rate and distribution across income quintiles. In that sense, international migrants, overall, are more educated and employed at a higher rate than their Chilean counterparts, while earning less. Identifying the quality of employment, in terms of wages, regularity, formality and conditions, is beyond the scope of this study, however, other studies have reported that a proportion of international migrants in Chile experience high levels of precarity with regards to their employment, due to subcontracting practices, migratory status, discrimination, among others (Stefoni et al., 2017, Blukacz et al., 2022). Furthermore, international migrants may face underemployment, defined as employment that do not fully utilise their skills, education, or availability to work, leading to a lower income regardless of their educational level (Risberg and Romani, 2022, Chwiałkowska, 2020). This could explain why international migrants may experience a mismatch between their educational level, employment rate, and income.

Regarding health, consistent with the descriptive results, the adjusted logistic regression models found that being a migrant vs. local was statistically significant for reporting both short- or long-term healthcare needs, to the disadvantage of local populations, although not every year, and without any marked trend. The general disadvantage of the local population compared to international migrants may be explained by the healthy migrant effect, which suggests that international migrants are healthier than locals, albeit temporarily, due to self-selection (Kennedy et al., 2015, Sserwanja and Kawuki, 2020, Markides and Rote, 2019). It may also be explained by international migrants underreporting health issues due to underdiagnoses or barriers to access the healthcare system (Giorgi Rossi et al., 2017). However, the main limitation of the analytical component of this study is that, although the adjusted models differ from the null model considering the complex design of the sample, for some years and age groups, especially in the case of the population over 60 years old, the adjusted Hosmer and Lemeshow tests could indicate the need to include additional variables or consider the non-linearity of the relationship between long- and short-term healthcare needs and the different variables analysed. Future research may apply different models or methods of analysis, even more so with regards to older adults who could benefit from a separate in-depth analysis. For 2022, we explored possible interactions between: (i) school attendance or educational attainment (ii) occupation and (iii) effect on healthcare needs. However, the decrease in sample size (especially for international migrants) decreased statistical power, limiting inferences. Collinearity between independent variables was not

directly assessed in logistic regression models with complex sample design (svy: logit), as the Variance Inflation Factor (VIF) analysis is not compatible with this type of models in Stata. To mitigate this problem, we analysed the associations between the variables occupation, autonomous income quintile and education, obtaining only weak associations. Despite its limitations, this exploratory study provides an overview of education, employment, income, and short- and long-term health needs among international migrants throughout a decade, which may be a point of departure for narrower in-depth analyses on the topic to inform intersectoral policymaking.

5. Conclusions

In conclusion, it is recognised that educational attainment is a social determinant of health insofar as it usually determines employment and income, which may, in turn, affect health. It is expected that the higher the educational level, the better the employment and the higher the income, leading to better health outcomes. However, international migrants in Chile have seen the proportion of their overall population represented in the wealthiest income quartile halved between 2013 and 2022. Although this did not lead to an identifiable effect on health, it may raise concerns as to future health issues that may emerge in the medium to long term and calls for further studies on the topic.

Consent for publication

Not applicable as the data presented was anonymised and no individual person may be identified.

Ethics approval and consent to participate

Not applicable.

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Availability of data and materials

The data is available through the following link: <https://observatorio.o.ministeriodesarrollosocial.gob.cl>

CRediT authorship contribution statement

Alice Blukacz: Writing – original draft, Methodology, Conceptualization. **Marcela Oyarte:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Báltica Cabieses:** Writing – review & editing, Methodology, Investigation, Formal analysis, Conceptualization. **Janepsy Díaz:** Writing – review & editing, Supervision, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

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