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Risk Factors of Overweight and Obesity in Primary School Students in Chile: A Gender Perspective

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Abstract

Chile has the highest rates of overweight and obesity among children and adolescents in South America, ranking among the top ten worldwide. **Aim:** To identify individual, family, and school-related risk factors associated with excess malnutrition among fifth-grade students in Chile, with particular focus on gender differences. **Methods:** Utilising data from the 2021 Chilean Fifth Primary School Level Survey, the study assessed nutritional status based on WHO Body Mass Index (BMI) z-scores for age. Multivariate logistic regression analyses were conducted by gender to identify predictors, and average marginal effects were analysed to evaluate the likelihood of overweight and obesity. **Results:** The study included 135,148 children and found a 32.8% overall prevalence of overweight, which was higher in girls, and a 36.3% obesity rate, which was higher in boys. The research confirmed several predictors of excess malnutrition, including male gender, limited physical activity, high birth weight, and lower parental education. It also identified younger age, low self-confidence, insufficient sleep, infrequent reading, dysfunctional family structures, and school schedules as relevant associated factors. Notably, significant gender differences were observed in obesity patterns among fifth-grade students. **Conclusions:** Interventions aimed at supporting psycho-emotional development, promoting physical, intellectual, and dietary healthy habits, and improving school infrastructure and daily schedules could effectively address the obesogenic environment in schools. Future research should explore the intersection of gender and socioeconomic inequalities, assessing the impact of implemented public policies on childhood obesity with a focus on social efficiency and equity.

Keywords

Child, Paediatrics Obesity, Risk Factors, Gender Differences, Schools, Chile

1. Introduction

Since the 1980s, child and adolescent obesity has become a pandemic and a major global health issue. By 2022, around 20% of children and teens aged 5 to 19 were reported as overweight or obese, an increase from 8% in 1990 (WHO, 2024). About half of these children with obesity are likely to continue to have it into adulthood, raising their risk of chronic diseases at earlier ages (Zhang et al., 2024; Rubino et al., 2025).

Obesity is recognised as a chronic disease that can result in serious health problems and affect quality of life (WHO, 2024; Zhang et al., 2024; Jebeile et al., 2022). In young people, obesity can lead to health issues such as musculoskeletal, respiratory and metabolic disorders, as well as negative impacts on physical activity, self-esteem, eating disorders and mental health issues (Zhang et al., 2024; Rubino et al., 2025).

The diagnosis of overweight and obesity is based on calculating the body mass index (BMI) using weight and height. According to the WHO (2007) Growth Reference, overweight is defined as a BMI ≥ 1 standard deviation (SD) above the mean, and obesity as a BMI ≥ 2 SD above the mean, for individuals aged 5 to 19 years (Jebeile et al., 2022; WHO, 2007). The increase in obesity rates has led to school BMI monitoring initiatives, but focusing solely on BMI risks promoting weight stigma and mental health problems among children and adolescents (Nihiser et al., 2007; Solmi et al., 2020; Richmond et al., 2021).

Obesity rates in children and adolescents differ by region and are influenced by race, ethnicity, culture, and socioeconomic status (Zhang et al., 2024; Jebeile et al., 2022). The highest prevalence of obesity rates was found in Polynesia, the Caribbean, North America, and Central America. South America had an overall prevalence of 9.4%, with Chile, Argentina, Ecuador, and Suriname exceeding 10.0%. In high-income countries (HICs), children from lower socioeconomic positions have a higher risk of obesity. In contrast, in lower- and middle-income countries (LMICs), it is often those from higher socioeconomic positions who face this risk (Jebeile et al., 2022).

The reasons behind childhood obesity are not entirely understood, but increased exposure to an "obesogenic environment" that promotes unhealthy eating and low physical activity is a significant factor (Lim et al., 2023). Early exposure to environmental factors during childhood is a significant factor in the development of obesity. Maternal obesity and diabetes during pregnancy are associated with higher birth weight, increasing the risk of obesity (Zhang et al., 2024; Jebeile et al., 2022). Other factors include parenting styles, family dynamics, and adverse

childhood experiences (Zhang et al., 2024; Jebeile et al., 2022; Schroeder et al., 2021). Unhealthy lifestyles among children, such as low physical activity, poor diet, insufficient sleep, and sedentary behaviour, are strong predictors of obesity (Gou et al., 2023; Eo & Kim, 2024).

Family dynamics, including structure and functioning, play a significant role in childhood obesity (Ramirez, 2023). Family income and parents' education are relevant risk factors for obesity (Ramirez, 2023; Gmeinder et al., 2023; Wang et al., 2022). Other influences include parental obesity, smoking, and psychosocial stress from poverty affecting the parent-child interaction and consequently the child's self-regulation (Ramirez, 2023).

Schools play a crucial role in preventing childhood obesity, as most children spend a significant amount of their time there. The food environment surrounding schools, including fast-food stores, also influences obesity rates (Ministerio de Salud de Chile, 2012). Other factors influencing obesity include school type, parental involvement, and opportunities for physical activity (Gray et al., 2019).

Childhood overweight and obesity rates in Chile are alarming, especially among primary school students. In 2021, more than 50% of first graders were overweight or obese. Among fifth graders, 32.8% were overweight, 27.2% were obese, and 9.2% were severely obese, with boys being more affected (JUNAEB, 2022). To address this, Chile passed a law in 2016 to promote healthy eating in schools by encouraging healthy food options and banning unhealthy foods (Ministerio de Salud de Chile, 2012). The law led to a temporary decline in purchases of unhealthy beverages. Still, a subsequent study found only a temporary decrease in obesity among children under 6, while rates among ninth graders rose over the following three years (Taillie et al., 2020; von Hippel & Bogolasky Fliman, 2024).

Despite ongoing efforts, several challenges remain. This study aims to identify individual, family, and school factors contributing to obesity among children, with particular attention to gender differences among fifth-grade students in Chile.

2. Methods

2.1. Design, Population and Data Collection

This study is an observational cross-sectional analysis based on the 2021 "Fifth Primary School Level Survey" (FPSS-2021) done by JUNAEB. The FPSS collects data annually, in conjunction with the JUNAEB Vulnerability Survey. This Survey is a statistical tool that enables the assessment and monitoring of the prevalence of various nutritional conditions (malnutrition, low weight, normal weight, overweight, obesity, severe obesity, and delayed height), both locally and nationally, and supports trend analysis over time. In no case should it be considered an individual clinical diagnosis; instead, it should be treated as a suspicion or investigation that should be confirmed at the primary health care level by trained professionals (JUNAEB, 2022).

Currently, physical education teachers collect students' anthropometric data,

whereas other information is obtained through administrative methods. However, due to COVID-19, many measurements in 2021 were taken at home by parents, with guidance provided (JUNAEB, 2022). This year, participation was lower, with almost 20% fewer surveys completed. The data were collected between April and December and subsequently processed and validated in accordance with WHO (2007) standards. Approximately 85% of students in state-funded schools participate each year. The z-score of Body Mass Index for Age (z-BMI/A) was calculated, and nutritional status was estimated using the JUNAEB Research Unit (JUNAEB, 2022) method. The total number of survey participants was 139,833. Children with malnutrition or underweight were excluded (3.4%); the analysis included data from 135,148 fifth-grade students classified as normal weight, overweight, or mild-to-severe obesity. Most questionnaires (95%) were completed by one or both parents, with mothers responding in 74% of cases. Despite this challenging situation for measurement, the results appear quite concordant and coherent with figures from previous years and, in addition, coincide with precedents on weight gain in schoolchildren in Chile (USACH, 2021; INTA, 2022).

2.2. Dependent Variable

The study's outcome, based on z-BMI/A scores, comprises the categories normal, overweight, mild obesity, and severe obesity. The JUNAEB Research Unit calculated the nutritional status. The individual z-score values were used to classify nutritional status using cut-off points derived from the normalised z-score distribution, according to WHO-2007 standards and references (WHO, 2007). The cut-off points were defined as follows: Normal weight (greater than −1 SD and less than +1 SD), Overweight (greater than +1 SD and less than +2 SD), Mild Obesity (greater than +2 SD and less than +3 SD), and Severe Obesity (greater than +3 SD). The analysis categorised excess malnutrition statuses into binary variables (1 = excess malnutrition, 0 = normal nutritional status), yielding three separate models: overweight, mild obesity, and severe obesity.

2.3. Independent Variables

Based on prior literature, these variables were selected for their significant associations with overweight and obesity among children and adolescents (Zhang et al., 2024; Eo & Kim, 2024; Wang et al., 2022; Mohd Saat et al., 2023).

Individual factors: Sex, nationality, membership in native communities, urban residence, chronic illnesses, dental caries, asthma and social participation were included in the models as dichotomous covariates, while age, birth weight, psycho-emotional factors, physical activity, sleep duration, reading habits and access to computers at home were treated as categorical variables. Psycho-emotional factors include the ability to express feelings toward others and the extent to which he/she demonstrates confidence and self-assurance. These characteristics are derived from specific survey questions—JUNAEB Vulnerability Survey—using a validated scale (JUNAEB, 2022). For reference groups, see **Table 1**.

Table 1. Individual, school, and family characteristics of the sample by nutritional status categories. FPSS-2021.

Characteristics	Normal (n: 38,542)	Overweight (n: 45,836)	Mild Obesity (n: 37,970)	Severe Obesity (n: 12,800)
Individual factors				
Age groups (%)* **				
9 - 10 years old	31.4%	33.1%	34.1%	37.0%
11 years old	62.0%	61.2%	60.3%	58.0%
12 - 13 years old (ref.)	6.6%	5.8%	5.7%	5.0%
Gender (%)* **				
male	51.5%	59.7%	71.5%	78.9%
female (ref.)	48.5%	40.3%	28.5%	21.1%
Nationality (%)* **				
Chilean	93.2%	94.9%	96.0%	95.5%
other nationalities (ref.)	6.8%	5.1%	4.0%	4.5%
Belong to native communities (%)* **				
native	14.2%	15.2%	16.5%	18.6%
not native (ref.)	85.8%	84.8%	83.5%	81.4%
Urban residence (%) **				
urban	87.7%	87.1%	86.0%	84.4%
rural (ref.)	12.3%	12.9%	14.0%	15.6%
Birth weight (%)* **				
low weight	8.1%	6.8%	6.3%	7.3%
normal weight (ref.)	83.4%	82.9%	80.9%	77.1%
high weight	8.5%	10.2%	12.9%	15.7%
Chronic illness or conditions (%)* **				
yes	18.5%	19.7%	23.8%	26.3%
not (ref.)	81.5%	81.5%	81.5%	81.5%
Caries (%)* **				
yes	47.2%	47.0%	47.6%	51.4%
not (ref.)	52.8%	53.0%	52.4%	48.6%
Asthma (%)* **				
yes	5.3%	6.2%	7.3%	7.2%
not (ref.)	94.7%	93.8%	92.7%	92.8%
Express feelings or emotions (%)* **				
never (ref.)	5.2%	5.2%	6.1%	6.1%
sometimes	16.7%	16.6%	17.3%	18.8%
frequently	78.0%	78.1%	76.6%	75.0%

Continued

Express Self-confidence (%)* **				
never	3.6%	3.9%	4.7%	5.6%
sometimes	18.5%	18.8%	21.2%	23.2%
frequently (ref.)	77.9%	77.3%	74.2%	71.3%
Physical activity last week (%)* **				
none	15.5%	16.6%	19.1%	20.6%
once a week	42.7%	44.1%	44.1%	43.0%
2 - 3 times a week	28.9%	28.0%	26.8%	26.3%
4 or more times (ref.)	12.9%	11.3%	10.0%	10.1%
hours of sleep/working day/week (%)* **				
<9 hr/day	11.4%	11.6%	12.4%	12.3%
9 - 12 hr/day (ref.)	87.2%	87.1%	86.4%	86.1%
>12 hr/day	1.5%	1.3%	1.2%	1.7%
Book reader habits (%)* **				
rarely or never	37.4%	39.5%	44.1%	45.3%
sometimes	40.1%	39.3%	37.7%	37.5%
frequently (ref.)	22.5%	21.2%	18.2%	17.1%
Access to a computer, notebook or tablet at home (%)* **				
no access (ref.)	17.2%	17.0%	17.9%	20.5%
access with restriction	17.2%	18.2%	17.4%	17.9%
unrestricted access (ad libitum)	65.7%	64.8%	64.6%	61.6%
Social participation (yes) (%) **	78.1%	78.1%	78.4%	79.8%
Family factors				
A father figure present (%)* **				
never present	11.1%	11.0%	11.5%	12.1%
occasionally present	22.2%	23.0%	23.6%	24.3%
always present (ref.)	66.8%	66.0%	64.9%	63.6%
Mother's educational level (%)* **				
low level	13.0%	13.0%	14.0%	17.4%
medium level	56.5%	57.9%	58.7%	61.5%
high level (ref.)	30.5%	29.1%	27.2%	21.1%
Cohabitation (lives with…) (%)* **				
both parents (ref.)	52.4%	52.0%	50.9%	50.6%
only mother	41.7%	42.4%	43.6%	43.2%
only father	2.7%	2.7%	2.8%	3.0%
other family member	2.7%	2.4%	2.3%	2.3%
state protection	.6%	.5%	.4%	.9%

Continued

Occupational status of the head of household (%)* **				
unemployed	14.1%	14.5%	14.9%	15.2%
salaried	43.9%	43.9%	42.8%	38.5%
own account	23.0%	23.1%	23.1%	25.2%
maid	1.4%	1.4%	1.4%	1.5%
retired	2.8%	2.8%	2.7%	2.7%
student	.7%	.6%	.6%	.5%
homemaker (ref.)	14.3%	13.8%	14.5%	16.3%
School factors				
School attendance (%)* **				
public school	44.5%	44.6%	46.1%	51.7%
private school (ref.)	55.5%	55.4%	53.9%	48.3%
School day schedule (%)* **				
morning day	18.7%	18.2%	17.6%	17.3%
afternoon day	3.1%	2.7%	2.7%	2.4%
full-day (ref.)	78.2%	79.1%	79.6%	80.3%

ref: reference group; **: $p < .05$; ***: $p < .0001$.

Family factors: The mother's education level, presence of a father figure, living situation, and the household head's occupational status were all included as categorical variables. According to the International Standard Classification of Education (ISCED-2011) (UNESCO, 2011), the mother's educational level was categorised as low (primary school or lower), medium (completed high school), or high (bachelor's degree or postgraduate qualification). The father's presence was categorised as never, occasionally, or always present. Living situations were classified into five categories, and the household head's occupational status into seven. For more details, see Table 1.

School factors: Two school-related factors were included in the models: the administrative dependency and the school day schedule. Administrative dependency was either public or private, with private schools including those with tuition-based and state-subsidised fees. The public school was the reference group. School day schedules were categorised as morning, afternoon, or full-day, with full-day as the reference group.

2.4. Model Specification

Before conducting regression analysis, multicollinearity was assessed using correlation matrices and variance inflation factors (VIFs). Separate logistic regression models were used for overweight, mild obesity, and severe obesity, with analyses conducted on the overall sample and on males and females separately.

A univariate analysis refined with a purposeful approach from Hosmer and Lemeshow, keeping significant covariates with p-values < .15. Odds ratios were estimated with 95% confidence intervals. Model goodness-of-fit was assessed using the Hosmer-Lemeshow test, and the area under the curve (AUC) was used to evaluate predictive ability. Average marginal effects (AMEs), reflecting predicted probabilities, were calculated, and marginal effects at representative values (MERs) were also determined for key predictors (Williams, 2012). Statistical significance was assessed using the Wald chi-square test, and, given the exploratory nature of the study, a 10% significance level was used. Analyses were conducted using STATA version 14.0.

3. Results

The study involved 135,148 fifth-grade students, with 28.5% normal weight, 33.9% overweight, 28.1% mildly obese, and 9.5% severely obese. The average BMI was 17.6 kg/m^2 for normal weight, 20.8 kg/m^2 for overweight, 24.7 kg/m^2 for mildly obese, and 31.0 kg/m^2 for severely obese. Participants were primarily Chilean boys, with an average age of 11 years; 16% were from indigenous communities. Table 1 provides details on individual, school, and family characteristics by nutritional status.

Overweight and Obesity Logistic Regression Models in the overall sample

The check revealed low correlation and a mean VIF of 1.13, indicating no multicollinearity. Models performed well with different predictive strengths for overweight and obesity. Logistic regression models, as detailed in Table 2, were used to analyse excess malnutrition among fifth graders.

Table 2. Predictors of excess malnutrition status from logistic regression models.

	Overweight			Mild Obesity			Severe Obesity		
	OR	Std. Error	[95% C. I.)	OR	Std. Error	[95% C. I.)	OR	Std. Error	[95% C. I.)
Age									
9 - 10 years old	**1.324*** **	.0513	(1.228 - 1.429)	**1.751*** **	.0729	(1.614 - 1.900)	**2.613*** **	.1625	(2.313 - 2.952)
11 years old	**1.187*** **	.0441	(1.104 - 1.277)	**1.428*** **	.0572	(1.320 - 1.545)	**1.790*** **	.1079	(1.591 - 2.014)
Boy	**1.439*** **	.0241	(1.392 - 1.487)	**2.535*** **	.0471	(2.444 - 2.629)	**3.931*** **	.1178	(3.707 - 4.169)
Chilean nationality	**1.369*** **	.0511	(1.273 - 1.473)	**1.734*** **	.0749	(1.593 - 1.887)	**1.475*** **	.0926	(1.304 - 1.668)
Belong to native communities	**1.064** **	.0245	(1.017 - 1.113)	**1.139*** **	.0279	(1.086 - 1.195)	**1.270*** **	.0437	(1.187 - 1.358)
Urban residence	**.965^{ns}**	.0253	(.917 - 1.016)	**.888*** **	.0246	(.841 - .938)	**.899** **	.0347	(.834 - .970)
Birth weight									
low weight	**.843*** **	.0261	(.793 - .896)	**.784*** **	.0269	(.733 - .839)	**.928^{ns}**	.0461	(.842 - 1.023)
high weight	**1.163*** **	.0327	(1.102 - 1.230)	**1.433*** **	.0412	(1.355 - 1.516)	**1.706*** **	.0651	(1.583 - 1.838)

Continued

Chronic illness or conditions	**1.031^{ns}**	.0249	(.984 - 1.081)	**1.327*****	.0332	(1.264 - 1.394)	**1.563*****	.0543	(1.460 - 1.673)
Caries	**.981^{ns}**	.0164	(.949 - 1.014)	**.952****	.0171	(.919 - .986)	**1.038^{ns}**	.0272	(.986 - 1.093)
Asthma	**1.122****	.0446	(1.037 - 1.213)	**1.051^{ns}**	.0431	(.969 - 1.139)	**.918^{ns}**	.0525	(.821 - 1.027)
Express feelings or emotions									
sometimes	**1.022^{ns}**	.0464	(.935 - 1.117)	**.991^{ns}**	.0472	(.902 - 1.088)	**1.174****	.0803	(1.027 - 1.342)
frequently	**1.082***	.0470	(.994 - 1.179)	**1.069^{ns}**	.0486	(.978 - 1.169)	**1.297*****	.0853	(1.141 - 1.476)
Express self-confidence									
never	**1.064^{ns}**	.0540	(.962 - 1.195)	**1.231*****	.0640	(1.112 - 1.363)	**1.377*****	.0974	(1.200 - 1.582)
sometimes	**1.020^{ns}**	.0239	(.974 - 1.068)	**1.102*****	.0272	(1.050 - 1.156)	**1.225*****	.0431	(1.143 - 1.312)
Physical activity last week									
none	**1.353*****	.0434	(1.270 - 1.441)	**1.759*****	.0608	(1.644 - 1.883)	**1.954*****	.0979	(1.772 - 2.156)
once a week	**1.257*****	.0333	(1.193 - 1.324)	**1.468*****	.0428	(1.386 - 1.554)	**1.501*****	.0650	(1.379 - 1.634)
2 - 3 times a week	**1.144*****	.0315	(1.084 - 1.208)	**1.252*****	.0379	(1.180 - 1.328)	**1.272*****	.0573	(1.164 - 1.389)
Hours of sleep (working day)									
<9 hr/day	**1.020^{ns}**	.0265	(.970 - 1.074)	**1.129*****	.0310	(1.070 - 1.191)	**1.141****	.0461	(1.054 - 1.235)
>12 hr/day	**.921^{ns}**	.0657	(.801 - 1.060)	**.817****	.0647	(.700 - .955)	**1.016^{ns}**	.1084	(.824 - 1.252)
Book reader									
rarely or never	**1.042***	.0234	(.997 - 1.089)	**1.212*****	.0297	(1.155 - 1.271)	**1.176*****	.0429	(1.094 - 1.263)
sometimes	**1.014^{ns}**	.0218	(.972 - 1.057)	**1.100*****	.0263	(1.050 - 1.153)	**1.042^{ns}**	.0376	(.970 - 1.118)
Access to a computer, notebook or tablet at home									
access with restriction	**1.062****	.0304	(1.004 - 1.123)	**.972^{ns}**	.0299	(.915 - 1.033)	**.928***	.0403	(.852 - 1.010)
unrestricted access	**1.007^{ns}**	.0240	(.961 - 1.055)	**1.005^{ns}**	.0256	(.956 - 1.057)	**.941***	.0334	(.8776 - 1.009)
Social participation	**1.052****	.0210	(1.012 - 1.094)	**1.047****	.0226	(1.004 - 1.093)	**.993^{ns}**	.0319	(.932 - 1.058)
Public School	**.997^{ns}**	.0177	(.963 - 1.032)	**1.073*****	.0205	(1.033 - 1.114)	**1.267*****	.0350	(1.200 - 1.337)
School day									
morning day	**.980^{ns}**	.0206	(.940 - 1.021)	**.971^{ns}**	.0222	(.929 - 1.016)	**.929****	.0317	(.869 - .993)
afternoon day	**.825*****	.0403	(.750 - .908)	**.866****	.0453	(.781 - .959)	**.808****	.0661	(.688 - .949)
A father figure is present									
occasional	**1.038***	.0227	(.995 - 1.084)	**1.024^{ns}**	.0240	(.978 - 1.072)	**1.065***	.0362	(.996 - 1.138)
never	**.985^{ns}**	.0299	(.928 - 1.045)	**.974^{ns}**	.0315	(.914 - 1.038)	**1.079^{ns}**	.0500	(.985 - 1.181)

Continued

Mother's educational level									
low level	**1.073****	.0325	(1.011 - 1.138)	**1.218*****	.0394	(1.143 - 1.297)	**1.707*****	.0783	(1.560 - 1.867)
medium level	**1.008*****	.0204	(1.034 - 1.114)	**1.154*****	.0238	(1.108 - 1.201)	**1.392*****	.0444	(1.308 - 1.482)
Cohabitation (lives with…)									
only mother	**1.044****	.0206	(1.004 - 1.085)	**1.085*****	.0230	(1.041 - 1.131)	**1.043**^{ns}	.0325	(.981 - 1.108)
only father	**1.126***	.0720	(.994 - 1.277)	**1.123***	.0773	(.982 - 1.286)	**1.266****	.1219	(1.049 - 1.529)
other family member	**.840****	.0588	(.732 - .963)	**.900**^{ns}	.0666	(.778 - 1.040)	**.836***	.0905	(.676 - 1.033)
state protection	**1.122**^{ns}	.1852	(.812 - 1.550)	**.789**^{ns}	.1419	(.555 - 1.122)	**2.170*****	.4071	(1.501 - 3.134)
Occupational status of the head of household									
unemployed	**1.065****	.0331	(1.002 - 1.132)	**1.027**^{ns}	.0341	(.962 - 1.096)	**.963**^{ns}	.0454	(.878 - 1.057)
salaried	**1.065****	.0279	(1.012 - 1.121)	**1.009**^{ns}	.0281	(.955 - 1.065)	**.892****	.0356	(.826 - .965)
own account	**1.062****	.0300	(1.005 - 1.123)	**1.034**^{ns}	.0312	(.975 - 1.098)	**1.046**^{ns}	.0444	(.962 - 1.137)
maid	**1.025**^{ns}	.0772	(.885 - 1.188)	**1.050**^{ns}	.0841	(.897 - 1.228)	**.901**^{ns}	.1035	(.720 - 1.129)
retired	**1.023**^{ns}	.0577	(.916 - 1.143)	**.976**^{ns}	.0589	(.868 - 1.099)	**.862***	.0761	(.725 - 1.025)
student	**.975**^{ns}	.0980	(.801 - 1.187)	**.876**^{ns}	.0953	(.707 - 1.084)	**.729***	.1252	(.520 - 1.021)
Constant	**.381*****	.0339	(.320 - .453)	**.082*****	.0079	(.0674 - .0985)	**.009*****	.0013	(.007 - .012)
Hosmer-Lemeshow test	**.5957**			**.2991**			**.8344**		
AUC measures	**.567**			**.653**			**.718**		

*: $p < .1$; **: $p < .05$; ***: $p < .0001$; **ns**: no significant. **AUC**: The area under the receiver operating characteristic (ROC) curve.

The main predictors of overweight in fifth-grade students include being younger, male, Chilean, engaging in limited physical activity, and having a high birth weight. Other factors include having asthma, living with a father, belonging to a native community, rarely reading books, and limited access to computers. Significant factors also include social participation, occasional father presence, lower maternal education, single-parent households, and having an unemployed or self-employed head of household.

In mild obesity, predictors are similar, with additional factors such as chronic illness, low self-confidence, sleep disorders and attending public school. Severe obesity risk factors are similar to those of mild obesity, with the addition of individuals who report emotional distress and live under state protection.

The primary protective factor across all models was the afternoon school schedule. Low birth weight affected overweight and mild obesity, while urban living impacted mild and severe obesity. Living with family helped prevent being overweight and mild obesity. Sleeping more than 12 hours was associated with mild obesity, whereas computer access and morning schedules were associated with se-

vere obesity. Details on logistic regression for excess malnutrition by gender are provided in the supplementary material (**Supplementary** Table S1 and Table S2).

Average marginal effects (AMEs) for the excess malnutrition status in fifth-grade girls

Table 3 presents the AMEs and 95% CI for factors influencing overweight and obesity in fifth-grade girls, illustrating changes in predicted probabilities when predictors shift from the reference category to the category of interest, while controlling for the other variables (Williams, 2012).

Table 3. Average Marginal Effects for excess malnutrition status in fifth-grade girl students.

	Overweight			Mild Obesity			Severe Obesity		
	dy/dx	Std. Error	[95% C. I.)	dy/dx	Std. Error	[95% C. I.)	dy/dx	Std. Error	[95% C. I.)
Age									
9 - 10 years old	**.085*** **	.0210	(.044 - .126)	**.116*** **	.0209	(.075 - .157)	**.071*** **	.0128	(.046 - .096)
11 years old	**.051** **	.0208	(.011 - .093)	**.056** **	.0206	(.015 - .096)	**.030** **	.0124	(.006 - .055)
Chilean nationality	**.084*** **	.0147	(.055 - .113)	**.107*** **	.0152	(.078 - .137)	**.040*** **	.0105	(.019 - .060)
Belong to native communities	-	-	-	**.022** **	.0089	(.004 - .039)	**.022** **	.0072	(.008 - .036)
Urban residence	-	-	-	**−.026** **	.0101	(−.046 - −.006)	-	-	-
Birth weight									
low weight	**−.045*** **	.0115	(−.068 - −.023)	**−.050*** **	.0119	(−.073 - −.027)	-	-	-
high weight	**.061*** **	.0113	(.039 - .083)	**.124*** **	.0121	(.100 - .147)	**.072*** **	.0112	(.049 - .094)
Chronic illness or conditions	-	-	-	**.075*** **	.0092	(.057 - .093)	**.048*** **	.0069	(.035 - .061)
Caries	-	-	-	-	-	-	**.011** **	.0052	(.000 - .021)
Asthma	-	-	-	-	-	-	**−.023***	.0122	(−.047 - .001)
Express feelings or emotions.									
sometimes	-	-	-	-	-	-	-	-	-
frequently	-	-	-	-	-	-	-	-	-
Express self-confidence									
never	**.049** **	.0185	(.013 - .085)	**.068** **	.0196	(.030 - .106)	**.031** **	.0160	(−.000 - .062)
sometimes	-	-	-	**.019** **	.0092	(.001 - .037)	-	-	-
Physical activity last week									
none	**.096*** **	.0123	(.072 - .120)	**.116*** **	.0128	(.091 - .141)	**.063*** **	.0098	(.044 - .082)
once a week	**.073*** **	.0107	(.052 - .094)	**.061*** **	.0110	(.040 - .083)	**.034*** **	.0078	(.019 - .050)
2 - 3 times a week	**.052*** **	.0112	(.030 - .074)	**.037** **	.0116	(.014 - .060)	**.014***	.0082	(−.002 - .030)

Continued

hours of sleep (working day)									
<9 hr/day	-	-	-	-	-	-	-	-	-
>12 hr/day	-	-	-	**−.047***	.0268	(−.099 - .006)	-	-	-
Book reader									
rarely or never	-	-	-	**.039*****	.0087	(.022 - .056)	-	-	-
sometimes	-	-	-	**.029*****	.0081	(.013 - .045)	-	-	-
Access to a computer, notebook or tablet at home									
access with restriction	-	-	-	-	-	-	-	-	-
unrestricted access	-	-	-	-	-	-	**−.021****	.0073	(−.036 - .007)
Social participation	**.020****	.0076	(.005 - .035)	**.016****	.0082	(.000 - .033)	-	-	-
Public School	**.016****	.0066	(.003 - .028)	**.028*****	.0070	(.014 - .042)	**.035*****	.0054	(.025 - .046)
School day									
morning day	-	-	-	-	-	-	**−.019****	.0063	(−.031 - .006)
afternoon day	**−.045****	.0185	(−.081 - .009)	**−.046****	.0194	(−.084 - −.008)	-	-	-
A father figure is present									
occasional	-	-	-	-	-	-	-	-	-
never	-	-	-	-	-	-	-	-	-
Mother's educational level									
low level	**.027****	.0113	(.005 - .049)	**.062*****	.0120	(.039 - .086)	**.076*****	.0099	(.057 - .096)
medium level	**.023****	.0071	(.009 - .037)	**.045*****	.0076	(.030 - .060)	**.031*****	.0057	(.019 - .042)
Cohabitation (live with…)									
only mother	-	-	-	**.022****	.0078	(.006 - .037)	-	-	-
only father	-	-	-	-	-	-	**.053****	.0236	(.007 - .099)
other family member	-	-	-	-	-	-	-	-	-
state protection	-	-	-	**−.105***	.0569	(−.217 - .006)	**.089***	.0494	(−.008 - .186)
Occupational status of the head of household									
unemployed	-	-	-	-	-	-	-	-	-
salaried	**.028****	.0097	(.009 - .047)	-	-	-	**−.018****	.0080	(−.033 - −.002)
own account	**.022****	.0105	(.002 - .043)	-	-	-	-	-	-
maid	-	-	-	-	-	-	**−.039***	.0206	(−.079 - .002)
retired	-	-	-	-	-	-	**−.039****	.0161	(−.070 - .007)
student	-	-	-	-	-	-	-	-	-

dy/dx: it represents the marginal change of the outcome variable (y) concerning the change from the reference group of the factors (x). *: $p < .1$; **: $p < .05$; ***: $p < .0001$.

Individual factors significantly influence the risk of mild obesity in girls. High birth weight increases the risk by 12.4%, whereas low birth weight reduces it by 5.0%. Lack of self-confidence and chronic health issues increase the likelihood by 6.8% and 7.5%, respectively. Rare readers have a 4.0% higher chance. Urban girls and those sleeping over 12 hours a day are less likely to be mildly obese.

Family factors contribute to obesity, as girls with less-educated mothers have a 7.6% higher chance of severe obesity. Living with only fathers, being under state protection, or being under the authority of certain household heads also increases this risk.

School factors also play a role. Girls in public schools are more likely to be severely obese, while those in afternoon schedules are at lower risk of being overweight or mildly obese, and those in morning sessions are at lower risk of severe obesity.

Because factor effects can vary across combinations of individual characteristics, MERs that combine nationality and age groups for relevant factors such as physical activity, self-confidence, maternal education, and public school attendance were considered.

Inactive Chilean girls have a higher risk of being overweight at 55.2% for ages 9 - 10 and 46.6% for ages 12 - 13, compared to 46.7% and 38.3% for foreign girls. The risk of severe obesity is also higher for inactive Chilean girls. However, Chilean girls aged 12 - 13 who exercise frequently have a lower risk of developing severe obesity than their foreign counterparts.

Chilean girls aged 9 - 10 with low-educated mothers have a 53.2% chance of being overweight, while foreign girls have a 44.7% chance. Among those lacking self-confidence, the risk is higher among Chilean girls: 56.7% for ages 9 - 10 and 48.2% for ages 12 - 13. The chance of mild and severe obesity decreases with age. Chilean girls aged 9 - 10 attending public school are 53.0% overweight, compared to 44.5% of foreign girls. The risk of severe obesity decreases with age in both nationalities.

Average marginal effects (AMEs) for the excess malnutrition status in fifth-grade boys

Table 4 presents the AMEs and 95% C. I. for key predictors of excess malnutrition in fifth-grade boys.

Individual factors significantly affect the risk of mild and severe obesity in boys. Younger boys are more prone to excess malnutrition. Chilean and native community boys are at a higher risk of obesity than their peers. High birth weight increases the chance of being overweight, while low birth weight lowers it, especially for mild obesity. Physically inactive boys and those expressing emotions or lacking self-confidence are more likely to be obese. Rare readers face higher risks of excess malnutrition. Boys with chronic health issues are more likely to be obese, while urban boys and those sleeping over 12 hours a day are less likely to be mildly obese.

Table 4. Average Marginal Effects for excess malnutrition status in fifth-grade boy students.

	Overweight			Mild Obesity			Severe Obesity		
	dy/dx	Std. Error	[95% C. I.)	dy/dx	Std. Error	[95% C. I.)	dy/dx	Std. Error	[95% C. I.)
Age									
9 - 10 years old	**.059*** **	.0109	(.038 - .081)	**.126*** **	.0111	(.104 - .148)	**.187*** **	.0112	(.165 - .209)
11 years old	**.039*** **	.0103	(.019 - .059)	**.088*** **	.0106	(.067 - .108)	**.106*** **	.0103	(.086 - .126)
Chilean nationality	**.071*** **	.0117	(.048 - .094)	**.137*** **	.0123	(.112 - .161)	**.071*** **	.1288	(.046 - .096)
Belong to native communities	**.020** **	.0075	(.005 - .034)	**.035*** **	.0073	(.021 - .049)	**.053*** **	.0088	(.036 - .070)
Urban residence	-	-	-	**−.027** **	.0083	(−.044 - −.011)	**−.036*** **	.0097	(−.055 - −.017)
Birth weight									
low weight	**−.040*** **	.0103	(−.060 - −.020)	**−.061*** **	.0105	(−.081 - −.040)	**−.030** **	.0115	(−.052 - −.007)
high weight	**.023** **	.0084	(.007 - .040)	**.066*** **	.0079	(.051 - .081)	**.113*** **	.0098	(.094 - .132)
Chronic illness or conditions	-	-	-	**.061*** **	.0074	(.046 - .075)	**.091*** **	.0083	(.075 - .107)
Caries	-	-	-	**−.020*** **	.0054	(−.030 - −.009)	-	-	-
Asthma	**.029** **	.0125	(.005 - .054)	-	-	-	-	-	-
Express feelings or emotions									
sometimes	-	-	-	-	-	-	**.034** **	.0151	(.005 - .064)
frequently	-	-	-	**.031** **	.0137	(.004 - .058)	**.059*** **	.0145	(.030 - .087)
Express self-confidence									
never	-	-	-	**.036** **	.0154	(.006 - .066)	**.072*** **	.0184	(.036 - .108)
sometimes	-	-	-	**.025** **	.0073	(.011 - .040)	**.052*** **	.0088	(.035 - .069)
Physical activity last week									
none	**.060*** **	.0103	(.040 - .080)	**.137*** **	.0102	(.117 - .157)	**.140*** **	.0117	(.117 - .163)
once a week	**.046*** **	.0083	(.030 - .063)	**.104*** **	.0085	(.087 - .120)	**.081*** **	.0092	(.063 - .099)
2 - 3 times a week	**.022** **	.0085	(.006 - .039)	**.059*** **	.0088	(.042 - .076)	**.050*** **	.0095	(.031 - .068)
hours of sleep (working day)									
<9 hr/day	-	-	-	**.039*** **	.0083	(.023 - .056)	**.034** **	.0102	(.014 - .054)
>12 hr/day	-	-	-	**−.047** **	.0244	(−.095 - .000)	-	-	-
Book reader									
rarely or never	**.013***	.0075	(−.002 - .028)	**.047*** **	.0075	(.032 - .062)	**.037*** **	.0088	(.020 - .055)
sometimes	-	-	-	**.018** **	.0075	(.003 - .032)	-	-	-

Continued

Access to a computer, notebook or tablet at home									
access with restriction	**.016***	.0092	(−.002 - .034)	-	-	-	-	-	-
unrestricted access	-	-	-	-	-	-	-	-	-
Social participation	-	-	-	-	-	-	-	-	-
Public School	**−.014****	.0058	(−.025 - −.002)	-	-	-	**.040*****	.0066	(.027 - .053)
School day									
morning day	-	-	-	-	-	-	-	-	-
afternoon day	**−.050****	.0158	(−.081 - −.019)	**−.029***	.0154	(−.059 - .001)	**−.048****	.0180	(−.084 - −.013)
A father figure is present.									
occasional	-	-	-	-	-	-	**.018****	.0083	(.002 −.034)
never	-	-	-	-	-	-	-	-	-
Mother's educational level									
low level	-	-	-	**.035*****	.0096	(.016 - .054)	**.094*****	.0113	(.072 - .116)
medium level	**.013****	.0062	(.001 −.025)	**.026*****	.0062	(.014 - .038)	**.067*****	.0072	(.053 - .081)
Cohabitation (live with…)									
only mother	**.011***	.0064	(−.002 - .023)	**.017****	.0063	(.005 - .029)	-	-	-
only father	**.040****	.0195	(.002 - .078)	-	-	-	-	-	-
other family member	**−.040***	.0227	(−.085 - .004)	**−.038***	.0223	(−.082 - .005)	**−.040***	.0241	(−.088 - .007)
state protection	-	-	-	-	-	-	**.177****	.0540	(.071 - .283)
Occupational status of the head of household									
unemployed	**.017***	.0102	(−.003 - .037)	-	-	-	-	-	-
salaried	-	-	-	-	-	-	**−.018***	.0097	(−.037 - .001)
own account	-	-	-	-	-	-	**.021****	.0105	(.000 - .041)
maid	-	-	-	-	-	-	-	-	-
retired	-	-	-	-	-	-	-	-	-
student	-	-	-	-	-	-	-	-	-

dy/dx: it represents the marginal change of the outcome variable (y) concerning the change from the reference group of the factors (x). *: $p < .1$; **: $p < .05$; ***: $p < .0001$.

Family factors, such as having less-educated mothers, living with single parents or under state protection, increase boys' chances of severe obesity. In contrast, boys living with salaried household heads or living with other family members are

less likely to be overweight. Boys in afternoon school schedules are less likely to be overweight or obese than those in full-day schools. Boys attending Public schools are less likely to be overweight but more likely to be severely obese than those in private schools.

The MERs in boys examined factors such as native community status, birth weight, physical activity and school attendance. Chilean native boys aged 9 - 10 have a 61.5% chance of being overweight, which drops to 55.6% for those aged 12 - 13, but they face a higher obesity risk than their foreign peers. High birth weight increases obesity risk, with significantly higher chances of being overweight and severely obese in Chilean boys compared to their foreign peers.

The risk of overweight among inactive Chilean boys is 62.4% for ages 9 - 10 and 56.6% for ages 12 - 13, which is higher than that of foreign boys. The risk of severe obesity is 47.5% for ages 9 - 10 and 26.4% for ages 12 - 13 in Chilean boys, compared to foreign boys. In contrast, Chilean boys aged 12 - 13 who engaged frequently in physical activity have a lower chance of severe obesity than their foreign peers.

Attending afternoon sessions, 55.1% of Chilean boys aged 9 - 10 are overweight, with a 34.7% chance of severe obesity, compared to 47.9% and 27.4% for foreign boys. The risk of obesity linked to afternoon schedules decreases with age.

4. Discussion

Childhood obesity is a significant global health issue, with increasing prevalence and serious health risks. Factors influencing a child's risk include bio-psycho-social aspects driven by rapid urbanisation, unhealthy dietary changes, and socioeconomic disparities (WHO, 2024; NCD-RisC, 2023). This study analyses predictors of overweight and obesity among fifth-grade students in Chile, emphasizing gender differences.

Before discussing the findings, it is crucial to consider the country context. In 2021, Chile had 259,887 fifth-grade students, with 62.3% in subsidised or paid private schools and 32.5% in public schools (Ministerio de Educación, Chile, 2021). Approximately 51% of Chilean students lived in mother-led households, and 70% of their mothers had low to medium levels of education. COVID-19 pandemic mitigation measures have significantly contributed to an increase in the overall childhood obesity rate (Vio del Río, 2023).

This study revealed that 32.8% of fifth-grade students were overweight and 36.3% were obese. Higher overweight rates were found in girls, while boys had higher obesity rates. It highlights that boys and girls respond differently to obesogenic environments, consistent with previous research on biological, behavioural, and social influences on childhood obesity (Eo & Kim, 2024; Keller et al., 2019; Shah et al., 2020).

Key factors contributing to overweight and obesity include younger age, male gender, Chilean nationality, high birth weight, low physical activity, and infrequent reading. Chronic illnesses, low self-confidence, and lack of sleep increase

obesity risk, while low birth weight and urban living may decrease it. Physical activity reduces the risk of obesity, especially in boys. These results corroborate previous studies showing that boys are more susceptible to obesity than girls in early adolescence, influenced by inactivity, socioeconomic, and familial factors (Eo & Kim, 2024; Song et al., 2016; Kowal et al., 2016).

This research shows significant gender differences. While both genders were influenced by age, nationality, birth weight, and maternal education, boys were more affected by belonging to native communities, emotional expression, sleep duration, reading, and the presence of a father figure than girls. These results confirm earlier studies on gender differences in childhood obesity (Song et al., 2016; Kowal et al., 2016).

At the family level, a mother's education level is a strong predictor of childhood obesity, as it reflects socioeconomic position, which influences children's unhealthy eating and inactivity. Additionally, children living only with their fathers or under state care are at a higher risk of being overweight or severely obese. These findings highlight the impact of family structure on children's health and well-being (White et al., 2022; Li et al., 2024; Fismen et al., 2022; Stahlmann et al., 2020).

Among school-related factors, attending public schools is a strong predictor of both mild and severe obesity, particularly in Chile, where these schools often serve disadvantaged socioeconomic groups and lack resources for healthy meals and physical activity. This aligns with other studies linking obesogenic school environments to childhood obesity (Gray et al., 2019; Mohd Saat et al., 2023). Conversely, afternoon schedules are significantly associated with a protective effect against excess malnutrition status, particularly among boys, possibly by reducing unhealthy snack consumption, promoting less sedentary behaviour, and favouring better sleep patterns. More research is needed on this.

This study has several strengths, including a large, representative sample, expert-developed outcome variables, reliable logistic regression models, and marginal effects analysis. However, it has limitations, including potential recall bias and selection bias in third-party-collected data, as well as a cross-sectional design. Parent-reported child anthropometrics generally exhibit small, systematic biases. In children aged 9 to 13 years, a common parental bias is underreporting of weight and a shrinkage/height change bias; consequently, child obesity may be underestimated (Shields et al., 2011; Weden et al., 2013). Future research should explore gender and socioeconomic inequalities, psychological factors, afternoon school schedules, and the effects of implemented public policies on social efficiency and equity.

5. Conclusion

The study emphasises the complexity of childhood obesity in Chile, focusing on the roles of individual, family, and school factors. Despite promoting breastfeeding and enacting the 2016 Law of Food Labelling and Advertising, childhood obesity rates remain alarming. A gender-specific analysis revealed different patterns

of overweight and obesity among boys and girls. The results suggest that addressing school-related factors—such as adjusting daily schedules, enhancing physical activity programs, and ensuring safe food environments—could be effective strategies for preventing childhood obesity. However, addressing school-age childhood obesity will require integrated strategies across schools, families, communities, and public policies. These interventions should be grounded in systemic, long-term, and equity-focused research. The effectiveness of these interventions will require significant family involvement and teacher engagement, as well as their continuous evaluation. The failure of obesity prevention policies in childhood carries the risk of serious adverse outcomes in adulthood.

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Data Availability

Access to the JUNAEB database can be obtained by submitting a request through the State Transparency Portal to the National School Aid and Scholarship Board (JUNAEB).

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Supplementary Materials

Supplementary Table S1 presents the logistic regression results for predictors of excess malnutrition among fifth-grade girls in Chile.

Table S1. Predictors of excess malnutrition status from Logistic Regression models in fifth-grade girl students.

	Overweight			Mild Obesity			Severe Obesity		
	OR	Std. Error	[95% C. I.)	OR	Std. Error	[95% C. I.)	OR	Std. Error	[95% C. I.)
Age									
9 - 10 years old	**1.412*** **	.1217	(1.192 - 1.672)	**1.711*** **	.1796	(1.392 - 2.101)	**2.202*** **	.4150	(1.522 - 3.186)
11 years old	**1.235** **	.1054	(1.045 - 1.460)	**1.307** **	.1363	(1.066 - 1.604)	**1.485** **	.2786	(1.028 - 2.145)
Chilean nationality	**1.408*** **	.0861	(1.249 - 1.587)	**1.680*** **	.1357	(1.434 - 1.968)	**1.596** **	.2324	(1.200 - 2.123)
Belong to native communities	**1.040^{ns}**	.0355	(.973 - 1.112)	**1.100** **	.0435	(1.018 - 1.189)	**1.236** **	.0813	(1.086 - 1.406)
Urban residence	**.965^{ns}**	.0373	(.894 - 1.041)	**.892** **	.0396	(.818 - .973)	**1.077^{ns}**	.0811	(.929 - 1 .249)
Birth weight									
low weight	**.833*** **	.0389	(.793 - .896)	**.792*** **	.0454	(.793 - .896)	**1.133^{ns}**	.1036	(.947 - 1.355)
high weight	**1.280*** **	.0590	(1.102 - 1.230)	**1.694*** **	.0853	(1.102 - 1.230)	**1.834*** **	.1500	(1.562 - 2.153)
Chronic illness or conditions	**1.025^{ns}**	.0380	(.953 - 1.102)	**1.403*** **	.0580	(1.293 - 1.521)	**1.621*** **	.1119	(1.416 - 1.856)
Caries	**1.002^{ns}**	.0251	(.954 - 1.053)	**1.012^{ns}**	.0299	(.955 - 1.072)	**1.113** **	.0579	(1.005 - 1.232)
Asthma	**1.100^{ns}**	.0694	(.972 - 1.245)	**.987^{ns}**	.0695	(.860 - 1.133)	**.791***	.0973	(.621 - 1.006)
Express feelings or emotions									
sometimes	**1.059^{ns}**	.0735	(.924 - 1.213)	**.937^{ns}**	.0733	(.804 - 1.093)	**1.125^{ns}**	.1533	(.862 - 1.469)
frequently	**1.074^{ns}**	.0713	(.943 - 1.224)	**.957^{ns}**	.0711	(.828 - 1.108)	**1.181^{ns}**	.1528	(.917 - 1.522)
Express self-confidence									
never	**1.064^{ns}**	.0540	(.962 - 1.195)	**1.345*** **	.1119	(1.143 - 1.583)	**1.331** **	.1813	(1.019 - 1.738)
sometimes	**1.020^{ns}**	.0239	(.974 - 1.068)	**1.089** **	.0442	(1.005 - 1.179)	**1.085^{ns}**	.0767	(.945 - 1.246)
Physical activity last week									
none	**1.473*** **	.0741	(1.335 - 1.626)	**1.683*** **	.0997	(1.499 - 1.890)	**1.896*** **	.2009	(1.540 - 2.334)
once a week	**1.347*** **	.0589	(1.236 - 1.467)	**1.328*** **	.0699	(1.198 - 1.473)	**1.468*** **	.1414	(1.216 - 1.774)
2 - 3 times a week	**1.235*** **	.0567	(1.128 - 1.351)	**1.191** **	.0662	(1.068 - 1.328)	**1.186***	.1215	(.970 - 1.450)
Hours of sleep (working day)									
<9 hr/day	**.998^{ns}**	.0376	(.927 - 1.075)	**1.050^{ns}**	.0461	(.964 - 1.145)	**1.048^{ns}**	.0818	(.900 - 1.221)
>12 hr/day	**.882^{ns}**	.0943	(.715 - 1.088)	**.806***	.1034	(.627 - 1.036)	**.880^{ns}**	.1812	(.588 - 1.318)

Continued

Book reader									
rarely or never	**1.020**^{ns}	.0337	(.956 - 1.088)	**1.193*****	.0471	(1.104 - 1.289)	**1.117**^{ns}	.0772	(.975 - 1.279)
sometimes	**1.029**^{ns}	.0313	(.969 - 1.092)	**1.142*****	.0423	(1.062 - 1.228)	**1.003**^{ns}	.0662	(.881 - 1.141)
Access to a computer, notebook or tablet at home									
access with restriction	**1.055**^{ns}	.0455	(.970 - 1.150)	**.954**^{ns}	.0480	(.864 - 1.053)	**.877**^{ns}	.0728	(.746 - 1.032)
unrestricted access	**.999**^{ns}	.0362	(.931 - 1.073)	**.957**^{ns}	.0399	(.882 - 1.038)	**.813****	.0556	(.711 - .929)
Social participation	**1.083****	.0330	(1.020 - 1.150)	**1.076****	.0393	(1.002 - 1.156)	**.999**^{ns}	.0666	(.877 - 1.139)
Public School	**1.065****	.0283	(1.011 - 1.122)	**1.133*****	.0356	(1.065 - 1.205)	**1.428*****	.0780	(1.283 - 1.589)
School day									
morning day	**.974**^{ns}	.0304	(.917 - 1.036)	**.952**^{ns}	.0355	(.885 - 1.024)	**.821****	.0569	(.717 - .941)
afternoon day	**.834****	.0629	(.719 - .967)	**.808****	.0745	(.675 - .968)	**.882**^{ns}	.1476	(.635 - 1.225)
A father figure is present									
occasional	**1.035**^{ns}	.0339	(.971 - 1.104)	**.993**^{ns}	.0382	(.921 - 1.071)	**.995**^{ns}	.0676	(.871 - 1.137)
never	**1.044**^{ns}	.0470	(.955 - 1.140)	**.968**^{ns}	.0512	(.873 - 1.074)	**1.077**^{ns}	.0975	(.902 - 1.286)
Mother's educational level									
low level	**1.073****	.0325	(1.011 - 1.138)	**1.323*****	.0702	(1.192 - 1.468)	**2.074*****	.1843	(1.743 - 2.469)
medium level	**1.008*****	.0204	(1.034 - 1.114)	**1.228*****	.0426	(1.147 - 1.314)	**1.405*****	.0936	(1.233 - 1.601)
Cohabitation (live with…)									
only mother	**1.041**^{ns}	.0308	(.982 - 1.103)	**1.101****	.0383	(1.029 - 1.179)	**1.033**^{ns}	.0641	(.915 - 1.167)
only father	**1.045**^{ns}	.1060	(.857 - 1.275)	**1.119**^{ns}	.1321	(.888 - 1.410)	**1.589****	.2839	(1.120 - 2.256)
other family member	**.844**^{ns}	.0911	(.683 - 1.043)	**.996**^{ns}	.1217	(.784 - 1.265)	**.895**^{ns}	.1900	(.591 - 1.357)
state protection	**.834**^{ns}	.1982	(.523 - 1.329)	**.594***	.1867	(.320 - 1.099)	**2.037****	.6576	(1.082 - 3.835)
Occupational status of the head of household									
unemployed	**1.058**^{ns}	.0491	(.966 - 1.159)	**.980**^{ns}	.0522	(.883 - 1.088)	**.865**^{ns}	.0769	(.726 - 1.029)
salaried	**1.121****	.0440	(1.038 - 1.211)	**.943**^{ns}	.0425	(.863 - 1.030)	**.843****	.0639	(.727 - .978)
own account	**1.094****	.0464	(1.006 - 1.188)	**1.013**^{ns}	.0493	(.921 - 1.114)	**.913**^{ns}	.0741	(.779 - 1.070)
maid	**1.011**^{ns}	.1160	(.808 - 1.266)	**.990**^{ns}	.1315	(.763 - 1.284)	**.663***	.1652	(.407 - 1.081)
retired	**1.090**^{ns}	.0932	(.922 - 1.289)	**.960**^{ns}	.0958	(.790 - 1.168)	**.664****	.1276	(.790 - 1.168)
student	**1.119**^{ns}	.1730	(.826 - 1.515)	**.743**^{ns}	.1469	(.504 - 1.095)	**.640**^{ns}	.2424	(.456 - .968)
_cons	**.304*****	.0455	(.226 - .407)	**.095*****	.0171	(.067 - .136)	**.0104*****	.0033	(.006 - .020)
Hosmer-Lemeshow test	**.8657**			**.2650**			**.2976**		
AUC measures	**.5536**			**.6080**			**.6598**		

*: $p < .1$; **: $p < .05$; ***: $p < .0001$; **ns**: no significant.

Supplementary Table S2 presents the logistic regression models predicting the excess malnutrition status among fifth-grade boys in Chile.

Table S2. Predictors of excess malnutrition status from Logistic Regression models in fifth-grade boy students.

	Overweight			Mild Obesity			Severe Obesity		
	OR	Std. Error	[95% C. I.)	OR	Std. Error	[95% C. I.)	OR	Std. Error	[95% C. I.)
Age									
9 - 10 years old	**1.275*** **	.0568	(1.169 - 1.392)	**1.690*** **	.0780	(1.543 - 1.850)	**2.612*** **	.1729	(.229 - 2.974)
11 years old	**1.173*** **	.0489	(1.045 - 1.460)	**1.436*** **	.0625	(1.066 - 1.604)	**1.793*** **	.11340	(1.583 - 2.031)
Chilean nationality	**1.337*** **	.0632	(1.218 - 1.466)	**1.757*** **	.0897	(1.589 - 1.942)	**1.434*** **	.1000	(1.251 - 1.644)
Belong to native people	**1.084** **	.0340	(1.019 - 1.153)	**1.161*** **	.0364	(1.091 - 1.234)	**1.282*** **	.0518	(1.184 - 1.388)
Urban residence	**.967^{ns}**	.0343	(.908 - 1.037)	**.890** **	.0315	(.831 - .954)	**.845*** **	.0381	(.774 - .923)
Birth weight									
low weight	**.850*** **	.0354	(.793 - .896)	**.778*** **	.0334	(.715 - .846)	**.862** **	.0506	(.768 - .967)
high weight	**1.102** **	.0390	(1.028 - 1.181)	**1.328*** **	.0460	(1.241 - 1.421)	**1.673*** **	.0720	(1.537 - 1.820)
Chronic illness or conditions	**1.039^{ns}**	.0332	(.976 - 1.106)	**1.291*** **	.0405	(1.214 - 1.373)	**1.550*** **	.0624	(1.432 - 1.677)
Caries	**.966^{ns}**	.0217	(.924 - 1.009)	**.920*** **	.0209	(.880 - .962)	**1.012^{ns}**	.0307	(.954 - 1.074)
Asthma	**1.129** **	.0581	(1.021 - 1.249)	**1.078^{ns}**	.0545	(.977 - 1.191)	**.954^{ns}**	.0620	(.840 - 1.083)
Express feelings or emotions.									
sometimes	**.992^{ns}**	.0595	(.882 - 1.116)	**1.022^{ns}**	.0608	(.910 - 1.149)	**1.191** **	.0939	(1.021 - 1.390)
frequently	**1.087^{ns}**	.0626	(.971 - 1.217)	**1.138** **	.0648	(.648 - 1.018)	**1.341*** **	.1021	(1.155 - 1.557)
Express self-confidence									
never	**.950^{ns}**	.0651	(.830- 1.086)	**1.166** **	.0769	(1.025 - 1.327)	**1.401*** **	.1158	(1.192 - 1.647)
sometimes	**1.016^{ns}**	.0320	(.955 - 1.081)	**1.112** **	.0346	(1.047 - 1.182)	**1.277*** **	.0521	(1.179 - 1.384)
Physical activity last week									
none	**1.279*** **	.0545	(1.176 - 1.390)	**1.774*** **	.0763	(1.630 - 1.930)	**1.964*** **	.1126	(1.755 - 2.197)
once a week	**1.210*** **	.0409	(1.132 - 1.292)	**1.537*** **	.0538	(1.435 - 1.646)	**1.505*** **	.0730	(1.369 - 1.655)
2 - 3 times a week	**1.096** **	.0378	(1.024 - 1.172)	**1.273*** **	.0459	(1.186 - 1.366)	**1.294*** **	.0649	(1.173 - 1.428)
Hours of sleep (working day)									
<9 hr/day	**1.041^{ns}**	.0374	(.970 - 1.117)	**1.183*** **	.0421	(1.103 - 1.268)	**1.176** **	.0560	(1.072 - 1.292)
>12 hr/day	**.954^{ns}**	.0917	(.790 - 1.151)	**.821** **	.0825	(.674 - .0999)	**1.069^{ns}**	.1343	(.836 - 1.368)
Book reader									
rarely or never	**1.055***	.0326	(.993 - 1.120)	**1.217*** **	.0384	(1.144 - 1.295)	**1.198*** **	.0517	(1.101 - 1.304)
sometimes	**.999^{ns}**	.0304	(.941 - 1.061)	**1.076** **	.0337	(1.011 - 1.144)	**1.061^{ns}**	.0458	(.975 - 1.155)

Continued

Access to a computer, notebook or tablet at home									
access with restriction	**1.067***	.0408	(.990 - 1.150)	**.980^{ns}**	.0380	(.864 - 1.053)	**.947^{ns}**	.0482	(.857 - 1.046)
unrestricted access	**1.013^{ns}**	.0322	(.952 - 1.078)	**1.032^{ns}**	.0330	(.882 - 1.038)	**.993^{ns}**	.0412	(.915 - 1.077)
Social participation	**1.029^{ns}**	.0272	(.977 - 1.084)	**1.036^{ns}**	.0279	(.983 - 1.092)	**.992^{ns}**	.0364	(.923 - 1.066)
Public School	**.946****	.0225	(.903 - .991)	**1.038^{ns}**	.0249	(.990 - 1.088)	**1.214*****	.0389	(1.140 - 1.293)
School day									
morning day	**.983^{ns}**	.0282	(.9300 - 1.040)	**.985^{ns}**	.0286	(.930 - 1.042)	**.967^{ns}**	.0382	(.895 - 1.045)
afternoon day	**.816****	.0523	(.720 - .925)	**.886***	.0568	(.781 - 1.005)	**.785****	.0735	(.654 - .943)
The father figure is present									
occasional	**1.040^{ns}**	.0308	(.982 - 1.102)	**1.043^{ns}**	.0310	(.984 - 1.106)	**1.090****	.0430	(1.009 - 1.178)
never	**.939^{ns}**	.0384	(.866 - 1.017)	**.977^{ns}**	.0400	(.902 - 1.058)	**1.076^{ns}**	.0581	(.968 - 1.196)
Mother's educational level									
low level	**1.042^{ns}**	.0423	(.963 - 1.129)	**1.160*****	.0473	(1.071 - 1.257)	**1.577*****	.0845	(1.420 - 1.752)
medium level	**1.056****	.0270	(1.005 - 1.111)	**1.115*****	.0288	(1.060 - 1.173)	**1.391*****	.0507	(1.296 - 1.495)
Cohabitation (live with…)									
only mother	**1.046***	.0278	(.993 - 1.102)	**1.074****	.0287	(1.019 - 1.132)	**1.047^{ns}**	.0378	(.975 - 1.123)
only father	**1.181****	.0978	(1.004 - 1.389)	**1.119^{ns}**	.0948	(.948 - 1.321)	**1.165^{ns}**	.1311	(.935 - 1.452)
other family member	**.848***	.0780	(.708 - 1.016)	**.852***	.0786	(.711 - 1.021)	**.817^{ns}**	.1022	(.639 - 1.044)
state protection	**1.186^{ns}**	.2480	(.788 - 1.787)	**.919^{ns}**	.2074	(.590 - 1.430)	**2.201****	.5076	(1.400 - 3.459)
Occupational status of the head of household									
unemployed	**1071^{ns}**	.0449	(.986 - 1.163)	**1.058^{ns}**	.0448	(.973 - 1.149)	**1.005^{ns}**	.0557	(.901 - 1.120)
salaried	**1.022^{ns}**	.0360	(.954 - 1.095)	**1.052^{ns}**	.0373	(.982 - 1.128)	**.916***	.0428	(.836 - 1.004)
own account	**1.039^{ns}**	.0395	(.964 - 1.119)	**1.052^{ns}**	.0404	(.976 - 1.134)	**1.102****	.0548	(1.000 - 1.215)
maid	**1.039^{ns}**	.1040	(.854 - 1.264)	**1.108^{ns}**	.1116	(.910 - 1.350)	**.999^{ns}**	.1312	(.772 - 1.292)
retired	**.974^{ns}**	.0733	(.841 - 1.129)	**.984^{ns}**	.0743	(.849 - 1.141)	**.942^{ns}**	.0947	(.773 - 1.147)
student	**.881^{ns}**	.1162	(.680 - 1.141)	**.940^{ns}**	.1242	(.726 - 1.218)	**.763^{ns}**	.1477	(.523 - 1.116)
_cons	**.631*****	.0715	(.505 - .788)	**.199*****	.0230	(.158 - .250)	**.035*****	.0054	(.025 - .047)
Hosmer-Lemeshow test	**.2369**			**.4676**			**.9303**		
AUC measures	**.5467**			**.5962**			**.6453**		

*: $p < .1$; **: $p < .05$; ***: $p < .0001$; **ns**: no significant.