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Original Article

Evaluating nutrient profiles of packaged foods in Peru pre- and post-introduction of front-of-pack warning labels, 2018–2021

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Abstract

This study assessed differences in the nutritional labeling content of processed foods based on Peruvian regulations before and during the two implementation stages of Law 30021. A cross-sectional analysis of 1137 food labels collected between 2018 and 2021 was conducted, comparing nutritional information across three periods: pre-implementation (2018), first stage (2019–2020), and second stage (2021). Nutrient content variations were analyzed using the Kruskal-Wallis test, while changes in front-of-package labeling were assessed with the McNemar test. Statistical analyses were performed using SPSS version 25, with significance set at $p<0.05$. The study found significant reductions in key nutrients over time, with total decreases of 3.4% in calories ($p=0.001$), 14% in sodium ($p=0.001$), 36.7% in sugar ($p=0.001$), and 9.2% in saturated fats ($p=0.028$). The introduction of front-of-package warning labels contributed to a 10–30% decline in high sodium, high sugar, and high saturated fat warnings in solid foods, except for trans-fat labeling, which remained unchanged ($p=0.874$). Among liquid ultra-processed foods, sugar content showed a notable 49% reduction during the initial implementation phase ($p=0.01$). These findings suggest that the implementation of Law 30021 in Peru has led to a decline in critical nutrient levels in processed foods, particularly in calories and saturated fats. Front-of-package warning labels play a role in improving nutritional profiles, potentially promoting healthier food choices. However, further research is necessary to assess long-term consumer behavior and health impacts.

Keywords: processed food, food labeling, sodium, dietary, sugars, fats, trans fatty acids (source: MeSH NLM).

Introduction

After overcoming a series of significant events in the realms of politics, economics, commerce, and advertising [1–3], Peru has been implementing Law 30021 since 2019, also known as the Law for the Promotion of Healthy Nutrition for Children and Adolescents [4]. The primary objective of this law is to reduce diseases associated with overweight, obesity, and non-communicable chronic illnesses [5]. One of the initial actions mandated by Law 30021 is the implementation of front-of-pack labels on processed food. These labels, commonly referred to as octagons (warning labels), feature a simple and easily interpretable format, enabling consumers to make swift decisions regarding the nutritional content of the foods they choose [6, 7].

Research evaluating the development of this public policy in Peru is limited. A study conducted on processed foods before their implementation in Peru found that saturated fats in solid processed products exceeded the established parameters in most items. Furthermore, regardless of their type and category, the critical nutrient, sugar, was present in elevated amounts in the majority of evaluated products [8]. Meza-Hernández

and colleagues obtained similar results, observing that most processed and ultra-processed foods sold in a Peruvian supermarket chain would carry at least one octagon, and over 10% of them would bear octagons for three of the four critical nutrients (sodium, sugar, saturated fats, and trans fats) prior to their implementation [5].

Peru has adopted nutritional octagons as an alternative warning system, aligning itself with other Latin American countries such as Chile, Uruguay, Mexico, Brazil, and Argentina [9, 10]. This new public policy aims to prevent misleading information about the composition of packaged foods and beverages, particularly ultra-processed foods, from deceiving consumers. It serves as a clear warning regarding the high presence of these harmful nutrients in processed foods [11]. However, the impact of this regulation on changes in the composition of industrially processed foods in the region, including Peru, remains unclear. While octagons facilitate easy and precise identification of products with excessive nutrients that could impact people's health and reduce their purchases [9, 10], the food industry has taken steps to delay their implementation in each country seeking to apply them. This complicates the assessment of nutrient composition changes in these products [11, 12].

Therefore, the study's objective was to evaluate differences in the nutritional labeling of processed foods, with an emphasis on critical nutrients, according to the technical parameters established in Peruvian regulations before (T0) and during the primary (T1) and secondary (T2) phases of front-of-pack label implementation.

Material and methods

Methodology

This is a cross-sectional study. The information on the content of critical nutrients such as sodium, total sugars, saturated fats, and trans fats described in the nutritional labels of processed foods was reviewed and compared with the technical parameters (Table 1) established in the regulation of Law 30021 [13].

Study population

The dataset comprises labels of processed foods available in 103 food retail establishments (supermarkets, markets, and grocery stores) located in the districts of Metropolitan Lima, acquired by university students during the years 2018–2021. This information was transformed into a repository of images (photographs). Three-time points were considered: before implementation (T0=2018), during the first stage (T1=2019–2020), and during the second stage (T2=2021) of the implementation of front-of-pack labeling (octagons) according to

Table 1: Technical parameters and implementation of front-of-package labeling in Peru [8].

Technical parameters	**Deadline for entry into force**	
	First stage of front-of-package labeling (since June 2019)	Second stage of front-of-package labeling (since September 2021)
Sodium in solid foods	Greater than or equal to 800 mg/100 g	Equal to or greater than 400 mg/100 g
Sodium in beverages	Greater than or equal to 100 mg/100 ml	Equal to or greater than 100 mg/100 m
Total sugar in solid foods.	Greater than or equal to 22.5 g/100 g	Equal to or greater than 10 g/100 g
Total sugar in beverages	Greater than or equal to 6 g/100 ml	Equal to or greater than 5 g/100 ml
Saturated Fats in solid foods.	Greater than or equal to 6 g/100 g	Equal to or greater than 4 g/100 g
Saturated Fats in Beverages	Greater than or equal to 3 g/100 m	Equal to or greater than 3 g/100 ml
Trans-fat According to the current regulations, this applies only to the first stage of front-of-pack labeling. In the second stage, trans-fats must be eliminated from foods and beverages	**According to current regulations**	
	Product	Trans-fat cut off
	a) Fats, vegetable oils and margarines	2 g of trans fatty acids per 100 g or 100 ml of fat
	b) Other processed foods and non-alcoholic beverages	5 g of trans-fatty acids per 100 g or 100 ml of fat content

the technical parameters established in Peruvian regulations [14].

Sample size and sampling

According to the Peruvian Healthy Eating Law, a study on the nutritional quality of food and beverages in Lima was used as a reference, considering that they had similar study variables [5]. OpenEpi was employed as a tool to determine the sample size with 80% power and a 95% confidence interval. The initial calculated sample size was 630 processed foods. Additionally, based on the reference study, a loss of 24% was considered due to undeclared, unclear, or confusing nutritional information on the labeling compared to national regulations. Convenience sampling was used, for which students took pictures of food retail establishments near their homes, resulting in a total of 1137 nutrition labels.

Study procedures

The nutritional content information from processed food labels was entered into an Excel spreadsheet. Nutritional labels of food items were evaluated based on their categorization into types (solid or liquid). The solid and liquid food types were defined according to the unit of measurement used on the packaging, such as net weight [8]. The definition of processed foods was based on the Dietary Guidelines for the Peruvian population [15] and the criteria of the PAHO/WHO [16].

In cases where an exact value was not specified or the information was not found on the label, it was coded as "not specified/does not indicate", according to the corresponding critical nutrient. Additionally, those for which it was impossible to assign a specific category were removed from the study. Regarding exact duplicates, only one entry was included in the Excel spreadsheet.

The researchers checked the completeness and accuracy of the data entered for all products, including double data entry, given by two of the researchers, to compare possible differences. The database included the following information: type, commercial name, brand, energy content, and critical nutrients per declared serving size of 100 g or 100 ml; prior encoding was conducted to maintain data confidentiality (brands, manufacturers). These results were compared according to the technical parameters established for the first and second stages of MAP implementation. The content of critical nutrients was recorded in milligrams for sodium and in grams for sugar, saturated fats, and trans fats. Subsequently, the content of each critical nutrient per product was calculated for the equivalent amount of 100 g or 100 ml, depending on the food type, for comparison with the parameters established for the first and second stages of MAP implementation.

Statistical analysis

It was found that the variables did not follow a normal distribution (Kolmogorov-Smirnov test, $p<0.05$), so non-parametric tests were employed. The Kruskal-Wallis test was used to determine if there was a significant difference in the medians of nutrients (quantity) among processed food during the three time periods, and the McNemar test was used to compare the changes in nutritional content in labeling between the first and second stages of front-of-package labeling implementation. Additionally, the percentage variation between each stage of the study was compared. The analysis was performed using SPSS version 25, and a p-value of less than 0.05 was considered statistically significant.

Results

An analysis was conducted on 1137 labels of processed foods. The evaluation of calorie and critical nutrient content was carried out at three different times, and it was determined that the variation in the number of calories and saturated fats across all labels is statistically significant for calories ($p<0.01$) and saturated fats ($p<0.05$). Post hoc tests indicated a significant decrease in calorie content occurred between time 0 and time 1, while a significant reduction in saturated fats was observed between time 1 and 2. It can be observed that in the three times studied, there is variation in the quantities except for trans fats (Table 2).

In all the evaluated labels, there is a percentage decrease between the median of calories and critical nutrients. The greatest variation occurs in sugar content (49%) between period T0 (prior to implementation) and period T1 (first stage of implementation), although values then increase again between T1 and T2 (second stage of implementation). Regarding the total variation (Δ T0 and T2), there is a decrease of 3.4% in calories, 14% in sodium, 36.7% in sugar, and 9.2% in saturated fats (Figure 1).

Regarding the implementation of front-of-package warning labels in Peru, it is possible to highlight the

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Table 2: Content of calories, sodium, total sugar, saturated fats, and trans-fats in processed food products by Peru, 2018–2021 study periods.

Variables	Time 0 (n=193)			Time 1 (n=774)			Time 2 (n=170)			P-value*
	Median	95% IC		Median	95% IC		Median	95% IC		
Total (n=1137)										
Calories	460.0	432.4	472.2	403.5	396.4	427.5	444.3	406.7	470.0	<0.01[a]
Sodium (mg)	266.7	200.0	333.3	225.6	180.0	254.5	229.4	172.4	280.0	0.134
Sugar (g)	21.1	12.8	25.5	10.7	10.0	13.3	13.3	8.9	22.2	0.278
Saturated fat (g)	6.4	5.0	8.0	4.7	4.0	5.3	5.8	5.6	7.8	<0.05[b]
Trans-fat (g)	0.0	-	-	0.0	-	-	0.0	-	-	0.874

Note: * – Kruskal-Wallis test; [a] – Post hoc test Time 1-Time 0 P=0.000; [b] – Post hoc test Time 1-Time 2 P=0.042.

statistical differences between the first and second stages of implementation found at the three study points in processed food. However, the change in the presence of front-of-package labels is noticeable in solid products high in sodium, sugar, and saturated fats (p<0.01). Suppose we consider the changes in liquid products between the first and second stages of implementation. In that case, no significant changes are observed across the three study periods (p>0.05), except for products high in sugar during the intermediate period (T1). Additionally, the frequency of products containing trans fats in solid products decreased significantly from T0 to T1 (p<0.01) but did not significantly change from T1 to T2. The results also show that the presence of high sodium content in solid products consistently decreased across the study periods (Table 3).

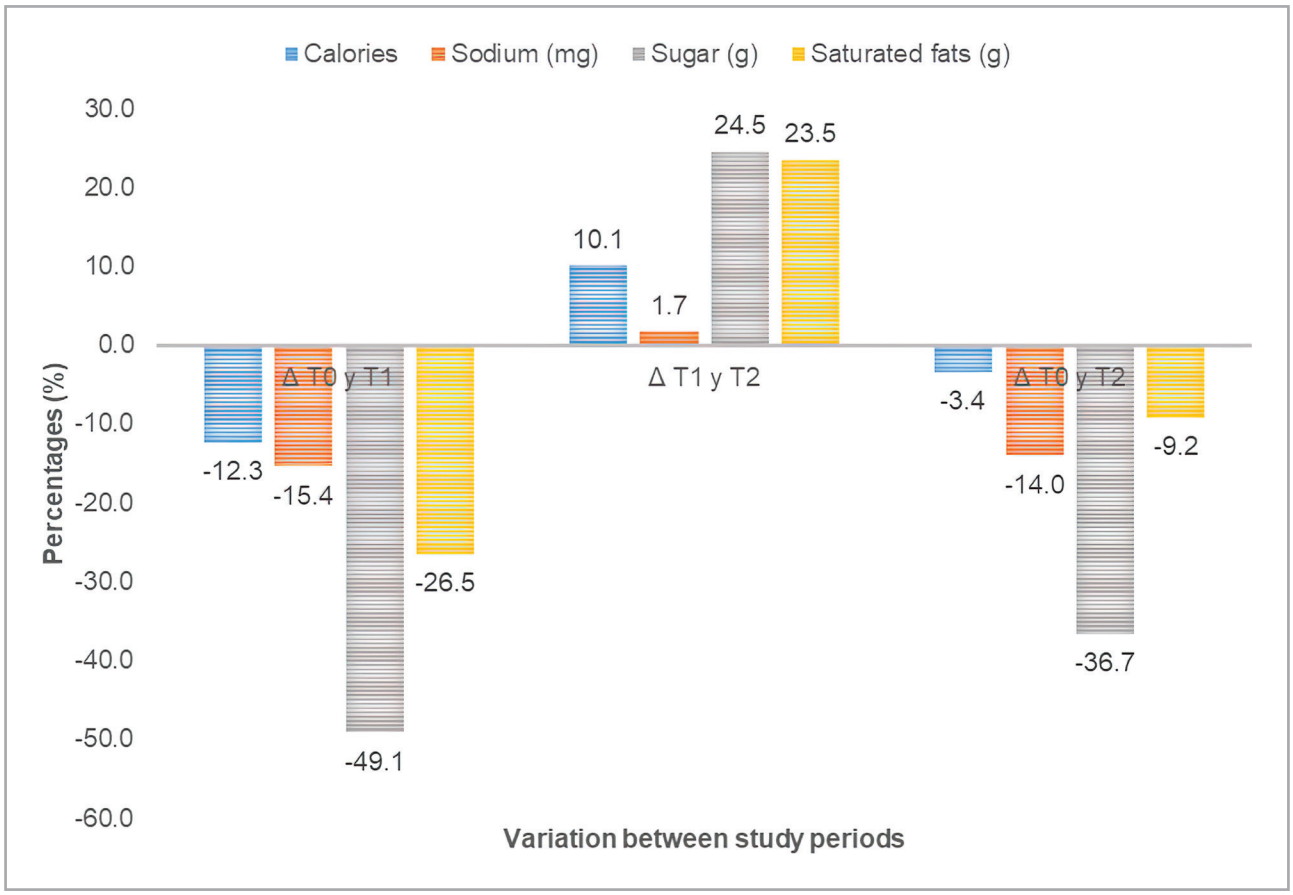

Figure 1: Percentage variation of calorie content, sodium, total sugar, saturated fats, and trans-fats in processed food products over study periods in Peru, 2018–2021.

Table 3: Changes in the prevalence of front-of-package labeling for processed products according to the implementation of technical parameters for critical nutrients. Lima, Peru.

Categories/ Time periods	Total	High in sodium		p-value	High in sugar		p-value	High in saturated fats		p-value	Contains trans-fats		p-value*
		Stage 1	Stage 2		Stage 1	Stage 2		Stage 1	Stage 2		Stage 1	Stage 2	
	n	%	%		%	%		%	%		%	%	
Total (n=1137)													
Time 0	193	13.0	37.8	<0.01	54.9	61.7	<0.01	53.9	62.2	<0.01	1.0	3.1	0.125
Time 1	774	11.0	33.9	<0.01	43.5	63.2	<0.01	42.1	54.5	<0.01	0.1	2.3	<0.01
Time 2	170	12.4	30.0	<0.01	45.3	60.6	<0.01	50.0	60.6	<0.01	0.0	1.2	N/A
Solid (n=869)													
Time 0	159	8.2	38.4	<0.01	53.5	59.7	<0.01	61.6	71.7	<0.01	1.3	3.8	0.125
Time 1	575	6.6	37.2	<0.01	43.7	62.4	<0.01	52.0	68.7	<0.01	0.2	3.1	<0.01
Time 2	134	6.7	29.1	<0.01	46.3	62.7	<0.01	60.4	73.9	<0.01	0.0	1.5	N/A
Liquid (n=269)													
Time 0	34	35.3	35.3	1.00	61.8	70.6	0.250	17.6	17.6	1.00	0.0	0.0	N/A
Time 1	199	24.1	24.1	1.00	43.2	65.3	<0.01	13.6	13.6	1.00	0.0	0.0	N/A
Time 2	36	33.3	33.3	1.00	41.7	52.8	0.125	11.1	11.1	1.00	0.0	0.0	N/A

Note: N/A – Not applicable; <0.05 – significant; <0.01 – highly significant; * – McNemar's Chi-square test.

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Discussion

This study represents one of the few that analyzes changes in the quantity of critical nutrients using information from the labels of processed products in three study periods: before (T0), first stage (T1), and second stage (T2) since the implementation of the Healthy Food Law in Peru [14]. The findings reveal significant disparities in the overall nutritional content of processed food labels, particularly in sodium, sugar, and saturated fats, at different points during the study. On the other hand, processed solid foods show changes in the proportion of front-of-package labeling for all evaluated nutrients (sodium, total sugar, saturated fats, and trans fats) across all study periods, except for trans fats at T0 and T2. In the case of processed liquid foods, changes are discernible only for sugar at T1.

During the period from 2018 to 2021, notable changes were observed in the amounts of calories and saturated fats ($p<0.01$). It is worth noting that Quintiliano *et al.* [17] conducted a study on the impact of Chile's food labeling and advertising law and found similar changes in calorie content before and after its implementation. However, their study did not show significant differences in saturated fats, which is in contrast to the findings of this study. This discrepancy could be due to the difference in the periods analyzed. The Chilean study examined the periods before and after the implementation from 2013 to 2019, whereas this study evaluated three points in time between 2018 and 2021 (T0, T1, and T2). Nevertheless, both studies detected changes in the levels of all evaluated nutrients.

Additionally, it was found that the percentage decrease between T0 and T2 of the study for calories was 3.4%, 14% for sodium, 36.7% for sugar, and 9.2% for saturated fats. It is noteworthy that between T0 and T1, a decrease in all critical nutrients is evident, but between T1 and T2, their values increase again, with sodium showing a lesser increase. These results are similar to those found by Kanter *et al.* [18], who sought to evaluate the possible early reformulation of the food industry in Chile before the implementation of front-of-package labeling. In their study, none of the food categories showed reductions greater than 5%, although sugar and sodium were the nutrients that could undergo the most changes, which is also evident in this study. As for trans fats, the lack of significant statistical changes observed could be due to the regulatory measures taken in Peru to eliminate ingredients containing trans fats.

During the implementation of Law 30021 in Peru, there was a significant increase in the use of front-of-package labeling on total processed foods. Among the solid foods, there were also significant increases in the presence of high sodium, high sugar, and high saturated fat warnings, ranging from 10% to 30% at all time points, except for the front-of-package labeling containing trans fats at T0 and T2. Among the processed liquid foods, only the high sugar warning showed a significant increase of 20%, particularly at T1, while the other results remained the same or showed insignificant increases throughout the stages of implementation in Peru. It is important to highlight that the study conducted in Chile by Reyes *et al.* [17] yielded different results from the findings presented here. They found that only salty snacks, desserts, and ice cream were significantly impacted by front-of-package nutrient labels before and after implementing octagons in Chile. The other octagons either decreased or remained unchanged in the proportion of presence in packaged processed foods. The differences in results may be due to the implementation approach taken in each country. While our study focused on overall nutrient content changes, Reyes *et al.* examined specific product categories, which may explain the observed discrepancies.

Furthermore, Contreras-Manzano *et al.* [18] evaluated nutrient profiles in Latin America against the OPS model and found that the model established for the nutrients evaluated in stage 1 of Peru and Chile had the lowest agreement with the OPS model. However, agreement increased for stage 2 of Peru and stage 3 of Chile, suggesting that early stages of implementation of nutritional octagons may have limited utility for classifying products based on nutrient content. It is also worth noting that the Mexican model, approved recently, had better results in identifying healthy products [19]. This suggests that experiences in other countries provide valuable insights for implementing front-of-package labeling in countries that are adopting it.

The objective of implementing nutritional warning labels, such as octagons, is to promote positive changes in the consumption of unhealthy foods [20–22] and reduce their excessive consumption within the population [23, 24]. This, in turn, can contribute to reducing non-communicable diseases and their health and economic implications for low- and middle-income countries [25]. In Chile, a 24% decrease in the purchase of beverages with nutritional warning labels has been observed [26]. Additionally, the proportion of calories consumed by children and adolescents from sugars, saturated fats, and sodium has decreased after the implementation of front-of-package labeling [27]. However, in Peru, research examining changes in consumer behavior after the implementation of front-of-package

labeling has not yet been carried out. It is important to continue researching the effects of this policy to evaluate its impact and make adjustments if necessary.

This study does have limitations that should be taken into account. Firstly, the sample used was not representative of the entire country, as only Lima was considered. Additionally, since the sample was obtained through convenience sampling and students took photos of establishments near their homes, there is a possibility of selection bias. However, Lima, being the capital and accounting for 29.3% of the population, serves as a major center for food production and imports. It is important to acknowledge that the variety of processed foods in border cities near other countries may differ [27]. For this reason, and other characteristics such as the study design, a direct causal relationship between the implementation of Law 30021 and changes in the energy, sodium, total sugar, saturated fats, and trans fats content of processed foods cannot be established. Nevertheless, the observed changes in most nutrients suggest that regulation could play a relevant role. It is worth mentioning that the analysis relied on information provided by food manufacturers on the printed nutritional labels rather than laboratory testing. However, it is mandatory for products sold in Peru to have obtained sanitary registration from the competent health authority [28].

Despite the limitation of having only the information provided by the manufacturer, a notable strength of this study is its inclusion of data from the pre-implementation phase as well as the first and second phases of the Octagon implementation. This comprehensive approach made it possible to reliably assess the changes in the nutrient composition of the processed foods studied. The results provide valuable insights into the impact of front-of-pack labeling on the nutritional quality of foods. These findings highlight the potential of regulatory measures to enhance public health and emphasize the importance of continued research and evaluation of such policies.

To summarize, the findings suggest that processed food offered in Peru has decreased certain critical nutrient values following the enactment of Law 30021. However, only energy and saturated fats showed statistically significant changes. Although all evaluated, vital nutrients experienced a percentage variation, the amounts of sugar and sodium stood out as notable concerns, requiring further assessment to determine if adjustments to the current parameters are necessary.

Further research is necessary to determine the effects of the reformulation on the quality of food intake among the Peruvian population, taking into account various nutrients and food components like sweeteners and calories. The discoveries made in this study could serve as guidance for other countries in implementing front-of-package labeling tailored to their needs and requirements.

It remains to be observed whether this reformulation will be sustained in the long term and whether Peruvian health authorities will enhance procedures for assessing the nutritional value of processed foods consumed by their citizens. Such efforts could encourage healthier food choices and contribute to improved public health outcomes.

Conclusion

Overall, the labels on processed food in Peru have shown reductions in the amount of critical nutrients since the implementation of labeling regulations. However, these changes were only significant for energy and saturated fats. The findings suggest that the implementation of front-of-package labeling has impacted the nutritional composition of processed foods, although further research is needed to evaluate its effect on consumer behavior and overall public health outcomes.

Conflict of interest

The authors declare no conflict of interest.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Research Ethics Committee of the Instituto Nacional de Salud del Niño, Lima, Perú (PI-31/21). The need for written informed consent was waived by the institution, as the research was solely based on product nutrition labeling data and did not involve humans or tissue samples. Therefore, informed consent was not applicable.

Data availability statement

The data presented in this study are currently available upon request from the corresponding author. As it

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is currently being utilized in the composition of other research articles, it is not yet freely accessible.

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