Article

Not peer-reviewed version

Nutrition Profile of Infant Formulas and Foods Intended for Children Aged 0-3 Years Marketed in Metropolitan Lima, Peru 2023

Adolfo Aramburu [*] , Jackeline Chupica , Beatriz Quispe-Quille , Julie Mariaca , Patricia Velarde-Delgado , Gilmer Solis-Sanchez , Bladimir Morales-Cahuancama , Fernando Bravo-Rebatta , María Elena Ugaz , Fredy Polo-Campos [*]

Posted Date: 10 January 2025

doi: 10.20944/preprints202501.0844.v1

Keywords: food, processed; infant food; food labeling; food quality; nutritive value; legislation, food; supermarkets; Peru

Article

Nutrition Profile of Infant Formulas and Foods Intended for Children Aged 0–3 Years Marketed in Metropolitan Lima, Peru 2023

Adolfo Aramburu [1,2,*], Jackeline Chupica [3], Beatriz Quispe-Quille [1], Julie Mariaca [1], Patricia Velarde-Delgado [4], Gilmer Solis-Sanchez [4], Bladimir Morales-Cahuancama [2,4], Fernando Bravo-Rebatta [4], María Elena Ugaz [3] and Fredy Polo-Campos [1,*]

[1] Directorate of Health Promotion, Ministry of Health, Lima 15072, Perú; bquispeq@minsa.gob.pe (B.Q.-Q.); jmariaca@minsa.gob.pe (J.M.)

[2] Faculty of Science Health, Universidad Peruana de Ciencias Aplicadas, Lima 15067, Perú; bmorales@ins.gob.pe

[3] United Nations Children's Fund (UNICEF), Lima 15074, Peru; jackeline.lchl@gmail.com (J.C.); meugaz@unicef.org (M.E.U.)

[4] Centro Nacional de Alimentación, Nutrición y Vida Saludable, Instituto Nacional de Salud, Lima 15072, Peru; pvelarde@ins.gob.pe (P.V.-D.); gilmer.solis.s@gmail.com (G.S.-S.); fbravo@ins.gob.pe (F.B.-R.)

* Correspondence: ad.aramburu@gmail.com (A.A.); fpolo@minsa.gob.pe (F.P.-C.)

Abstract: The increased consumption of industrialized infant foods and infant formulas during early childhood has raised concerns due to their suboptimal nutritional composition, which could contribute to the development of risk factors for non-communicable diseases. This cross-sectional, descriptive, observational study aimed to describe the nutritional profile of infant formulas and foods intended for children aged 0–3 years marketed in metropolitan Lima, using the nutrient profile models of Peru (Law No. 30021) and the Pan American Health Organization (PAHO). Nutritional information from the labels of 64 products purchased between September and October 2023 in selected supermarkets and pharmacies was analyzed. According to Law No. 30021 parameters, 74.5%, 1.6%, and 37.3% of products were high in sugar, sodium, and saturated fats, respectively. According to PAHO parameters, these percentages increased to 83%, 6.3%, and 41.3%. Infant formulas were the main contributors to excessive saturated fat and sugar content. Additionally, 84.4% of the products declared added sugars, primarily originating from infant formulas and pureed foods. This study shows that most foods intended for children under three years old available in metropolitan Lima have an unhealthy nutritional profile.

Keywords: food, processed; infant food; food labeling; food quality; nutritive value; legislation, food; supermarkets; Peru

1. Introduction

Non-communicable diseases (NCDs) constitute a significant public health issue, being the leading cause of death and disability worldwide and disproportionately affecting low- and middle-income countries [1,2]. While NCDs often manifest during adulthood, many have their origins in early childhood, during which nutritional imbalances caused by poor-quality diets can induce permanent physiological alterations and increase the risk of developing various diseases throughout life [3–5].

Likewise, during early childhood, children learn to relate to new foods, develop preferences, and acquire eating habits that often persist into adulthood [6,7]. Therefore, it is essential to provide

 doi:10.20944/preprints202501.0844.v1

diverse, safe, nutritious, and appropriate foods during this period to meet their nutritional needs [8,9].

However, infant feeding, traditionally focused on minimally processed foods, is undergoing a continuous transition towards a greater consumption of processed and ultra-processed foods [10,11]. These foods often have high caloric density, added sugars, and excessive levels of sodium, total fats, and saturated fats [9,12–14], potentially contributing to childhood overweight, unhealthy eating habits, and the development of risk factors for NCDs [9,12].

In Peru, over 60% of adults suffer from excess weight, as well as 10.8% of children under five years old [13], with this prevalence having doubled compared to what was observed in 2007 [14]. Similarly, Peru experienced the highest per capita growth in the sale of ultra-processed foods in Latin America between 2009 and 2014 [15]. In response to this issue, the Peruvian government enacted the Law to Promote Healthy Eating for Children and Adolescents (Law No. 30021), which includes a front-of-package nutrition labeling (FOPNL) regulation that states that packaged foods and beverages that exceed specific thresholds of critical nutrients such as sugar, saturated fats, or sodium, or containing trans fats, must carry black octagonal warnings on the packaging and all forms of advertising. The thresholds for these critical nutrients were implemented gradually in two phases, with the first phase coming into effect in June 2019 and the second in September 2021.

Following the implementation of the first phase of Law No. 30021, a study identified that 31% of beverages and 62% of foods should carry an octagonal warning [16]. However, this study included foods targeted at both children and adolescents and did not include infant formulas. For this reason, we conducted a study aimed at describing the nutritional profile of infant formulas and foods intended for children aged 0–3 years marketed in Metropolitan Lima, specifically regarding their content and profile of critical nutrients (sugar, saturated fats, sodium, and trans fats), as well as the presence and type of added sugars and non-caloric sweeteners.

2. Materials and Methods

2.1. Study Design

This was a cross-sectional, descriptive, and observational study. The study population included all infant formulas and foods intended for children aged 0–3 years marketed in Metropolitan Lima.

2.2. Selection of Establishments

The 43 districts that comprise Metropolitan Lima were grouped into sectors based on the jurisdiction of the Integrated Health Networks of the Ministry of Health of Peru: Lima North, Lima Center, Lima East, and Lima South. Within each sector, supermarkets and hypermarkets from the eight chains with the largest market share in Peru [17] were identified, along with the hospital with the highest number of births in 2022, according to the National Unique Health Information Registry (REUNIS, in Spanish). In each sector, the following were selected: (a) one supermarket and one hypermarket (using convenience sampling); (b) all pharmacies around the hospital with the highest number of births; and (c) the online stores of the establishments listed in points (a) and (b).

2.3. Selection of Products

The study included all foods and beverages labeled for children under 36 months that did not require a medical prescription. For products available in different flavors, one flavor was randomly selected. The complete eligibility criteria are detailed in Supplementary Table S1.

2.4. Data Collection

A snowball sampling technique was used for product collection until saturation was achieved. The first selected establishment was visited, and all products meeting the eligibility criteria were obtained. Subsequently, the second selected establishment was visited, and the remaining available

 doi:10.20944/preprints202501.0844.v1

products were acquired. This process was repeated at other establishments until all study products were collected.

Sample collection began with visits to all selected super- and hypermarkets, following this sequence: Lima Center, Lima North, Lima East, and Lima South. The process continued with the acquisition of products from the online stores of the selected establishments and concluded with the purchase of products from pharmacies near the selected hospitals in each sector. Once the products were acquired, they were photographed and stored according to the manufacturers' instructions.

2.5. Data Entry and Processing

Nutritional composition and ingredient information from the labels of the products included in the study were entered into a spreadsheet designed in Microsoft Excel®. To ensure integrity and consistency, the entered information was verified for a random sample representing 15% of the products.

2.6. Outcomes

The following outcomes were analyzed (operational definitions for each outcome are detailed in Supplementary Table S2):

- the content of energy, proteins, total fats, carbohydrates, sugar, saturated fats, trans fats, and sodium per 100 g or 100 mL of product;
- the percentage of products with high levels of sugar, saturated fats, and sodium according to the thresholds established by Law No. 30021 [18] and those proposed by the Pan American Health Organization (PAHO) in the context of the update to Law No. 30021 [19] (Table 1).
- the percentage of products containing trans fats (greater than 0 g per 100 g or milliliters of product, and greater than 2 g per 100 g or milliliters of fat content);
- the percentage of products containing added sugars, as well as the type of added sugars used
- the percentage of products containing non-caloric sweeteners, as well as the type of non-caloric sweetener used;

Table 1. Technical Parameters for Classifying Foods as "High" in Sugar, Saturated Fats, and Sodium According to Law No. 30021 and PAHO.

Classification	Law No. 30021 [a]	PAHO [b]
High in Sugar [c]	≥10 g/100 g in solid foods or ≥5 g/100 mL in beverages	>0 kcal/100 kcal
High in Saturated Fats	≥ 4 g/100 g in solid foods or ≥ 3 g/100 mL in beverages	≥10 kcal/100 kcal
High in Sodium	≥400 mg/100 g in solid foods or ≥100 mg/100 mL in beverages	≥60 mg/100 kcal

[a] Parameters according to the Regulations of Peruvian Law No. 30021, Law to Promote Healthy Eating for Children and Adolescents [18]; [b] Parameters proposed by the Pan American Health Organization (PAHO) within the context of the update to Law No. 30021 [19]; [c] The parameters of Law No. 30021 consider total sugars, while the parameters proposed by PAHO consider added free sugars.

2.7. Statistical Analysis

Qualitative variables were summarized using absolute (count) and relative (percentage) frequency measures. Quantitative variables were described as medians with interquartile ranges. Study results were presented as totals and stratified by product type (infant formulas, infant cereals, and pureed foods). Analyses were conducted using Stata/SE version 17.0 (StataCorp, College Station, TX, USA).

2.8. Ethics

 doi:10.20944/preprints202501.0844.v1

The study protocol was submitted to the Institutional Review Board of the Asociación Benéfica PRISMA and was exempted from review as it involved an analysis of information declared on product labels and did not pose any risk to human subjects (Letter #CE0426.23).

3. Results

A total of 64 products collected between September and October 2023 were included in the analysis. These consisted of 39 infant formulas (60.9%), 13 infant cereals (20.3%), and 12 pureed foods (18.8%).

3.1. Content of Energy and Macronutrients

Per 100 g or milliliters, the analyzed products contained a median of 435.4 kcal (IQR: 295.3–489), 56.1 g of carbohydrates (IQR: 47.1–59.6), 10.4 g of protein (IQR: 4.5–15.0), and 15.1 g of total fat (IQR: 1.7–22.8). Infant formulas were the products with the highest content of energy, protein, and total fat, while infant cereals had the highest carbohydrate content (Table 2).

Table 2. Content [(a)] of Energy and Macronutrients per 100 g or 100 mL.

Type of Food	n	Energy (Kcal)	Carbohydrates (g)	Proteins (g)	Total Fats (g)
Infant formulas	39	486 (456–500)	56.2 (54.2–58.7)	14.3 (10.6–15.5)	22.0 (18.1–25.6)
Infant Cereals	13	393 (378–404.8)	80.5 (73.3–84.0)	9.0 (7.3–10.0)	2.5 (1.9–3.6)
Pureed Foods	12	57.4 (52.5–65)	15.6 (13.9–17.2)	0.1 (0.0–0.6)	0.0 (0–0.1)
Total	64	435.4 (295.3–489)	56.1 (47.1–59.6)	10.4 (4.5–15.0)	15.1 (1.7–22.8)

[(a)] Medians and interquartile ranges (IQR) (25–75 percentiles).

3.2. Profile of Critical Nutrients

According to the parameters of Law No. 30021, the proportion of products rated as high in sugar, sodium, and saturated fats was 74.5%, 1.6%, and 37.3%, respectively. When using the parameters proposed by PAHO, these percentages increased to 83%, 6.3%, and 41.3%, respectively. For both parameters, infant formulas were the most frequently classified as "high in sugar" and "high in saturated fats". Infant cereals were the food group most frequently classified as "high in sodium" using the PAHO parameters (15.4%) (Table 3). When the PAHO parameters were used to identify products excessive in sugars, sodium or saturated fats, the proportion of products with no warning labels dropped to less than half compared to the current parameters of the Law No. 30021 (Table 4).

3.3. Presence of Trans Fats

A total of 19 infant formulas (48.7%) and 8 pureed foods (66.7%) did not declare information on trans fat content on their labels. Among the remaining 37 products, 8 (21.6%) had a trans fats content greater than 0 g, and one of them exceeded 2 g of trans fats per 100 g/mL of fat content. The presence of trans fats was observed in seven infant formulas and one infant cereal (Table 3).

 doi:10.20944/preprints202501.0844.v1

Table 3. Content [a] and Profile of Critical Nutrients [b].

Type of Food	Sugar			Sodium			Saturated fats			Trans fats [e]		
	Content [c] (g/100g)	"High in" [d]		Content (mg/100g)	"High in"		Content (g/100g)	"High in"		Content (g/100g)	>0 g/100 g	>2 g/100 g of fat
		Law No. 30021	PAHO		Law No. 30021	PAHO		Law No. 30021	PAHO			
		n/N (%)	n/N (%)		n/N (%)	n/N (%)		n/N (%)	n/N (%)		n/N (%)	n/N (%)
Infant formulas	52.2 (31.0–57.0)	21/22 (95.5%)	15/22 (68.2%)	200 (170–240)	1/39 (2.6%)	2/39 (5.1%)	7.9 (3.7–8.8)	18/26 (69.2%)	19/24 (79.2%)	0.0 (0.0–0.2)	7/20 (35.0%)	1/20 (5.0%)
Infant Cereals	17 (9.1–21.0)	8/13 (61.5%)	12/13 (92.3%)	45 (17–150)	0/13 (0.0%)	2/13 (15.4%)	0.6 (0.4–0.8)	1/13 (7.7%)	0/13 (0.0%)	0.00 (0.0–0.0)	1/13 (7.7%)	0/13 (0.0%)
Pureed Foods	10.8 (9.3–12.8)	6/12 (50.0%)	12/12 (100.0%)	2.7 (1.5–9.1)	0/12 (0.0%)	0/12 (0.0%)	0.0 (0.0–0.0)	0/12 (0.0%)	0/9 (0.0%)	0.00 (0.0–0.0)	0/4 (0.0%)	0/4 (0.0%)
Total	20.0 (9.5–51.5)	35/47 (74.5%)	39/47 (83.0%)	170 (23.5–223.5)	1/64 (1.6%)	4/64 (6.3%)	2.5 (0.6–8.0)	19/51 (37.3%)	19/46 (41.3%)	0.00 (0.0–0.0)	8/37 (21.6%)	1/37 (2.7%)

[a] Medians and interquartile ranges (IQR) (25–75 percentiles). [b] "n/N" represents the number of items that are above the threshold established (n) out of the total number of items assessed (N). [c] Total sugars. [d] The parameters of the Law No. 30021 consider total sugars, while the parameters proposed by PAHO consider added free sugars. [e] According to current regulations in Peru, foods must not contain trans fats from partial hydrogenation. However, a limit of 2 g/100 g of fat is allowed when *"the trans fat content has been reduced as much as possible according to the technology used for processing, and there is no technological substitution for its complete removal"*.

 doi:10.20944/preprints202501.0844.v1

Table 4. Proportion of products required to feature warning labels for sugars, sodium and/or saturated fats according to PAHO and the second phase of the Law No. 30021 criteria by number of warnings, and respective prevalence ratios.

Number of warnings	Law No. 30021 (N = 45)	PAHO (N = 42)	Prevalence ratio (PAHO vs Law No. 30021)
0	26.7%	9.5%	0.36
1	37.8%	50%	1.32
2	35.6%	40.5%	1.14
3	0.0%	0.0%	--
One or more warnings	73.3%	90.5%	1.23

3.4. Presence and Type of Added Sugars

100% of infant formulas, 53.9% of infant cereals, and 66.7% of pureed foods reported one or more added sugars in their ingredient lists. Among infant formulas, added lactose was the most frequently reported (69.2%), while sugar or sucrose was the most used added sugar in infant cereals (30.8%) and pureed foods (66.7%) (Supplementary Table S3).

3.5. Presence and Type of Non-Caloric Sweeteners

None of the infant cereals or pureed foods declared the presence of non-caloric sweeteners in their composition. Among the infant formulas, two products (3.1%) declared containing non-caloric sweeteners, specifically steviol glycosides (E960A) and sodium saccharin (E954).

4. Discussion

Our research aimed to describe the nutritional profile of infant formulas and foods intended for children aged 0–3 years marketed in Metropolitan Lima. These products can account for up to 30% of the calories consumed by children in other Latin American countries [20], and have been associated with a deterioration in overall diet quality, as well as excessive content of calories, sugar, fat, and sodium [10].

We employed two technical parameters to assess the content of critical nutrients such as sugar, sodium, and saturated fats: the parameter established by Law No. 30021, which regulates warning labels for foods and beverages in Peru, and the nutrient profile model proposed by PAHO. Overall, we observed a significant proportion of foods with excessive content of sugar and saturated fats. When using the parameters established by Law No. 30021, 74.5% of products were classified as "high in sugar" and 37.3% as "high in saturated fats." These percentages increased to 83% for "high in sugar" and 41.3% for "high in saturated fats" when applying the PAHO parameters.

Studies in Latin America [21–25] have reported varying percentages of infant foods with excessive content of critical nutrients. Regarding excessive sugar content, percentages have ranged from 37% in Brazil [21], to 91% in Uruguay [22], while the percentage of infant foods with excessive saturated fat content has varied from 11% in Chile [21] to 50% in Uruguay [24]. This variability could be attributed to differences in regulation implementation periods across countries, the use of different definitions of infant foods, eligibility criteria, and sources of information, as well as by the application of various technical parameters to classify foods with excessive critical nutrient content.

Regarding this matter, Borges et al. [25] analyzed a sample of infant foods using six different technical parameters, demonstrating that the percentage of foods classified as 'high in sodium' and 'high in saturated fats' could be up to two or three times higher, and that the percentage of foods

 doi:10.20944/preprints202501.0844.v1

'high in sugar' could be up to 35% higher depending on the technical parameter used. Similarly, Karageuzián et al. [22] observed that the percentage of infant foods containing at least one critical nutrient increased from 74% using the parameters established by Uruguay's national regulations to 96% when the parameters proposed by PAHO were used. Consistent with our study, both authors [22,25] reported that using the technical parameters proposed by PAHO allowed for the identification of a greater number of foods with excessive levels of critical nutrients.

The choice of a specific technical parameter or nutrient profile model (NPM) is crucial for food policies, as it can affect the proportion of foods that should carry warning nutritional labeling and could be subject to advertising and marketing restrictions [25,26]. Consequently, a less stringent NPM might misinform consumers, encourage the consumption of less healthy foods, and impact food policies and the achievement of nutritional goals [25,26]. At the same time, the use of different NPMs among countries can lead to inconsistencies, confusion, and hinder comparability and tracking of progress [26,27].

In this context, PAHO established evidence-based regional criteria in 2016, developed with the involvement of nutrition experts [28]. However, most countries in the region have developed their own models or modified the original criteria proposed by PAHO with input from various sectors, including the food industry [26,29]. In this regard, a recent systematic review [30] indicates that NPMs developed with participation from the food industry often have less stringent criteria compared to those involving independent academic experts.

The use of warning nutritional labeling, as part of a comprehensive policy that includes restrictions on the advertising and marketing of foods high in critical nutrients, has shown a positive impact on purchasing decisions and the reformulation of the nutritional content of processed foods in Latin American countries [29]. For example, two years after the implementation of the first phase of the national warning nutritional labeling policy in Peru, a study reported a decrease in sugar content in beverages, which in turn led to a reduction from 59% to 31% in the percentage of products that would require high-sugar labeling, compared to the phase before implementation. Similarly, a reduction in saturated fat content in foods was observed, decreasing the percentage of products high in saturated fats from 82% to 62% [16].

On the other hand, an important aspect in the context of implementing a warning nutrition labeling system concerns the criteria that determine which foods and beverages are subject to regulation [31]. Often, infant formulas are considered "foods for special dietary uses (FSDU)" and are not included in the scope of warning nutrition labeling policies [31]. However, these products were one of the main contributors to the high proportion of foods high in sugar and saturated fats observed in our study. Therefore, their exclusion could represent a limitation on consumers' right to be adequately informed and discourage the food industry from reformulating their nutritional content [16].

Added sugars were present in all infant formulas, 67% of infant cereals, and 54% of pureed foods. Additionally, between 74.5% and 83% of the products included in our study had excessive sugar content. Excessive sugar content in infant foods has been widely reported by various studies around the world [32–35], and is a cause for concern because these are calorically dense, non-nutritive elements, and repeated and excessive exposure can reinforce the innate preference for sweet taste in children, affect the overall diet quality, displace the consumption of more nutritionally valuable foods, promote excessive weight gain, and increase the risk of non-communicable diseases [36,37]. For this reason, various guidelines, such as the WHO complementary feeding guidelines and the U.S. Dietary Guidelines, now recommend that children under two years old avoid consuming foods high in sugar or with added sugars, and sweetened beverages [38,39].

Regarding sodium content, less than 10% of the products included in our study were classified as high in sodium. These findings were consistent with those reported by Saavedra-Garcia et al. [16] in a study conducted in Peru to compare the impact of the first phase of the implementation of Law No. 30021 on the content of critical nutrients in foods and beverages. In that study, the researchers reported a low number of high-sodium products, even before the implementation of the Law.

 doi:10.20944/preprints202501.0844.v1

Interestingly, the authors suggest that this effect could be an indirect result of the prior implementation of regulations on sodium content in neighboring countries like Chile, which may have led to the reformulation of products also distributed by transnational companies in the Peruvian market [16].

Concerning saturated fat content, around 40% of the included products had excessive levels. However, there were significant differences within the groups. While excess saturated fat was present in less than 10% of cereals and in none of the purees or mashed foods, between 70% and 80% of infant formulas had excessive levels of this critical nutrient. Additionally, the median saturated fat content in infant formulas was nearly 8 g (data not shown), which was even higher than the median observed for processed foods before the implementation of Law No. 30021 | [16].

Considering that infant formulas were the main contributors to saturated fat content, our findings cannot be compared with other studies in Latin America that did not include these products [21,23,24]. However, in the United States, it has been observed that more than 70% of children under five years old exceeded the recommended intake of saturated fats, and that 90% of the saturated fat consumed by children under 1 year came from infant formulas [40]. Our findings are particularly important in the context of WHO's recommendation to reduce saturated fat intake in children to less than 10% of total energy intake [41], as reducing saturated fat in childhood has been linked to decreases in total and low-density cholesterol, as well as blood pressure [42].

Finally, we must consider some potential limitations of our study. First, products were acquired from supermarkets and selected pharmacies. This may have limited the identification of products distributed through other channels, such as those marketed as part of social programs or through e-commerce. However, we believe that the stores selected in our study represent the locations with the highest sales volume of these products and thus reflect the infant foods with the greatest availability for the Peruvian population.

Secondly, our analysis was based on information declared on the product labels. In this regard, we found that 40% of infant formulas did not report sugar and/or saturated fat content, making it impossible to evaluate the nutritional profile for these two critical nutrients in those products. Additionally, some studies [43,44] have reported discrepancies between the nutritional information declared on infant food labels and the analytical values derived from laboratory tests. Therefore, there is a need to update nutritional labeling regulations in Peru to mandatorily include reporting of critical nutrients such as sugar, trans fats, and saturated fats, and, at the same time, future studies are needed to confirm our findings through laboratory determinations.

Finally, we only selected one unit of each product, regardless of size or flavor. This could be a limitation considering that some labeling characteristics might change according to the packaging dimensions. Similarly, different flavors of the same product could vary in their nutritional composition, although we believe that this would not significantly alter the critical nutrients of interest for our study.

5. Conclusions

Our study identified that most foods marketed for children under three years old in Lima Metropolitan Area contain added sugars and excessive amounts of critical nutrients such as sugar and saturated fats. Infant formulas significantly contributed to these results. Finally, the use of the technical parameters proposed by PAHO allowed for the identification of a higher number of products high in critical nutrients compared to the current parameters established by Law No. 30021.

Supplementary Materials: The following supporting information can be downloaded at the website of this paper posted on Preprints.org, Table S1. Eligibility criteria used in the study; Table S2. Operational definitions of the study outcomes; Table S3. Presence and Type of Added Sugars.

Author Contributions: Conceptualization, B.Q.-Q., J.M. and P.V.-D.; methodology, A.A., G.S.-S., B.Q.-Q., J.M. and P.V.-D.; formal analysis, A.A. and J.C.; investigation, A.A. and J.C.; data curation, A.A. and J.C.; writing—original draft preparation, A.A.; writing—review and editing, A.A., J.C., B.Q.-Q., J.M., P.V.-D., G.S.-S., B.M.-C.,

F.B.-R., M.E.U. and F.P.-C.; visualization, A.A. and J.C.; supervision, F.P.-C., B.Q.-Q., J.M. and P.V.-D.; project administration, B.Q.-Q. and J.M.; funding acquisition, M.E.U. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Directorate of Health Promotion of the Ministry of Health and the United Nations Children's Fund (UNICEF) of Peru.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The dataset used in the study (with sensitive information censored) and the analysis syntax are available at https://doi.org/10.5281/zenodo.14623956

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Bai, J.; Cui, J.; Shi, F.; Yu, C. Global Epidemiological Patterns in the Burden of Main Non-Communicable Diseases, 1990–2019: Relationships With Socio-Demographic Index. *Int J Public Health* **2023**, *68*, 1605502, doi:10.3389/ijph.2023.1605502.
2. NCD Countdown 2030 collaborators NCD Countdown 2030: Worldwide Trends in Non-Communicable Disease Mortality and Progress towards Sustainable Development Goal Target 3.4. *Lancet* **2018**, *392*, 1072–1088, doi:10.1016/S0140-6736(18)31992-5.
3. Barouki, R.; Gluckman, P.D.; Grandjean, P.; Hanson, M.; Heindel, J.J. Developmental Origins of Non-Communicable Disease: Implications for Research and Public Health. *Environmental Health* **2012**, *11*, 42, doi:10.1186/1476-069X-11-42.
4. Brumana, L.; Arroyo, A.; Schwalbe, N.R.; Lehtimaki, S.; Hipgrave, D.B. Maternal and Child Health Services and an Integrated, Life-Cycle Approach to the Prevention of Non-Communicable Diseases. *BMJ Glob Health* **2017**, *2*, e000295, doi:10.1136/bmjgh-2017-000295.
5. Cerf, M.E. Maternal and Child Health, Non-Communicable Diseases and Metabolites. *Metabolites* **2023**, *13*, 756, doi:10.3390/metabo13060756.
6. Lutter, C.K.; Grummer-Strawn, L.; Rogers, L. Complementary Feeding of Infants and Young Children 6 to 23 Months of Age. *Nutr Rev* **2021**, *79*, 825–846, doi:10.1093/nutrit/nuaa143.
7. Mahmood, L.; Flores-Barrantes, P.; Moreno, L.A.; Manios, Y.; Gonzalez-Gil, E.M. The Influence of Parental Dietary Behaviors and Practices on Children's Eating Habits. *Nutrients* **2021**, *13*, 1138, doi:10.3390/nu13041138.
8. World Health Organization *Infant and Young Child Feeding: Model Chapter for Textbooks for Medical Students and Allied Health Professionals.*; WHO: Geneva, 2009;
9. da Rocha, K.F.; de Araújo, C.R.; de Morais, I.L.; Padrão, P.; Moreira, P.; Ribeiro, K.D. da S. Commercial Foods for Infants under the Age of 36 Months: An Assessment of the Availability and Nutrient Profile of Ultra-Processed Foods. *Public Health Nutr* **2021**, *24*, 3179–3186, doi:10.1017/S1368980021001555.
10. Dunford, E.K.; Popkin, B.M. Ultra-Processed Food for Infants and Toddlers; Dynamics of Supply and Demand. *Bull World Health Organ* **2023**, *101*, 358–360, doi:10.2471/BLT.22.289448.
11. Baker, P.; Santos, T.; Neves, P.A.; Machado, P.; Smith, J.; Piwoz, E.; Barros, A.J.D.; Victora, C.G.; McCoy, D. First-Food Systems Transformations and the Ultra-Processing of Infant and Young Child Diets: The Determinants, Dynamics and Consequences of the Global Rise in Commercial Milk Formula Consumption. *Matern Child Nutr* **2021**, *17*, e13097, doi:10.1111/mcn.13097.
12. Neri, D.; Steele, E.M.; Khandpur, N.; Cediel, G.; Zapata, M.E.; Rauber, F.; Marrón-Ponce, J.A.; Machado, P.; da Costa Louzada, M.L.; Andrade, G.C.; et al. Ultraprocessed Food Consumption and Dietary Nutrient Profiles

Associated with Obesity: A Multicountry Study of Children and Adolescents. *Obes Rev* **2022**, *23 Suppl 1*, e13387, doi:10.1111/obr.13387.

13. Huamani-Champi W. Factores Asociados a Sobrepeso y Obesidad En Niños Menores de 5 Años Según ENDES 2020. Master's Thesis, Universidad Ricardo Palma: Lima, Perú, 2022.
14. Tarqui-Mamani, C.; Alvarez-Dongo, D.; Espinoza-Oriundo, P.; Sanchez-Abanto, J.; Tarqui-Mamani, C.; Alvarez-Dongo, D.; Espinoza-Oriundo, P.; Sanchez-Abanto, J. Análisis de La Tendencia Del Sobrepeso y Obesidad En La Población Peruana. *Rev Esp Nutr Hum Diet* **2017**, *21*, 137–147, doi:10.14306/renhyd.21.2.312.
15. Pan American Health Organization *Ultra-Processed Food and Drink Products in Latin America: Sales, Sources, Nutrient Profiles and Policy Implications*; PAHO: Washington, DC, 2019;
16. Saavedra-Garcia, L.; Meza-Hernández, M.; Diez-Canseco, F.; Taillie, L.S. Reformulation of Top-Selling Processed and Ultra-Processed Foods and Beverages in the Peruvian Food Supply after Front-of-Package Warning Label Policy. *Int J Environ Res Public Health* **2022**, *20*, 424, doi:10.3390/ijerph20010424.
17. Del Alcazar-Bardales AK; Rojas Benites IK; Tafur Gutiérrez MN Valorización de Supermercados Peruanos. Master's Thesis, Universidad del Pacífico: Lima, Perú, 2019.
18. Ministerio de Salud del Perú. *Decreto Supremo Que Aprueba El Reglamento de La Ley No. 30021, Ley de Promoción de La Alimentación Saludable—Decreto Supremo No. 017-2017-SA*; Ministerio de Salud del Perú: Lima, Perú, 2017;
19. Organización Panamericana de la Salud. *Nota Técnico-Jurídica de La Organización Panamericana de La Salud / Organización Mundial de La Salud Respecto a Modificaciones al D.S. N° 017-2017-SA*; Organización Panamericana de la Salud: Lima, Perú, 2022;
20. Louzada, M.L. da C.; Costa, C.D.S.; Souza, T.N.; Cruz, G.L. da; Levy, R.B.; Monteiro, C.A. Impact of the Consumption of Ultra-Processed Foods on Children, Adolescents and Adults' Health: Scope Review. *Cad Saude Publica* **2022**, *37*, e00323020, doi:10.1590/0102-311X00323020.
21. Bassetti, E.; Khosravi, A.; Pries, A.M. Prevalence of Front-of-Pack Warning Signs among Commercial Complementary Foods in Seven High and Upper Middle-Income Countries. *Nutrients* **2023**, *15*, 1629, doi:10.3390/nu15071629.
22. Karageuzián, G.; Vidal, L.; de León, C.; Girona, A.; Ares, G. Marketing of Commercial Foods for Infant and Young Children in Uruguay: Sugary Products, Health Cues on Packages and Fun Social Products on Facebook. *Public Health Nutr* **2021**, *24*, 5963–5975, doi:10.1017/S1368980021002780.
23. Torres-Schiaffino, D.; Saavedra-Garcia, L. Relationship between Marketing to Children on Food Labeling and Critical Nutrient Content in Processed and Ultra-Processed Products Sold in Supermarkets in Lima, Peru. *Nutrients* **2020**, *12*, 3666, doi:10.3390/nu12123666.
24. Giménez, A.; Saldamando, L. de; Curutchet, M.R.; Ares, G. Package Design and Nutritional Profile of Foods Targeted at Children in Supermarkets in Montevideo, Uruguay. *Cad Saude Publica* **2017**, *33*, e00032116, doi:10.1590/0102-311X00032116.
25. Borges, C.A.; Khandpur, N.; Neri, D.; Duran, A.C. Comparing Latin American Nutrient Profile Models Using Data from Packaged Foods with Child-Directed Marketing within the Brazilian Food Supply. *Front Nutr* **2022**, *9*, 920710, doi:10.3389/fnut.2022.920710.
26. Contreras-Manzano, A.; Jáuregui, A.; Velasco-Bernal, A.; Vargas-Meza, J.; Rivera, J.A.; Tolentino-Mayo, L.; Barquera, S. Comparative Analysis of the Classification of Food Products in the Mexican Market According to Seven Different Nutrient Profiling Systems. *Nutrients* **2018**, *10*, 737, doi:10.3390/nu10060737.
27. Ares, G.; Antúnez, L.; Cabrera, M.; Thow, A.M. Analysis of the Policy Process for the Implementation of Nutritional Warning Labels in Uruguay. *Public Health Nutr* **2021**, *24*, 5927–5940, doi:10.1017/S1368980021002469.

 doi:10.20944/preprints202501.0844.v1

28. Organización Panamericana de la Salud *Modelo de Perfil de Nutrientes de La Organización Panamericana de La Salud*; OPS: Washington, DC, 2016;
29. Crosbie, E.; Gomes, F.S.; Olvera, J.; Rincón-Gallardo Patiño, S.; Hoeper, S.; Carriedo, A. A Policy Study on Front-of-Pack Nutrition Labeling in the Americas: Emerging Developments and Outcomes. *Lancet Reg Health Am* **2023**, *18*, 100400, doi:10.1016/j.lana.2022.100400.
30. Martin, C.; Turcotte, M.; Cauchon, J.; Lachance, A.; Pomerleau, S.; Provencher, V.; Labonté, M.-È. Systematic Review of Nutrient Profile Models Developed for Nutrition-Related Policies and Regulations Aimed at Noncommunicable Disease Prevention -An Update. *Adv Nutr* **2023**, *14*, 1499–1522, doi:10.1016/j.advnut.2023.08.013.
31. Duran, A.C.; Ricardo, C.Z.; Mais, L.A.; Bortoletto Martins, A.P. Role of Different Nutrient Profiling Models in Identifying Targeted Foods for Front-of-Package Food Labelling in Brazil. *Public Health Nutr* **2021**, *24*, 1514–1525, doi:10.1017/S1368980019005056.
32. Khosravi, A.; Bassetti, E.; Yuen-Esco, K.; Sy, N.Y.; Kane, R.; Sweet, L.; Zehner, E.; Pries, A.M. Nutrient Profiles of Commercially Produced Complementary Foods Available in Burkina Faso, Cameroon, Ghana, Nigeria and Senegal. *Nutrients* **2023**, *15*, 2279, doi:10.3390/nu15102279.
33. Maalouf, J.; Cogswell, M.E.; Bates, M.; Yuan, K.; Scanlon, K.S.; Pehrsson, P.; Gunn, J.P.; Merritt, R.K. Sodium, Sugar, and Fat Content of Complementary Infant and Toddler Foods Sold in the United States, 2015. *Am J Clin Nutr* **2017**, *105*, 1443–1452, doi:10.3945/ajcn.116.142653.
34. Grammatikaki, E.; Wollgast, J.; Caldeira, S. High Levels of Nutrients of Concern in Baby Foods Available in Europe That Contain Sugar-Contributing Ingredients or Are Ultra-Processed. *Nutrients* **2021**, *13*, 3105, doi:10.3390/nu13093105.
35. Hutchinson, J.; Rippin, H.; Threapleton, D.; Jewell, J.; Kanamäe, H.; Salupuu, K.; Caroli, M.; Antignani, A.; Pace, L.; Vassallo, C.; et al. High Sugar Content of European Commercial Baby Foods and Proposed Updates to Existing Recommendations. *Matern Child Nutr* **2021**, *17*, e13020, doi:10.1111/mcn.13020.
36. Fidler Mis, N.; Braegger, C.; Bronsky, J.; Campoy, C.; Domellöf, M.; Embleton, N.D.; Hojsak, I.; Hulst, J.; Indrio, F.; Lapillonne, A.; et al. Sugar in Infants, Children and Adolescents: A Position Paper of the European Society for Paediatric Gastroenterology, Hepatology and Nutrition Committee on Nutrition. *J Pediatr Gastroenterol Nutr* **2017**, *65*, 681–696, doi:10.1097/MPG.0000000000001733.
37. Murray, R.D. Savoring Sweet: Sugars in Infant and Toddler Feeding. *Ann Nutr Metab* **2017**, *70 Suppl 3*, 38–46, doi:10.1159/000479246.
38. U.S. Department of Agriculture; U.S. Department of Health and Human Services *Dietary Guidelines for Americans, 2020-2025*; USDA/HHS: Washington, D.C., 2020;
39. World Health Organization *WHO Guideline for Complementary Feeding of Infants and Young Children 6–23 Months of Age*; WHO: Geneva, 2023;
40. Wang, Y.; Guglielmo, D.; Welsh, J.A. Consumption of Sugars, Saturated Fat, and Sodium among US Children from Infancy through Preschool Age, NHANES 2009-2014. *Am J Clin Nutr* **2018**, *108*, 868–877, doi:10.1093/ajcn/nqy168.
41. World Health Organization *Saturated Fatty Acid and Trans-Fatty Acid Intake for Adults and Children WHO Guideline*; WHO: Geneva, 2023;
42. Te Morenga, L.; Montez, J.M. Health Effects of Saturated and Trans-Fatty Acid Intake in Children and Adolescents: Systematic Review and Meta-Analysis. *PLoS One* **2017**, *12*, e0186672, doi:10.1371/journal.pone.0186672.

 doi:10.20944/preprints202501.0844.v1

43. Walker, R.W.; Goran, M.I. Laboratory Determined Sugar Content and Composition of Commercial Infant Formulas, Baby Foods and Common Grocery Items Targeted to Children. *Nutrients* **2015**, *7*, 5850–5867, doi:10.3390/nu7075254.
44. Champeny, M.; Yuen-Esco, K.; Juniza, E.; Sy, N.Y.; Kane, R.; Badham, J.; Mulder, A.; Pries, A.M. Accuracy of Declared Nutrient Content on Labels of Commercial Complementary Food Products in Cambodia, Indonesia and Senegal. *Matern Child Nutr* **2023**, *19*, e13504, doi:10.1111/mcn.13504.