The impact of Chile's multipronged food labelling and advertising law on early childhood excess weight: a cohort difference-in-differences study

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Summary

Background The 2016 Chilean Food Labelling and Advertising Law (FLAL), featuring black octagonal front-of-package warning labels and marketing and school restrictions, was among the first sets of multiple healthy food policies globally. In spite of its relevance, no study has causally linked the FLAL implementation to health outcomes. We aimed to estimate the plausible causal effect of the implementation of phase 1 of the FLAL on the relevance of excess weight among young children.

Methods In this cohort difference-in-differences approach, we assessed the effect of phase 1 of the FLAL on children's BMI when initital thresholds for critical nutrients were subsequently increased and implemented. Our analysis used national administrative data from the Chilean National Board of School Aid and Scholarships covering more than 300 000 school children aged 4–6 years across public and publicly subsidised schools nationwide from 2012 to 2017. We primarily used the Nutritional Map (Mapa Nutricional), available beginning in 2012, complemented with the Vulnerability Survey (Encuesta de Vulnerabilidad), available beginning in 2019. We defined cohorts by the year students entered prekindergarten, and compared unexposed cohorts (2012 and 2013, control group) with cohorts exposed to phase 1 (2014 and 2015, treatment group) during prekindergarten, kindergarten, and first grade. The primary outcome was a binary indicator of excess weight (ie, overweight or obesity) analysed using logit models and reported as marginal effects. We conducted subgroup analyses by children's school type, school area, maternal education and age at childbirth, birthweight, and gender.

Findings The final analytical sample included 321 597 students (of cohorts 2012–15) covering the years 2012 to 2017 across prekindergarten, kindergarten, and first grade. Exposure to phase 1 of the FLAL led to significant reductions in the probability of a child having excess weight. Children exposed during both kindergarten and first grade (ie, 18 months of exposure) had the largest effects. Girls had a 2·85% lower probability of excess weight (95% CI –0·0407 to –0·0163), while boys had a 2·40% lower probability (–0·0358 to –0·0122). We also observed significant effects after 6 months of exposure (ie, first grade only): 1·91% lower probability (–0·0315 to –0·0068) for girls and 2·24% (–0·0345 to –0·0104) lower probability for boys.

Interpretation Phase 1 of Chile's comprehensive FLAL plausibly caused a measurable decrease in the prevalence of excess weight among young school children. The results provide crucial, evidence-based support for policy makers worldwide who are considering food environment policies as a scalable, impactful strategy to combat the childhood obesity epidemic.

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Introduction

Food environments—defined as "the conditions that influence people's food and beverage choices and nutritional status"[1]—are an important determinant of children's diets and nutritional status. They include key physical, economic, and sociocultural factors that drive dietary behaviours, comprising availability, marketing, cost, social norms, and preferences. Promoting healthier food environments is particularly crucial for children, given the early establishment of food preferences and the tracking of dietary behaviours and nutritional status over time.[2]

Chile ranks among the highest countries globally for childhood excess weight prevalence.[3,4] National data from 2023 show that 50·9% of schoolchildren under the age of 14 years were overweight and 23·9% were obese.[5] In response to this urgent situation, in 2016, Chile implemented one of the world's most comprehensive and ambitious food environment laws, the Food Labelling and Advertising Law (FLAL), including three core components: (1) mandatory front-of-package warning labels (ie, black octagons with a "high in" [critical nutrient] text) for foods and beverages with high content of sugars, saturated fats, sodium, or energy density

Research in context

Evidence before this study

Although single national food environment policies, such as sugar-sweetened beverage taxes, have demonstrated effects on health outcomes, there are currently no published studies assessing the real-world health effects of multi-pronged food environment policies that integrate front-of-package warning labels, marketing restrictions, and school food environment regulations.

Added value of this study

This study offers the first plausible causal evidence at the national level that a comprehensive food environment policy influences children's excess weight. Using a national administrative dataset of more than 300 000 Chilean schoolchildren aged 4–6 years from 2012 to 2017 and a cohort difference-in-differences approach, we went beyond mere association to quantify the Food and Advertisement Law's (FLAL) direct, plausible causal impact. Our findings indicate that exposure to phase 1 of the Chilean FLAL during early school years resulted in a significant decrease in the likelihood of excess weight and in BMI. We also observed a strong protective effect for biologically vulnerable children (eg, those with low birthweight). Results for girls should be interpreted with caution regarding plausible causality.

Implications of all the available evidence

This research shows that a mutually reinforcing set of food environment policies, anchored by a front-of-package warning label, reduces the risk of excess weight among early school-age children. These findings provide crucial evidence-based support for policy makers worldwide who are considering mandatory nutritional warning labelling in particular, and food environment policies in general, as powerful, scalable strategies to address the childhood obesity epidemic.

(ie, calories); (2) restrictions on the sale of regulated products in schools; and (3) comprehensive limits on regulated food marketing directed at children.[6] The law initially set thresholds for these ingredients and calories, and over time, they were progressively tightened, allowing for manufacturing reformulation (appendix p 1). Phase 1 of the regulation started in June 26, 2016. Phases 2 and 3, which had more stringent thresholds, began in June 27, 2018, and June 27, 2019, respectively.

See Online for appendix

Consistent with proposed pathways of impact for front-of-package labelling and marketing regulations, the FLAL was expected to affect both food demand and the supply of regulated products.[7,8] On the demand side, by providing clear information to consumers, restricting sales of products at schools, and banning advertisements directed to children, the FLAL was expected to change consumers' willingness to purchase regulated products. In terms of supply, the government anticipated that companies would widely reformulate regulated products to avoid restrictions.[9,10] The goal was that, together, these measures would contribute to consumers' reduced intake of regulated critical nutrients.

Evidence has already documented early effects consistent with these expected pathways. Studies show that consumers notice and understand high-in warning labels across educational levels and report using them more frequently than other forms of nutrition information when making food purchase decisions.[11] Exposure to marketing of high-in products directed at children declined by approximately 60%,[12] and their availability decreased by nearly 80% in public school settings.[13] These changes have been associated with reductions in purchased calories, total sugars, saturated fats, and sodium,[14] and decreased consumption of regulated nutrients among children, particularly within school environments.[15] On the supply side, industry reformulation substantially contributed to these changes. The share of products classified as high-in decreased from 55% to 44% of total items within 6 months. These trends strengthened further following full implementation of the regulation.[16,17]

Taken together, we believe evidence across demand-side and supply-side responses supports the proposed pathways of effect, with the assessment of effects on excess weight outcomes representing the remaining gap in the evidence base. Therefore, the primary objective of this study was to estimate the plausible causal effect of the implementation of phase 1 of Chile's FLAL on the prevalence of excess weight among young children. Our primary working hypothesis was that the FLAL reduced excess weight in young children and the longer their exposure to the FLAL, the greater the effect.

Methods

Study design

We used the largest public, national, longitudinal database of weight, height, and socioeconomic characteristics in Chile, covering more than 300 000 children attending public and publicly subsidised schools. We used a quasi-experimental difference-in-differences design to estimate the plausible causal effect of the Chilean FLAL on the prevalence of excess weight by comparing changes over school grades between exposed and unexposed cohorts of children aged 4–6 years attending public and publicly subsidised schools. Public schools are entirely free, whereas publicly subsidised schools might charge tuition fees, which are fully or partially covered by a public voucher system that provides families with a fixed per-student subsidy. We conducted analyses by school type, school area, maternal education, maternal age at childbirth, child's birthweight, and gender. As cohorts experienced phase 1 implementation at different stages of schooling, it is possible to measure the differential effect of exposure to the policy. This study relied on comprehensive administrative and survey data collected by the Chilean National Board of School Aid and Scholarships (the Junta Nacional de Auxilio Escolar y Becas, known as JUNAEB) between 2012 and 2017. We primarily used the Nutritional Map (Mapa Nutricional), available beginning in 2012, complemented with the Vulnerability Survey (Encuesta de Vulnerabilidad), available beginning in 2019.[5,18–20] Both instruments were collected annually in public and publicly subsidised schools and target students enrolled in prekindergarten (ie, age 4 years), kindergarten (ie, age 5 years), the first grade (ie, age 6 years) and fifth grade (ie, age 10 years) of primary education, and the first grade of secondary education (ie, age 14 years).[21] Preprimary education is optional while primary and secondary schooling are compulsory.[22] Although public schools are free, private schools—which often serve higher-income families—can be of two types: (1) fully private, charging tuition and leading to socioeconomic stratification; and (2) publicly subsidised, through fixed-amount vouchers that can partially or fully pay tuition (the percentage of tuition coverage depends on the tuition charged by each school).[23]

The Nutritional Map is the primary source of information on students' physical development in Chilean public and publicly subsidised schools. Before public release, the data undergo a harmonisation process that ensures consistency in anthropometric measurements and accuracy in the recorded ages of children at the time of assessment. The collected information guides JUNAEB's institutional programmes and informs national strategies on nutrition and physical activity. Although it is not considered an official national statistic—this responsibility lies with the Ministry of Health—the Nutritional Map is the primary source for academic research, public policy planning, and international monitoring efforts. In 2012, the Nutritional Map reached 74·8% of students within its intended coverage group.[24] The Nutritional Map includes data on weight and height collected on-site at schools, typically by physical education teachers or designated school personnel. JUNAEB provides training and audiovisual materials to improve data reliability. The datasets provide BMI-for-age Z scores (BAZ), which are used to categorise students into one of six nutritional groups according to 2006–07 WHO standards: underweight (BAZ less than –2), low weight (BAZ less than –1), normal weight (BAZ more than –1 and less than 1), overweight (BAZ more than 1), obesity (BAZ more than 2), or severe obesity (BAZ more than 3).[24,25] Further individual-level data include sex and region of residence. Contextual school-level information includes school size (four quartiles based on the number of students enrolled), area (urban *vs* rural), type of school (public *vs* publicly subsidised), and the student's school attendance regime (morning, afternoon, or full day).

Because the Nutritional Map does not collect data on children's socioeconomic characteristics, we complemented the Nutritional Map data with Vulnerability Survey data, which can be linked to the Nutritional Map at the individual level. The Vulnerability Survey provides time-invariant characteristics that are particularly relevant for analysing heterogeneity in nutritional outcomes and policy impact, such as maternal education level at childbirth, maternal age at childbirth, and child's birthweight, with children born weighing less than 2·5 kg classified as low birthweight. Maternal education was categorised into three groups: no high school diploma, high school as the highest degree completed, and a diploma of a higher level than high school. Because these variables are time-invariant, we were able to use data from the 2019 and subsequent Vulnerability Surveys. In 2019, the Vulnerability Survey captured 62·4% of the eligible student cohort.[26]

A key feature of both datasets is a unique and anonymised student identifier derived from Chile's national identification number system that enabled deterministic linkage of records across data sources and over time and ensured participant privacy. JUNAEB anonymised all data to ensure confidentiality and compliance with data protection regulations.

The researchers accessed the study data in accordance with JUNAEB's specific data protection policies. The study used anonymised, de-identified longitudinal records, which do not require direct interaction with human subjects or the collection of personal data by the authors. As the research uses aggregated and anonymised national administrative data, it was considered exempt from formal review by an Institutional Review Board for primary data collection.

Participants

The analytical sample included children whose anthropometric measurements were collected during prekindergarten, kindergarten, and first grade of primary education between 2012 and 2017 (appendix pp 1–2). We chose the time frame and school grades to align with the conditions of the difference-in-differences approach, which requires at least two observations for children unexposed to the policy at any educational level (ie, control cohorts) and at least one pre-exposure and one post-exposure observation for those exposed to the FLAL (ie, treatment cohorts). Due to this methodological design, we did not include data from Jan 1, 2018, onwards, as children entering prekindergarten in 2016 or later lack baseline anthropometric data prior to the FLAL implementation.

We defined cohorts by the year students entered prekindergarten. For example, the 2012 cohort included all students who began prekindergarten in that year. The raw dataset spanned cohorts from 2012 to 2015 and included student records from prekindergarten through to first grade.

To preserve the longitudinal structure of the dataset, we restricted the sample to students who progressed from prekindergarten to kindergarten and then to first grade in consecutive years. This excluded students who either repeated a grade or skipped kindergarten, which is an option allowed in Chile, where early childhood education is not mandatory. We also excluded students who had missing values in key Nutritional Map variables, those lacking records in the Vulnerability Survey, and those who had incomplete responses to essential Vulnerability Survey variables.

Procedures and outcomes

We described the data by reporting means and standard deviations for girls and boys separately, combining control cohorts and reporting treatment cohorts by children's, mothers', and school characteristics. We also presented a comparison of descriptive statistics between excluded and included observations. Additionally, we graphically described longitudinal trends in the unconditional prevalence of excess weight among girls and boys from prekindergarten through to first grade between 2012 and 2017.

For the **Biblioteca del Congreso Nacional de Chile** see https://www.bcn.cl/portal/

The primary outcome was a binary indicator for excess weight (ie, overweight or obesity), equal to one for children classified as overweight, obese, or severely obese, and zero otherwise. Our secondary outcome was the continuous BAZ score.

Statistical analysis

We assessed the plausible causal effect of the FLAL on children's nutritional status using a cohort difference-in-differences identification strategy that exploits variations in exposure to the FLAL across cohorts attending different school grades and years.[27–29] The cohort difference-in-differences strategy differs from the traditional difference-in-differences by exploiting variations in policy exposure across birth cohorts rather than over time among the same individuals or groups. Instead of comparing treated and control individuals (ie, group difference) before and after the year in which the policy was implemented (ie, time difference), the method compares individuals in treated and control cohorts (ie, group difference as defined by cohort) before and after the grade at which the policy became binding for the treated group (ie, grade difference).

The 2012 and 2013 cohorts served as the control group in the difference-in-differences framework, as they were not exposed to the FLAL policy during the early school grades. By contrast, the 2014 and 2015 cohorts comprised the treatment group. A child was considered exposed to the FLAL if they attended any portion of a school grade after June 26, 2016, the date when the policy was implemented. Based on this definition, the 2014 cohort was first exposed during first grade, amounting to approximately 6 months of exposure. Meanwhile, the 2015 cohort was in kindergarten while the policy took effect and therefore had up to 18 months of exposure by the end of first grade.

To support the validity of the identification strategy, we tested the parallel trends assumption and examined the broader policy environment for potential confounding interventions. To test for parallel trends, we re-estimated the main equation using only pre-FLAL cohorts (ie, 2012, 2013, and 2014), restricted to prekindergarten and kindergarten observations, where a non-significant coefficient on the treatment indicator would indicate that treated and control cohorts followed similar nutritional trajectories before the policy. This test is feasible for the 6-month exposure effect, which involves cohorts with two pre-treatment observations (pre-kindergarten and kindergarten). However, the test could not be conducted for the 18-month exposure effect, as the 2015 cohort had only one pre-treatment observation (prekindergarten), which was insufficient to assess trend parallelism. To rule out contemporaneous confounders, we systematically searched the Biblioteca del Congreso Nacional de Chile (The Library of the Congress of Chile), the official repository of all legal and regulatory instruments enacted in Chile, across all state institutions and policy areas that could plausibly affect children's nutritional outcomes (appendix pp 20–25).

The primary outcome of excess weight was analysed using logit models. Results are reported as average marginal effects (ME), which reflect changes in the slope of the probability of excess weight across grades between the treated and control cohorts, rather than level differences at a single point in time. We used the BAZ as the dependent variable to conduct sensitivity analyses, using ordinary least square regressions. In all cases, we performed subgroup analyses by school type, school area (urban *vs* rural), maternal education and age at childbirth, child's birthweight, and gender. The supplementary appendix includes a detailed explanation of the data and the models we used. We conducted all analyses with STATA 19 (version 19.5).

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

The raw dataset (cohorts 2012–15) comprised 525 821 children. 110 661 (21·0%) students were excluded either due to repeating a grade or skipping kindergarten. A further 1983 (0·4%) students were excluded due to missing values in key Nutritional Map variables, and an additional 63 104 (12·0%) students lacking records in the Vulnerability Survey. Finally, 28 476 students (5·4%) were excluded due to incomplete responses to essential Vulnerability Survey variables. The final analytical sample included 321 597 students (of cohorts 2012–15) covering the years 2012 to 2017 across prekindergarten, kindergarten, and first grade (appendix pp 1–2). A comparison of descriptive statistics between the excluded observations and the final analytical sample revealed statistically significant differences (due to the large sample size) but no relevant qualitative differences (appendix pp 3–4).

Although the analytical sample applies several restrictions, additional analyses using broader samples and alternative model specifications (appendix pp 25–27), suggested that these restrictions do not compromise the validity of the main results.

A small percentage of children had low birthweight (8%) or undernutrition (2%; appendix pp 3–6). The education data show a high level of schooling among most mothers (high school or more), and 19% of mothers were younger than 20 years old at the time of the child's birth (appendix p 5).

Across all cohorts and grade levels, boys consistently had a higher unconditional prevalence of excess weight than girls (figure 1). The untreated cohorts (ie, 2012 and 2013) showed a clear upward trajectory in the unconditional prevalence of excess weight as children progressed through grades, except for that of boys in the 2013 cohort, which showed a decrease in the unconditional prevalence in first grade. By contrast, in the treated cohorts (ie, 2014 and 2015) the upward trend is less pronounced or flattens after exposure, which is especially notable in first grade.

The empirical evidence was consistent with the validity of the identification strategy. For boys, CIs were centred around 0 for both outcomes, providing convincing support for the parallel trends assumption (excess weight –0·0192 to 0·0082; BAZ –0·0285 to 0·0109). For girls, the evidence was less conclusive: although 0 was included in the CI for excess weight, the interval was shifted towards positive values with zero near the lower bound (–0·0004 to 0·0278); for BAZ, 0 fell within the interval but was similarly close to the lower bound (0·0005 to 0·0354). Cohort-specific trend plots further corroborate these findings (appendix pp 21–22). We also found no evidence of institutional changes enacted contemporaneously with the FLAL, with all relevant regulations identified in our policy review predating or postdating 2016 (appendix p 24).

Across nearly all model specifications, the estimated effect of the FLAL on the nutritional status of girls and boys indicated a statistically significant reduction in the probability of excess weight attributable to exposure to the law (figure 2).

Results were not significant for several subgroups. Among girls, no significant effects were found for those whose mothers did not complete high school, for maternal age younger than 20 years with first grade exposure only, for maternal age older than 35 years with first grade exposure only, and for birthweights above 4 kg under both exposure periods. Among boys, effects were likewise non-significant for those whose mothers did not complete high school, for those whose mothers completed more than high school but were exposed only in first grade, for maternal age older than 35 years under both exposure periods, for birthweights below 2·5 kg and above 4 kg under both exposure periods, and for those attending rural schools under both exposure periods.

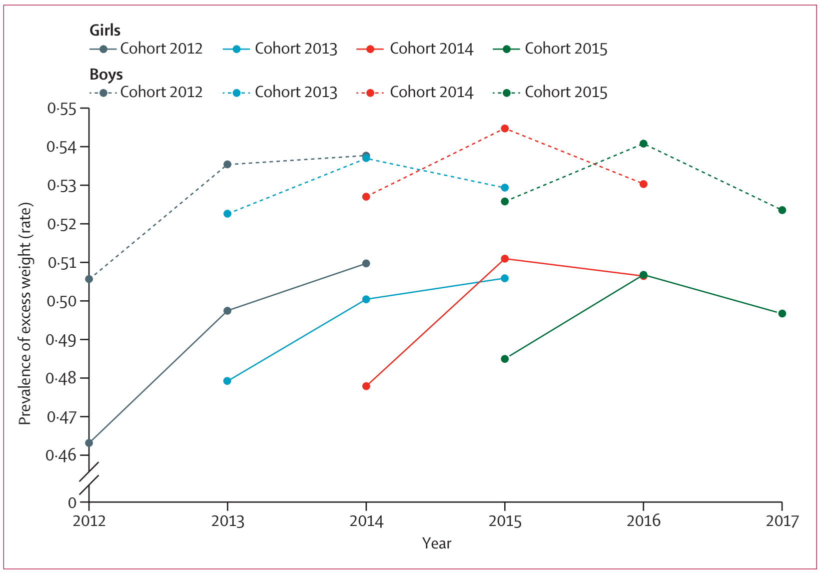

Figure 1: **Cohort-specific trends in the unconditional prevalence of childhood excess weight by school grade, year, and gender, children from public and publicly subsidised schools, 2012–17**
Each line represents a birth cohort of children followed over time from prekindergarten through to first grade between 2012 and 2017. The y-axis shows the proportion of children with excess weight (overweight or obesity) as defined by the age-adjusted BAZ (>1) and the x-axis shows the calendar year in which anthropometric measurements were taken. Full lines represent girls, while dashed lines represent boys. The first datapoint for each line indicates prekindergarten, the second represents kindergarten, and the third represents first grade. The Food Labelling and Advertising Law was implemented in 2016, affecting cohorts differently depending on their school grades at the time of implementation. Cohorts 2012 and 2013 were unexposed during early grades (control, grey and blue lines), while cohorts 2014 and 2015 were partially exposed (treatment, red and green lines). BAZ=BMI-for-age Z scores.

Girls exposed to the FLAL for 6 months (during first grade) had a 1·91% lower probability (95% CI –0·0315 to –0·0068) of excess weight compared with their unexposed counterparts, while those exposed for 18 months (in both kindergarten and first grade) had a reduction of 2·85% (–0·0407 to –0·0163) compared with their unexposed counterparts (table 1). Among boys, the corresponding reductions are similarly meaningful: a 2·24% decrease (95% CI –0·0345 to –0·0104) after 6 months of exposure and a 2·40% reduction (–0·0358 to –0·0122) following 18 months of exposure compared with their unexposed counterparts (table 2).

Subgroup analyses revealed that the reduction in excess weight was more pronounced among children whose mothers attained at least a high school diploma, although no consistent pattern was observed by maternal age at childbirth. Effects were significant among girls with low birthweight (less than 2·5 kg) and among children with birthweights between 2·5 kg and 4·0 kg, but not for those above 4·0 kg. Results were also larger among children attending subsidised and urban schools, with

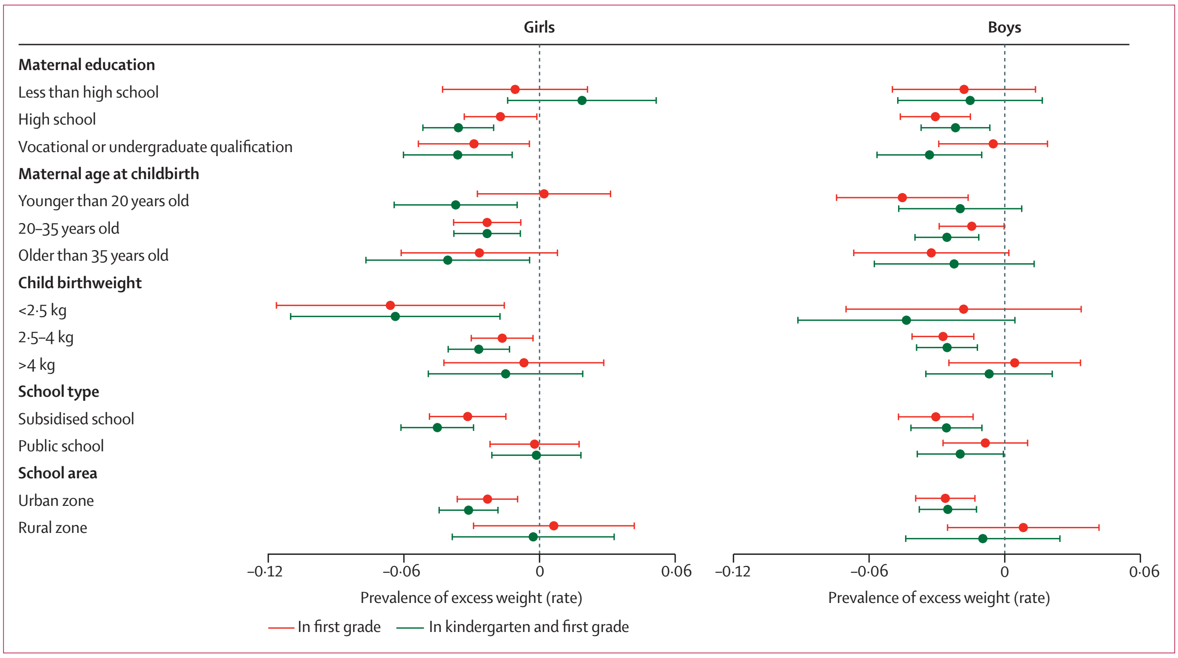

***Figure 2:* ME (95% CI) of the FLAL on excess weight among girls and boys in public and publicly subsidised schools, 2012–17**

ME (95% CI) of the FLAL on excess weight (defined as BAZ >1) among girls and boys based on logit regressions. Results are reported separately for the 2014 (red) and 2015 (green) treatment cohorts (appendix p 10). Estimates are stratified by maternal education, maternal age at childbirth, child birthweight, school type, and school area. Effects represent slope changes in excess weight prevalence across school grades relative to the control cohorts. BAZ=BMI-for-age Z scores. FLAL=Food Labelling and Advertising Law. ME=marginal effects.

no significant effects observed in rural areas. Excess weight reduction was more pronounced among children whose mothers have higher levels of education, although this result was statistically significant only for girls with 18 months of exposure (appendix pp 18–19). By contrast, the estimated effects for children whose mothers did not complete high school (~15% of the sample) were not statistically significant. Among girls whose mothers attained a high school diploma, the likelihood of having excess weight was 1·73% (95% CI –0·0333 to –0·0012) lower for those exposed in first grade compared with their non-exposed counterparts and 3·59% lower for those exposed in both kindergarten and first grade (95% CI –0·0516 to –0·0203). For girls whose mothers completed a diploma of a higher level than high school, the corresponding reductions were 2·90% (95% CI –0·0536 to –0·0045) and 3·62% (–0·0602 to –0·0121), respectively. A similar pattern was observed among boys. By contrast, when stratifying by maternal age at childbirth, there was no consistent pattern in the estimated effects (table 2).

For child birthweight we observed significant effects among girls with a birthweight below 4·0 kg, and boys with a birthweight between 2·5 kg and 4·0 kg. For girls with a birthweight of less than 2·5 kg (ie, low birthweight) exposure to the FLAL in first grade reduced the probability of excess weight by 6·60% compared with their unexposed counterparts (95% CI –0·1164 to –0·0156), while exposure across both kindergarten and first grade led to a reduction of 6·38% (–0·1101 to –0·0175) compared with their unexposed counterparts. Results for boys in the low birthweight category were non-significant. Among girls who weighed between 2·5 kg and 4·0 kg at birth, the reduction was 1·65% (–0·0302 to –0·0029) for those exposed in first grade only and 2·69% (–0·0404 to –0·0134) for those exposed in both kindergarten and first grade. Among boys, the estimated reductions were 2·73% (–0·0410 to –0·0137) and 2·55% (–0·0390 to –0·0121), respectively.

The effects of the FLAL were larger in subsidised schools for the cohort exposed for 18 months (appendix pp 18–19). Girls enrolled in subsidised schools had a 3·19% (95% CI –0·0487 to –0·0150) and 4·52% (–0·0613 to –0·0292) lower probability of excess weight when exposed to the policy during first grade and both kindergarten and first grade, respectively, compared with control cohorts in similar schools. For boys there was a reduction of 3·05% (–0·0470 to –0·0139) and 2·58% (–0·0415 to –0·0102) for first grade and both kindergarten and first grade exposures, respectively. There was no observed effect among girls enrolled in public schools, whereas there was a significant reduction for boys of 1·97% (–0·0387 to –0·0007).

Finally, the overall impact of the FLAL is driven primarily by changes in the nutritional status of children attending schools in urban areas, with no statistically significant effects observed among those in rural areas (tables 1, 2). Among urban students exposed to the policy

	Exposure to the FLAL in first grade			Exposure to the FLAL in kindergarten and first grade		
	Sample size, n	ME (95% CI)	Excess weight prevalence (rate) in pre-kindergarten (control and treated cohorts)	Sample size, n	ME (95% CI)	Excess weight prevalence (rate) in pre-kindergarten (control and treated cohorts)
Full sample	118 188	−0·0191* (−0·0315 to −0·0068)	0·474	121 982	−0·0285† (−0·0407 to −0·0163)	0·477
Maternal education						
Less than high school	17 374	−0·0108 (−0·0429 to 0·0212)	0·487	17 171	0·0188 (−0·0141 to 0·0516)	0·487
High school	71 606	−0·0173‡ (−0·0333 to −0·0012)	0·473	74 152	−0·0359† (−0·0516 to −0·0203)	0·476
More than high school	29 208	−0·0290‡ (−0·0536 to −0·0045)	0·471	30 659	−0·0362* (−0·0602 to −0·0121)	0·475
Maternal age at childbirth						
<20 years	21 337	0·0020 (−0·0275 to 0·0315)	0·468	23 816	−0·0371* (−0·0643 to −0·0099)	0·474
20 to 35 years	82 408	−0·0232* (−0·0380 to −0·0083)	0·474	84 198	−0·0232* (−0·0379 to −0·0085)	0·477
>35 years	14 443	−0·0266 (−0·0612 to 0·0080)	0·483	13 968	−0·0406‡ (−0·0768 to −0·0044)	0·485
Child birthweight						
<2·5 kg	9599	−0·0660‡ (−0·1164 to −0·0156)	0·410	10 753	−0·0638* (−0·1101 to −0·0175)	0·414
2·5 to 4 kg	99 091	−0·0165‡ (−0·0302 to −0·0029)	0·471	101 231	−0·0269† (−0·0404 to −0·0134)	0·474
>4 kg	9498	−0·0069 (−0·0423 to 0·0284)	0·575	9998	−0·0150 (−0·0492 to 0·0191)	0·581
School type						
Public	58 052	−0·0022 (−0·0219 to 0·0175)	0·479	59 132	−0·0014 (−0·0211 to 0·0183)	0·478
Subsidised	77 468	−0·0319† (−0·0487 to −0·0150)	0·471	80 371	−0·0452† (−0·0613 to −0·0292)	0·477
School location						
Urban	106 537	−0·0230† (−0·0364 to −0·0097)	0·473	110 198	−0·0314† (−0·0444 to −0·0184)	0·476
Rural	16 509	0·0063 (−0·0292 to 0·0419)	0·485	16 771	−0·0028 (−0·0386 to 0·0331)	0·484

ME (95% CI) from logit regressions assessing the impact of the FLAL on excess weight (defined as BAZ >1) among girls. ME are reported as the proportional change in the probability of excess weight, relative to the average prevalence observed in prekindergarten for the corresponding sample. The number of children in the school-type and school-location subgroups does not sum to the total in the full sample because some students switched schools over time and are thus included in both groups. Those exposed to the FLAL in the first grade had 6 months of exposure, while those exposed in kindergarten had 18 months. Standard errors are clustered at the individual (child) level. BAZ=BMI-for-age Z score. FLAL=Front-of-Package Labelling Law. ME=marginal effects. *p<0·01. †p<0·001. ‡p<0·05.

Table 1: **ME of exposure to Chile's FLAL on excess weight in girls, 2012–17**

during first grade (ie, 6 months of exposure), the probability of having excess weight declined by 2·30% for girls (95% CI −0·0364 to −0·0097) and 2·63% for boys (−0·0394 to −0·0133). When exposure extended to both kindergarten and first grade (ie, 18 months), the reduction in excess weight was 3·14% for girls (−0·0444 to −0·0184) and was 2·52% for boys (−0·0378 to −0·0125).

Girls with first grade exposure to the FLAL had a reduction in BAZ of 0·0168 SD units (95% CI −0·0316 to −0·0020), while girls with kindergarten and first grade exposure had a decline of 0·0288 (−0·0438 to −0·0137) compared with unexposed peers (appendix pp 13–15). For boys, first grade exposure corresponded to a 0·0226 SD reduction in BAZ (95% CI −0·0399 to −0·0053), and kindergarten and first grade exposure corresponded to a decrease of 0·0318 SD (−0·0488 to −0·0147; appendix pp 13–15).

The main findings were robust across alternative sample definitions and model specifications. Estimated effects remained significant and were generally larger in magnitude than the main results. The exception was the specification incorporating child-level fixed-effects, which produced smaller estimates (appendix pp 25–27).

Discussion

This study examines the impact of phase 1 of Chile's FLAL on childhood excess weight using rich administrative data and a cohort difference-in-differences framework. The results indicate statistically significant, meaningful reductions in the prevalence of excess weight and decreases in BAZ among young children exposed to the first 18 months of the policy. The findings are robust across both binary and continuous outcome measures and are observed in both girls and boys, suggesting a broad and generalisable policy impact.

These results might contribute to the evidence showing that earlier exposure to nutritional interventions could result in more durable behavioural changes and physiological effects, as observed with other food policies, such as sugar-sweetened beverage taxes and school food environment policies.[30,31] The results shown only cover phase 1 of the FLAL. Further tightening of ingredient thresholds in 2018 and 2019 likely increased the plausible causal effects of the FLAL on children's nutritional outcomes, especially given evidence that the decrease in purchases of labelled products observed in phase 2 tended to be larger than that observed in phase 1 of the law.[14]

	Exposure to the FLAL in first grade			Exposure to the FLAL in kindergarten and first grade		
	Sample size, n	ME (95% CI)	Excess weight prevalence (rate) in pre-kindergarten (control and treated cohorts)	Sample size, n	ME (95% CI)	Excess weight prevalence (rate) in pre-kindergarten (control and treated cohorts)
Full sample	107 393	−0·0224* (−0·0345 to −0·0104)	0·520	111 402	−0·0240* (−0·0358 to −0·0122)	0·520
Maternal education						
Less than high school	15 486	−0·0180 (−0·0497 to 0·0136)	0·529	15 308	−0·0153 (−0·0473 to 0·0166)	0·528
High school	65 181	−0·0307* (−0·0462 to −0·0152)	0·521	67 722	−0·0218† (−0·0370 to −0·0066)	0·519
More than high school	26 726	−0·0051 (−0·0292 to 0·0189)	0·513	28 372	−0·0333† (−0·0565 to −0·0102)	0·517
Maternal age at childbirth						
<20 years	19 382	−0·0453† (−0·0744 to −0·0162)	0·514	21 717	−0·0197 (−0·0469 to 0·0075)	0·511
20 to 35 years	75 075	−0·0146‡ (−0·0290 to −0·0003)	0·521	76 972	−0·0256* (−0·0397 to −0·0115)	0·523
>35 years	12 936	−0·0325 (−0·0668 to 0·0018)	0·520	12 713	−0·0224 (−0·0577 to 0·0130)	0·515
Child birthweight						
<2·5 kg	7835	−0·0182 (−0·0702 to 0·0339)	0·448	8819	−0·0435 (−0·0915 to 0·0045)	0·451
2·5 to 4 kg	86 412	−0·0273* (−0·0410 to −0·0137)	0·513	88 721	−0·0255* (−0·0390 to −0·0121)	0·512
> 4 kg	13 146	0·0044 (−0·0247 to 0·0335)	0·610	13 862	−0·0069 (−0·0349 to 0·0211)	0·609
School type						
Public	54 489	−0·0086 (−0·0273 to 0·0102)	0·526	55 677	−0·0197‡ (−0·0387 to −0·0007)	0·525
Subsidised	69 567	−0·0305* (−0·0470 to −0·0139)	0·516	73 005	−0·0258* (−0·0415 to −0·0102)	0·516
School location						
Urban	96 374	−0·0263* (−0·0394 to −0·0133)	0·517	100 328	−0·0252* (−0·0378 to −0·0125)	0·518
Rural	15 773	0·0082 (−0·0253 to 0·0417)	0·538	15 858	−0·0097 (−0·0438 to 0·0244)	0·533

ME (95% CI) from logit regressions assessing the impact of the FLAL on excess weight (defined as BAZ >1) among boys. ME are reported as the proportional change in the probability of excess weight, relative to the average prevalence observed in prekindergarten for the corresponding sample. The number of children in the school-type and school-location subgroups does not sum to the total in the full sample because some students switched schools over time and are thus included in both groups. Those exposed to the FLAL in the first grade has 6 months of exposure, while those exposed in kindergarten had 18 months. Standard errors are clustered at the individual (child) level. BAZ=BMI-for-age Z score. FLAL=Front-of-Package Labelling Law. ME=marginal effects. *p<0·001. †p<0·01. ‡p<0·05.

Table 2: **ME of exposure to Chile's FLAL on excess weight in boys, 2012–17**

Our results align with the expected pathways of effect of these policies. Previous evidence shows that the FLAL was successfully implemented, leading to improved front-of-package labelling, reduced children's exposure to food marketing, and a healthier school food environment.[11,13] These changes were associated with lower purchases and intake of regulated foods among children and adolescents, alongside reductions in regulated nutrients, although changes in total calories were less consistent.[14] Overall, the observed reductions in obesity prevalence in this age group are aligned with previous findings of clinical or multi-component school-based interventions.[32,33] These findings are also consistent with modelling projections from implementation of a similar set of policies in Mexico: Basto-Abreu and colleagues estimated a 36·8 kcal per day per person, which after 5 years would translate into nearly a 5-percentage point decrease in obesity prevalence in Mexico.[34] The smaller magnitude of our results likely reflects that our analysis focuses on phase 1 of the law, associated with a 16·4 kcal per capita per day reduction, and a shorter follow-up period of 18 months.[10] Nonetheless, the pattern of effects observed in the present study, together with the estimated 36·2 kcal per day per person reduction at full implementation and the nationwide implementation of the policy, suggests that larger effects could be achieved over time.[14] Although the observed reduction in excess weight among preschoolers might seem modest, it is likely to confer meaningful long-term health benefits given the strong associations between childhood obesity and later risk of obesity, diabetes, hypertension, and cardiovascular disease, and evidence that early prevention can substantially lower these risks.[35,36]

The analysis of heterogeneity revealed that the benefits of the FLAL are not uniformly distributed across individuals. If the FLAL enhanced awareness and knowledge regarding the nutritional content of food, it would be expected that stronger responses would occur among mothers with higher education, who might be better at interpreting labelling information and more likely to translate it into healthier purchasing and consumption behaviours.[37–39] Additionally, higher maternal education is often associated with greater financial resources, which can facilitate access to healthier food alternatives.[40] Our results for 18 months of exposure indicate beneficial effects of the FLAL among children whose mothers had at least a high school education, although these effects are absent among children whose mothers had less education.

Socioeconomic differences in the effects of the FLAL also emerge when examining school type (public *vs* subsidised) and geographic area (urban *vs* rural). Public schools in Chile typically serve students from lower-income households and might have greater resource constraints. By contrast, subsidised schools often cater to more affluent populations and might be better equipped to implement health-promoting policies. According to official data, families sending their children to subsidised schools had a 34% higher household per capita income in 2017 than those sending their children to public schools.[41] These differences remain mostly unchanged today.[42] The same holds for urban versus rural households: urban households had a 50% higher household per capita income than rural households in 2017.[41] Similarly, rural schools generally have less access to health services, infrastructure, and food options than their urban counterparts, and therefore, they might rely more heavily on informal or small-scale food outlets where labelled products are less prevalent.[43] We did not directly observe enforcement or compliance; therefore, we cannot fully exclude differential implementation across school types or regions as a contributing factor to the observed gaps. For instance, public schools might have greater constraints in implementing complementary food policies or in monitoring compliance than subsidised schools. However, these mechanisms might translate into a smaller aggregate effect in Chile than in low-income and middle-income countries, as the urban population accounts for 88% of the population, and health-care insurance and access are universal.[44]

The fact that effects of the FLAL appear in children from relatively better-off households (ie, those attending urban subsidised schools and having more educated mothers) may raise doubts about the policy's progressive nature. However, we are not aware of evidence suggesting that households without these advantages were adversely affected by the FLAL. For instance, a study examining relative price changes between labelled and non-labelled products found no change after the FLAL, suggesting that, at least in terms of prices, the regulation did not have a differential effect on households.[45] Taken together, these findings suggest that FLAL regulations might need to be complemented by targeted interventions to reduce the observed gap in excess weight, including reinforced and tailored communication strategies for lower-educated and poorer households, stronger integration with school food programmes in public schools, and policies addressing the food environment in rural areas, particularly through small retailers and informal markets.

Children born with a birthweight above 4·0 kg might be more prone to excess weight later in life, potentially due to genetic or in utero factors.[46] Children born weighing less than 2·5 kg—medically classified as low birthweight—have distinct nutritional risks.[47] Low birthweight is commonly associated with undernutrition and impaired early-life growth; however, the literature also links low birthweight to greater susceptibility to excess weight later in life, particularly when followed by rapid catch-up growth.[48] The results presented here show that girls with low birthweight had significant reductions in excess weight, suggesting that nutritional labelling might offer protective effects for biologically vulnerable groups. In the Chilean context, birthweight has been shown to be more strongly associated with maternal biological characteristics than with social factors, which might help explain why responses observed for low birthweight differ from those observed for social vulnerability indicators such as socioeconomic status within this study.[49] These findings might indicate that biological and social vulnerabilities respond differently to food policy interventions. However, this interpretation should be treated with caution, as these results require further verification.

Overall, the results of the present study highlight the value of early life interventions aimed at shaping food environments and behaviours. As Chile and other countries seek to combat rising childhood obesity rates, this study provides empirical evidence in support of a mandatory warning label FLAL as a scalable and impactful public health strategy. By providing clear and accessible nutritional information and protecting children from targeted marketing and unhealthy food environments at school, such policies might influence parental choices and children's dietary habits, primarily when supported by complementary measures, such as public campaigns, school-based programmes, or food environment regulations. Clearly, this is why so many other countries have already adopted front-of-package warning labels and are actively considering marketing bans and healthier school food policies.[50]

We acknowledge several data limitations that could affect the findings of the present study. First and foremost, anthropometric measurements are collected by school staff who, although trained for this task, might not achieve the same precision typically found in primary health-care settings. Nevertheless, our use of longitudinal data helped to mitigate concerns about measurement error by allowing us to track relative changes within individuals over time. Second, the analysis is limited to early childhood outcomes within a short-term framework. A more comprehensive evaluation of the FLAL's effects on nutritional status during later developmental stages, such as adolescence, is currently not feasible due to a lack of controls for this age group. Third, we only have information for public and subsidised schools. Children attending private schools (approximately 10–15% of the population) were not surveyed, and their inclusion could exacerbate the socioeconomic gradient in the results presented here as they typically come from more affluent households. Fourth, the analytical sample contained fewer observations than the raw sample, as a number of observations were deleted for not having relevant information and other reasons; this could imply a selection bias in the sample. However, alternative analyses conducted with the entire sample and using alternative model specifications (eg, a non-balanced panel and a reduced set of control variables to minimise concerns) show that the results are robust to data exclusion. In nearly all cases the estimated effects from these alternative models are larger in absolute terms than those reported in the main specifications, reinforcing the robustness of our core findings. Unfortunately, we were unable to conduct a formal generalisability assessment for the children missing from the Nutritional Map and Vulnerability Survey datasets as there was no comprehensive administrative dataset in Chile that contained information on the full population of children in the relevant age group, which would have been required to systematically compare included versus excluded cases. Fifth, as with all difference-in-differences designs, causal identification rests crucially on the parallel trends assumption, namely that treated and control cohorts would have followed similar nutritional trajectories in the absence of the FLAL. This assumption is inherently untestable, as it concerns counterfactual trajectories that are never observed. Although we provide empirical support for this assumption through pre-policy trend tests, these tests have important limitations. For boys, we could not reject the null hypothesis of equal pre-policy trends for both excess weight and BAZ, although this should not be interpreted as proof that post-policy trends were in fact parallel. For girls, the evidence is less reassuring: the CI for excess weight was shifted towards positive values with zero near its lower bound, and the null hypothesis of equal trends for BAZ is marginally rejected. These findings suggest that estimates for girls, particularly for BAZ, should be interpreted with caution regarding plausible causality. Additionally, the parallel trends assumption could not be tested for the 2015 cohort, as it had only one pre-treatment observation, which is insufficient to assess pre-policy trend parallelism; estimates of the 18-month exposure effect are therefore subject to greater uncertainty regarding plausible causality. Sixth, because the FLAL was implemented nationally, there is no contemporaneous control group unexposed to the policy, and the sole source of treatment variation is birth cohort and school grade. This precluded fully separating cohort, period, and age effects, and required assuming that cohort-specific BMI trajectories would have evolved in parallel in the absence of the policy, which is an assumption that, while reasonable given that treated and control cohorts were born only 1–2 years apart, cannot be empirically verified. Since treated and control cohorts are born only 1–2 years apart and are compared at the same school grades, large systematic differences in underlying trajectories are unlikely. Finally, Chile's FLAL has many components. Although the black octagon warnings were the most prominent, they were accompanied by marketing restrictions, school sales bans, and other measures. Given their simultaneous adoption, it is not possible to measure their individual effectiveness or assess their specific impacts on children's nutritional status.

To conclude, phase 1 of Chile's FLAL plausibly caused a measurable reduction in the prevalence of excess weight among young schoolchildren. This study represents the first study showing such plausibility at a national scale that a multipronged food environment policy, combining mandatory front-of-package warning labels with marketing and school-sales restrictions, can shift childhood weight trajectories during a developmentally crucial window. Because our analysis captures only the initial phase of implementation and a short follow-up, the full public health impact of the FLAL, including the more stringent thresholds introduced in phases 2 and 3, is likely to be greater than reported here. Taken together, these findings strengthen the evidence base for policy makers worldwide considering comprehensive food environment regulation as a scalable, equitable, and impactful strategy to address the childhood obesity epidemic.

Contributors
GP, NV, and BP conceived the study. GP and NV designed the methodology. NV and AVM performed the analyses. GP, NV, and CC wrote the original draft. GP, NV, CC, and BP supervised the project and reviewed the manuscript. GP is the guarantor of the study. GP, NV, and AVM accessed and verified the data. All authors had full access to the data, contributed to the interpretation of the findings, approved the final manuscript, and made the decision to publish the Article. The corresponding author had final responsibility for the decision to submit for publication.

Declaration of interests
We declare no competing interests.

Data sharing
The data used in this study—the Nutritional Map (Mapa Nutricional) and the Vulnerability Survey (Encuesta de Vulnerabilidad)—are comprehensive administrative and survey data collected by the Chilean National Board of School Aid and Scholarships (JUNAEB). Due to JUNAEB's institutional data protection policies, access to the raw data is restricted. Interested qualified researchers may apply for access to these data through JUNAEB's official data request platform. The official data request platform is available at https://bibliotecadatos.sead.junaeb.cl/.

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References
1 Swinburn B, Sacks G, Vandevijvere S, et al, and INFORMAS. INFORMAS (International Network for Food and Obesity/non-communicable diseases Research, Monitoring and Action Support): overview and key principles. *Obes Rev* 2013; **14** (suppl 1): 1–12.

2 Duran AC, Mialon M, Crosbie E, et al. Food environment solutions for childhood obesity in Latin America and among Latinos living in the United States. *Obes Rev* 2021; **22** (suppl 3): e13237.

3 Kerr JA, Patton GC, Cini KI, et al, and the GBD 2021 Adolescent BMI Collaborators. Global, regional, and national prevalence of child and adolescent overweight and obesity, 1990–2021, with forecasts to 2050: a forecasting study for the Global Burden of Disease Study 2021. *Lancet* 2025; **405**: 785–812.

4 Zhang X, Liu J, Ni Y, et al. Global prevalence of overweight and obesity in children and adolescents: a systematic review and meta-analysis. *JAMA Pediatr* 2024; **178**: 800–13.

5 Junta Nacional de Auxilio Escolar y Becas. Resultados Mapa Nutricional 2024. Junta Nacional de Auxilio Escolar y Becas, 2025.

6 Corvalán C, Reyes M, Garmendia ML, Uauy R. Structural responses to the obesity and non-communicable diseases epidemic: update on the Chilean law of food labelling and advertising. *Obes Rev* 2019; **20:** 367–74.

7 World Cancer Research Fund International. Building momentum: lessons on implementing robust restrictions of food and non-alcoholic beverage marketing to children. World Cancer Research Fund International, 2020.

8 World Cancer Research Fund. Building momentum: lessons on implementing a robust front-of-pack food label. World Cancer Research Fund International, 2019.

9 Taillie LS, Reyes M, Colchero MA, Popkin B, Corvalán C. An evaluation of Chile's Law of Food Labeling and Advertising on sugar-sweetened beverage purchases from 2015 to 2017: a before-and-after study. *PLoS Med* 2020; **17:** e1003015.

10 Taillie LS, Bercholz M, Popkin B, Reyes M, Colchero MA, Corvalán C. Changes in food purchases after the Chilean policies on food labelling, marketing, and sales in schools: a before and after study. *Lancet Planet Health* 2021; **5:** e526–33.

11 Correa T, Fierro C, Reyes M, Dillman Carpentier FR, Taillie LS, Corvalan C. "Responses to the Chilean law of food labeling and advertising: exploring knowledge, perceptions and behaviors of mothers of young children". *Int J Behav Nutr Phys Act* 2019; **16:** 21.

12 Dillman Carpentier FR, Correa T, Reyes M, Taillie LS. Evaluating the impact of Chile's marketing regulation of unhealthy foods and beverages: pre-school and adolescent children's changes in exposure to food advertising on television. *Public Health Nutr* 2020; **23:** 747–55.

13 Massri C, Sutherland S, Källestål C, Peña S. Impact of the Food-Labeling and Advertising Law banning competitive food and beverages in Chilean public schools, 2014–2016. *Am J Public Health* 2019; **109:** 1249–54.

14 Taillie LS, Bercholz M, Popkin B, Rebolledo N, Reyes M, Corvalán C. Decreases in purchases of energy, sodium, sugar, and saturated fat 3 years after implementation of the Chilean food labeling and marketing law: an interrupted time series analysis. *PLoS Med* 2024; **21:** e1004463.

15 Fretes G, Corvalán C, Reyes M, et al. Changes in children's and adolescents' dietary intake after the implementation of Chile's law of food labeling, advertising and sales in schools: a longitudinal study. *Int J Behav Nutr Phys Act* 2023; **20:** 40.

16 Reyes M, Smith Taillie L, Popkin B, Kanter R, Vandevijvere S, Corvalán C. Changes in the amount of nutrient of packaged foods and beverages after the initial implementation of the Chilean Law of Food Labelling and Advertising: a nonexperimental prospective study. *PLoS Med* 2020; **17:** e1003220.

17 Rebolledo N, Ferrer-Rosende P, Reyes M, Smith Taillie L, Corvalán C. Changes in the critical nutrient content of packaged foods and beverages after the full implementation of the Chilean Food Labelling and Advertising Law: a repeated cross-sectional study. *BMC Med* 2025; **23:** 46.

18 Junta Nacional de Auxilio Escolar y Becas. Mapa Nutricional: Junta Nacional de Auxilio Escolar y Becas (JUNAEB). 2025. https://www.junaeb.cl/mapa-nutricional/ (accessed April 20, 2025).

19 Junta Nacional de Auxilio Escolar y Becas. Encuesta de Vulnerabilidad JUNAEB: Junta Nacional de Auxilio Escolar y Becas (JUNAEB). 2025. https://www.junaeb.cl/encuestas-vulnerabilidad/ (accessed Feb 12, 2025).

20 Junta Nacional de Auxilio Escolar y Becas. Biblioteca de Datos para la Investigación: Junta Nacional de Auxilio Escolar y Becas (JUNAEB). https://bibliotecadatos.sead.junaeb.cl (accessed Jan 15, 2025).

21 Ministerio de Educación del Gobierno de Chile. Admisión Escolar—Gobierno de Chile: Ministerio de Educación del Gobierno de Chile. 2025. https://www.sistemadeadmisionescolar.cl/organizacion_del_sistema_educativo_chileno.html (accessed July 15, 2025).

22 Congreso Nacional de Chile. LEY 19.876 Reforma Constitucional que establece la obligatoriedad y gratuidad de la educación media. Congreso Nacional de Chile, 2009.

23 Elacqua G. The impact of school choice and public policy on segregation: evidence from Chile. *Int J Educ Dev* 2012; **32:** 444–53.

24 Lira M. Antecedentes Mapa Nutricional. Junta Nacional de Auxilio Escolar y Becas. JUNAEB, 2022.

25 WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards based on length/height, weight and age. *Acta Paediatr Suppl* 2006; **450:** 76–85.

26 Lira M. Informe Mapa Nutricional 2019. Junta Nacional de Auxilio Escolar y Becas. JUNAEB, 2019.

27 Chen Y, Zhou L-A. The long-term health and economic consequences of the 1959–1961 famine in China. *J Health Econ* 2007; **26:** 659–81.

28 Duflo E. Schooling and labor market consequences of school construction in Indonesia: evidence from an unusual policy experiment. *Am Econ Rev* 2001; **91:** 795–813.

29 Zhou Y, Ren J, Zheng X. Feeding for a brighter future: the long-term labor market consequences of school meals in rural China. *Econ Hum Biol* 2024; **52:** 101335.

30 Colchero MA, Rivera-Dommarco J, Popkin BM, Ng SW. In Mexico, evidence of sustained consumer response two years after implementing a sugar-sweetened beverage tax. *Health Aff (Millwood)* 2017; **36:** 564–71.

31 Holford A, Rabe B. Universal free school meals and children's bodyweight. Impacts by age and duration of exposure. *J Health Econ* 2024; **98:** 102937.

32 Nordlund S, McPhee PG, Gabarin R, Deacon C, Mbuagbaw L, Morrison KM. Effect of obesity treatment interventions in preschool children aged 2–6 years: a systematic review and meta-analysis. *BMJ Open* 2022; **12:** e053523.

33 Vasques C, Magalhães P, Cortinhas A, Mota P, Leitão J, Lopes VP. Effects of intervention programs on child and adolescent BMI: a meta-analysis study. *J Phys Act Health* 2014; **11:** 426–44.

34 Basto-Abreu A, Torres-Alvarez R, Reyes-Sánchez F, et al. Predicting obesity reduction after implementing warning labels in Mexico: a modeling study. *PLoS Med* 2020; **17:** e1003221.

35 Simmonds M, Llewellyn A, Owen CG, Woolacott N. Predicting adult obesity from childhood obesity: a systematic review and meta-analysis. *Obes Rev* 2016; **17:** 95–107.

36 Salama M, Balagopal B, Fennoy I, Kumar S. Childhood obesity, diabetes, and cardiovascular disease risk. *J Clin Endocrinol Metab* 2023; **108:** 3051–66.

37 Grunert KG, Wills JM, Fernández-Celemín L. Nutrition knowledge, and use and understanding of nutrition information on food labels among consumers in the UK. *Appetite* 2010; **55:** 177–89.

38 Neuhouser ML, Kristal AR, Patterson RE. Use of food nutrition labels is associated with lower fat intake. *J Am Diet Assoc* 1999; **99:** 45–53.

39 Kim S-Y, Nayga RM, Capps O. The effect of food label use on nutrient intakes: an endogenous switching regression analysis. *J Agric Resour Econ* 2000; **25:** 215–31.

40 Darmon N, Drewnowski A. Does social class predict diet quality? *Am J Clin Nutr* 2008; **87:** 1107–17.

41 Ministerio de Desarrollo Social de Chile. CASEN 2017: Situación de Pobreza. Síntesis de resultados. Ministerio de Desarrollo Social de Chile; 2018.

42 Ministerio de Desarrollo Social y Familia. CASEN 2022: Encuesta de Caracterización Socioeconómica Nacional. Observatorio Social, Ministerio de Desarrollo Social y Familia, 2022.

43 Miyazaki Y, Stack M. Examining individual and school characteristics associated with child obesity using a multilevel growth model. *Soc Sci Med* 2015; **128:** 57–66.

44 Instituto Nacional de Estadísticas. Síntesis de Resultados Censo 2017. Instituto Nacional de Estadísticas; 2018.

45 Paraje G, Montes de Oca D, Corvalan C, Reyes M, Popkin B. Evolution of food and beverage prices after the front-of-package labeling regulations in Chile. *BMJ Glob Health* 2023; **8:** e011312.

46 Viswanathan S, McNelis K, Makker K, Calhoun D, Woo JG, Balagopal B. Childhood obesity and adverse cardiometabolic risk in large for gestational age infants and potential early preventive strategies: a narrative review. *Pediatr Res* 2022; **92:** 653–61.

47 Valero De Bernabé J, Soriano T, Albaladejo R, et al. Risk factors for low birth weight: a review. *Eur J Obstet Gynecol Reprod Biol* 2004; **116:** 3–15.

48 World Health Organization. Global nutrition targets 2025: low birth weight policy brief. WHO, 2014.

49 Garmendia ML, Mondschein S, Montiel B, Kusanovic JP. Trends and predictors of birth weight in Chilean children. *Public Health* 2021; **193:** 61–68.

50 Salgado JC, Jayaraman B, Taillie LS, Ng SW. Firm's responses to food policies to reduce consumption of ultra-processed food and beverages: lessons from the existing evidence. *Food Policy* 2025; **137:** 102975.