Nutrition status in adult Chilean population: economic, ethnic and sex inequalities in a post-transitional country

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Abstract

Objective: To assess the relationship between malnutrition, socioeconomic status (SES) and ethnicity in Chilean adult population.

Design: Nationally representative survey (ENS) conducted in 2016–2017. Sociodemographic information, weight, height and hemoglobin (Hb) were measured (2003 ENS). Excess weight was defined as BMI ≥ 25 kg/m². Undernutrition included underweight (BMI <18.5 kg/m²), short stature (height <1.49 m in women and <1.62 m in men) or anaemia (Hb <12 g/l). Education and household income level were used as indicators of SES; ethnicity was self-reported. We applied linear combinations of estimators to compare the prevalence of excess weight and undernutrition by SES and ethnicity.

Setting: Chile.

Participants: In total, 5082 adults ≥ 20 years (64 % women) and 1739 women ≥ 20 years for anaemia analyses.

Results: Overall, >75 % of women and men had excess weight. Low SES women either by income or education had higher excess weight ((82·0 (77·1, 86·1) *v.* 65·0 (54·8, 74·1)) by income; (85·3 (80·6, 89·0) *v.* 68·2 (61·6, 74·1) %) by education) and short stature (20–49 years; 31(17·9, 48·2) *v.* 5·2 (2·2,11·4) by education); obesity was also more frequent among indigenous women (20–49 years; 55·8 (44·4, 66·6) *v.* 37·2 (32·7, 42·0) %) than non-indigenous women. In men, excess weight did not significantly differ by SES or ethnicity, but short stature concentrated in low SES (20–49 years; 47·6 (24·6, 71·6) *v.* 4·5 (2·1, 9·5) by education) and indigenous men (21·5 (11·9, 5·5, 11·9) *v.* 8·2 (5·5, 11·9)) ($P < 0.05$ for all).

Conclusions: In Chile, malnutrition is disproportionately concentrated among women of low SES and indigenous origin; these inequalities should be considered when implementing prevention policies.

In the 1960s, Chilean population was affected by a high incidence of infectious diseases (300 per 100·000 inhabitants) and prevalence of infant mortality of 24 %[1]. Additionally, 37 % of children had undernutrition[2] and approximately 20 % were anaemic[3]. Public health policies and programs were focused on decreasing maternal–child mortality, undernutrition and micronutrient deficiency[4].

However, during the last decades, Chile has faced an extremely rapid nutrition transition[4,5].

Currently, Chile leads in obesity burden, with one of the highest prevalence worldwide[6]. According to the latest National Health Survey, 31 % of adult population (≥ 15 years) is obese, whereas the prevalence of overweight is almost 40 %[7]. The prevalence of excess weight,

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defined as the combined prevalence of overweight and obesity, has increased from 6 % in the 1980s[5] to 71 % in 2016[7]. Additionally, 9 % of children <5 years are overweight, increasing this prevalence to 31 % in children >5 years[8,9]. In contrast, the prevalence of anaemia is no longer a public health issue in Chilean women (<5 %) and neither is stunting or underweight[10,11]. Thus, Chile is considered as a country facing post-transitional stages in the nutrition transition[12]. This nutrition situation contrast with the reality of several Latin-American neighbouring countries that are facing early stages of this transition, where undernutrition and obesity coexist at the individual, household and country levels[13]. In Ecuador, 9 % of the adult population have excess weight and anaemia at the individual or household level[14], while in Guatemala, 48 % of children <5 years are stunted, 49 % have anaemia and 5 % have excess weight[15], whereas in Uruguay, 10 % of children are stunted and have excess weight[16].

This period of nutritional change in Chile has been concomitant with rapid economic growth characterised by the reduction in poverty rates (i.e. extreme poverty defined as a monthly per-capita income of $US 154 or less decreased from 3·5 % in 2006 to 2·6 % in 2015)[17,18]. However, according to the 2015 OCDE Inequality Report[19], Chile has the highest inequality level in the region, showing the lowest reduction in the GINI coefficient (−3·1 %), a well-known inequality index, in the period 2002–2011, compared with Argentina (−10·3 %), Bolivia (−12·4 %), Ecuador (−3·8 %) and Uruguay (−5·4 %)[20].

The relationship between socioeconomic status (SES) and several nutritional status indicators such as excess weight has been previously described[21–24]. In Chile, a study including more than 1 500 000 Chilean children (mean age 76·3 (sd 4·35) months) showed that poorest children had a higher prevalence of stunting compared with wealthier children[25], whereas Azar *et al.*[26] found that high-middle SES adolescents assessed by the mother's education level were less likely to be overweight or obese, compared with those with a low socioeconomic level. Similar results were found in a cohort study which included adults living in the Valparaíso Region of Chile, where low SES women showed a significant increase in BMI and waist circumference (WC) compared with high SES women in a 10-year period; in men, neither BMI nor WC differs by SES[27].

In addition to the influence of SES, previous studies have reported that ethnicity may play a key role on nutritional status of Chilean population. Currently, 10 % of Chilean population identifies themselves as indigenous, being the largest preference Mapuche[28]. Bustos *et al.*[25] reported that first-grade school Mapuche children were shorter than non-Mapuche children. Additionally, a recent longitudinal study in which pre-schooler children was followed for 2 years indicated that being indigenous was a risk factor for developing overweight or obesity at 6 years[29]. Similar findings were reported at school-age children where indigenous children had a 6 % higher risk of being

obese compared with non-indigenous children[25]. Nonetheless, there is still controversy on whether part of the observed nutritional differences by ethnicity are actually due to SES differences[30].

To date, the relationship between malnutrition, SES and ethnicity has not been studied in a Chilean national representative sample. Therefore, the aim of the current study is to assess the relationship between all malnutrition forms (e.g. excess weight, anaemia), socioeconomic indicators defined by the income and education level and ethnicity in a representative sample of Chilean women and men. Our goal is to describe how different forms of malnutrition are present on a post-transitional country that has alarming SES, ethnicity and sex inequalities.

Population and methods

Double burden series

- The current article corresponds to one of a series of papers exploring the double burden of malnutrition in LAC; therefore, sample, methods and data analyses definitions were made on agreement with all other countries. Some of these definitions or categories do not apply to the context of Chile but have been kept in the manuscript to keep comparability across articles.

Data source and sampling

National Health Survey 2016–2017: nutritional status and demographic characteristics
Data on height, weight, education, monthly household income level and ethnicity were obtained for adults (>20 years) from the latest available Chilean National Health Survey (ENS) conducted in 2016–2017[7].

The 2017 ENS included 6233 participants aged >15 years, using a random household sampling (multistage, cluster sample and stratification by urban–rural and region population), had a high rate of response of 85 %[10]. For the current study, subjects were excluded according to the following criteria: age <20 years (*n* 355), no available anthropometric measurements (*n* 750) and no available education level (*n* 46). Final sample included 5082 adults, 3257 women and 1825 men.

Nutritional status. Subjects were classified as underweight, overweight and obese using BMI (kg/m²) following the WHO criteria[31]. Excess weight was defined as BMI ≥25 kg/m². Given the physiological changes in height during late adulthood[32] and also the relationship between the obstetric risk and short stature[33], we only estimated the short stature prevalence in women and men between 20 and 49 years. Short stature was classified according to the tenth percentile of the sample distribution (height <1·49 m for women and <1·62 m for men). Undernutrition was defined as the presence of either underweight, short stature or anaemia (see below for definition).

Socioeconomic status. Education and monthly household income levels were considered as indicators of SES. Education level of the participants was classified as: (i) low (<8 years); (ii) medium (8–12 years) and (iii) high (>13 years) based on self-reported years of completed schooling. All participants were asked to report their monthly household income using eleven categories that ranged from less than $US 77·999 Chilean Pesos (CLP) (about $US 116) to more than $US 1·573·000 CLP (about $US 2348). We categorised the monthly household income in four levels as low (less than $US 295·999 CLP), medium (between $US 296·000 and $US 1·000·000 CLP) high (more than $US 1·000·000 CLP) and non-responders that accounted for a 14·6 % of final sample. Additionally, we provided descriptive information about bare-earth floor, use of firewood or carbon for cooking, public sanitary sewer system, public water network connection and electricity as an indirect indicator of SES.

Ethnicity. Ethnicity was classified by asking 'Do you belong or are you a descendant of any of the nine indigenous peoples recognizes by law in Chile?' which had ten possible answers (i.e. Aymara, Rapa-Nui (Pascuenses), Quechua, Mapuche, Acatameno (Lincai Antai), Coya, Kawesqar (Alacalufes), Yagan (Aymara) or Diaguita). We dichotomised the variable into 'yes' (belong to any of the nine indigenous peoples) and 'no' (do not belong).

National Health Survey 2003: anaemia information

Due to the lack of hemoglobin (Hb) information in 2016–2017 ENS, anaemia and the corresponding education information was obtained from the last national survey that had micronutrient status information that was the 2003 ENS[10]. The 2003 ENS is a cross-sectional national representative sample which included 3619 participants (women, *n* 1973), aged ≥17 years, stratified by urban–rural and region population and had a rate of response of 90 %. Sampling procedures followed a multistage, stratified and cluster design.

Anaemia. Given the vulnerability of developing iron deficiency and anaemia in women and the median age of menopause in Chilean women[34], Hb concentration was determined only in women population ≥20 years. Women were excluded if they were <20 years (*n* 86), had no available Hb measurement (*n* 144) or education information (*n* 4). In total, we analysed available Hb data of 829 (20–49 years) and 910 (>49 years) women. Hb concentration was determined by colorimetric method[10]. Anaemia was defined according to the WHO criteria as Hb concentration <12 g/dL[35]. Hb values were not adjusted by altitude, because this information was not available in the 2003 ENS. Women were classified with a low (<8 years), medium (8–12 years) and high (>13 years) education level based on self-reported years of completed schooling.

Statistical analyses

We estimated the prevalence and 95 % CIs of indicators of overweight, obesity, excess weight, underweight, short stature and anaemia according to sex, ethnicity, age groups, monthly household income and education levels. Continuous and categorical variables were described as means or percentages and 95 % CI, respectively. To compare our findings with the results of other Latin American countries included in this 'Double Burden Series', we classified adult population by age categories: 20–49 years and >49 years. Differences in means and proportions of excess and undernutrition by SES and ethnicity were tested using the test for linear combinations ('lincom' command in Stata 12.0). The statistical significance level was set at $P < 0.05$. All the statistical analyses were performed with Stata version 12 (Stata Corp.) incorporating appropriate survey sample weight.

Results

Age, education level, ethnicity and household characteristics of the sample stratified by income levels are shown in Table 1. The average age of 20–49 year samples was 34·6 years in women and 33·2 years in men, while in adults >49 years it was 62·9 years in women and 63·1 years in men. Additionally, 8 % of the subjects identified themselves as indigenous. Most of the participants had medium education level (women (53·1 %) and men (44·7 %)) and were classified as medium monthly household income level. Younger adults (20–49 years) had higher educational levels compared with older adults (>49 years). As expected, there was a positive relationship between education level and monthly household income levels and household characteristics; for example, women and men with a highest income had highest education, and women and men with lower income were more likely to use firewood or carbon for cooking and had less water and sanitation facilities than women and men that had a highest income level. Interestingly, 12·4 % of low SES adults identified themselves as indigenous, whereas only 3 % of high SES adults indicated being indigenous.

Nutrition status in adult Chilean population

Most of the population (78·7 % in women and 77·2 % in men) had excess weight, whereas short stature and anaemia were below 13 and 8 %, respectively. Underweight was almost negligible (<2 % in both sexes) (Table 2). Obesity was more prevalent in women than in men, while the opposite was seen for overweight prevalence ($P < 0.05$). Furthermore, in both sexes, the prevalence of obesity increased with age.

Nutrition status, socioeconomic status and ethnicity in women

We observed an inverse association between SES (either by income or educational level) with excess weight (<49 years) and obesity (>20 years) ($P < 0.05$) (Table 2; Figs 1 and 2). Obesity was also more frequent among indigenous than non-indigenous young women (<49 years;

Table 1 Sample characteristics by household income in Chile based on the 2016–2017 National Health Survey

	All		Low		Medium		High		Without information	
	Average age or %	95 % CI	Average age or %	95 % CI	Average age or %	95 % CI	Average age or %	95 % CI	Average age or %	95 % CI
Women 20–49 years (n 1489)			n 337		n 681		n 235		n 237	
Age (years)	34·6	33·9, 35·4	35·9	34·5, 37·3	35·1	34·0, 36·2	33·3	31·6, 35·1	32·6	30·5, 34·7
Education level										
Low (<8 years)	7·4	5·5, 10·2	15·5	10·3, 22·7	7·6	4·6, 12·4	0·0	0·0, 0·0	3·2	1·3, 7·4
Medium (8–12 years)	55·9	51·2, 60·4	66·9	57·6, 75·0	62·9	56·1, 69·2	37·8	26·8, 50·1	37·8	26·9, 50·1
High (13 years or more)	36·7	32·3, 41·3	17·6	11·1, 26·7	29·5	23·7, 36·1	62·2	49·8, 73·1	59·0	47·0, 70·3
Women >49 years (n 1768)			n 690		n 672		n 104		n 302	
Age (years)	62·9	62·1, 63·7	64·0	62·8, 65·2	61·5	60·1, 62·9	63·8	60·7, 66·9	63·1	60·9, 65·3
Education level										
Low (<8 years)	38·7	34·7, 42·9	54·1	47·9, 60·1	28·4	22·2, 35·5	10·9	5·0, 22·1	36·0	26·2, 47·2
Medium (8–12 years)	49·4	45·0, 53·9	42·3	36·4, 48·5	58·4	50·6, 65·7	42·9	26·7, 60·9	48·1	36·5, 60·0
High (13 years or more)	11·9	9·3, 15·1	3·6	2·0, 6·5	13·2	8·9, 19·2	46·2	29·9, 63·2	15·9	8·9, 26·6
Men 20–49 years (n 842)			n 128		n 357		n 226		n 131	
Age (years)	33·2	32·4, 34·1	36·1	34·3, 37·8	33·0	31·7, 34·4	32·7	31·2, 34·1	32·1	29·6, 34·6
Education level										
Low (<8 years)	4·9	3·0, 8·0	18·5	10·4, 30·8	3·2	1·3, 7·3	2·5	0·0, 15·3	0·0	0·0, 0·0
Medium (8–12 years)	52·4	47·0, 57·8	63·0	50·7, 73·8	62·1	53·8, 69·7	36·9	26·5, 48·7	42·6	29·9, 56·4
High (13 years or more)	42·7	37·3, 48·2	18·5	11·3, 28·8	34·7	27·3, 43·0	60·6	48·6, 71·4	57·1	43·3, 69·8
Men >49 years (n 787)			n 236		n 475		n 137		n 135	
Age (years)	63·1	62·1, 64·2	66·5	64·6, 68·3	62·6	60·8, 64·3	59·4	57·9, 60·9	62·9	60·4, 65·5
Education level										
Low (<8 year)	30·8	26·1, 35·9	62·2	53·8, 69·9	26·8	19·7, 35·3	0·3	0·0, 1·3	20·8	12·8, 31·9
Medium (8–12 years)	47·9	42·3, 53·5	36·6	28·9, 45·0	60·0	51·3, 68·1	38·1	21·9, 57·5	35·0	23·9, 48·1
High (13 years or more)	21·3	16·6, 27·0	1·3	0·0, 3·2	13·2	8·3, 20·4	61·6	42·3, 77·8	44·2	29·9, 59·5
Households (n 4886)										
Ethnicity										
Indigenous	7·6	6·6, 8·8	12·4	10·1, 15·2	7·6	6·0, 9·6	3·0	1·6, 5·4	5·3	3·3, 8·2
Non-indigenous	92·4	91·2, 93·4	87·6	84·8, 89·9	92·4	90·4, 94·0	97·0	94·6, 98·4	94·7	91·8, 96·7
Household characteristics										
Bare-earth floor	0·05	0·0, 0·1	0·2	0·0, 0·5	0·0	0·0, 0·0	0·0	0·0, 0·0	0·08	0·0, 0·2
Use of firewood or carbon for cooking	5·1	4·3, 6·0	13·0	10·7, 15·8	3·0	2·3, 4·0	1·1	0·4, 3·0	2·7	1·3, 5·6
Public sanitary sewer system	89·4	88·0, 90·6	79·4	76·0, 82·5	90·5	88·3, 92·4	97·4	95·4, 98·5	93·5	90·4, 95·6
Public water network connected to household	93·8	92·6, 94·8	86·8	84·0, 89·2	94·3	92·2, 96·0	99·3	98·5, 99·7	97·3	95·3, 98·5
Electricity	94·9	93·7, 95·9	91·3	88·6, 93·4	94·8	92·6, 96·4	98·3	94·8, 99·4	97·4	94·9, 98·0

ENS, National Health Survey.

Table 2 Malnutrition's prevalence by household income, education level and ethnicity among adult women and men in Chile based on the 2016–2017 National Health Survey

| | All | | Excess of weight | | | | | | Undernutrition | | | | | |
| | | | Overweight‖ | | Obesity¶ | | Excess weight†† | | Underweight‡‡ | | Short stature§§ | | Anaemia‖‖ | |
	n	%§	%	95 % CI	%	95 % CI	%	95 % CI	%	95 % CI	%	95 % CI	%	95 % CI
Women 20–49 years														
All	1489	100·0	36·7	32·3, 41·3	38·8	34·5, 43·3	75·5	71·4, 79·2	1·2	0·5, 3·0	12·4	9·3, 16·3	7·2	0·0, 16·1
Household income														
Low	337	22·6	40·9	32·3, 50·1	41·8†	33·4, 50·7	82·7†	74·2, 88·9	0·2	0·0, 0·9	11·1	7·3, 16·6		
Medium	681	45·7	30·3	24·7, 36·6	47·4*	40·8, 54·2	77·8*	71·8, 82·8	2·5*	0·9, 6·4	16·9	11·6, 24·0		
High	235	15·8	39·3	28·9, 50·9	24·3	16·6, 34·1	63·7	51·4, 74·4	0·0	0·0, 0·0	8·0	2·5, 22·4		
Without information	237	15·9	46·3	34·0, 59·1	24·2	16·3, 34·3	70·5	59·2, 79·7	0·0	0·0, 0·4	5·8	2·4, 13·3		
Education level														
Low (<8 years)	112	7·5	27·1	16·4, 41·3	65·5†‡	50·6, 77·9	92·6†‡	82·1, 97·1	0·5	0·1, 2·9	31·0†‡	17·9, 48·2	7·0	0·0, 19·6
Medium (8–12 years)	832	55·8	36·2	30·6, 42·2	43·6*	37·8, 49·6	79·9*	74·6, 84·3	1·2	0·5, 5·0	14·7*	10·4, 20·5	6·6	1·9, 11·3
High (13 years or more)	546	36·7	39·3	31·8, 47·4	26·0	20·1, 33·0	65·4	57·7, 72·4	0·7	0·2, 2·6	5·2	2·2, 11·4	9·7*	2·9, 16·4
Ethnicity														
Indigenous	128	8·6	25·1	17·4, 34·7	55·8**	44·4, 66·6	80·9	71·2, 87·9	0·0	0·0, 0·0	10·0	5·5, 17·6		
Non-indigenous	1361	91·4	37·8	33·1, 42·7	37·2	32·7, 42·0	75·0	70·5, 79·0	1·3	0·5, 3·2	12·7	9·3, 16·9		
Women >49 years														
All	1768	100·0	38·1	33·9, 42·5	45·0	40·6, 49·5	83·1	79·5, 86·1	0·7	0·3, 1·8			5·1	0·0, 10·7
Household income														
Low	690	39·0	32·0‡	27·1, 37·3	49·5	43·5, 55·5	81·5	75·3, 86·4	0·5	0·2, 1·5				
Medium	672	38·2	45·1	37·3, 53·1	41·7	34·0, 49·7	86·8*	81·7, 90·6	1·2	0·3, 4·6				
High	104	5·9	32·1	19·3, 48·2	37·9	21·9, 57·1	70·0	53·1, 82·8	0·0	0·0, 0·0				
Without information	302	17·1	38·3	27·5, 50·5	44·7	33·4, 56·5	83·0	72·2, 90·2	0·3	0·0, 1·8				
Education level														
Low (<8 years)	684	38·7	31·2†‡	25·9, 37·1	52·2†‡	46·0, 58·3	83·4	77·9, 87·8	1·4	0·4, 4·4			5·9	0·0, 18·3
Medium (8–12 years)	874	49·4	41·5	34·9, 48·4	42·1	35·4, 49·1	83·6	78·1, 87·9	0·3	0·0, 1·2			2·8	0·0, 11·0
High (13 years or more)	210	11·9	46·0	33·7, 58·8	33·7	22·5, 47·1	79·7	68·3, 87·8	0·0	0·0, 0·6			0·0	0·0, 0·0
Indigenous origin														
Indigenous	110	6·2	34·6	22·9, 48·4	52·5	39·8, 64·9	87·1	76·7, 93·2	0·0	0·0, 0·0				
Non-indigenous	1658	93·8	38·3	33·9, 42·9	44·5	39·9, 49·2	82·8	79·1, 86·0	0·7**	0·3, 1·9				
Men 20–49 years														
All	842	100·0	43·5	38·1, 49·1	30·5	25·8, 35·7	74·0	69·1, 78·4	0·9	0·3, 2·2	9·4	6·7, 12·9		
Household income														
Low	128	15·2	37·2	26·4, 49·5	35·6	24·7, 48·2	72·8	62·1, 81·4	3·5	1·1, 10·5	19·5	11·3, 31·7		
Medium	357	42·4	43·4	35·6, 51·6	30·6	24·0, 38·1	74·0	66·7, 80·2	0·0	0·0, 0·0	8·6†	5·1, 14·3		
High	226	26·9	43·4	32·2, 55·4	32·5	22·4, 44·5	75·9	64·6, 84·5	0·0	0·0, 0·0	6·8	2·8, 15·3		
Without information	131	15·6	50·0	36·2, 64·0	21·9	13·2, 33·9	72·0	57·3, 83·1	2·3	0·5, 10·2	6·0	2·5, 13·9		

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Table 2 *Continued*

| | All | | Excess of weight | | | | | | Undernutrition | | | | | |
| | | | Overweight‖ | | Obesity¶ | | Excess weight†† | | Underweight‡‡ | | Short stature§§ | | Anaemia‖‖ | |
	n	%§	%	95 % CI	%	95 % CI	%	95 % CI	%	95 % CI	%	95 % CI	%	95 % CI
Education level														
Low (<8 years)	41	4·9	18·6‡†	7·7, 38·5	35·5	15·9, 61·6	54·1	29·6, 76·8	4·4	0·6, 25·8	47·6‡†	24·6, 71·6		
Medium (8–12 years)	441	52·4	45·5	38·5, 52·7	32·2	26·1, 38·9	77·7	71·7, 82·7	1·2	0·4, 3·6	9·8*	6·5, 14·6		
High (13 years or more)	359	42·7	44·0	35·3, 53·0	27·9	20·5, 36·7	71·8	63·3, 79·1	0·0	0·0, 0·5	4·5	2·1, 9·5		
Ethnicity														
Indigenous	77	9·1	36·9	24·6, 51·3	42·4	29·4, 56·6	79·3	66·4, 88·2	0·0**	0·0, 0·0	21·5**	11·9, 35·7		
Non-indigenous	765	90·9	44·2	38·4, 50·1	29·3	24·3, 34·8	73·5	68·2, 78·2	1·0	0·4, 2·5	8·2	5·5, 11·9		
Men >49 years														
All	983	100·0	48·3	42·7, 54·0	33·7	28·5, 39·3	82·0	77·6, 85·7	0·3	0·1, 1·0				
Household income														
Low	236	24·0	44·1	36·0, 52·5	32·2	24·6, 40·8	76·3	69·0, 82·3	0·4	0·0, 2·3				
Medium	475	48·3	49·5	41·0, 58·0	32·0	24·6, 40·3	81·5	74·1, 87·1	0·5	0·0, 1·9				
High	137	13·9	47·3	29·6, 65·7	37·5	21·3, 57·2	84·9	67·4, 93·8	0·0	0·0, 0·0				
Without information	135	13·8	52·4	38·0, 66·4	38·4	25·3, 53·4	90·8	81·1, 95·8	0·0	0·0, 0·0				
Indigenous origin														
Education level														
Low (<8 years)	302	30·8	44·1	35·2, 53·4	35·5	27·2, 44·9	79·7	71·7; 85·8	0·4	0·1, 1·7				
Medium (8–12 years)	471	47·9	51·2	43·3, 59·1	29·6	22·8, 37·3	80·8	74·1, 86·1	0·4	0·1, 2·0				
High (13 years or more)	210	21·3	47·8	33·9, 62·1	40·3	27·2, 55·0	88·1	76·3, 94·4	0·0	0·0, 0·0				
Ethnicity														
Indigenous	77	5·6	46·1	23·3, 70·7	34·9	16·8, 58·6	81·0	63·0, 91·5	1·5	0·2, 10·6				
Non-indigenous	928	94·4	48·4	42·7, 54·2	33·6	28·3, 39·4	82·0	77·4, 85·9	0·2	0·0, 1·0				

§Weighted %.
‖Overweight: BMI ≥25 and <30 kg/m^2 for women and men.
¶Obesity: BMI ≥30 kg/m^2 for women and men.
††Overweight/obesity: BMI ≥ 25 kg/m^2 for women and men.
‡‡Underweight: BMI < 18·5 kg/m^2 for women and men.
§§Short stature: height < 1·49 m for women 20–49 years, height < 1·62 m for men 20–49 years.
‖‖Anaemia: defined as <120g/l for women. The sample size for anaemia was 829 for women 20–49 years and 910 for women +50 years. The data were based on the 2003 National Health Survey (ENS).
*P value < 0·05 medium *v.* high.
†$P < 0·05$ high *v.* low.
‡$P < 0·05$ low *v.* medium.
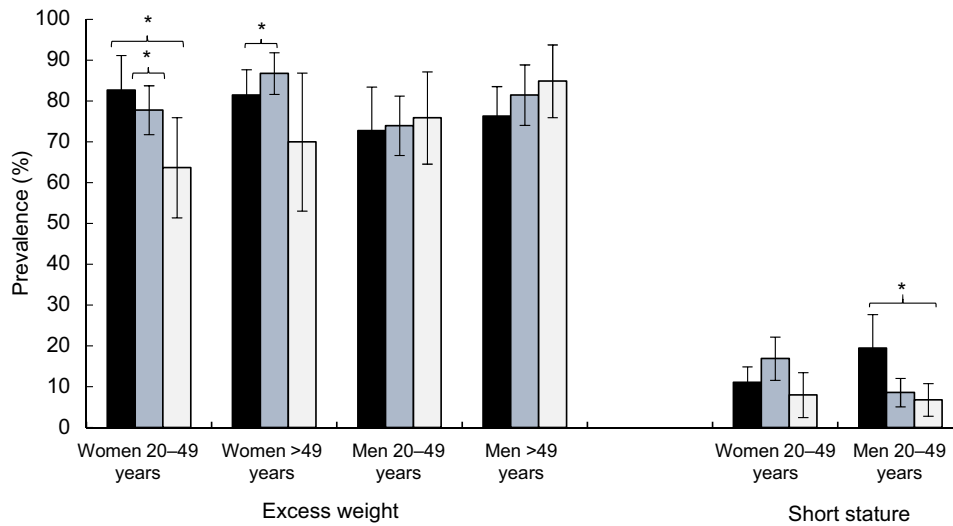**Indigenous *v.* non-indigenous.

Fig. 1 (colour online) Prevalence of excess weight and short stature in men and women by income. Low, low income level, medium; medium income level; and high, high income level. ■, low; ▨, medium; □, high. Women 20–49 years (*n* 1489), women > 49 years (*n* 1768), men 20–49 years (*n* 842), men > 49 years (*n* 983). *P value < 0·05
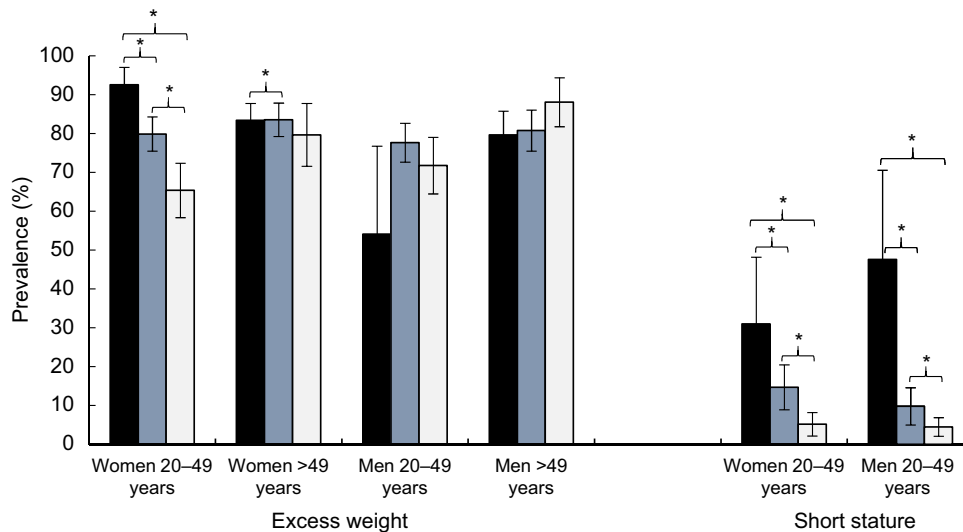

Fig. 2 (colour online) Prevalence of excess weight and short stature in men and women by education level. ■, low (0–7 years); ▨, medium (8–12 years); □, high (>12 years). Women 20–49 years (*n* 1489), women > 49 years (*n* 1768), men 20–49 years (*n* 842), men > 49 years (*n* 983). *P value < 0·05

$P < 0·05$); however, these differences did not reach statistical differences among older women ($P > 0·05$) (Fig. 3).

In young women (<49 years), short stature was more frequent among low-educated women ($P < 0·05$), while undernutrition was more frequent among mid-educated women ($P < 0·05$) and anaemia among high-educated women ($P < 0·05$). No significant differences in undernutrition indicators were observed in older women (>49 years; $P > 0·05$) by SES (Table 2).

Nutrition status, socioeconomic status and ethnicity in men

In men, excess weight did not significantly differ by SES or ethnicity, except for a lower prevalence of overweight among the young men (<49 years) with low education ($P < 0·05$, Figs 1 and 2).

In the case of undernutrition indicators, we observed an inverse relationship between education and short stature ($P < 0·05$); short stature was also more prevalent among indigenous men than in non-indigenous ($P < 0·05$) (Fig. 3).

Discussion

Our results showed that Chile presents a high prevalence of excess weight (78·7 % in women and 77·2 % in men), as well as a low prevalence of undernutrition (anaemia in women (7·2 %), short stature (13 %) and underweight (<1 %) in men and women). Compared with other
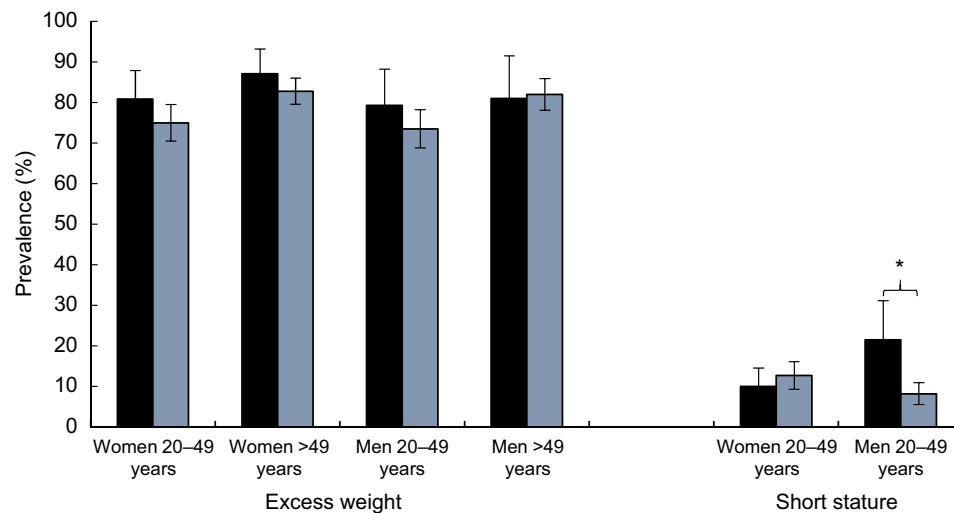
Fig. 3 (colour online) Prevalence of excess weight and short stature in men and women by ethnicity. ■, indigenous; ▨, non-indigenous. Women 20–49 years (*n* 1489), women > 49 years (*n* 1768), men 20–49 years (*n* 842), men > 49 years (*n* 983). *P value < 0·05

countries in the region, the prevalence of obesity and excess weight in the Chilean population is critically high. Our results are only comparable with those reported in Mexican and Salvadorian adult population, in which 71 and 33 % of women aged >20 years had excess weight and obesity, respectively[36], while other Latin American countries have shown a lower prevalence of obesity and excess weight in adults. In contrast, the prevalence of anaemia in childbearing age women and underweight is the lowest in the region[37]. Additionally, compared with other countries in the region, for example, Mexico, where the prevalence of short stature is significantly high in low education and low SES adults compared with those with high SES[38], Chilean population statures seems to be linked with socio-economic factors, showing that people from lower SES are more likely to be shorter that people from higher SES. As a result, the double burden situation does not exist in Chile anymore[11]; similar trends of the nutrition situation have been described in post-transitional countries in which undernutrition problems are eradicated but replaced by excess weight issues.

Potential explanations for this situation are related to the rapid nutritional transition experienced by Chilean population[4,5]. In 1960s, the prevalence of undernutrition in children (<6 years) was 37 %, dropping to 2·9 % in 2000[2]. Successful policies and programs such as the universal access to the healthcare system and the implementation of national complementary food programs have been key strategies to eradicate undernutrition in the country[39]. The improvement of sanitary conditions (e.g. sewage system)[40,41] and the mandatory Fe wheat flour fortification (30 mg of Fe/kg of wheat flour) have been described as key public health actions to prevent anaemia and underweight in vulnerable population[42,43]. Despite these successful results, Chile is facing an alarming prevalence of excess weight[7]. It is well-known that several

factors influence the nutritional status (e.g. dietary intake, socioeconomic status, healthcare facilities)[44]. Over the last decades, Chile has experienced rapid economic changes. Between 1980 and 2014, the average rate of economic growth was 5 %, being the highest rate in Latin America[18]. This situation has influenced the population's dietary patterns, increasing the consumption of energy-dense, sugar and fat-rich food, known as a 'Western diet'[45]. Trade liberalisation and rapid expansion of supermarkets and fast-food restaurants have profoundly influenced the dietary pattern[46]. Also, the increase in income in families has promoted greater portion sizes and away-home food intake[8,47]. Concomitant with the changes of food habits, the prevalence of sedentary lifestyle had continuously increase affecting more than 80 % of adult Chilean population[7].

We found a higher prevalence of obesity and excess weight in women compared with men, while men population had a higher prevalence of overweight than women. Previous research has indicated a complex relationship between sex, SES and the prevalence of excess weight and obesity[48]. On one side, it has been shown that women are more likely to choose added sugar and high-fat content foods compared with men, which may promote the weight gain due to an excess of energy intake[22]. Additionally, men classified in the low socioeconomic level had shown higher rates of occupation compared with women. Occupation in the lowest socioeconomic level population remained a significant source of physical activity and subsequently a higher energy expenditure, which may explain the differences found in the prevalence of obesity compared by sex in the low SES group[22].

However, not only dietary intake and physical activity may explain these differences, cultural factors, such as the role of woman in the society and differences on body-weight concerns, self-esteem[49] and dissatisfaction of their

body by sex[50] also define particular views of the beauty that do not necessarily follow biomedical standards may also contribute to explain our findings[51]. An interesting work recently published by Keller et al.[52] in children showed that encouragement to eat is reinforced in males but not in females. Additionally, their findings indicated that females have a higher neural reactivity to high-energy food compared with male children, which may contribute to the higher risk of obesity in females than males later in life.

In addition, our results showed that poorer and less educated women had a higher prevalence of obesity compared with the richest, while in men, no significant differences were found in obesity and excess weight prevalence's comparing by income and educational level. Contrary, less educated men had a lower prevalence of overweight compared with those with a higher educational level. Differences in malnutrition prevalence by sex and SES have been also shown in other countries of the region. Results of a novel modelling of nutrition stages dynamics in Colombian population showed that the burden of excess weight is likely higher in those with lower SES[53]. Additionally, Hernandez et al.[54] found that food insecure women had a greater percentage of obesity and overweight compared with food secure women, while among men the proportion of obesity and overweight was similar between food secure and food insecure participants.

Female sex is a well-known risk factor for inequity and poverty[55]. Findings from a large study conducted by Wells et al.[56] which included data from sixty-eight countries showed that wealth and sex inequalities are associated with the prevalence of obesity in women. Despite the rapid economic growth, Chile is affected by a dramatic income inequality. It has been reported that the income distribution is fourteen times lower in the poorer quartile compared with the richest[17]. In the USA, it has been described that poorer people have a less varied diet and less access to healthier food[57]. Low cost and easily accessible food are characterised by a high content of sugar, low-quality fat and increased palatability, which may explain a higher energy intake and a subsequent higher prevalence of obesity in poorer adults. However, women have a higher risk of food insecurity and inadequate dietary intake which may promote buying low cost and high-energy dense food. Also, it has been described that low SES woman has reduced participation in food's budget leading to poorer nutrient-quality diets[56], which may partially explain the sex differences in the prevalence of obesity in low SES adults.

We also found that richer and higher educated women had a lower prevalence of excess weight and short stature compared with the poorer group, while men with a higher income and education level were less likely to have short stature compared with the poorest and lowest education level group. It has been speculated that women with a higher educational level might develop obesity-preventing

health behaviour, as well as better healthcare access[58] that may partially explain the lower prevalence of excess weight. Additionally, a potential explanation for the link between SES and short stature is that height is closely related to a variation in net nutrition, meaning that poorer people probably have a more deficient diet, affecting early development and stature[59,60].

For the first time in Chile, we are showing in a national representative sample of adults that indigenous women (<49 years) have a higher prevalence of obesity, while men (<49 years) have a higher prevalence of short stature compared with non-indigenous population. It has been previously described a complex interaction between ethnicity, inequality and sex differences in indigenous population in Chile. Indigenous tend to have a lower SES and education level, which may affect the variety of the diet and the preference for low-cost and ultra-processed foods which may promote a positive energy balance and a subsequent higher risk of obesity in women. Additionally, a recent study conducted by Fernández et al.[61] showed that indigenous boys have a higher risk of precocious gonadarche and pubarche. In European and US boys[62,63], early puberal onset has been inversely associated with height in adulthood, which may explain the shorter height that we found in indigenous men compared with non-indigenous; higher adversity during infancy and adolescence may also contribute to long-term short stature.

Current programs and policies focused on preventing obesity

In Chile, there are several initiatives in place to promote breast-feeding, a known protective factor of obesity for both the children and the mother[64–67]. Baby Friendly Hospitals[68] that promote early bonding and latching ensure perinatal breast-feeding education, breast-feeding consultancy after birth and control the early introduction of formula, breast-feeding education to pregnant women and breast-feeding support for breast-feeding mothers, including lactating clinics, through primary healthcare and the multi-sectoral program 'Chile Crece Contigo'[68], and a six months paid maternity leave[69]. There is also the 'Vida Sana' program that was one of the first strategies that Chile developed against obesity. This program offers free-charge dietitian, medical and physical interventions in public healthcare centers for population between 2 and 64 years. Considering that obesity is a multifactorial disease, in 2006, the Chilean government endeavoured the implementation of a public–private strategy, 'Estrategia Global contra la Obesidad' (EGO), as a multi-sectorial and multidisciplinary collaborative initiative between the Chilean Ministry of Health and the WHO. This strategy was aimed to tackle the high rates of obesity and chronic diseases through the promotion of healthy diet and active lifestyle. Additionally, as an effort to promote healthy eating patterns and ensure healthier environments for children,

Chile implemented the first food labelling and advertising law (Law 20.606), which included the use of a warning label on packaged foods with excess calories, sodium, sugars or saturated fats as well as restricted marketing of those foods to children and restriction to sell or promote those foods in nursery schools or schools[8,70,71].

All these strategies have faced several challenges for an adequate implementation and do not consider evaluation components as part of their implementation. There have been several efforts to evaluate these policies, but evaluation components need to be incorporated in the phase of the design to be able to properly assess the effectiveness of the different actions, considering a sex, SES and ethnicity approach. This information is key to prevent inefficient allocation of valuable resources and to improve the current public health actions. Our study should contribute in highlighting high-risk groups in which to focus action as we included a large and national-representative data of women and men population. Our study also highlights the need of collecting updated data on anaemia prevalence in women of childbearing age as well as extending data collection on children to better monitor the nutritional trends in the country.

Conclusions

Currently, Chilean adult population presents a high prevalence of obesity and overweight while undernutrition (including anaemia) is low. Nutrition status of the population varies importantly by sex, SES and ethnicity highlighting the need that future policies and programs address these important inequalities.

Acknowledgements

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