Nutritional quality and use of claims in products with added micronutrients

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Abstract

Objective. To analyze the association between the addition of micronutrients and the use of health and nutrition claims (HNC) in processed and ultra-processed products, and to evaluate whether this association differs according to the nutritional quality. **Materials and methods.** This cross-sectional study utilized data from 17 264 packaged foods and beverages available in major supermarket chains in Mexico City in 2017. Information was obtained from the front-of-packages (for HNC), nutrition facts table (energy and nutrients of concern), and ingredient lists (sources of micronutrients). **Results.** 25% (95%CI: 26.8,28.3%) of products reported added micronutrients. In this group, the use of HNC was higher compared to those without added micronutrients (55.1 vs. 27.5%). Finally, the proportion of products classified as excess energy (PR 1.11, 95%CI: 1.07,1.16), free sugars (PR 1.09, 95%CI: 1.04,1.15), and with non-sugar sweeteners (PR 4.05, 95%CI: 3.64,4.50) were higher in products that displayed HNC and with micronutrients added compared to products without HNC and micronutrients. **Conclusion.** The addition of micronutrients was more frequent in ultra-processed products that displayed HNC and products excessive in energy, free sugars or those containing non-sugar sweeteners.

Keywords: ultra-processed foods; health claims; nutrition claims; micronutrients

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Resumen

Objetivo. Analizar la asociación de la adición de micronutrimentos y el uso de declaraciones nutrimentales y saludables (DNS) en productos procesados y ultraprocesados y evaluar si esta asociación es diferente de acuerdo con la calidad nutrimental. **Material y métodos.** Estudio transversal que utilizó información de 17 264 empaques de alimentos y bebidas disponibles en supermercados de la Ciudad de México en 2017. La información de las DNS se obtuvo del empaque frontal de los productos. El resto de la información se obtuvo de la tabla nutrimental (contenido de energía y nutrimentos) y la lista de ingredientes (fuentes de micronutrimentos). **Resultados.** 25% (IC95%: 26.8,28.3) de los productos reportaron micronutrimentos añadidos. En este grupo, el uso de DNS fue más frecuente en comparación con productos sin micronutrimentos (55.1 vs. 27.5%). Finalmente, la proporción de productos clasificados con exceso de calorías (PR 1.11, IC95%: 1.07,1.16), azúcares libres (PR 1.09, IC95%: 1.04,1.15) y con edulcorantes (PR 4.05, IC95%: 3.64,4.50) fue mayor en productos que mostraron DNS y que contenían micronutrimentos añadidos en comparación con los que no contenían micronutrimentos ni DNS. **Conclusión.** La adición de micronutrimentos fue más frecuente en productos ultraprocesados que mostraron DNS y que excedieron los umbrales de energía, azúcares libres y edulcorantes.

Palabras clave: productos ultraprocesados; declaraciones nutrimentales; declaraciones saludables; micronutrimentos

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The addition of micronutrients (*e.g.*, through fortification or enrichment) in foods and beverages is a public health strategy aimed at addressing deficiencies and health-related conditions to their intake.[1] Nowadays, the addition of micronutrients in specific foods or ingredients such as salt, milk or wheat flour, is a common part of mandatory and voluntary policies in many countries.[2]

Generally, micronutrient deficiencies are caused by limited access to a diverse and sufficient quantity of foods.[3] However, recent studies suggest that a higher consumption of processed and ultra-processed products is associated with a lower intake of micronutrients.[4,5] According to the NOVA food classification system, processed products are those containing added sugars, fats, or sodium aimed at prolonging their durability and enhancing their palatability. On the other hand, ultra-processed products are characterized by food formulations containing excessive amounts of energy and critical nutrients, they often contain additives such as non-sugar sweeteners, colorants, flavorings, texturizers, and humectants.[6]

Excessive consumption of processed and ultra-processed products is also associated with a higher intake of critical nutrients such as free sugars, saturated and trans fats, and sodium.[7] Consequently, increased consumption of these products is associated with a higher risk of overweight, obesity, hypertension, cancer, and other non-communicable diseases (NCDs).[8,9]

Some of the global strategies to reduce the intake of processed and ultra-processed products and to improve diets include (but are not limited to) front-of-pack labelling (FOPL).[10] Improving FOPL involves of facilitating access to information about food and beverages for consumers and promoting healthier choices. It also involves regulating health and nutrition claims (HNC) as a way to present information to consumers.[11] Health claims are defined as "any statement that suggests or implies a relationship between a food or a constituent of that food and health" while nutrition claims are "any presentation that states, suggests, or implies that a food has particular nutritional properties, including but not limited to the energy value and to the content of protein, fat and carbohydrates, as well the content of vitamins and minerals".[11] The use of HNC depends on different factors such as reducing a product's less healthy components (for example, critical nutrients) or adding healthier ones, such as fiber and vitamins.[12]

HNC can create a misperception about the nutritional quality of the products that use them, known as the health halo effect.[13] Some studies have shown that products that display HNC on the FOPL are not associated with better nutritional quality, therefore, they are often used as a marketing strategy.[14,15] The addition of micronutrients to less healthy foods, communicated through HNC, can lead consumers to misjudge the product's nutritional quality.[16]

In most countries, regulations on HNC have primarily focused on standardizing the reduction or absence of critical nutrients (for example, 'low fat' or 'sugar free'). However, there are few regulations specifically addressing claims related to micronutrient content. Most of the countries with such regulations have adopted the Codex specifications to harmonize their use, but these often lack limitations or specifications for less healthy foods.[17] This study aims to analyze the association between the addition of micronutrients and the use of HNC in processed and ultra-processed products, and evaluate if this association differs according to the nutritional quality.

Materials and methods

This was a cross-sectional study that analyzed the association of the use of HNC on the FOPL of foods and beverages that contained added micronutrients and their nutritional quality using a nutrient profile model. The procedures for data collection and handling have been previously published.[18] Briefly, we collected data on products available in 136 food retail outlets that included the biggest supermarket chains (such as the Walmart group, *La Comer*, *Soriana*, and *Chedraui*) in Mexico City during the period from January to March 2017. First, we identified areas with a population density of 20 000 or more inhabitants (Urban Basic Geostatistics Areas, AGEB by its acronym in Spanish) and were selected according to the level of marginalization (low, middle, and high) by the National Institute of Statistics and Geography (Inegi, by its acronym in Spanish). Subsequently, the selection of establishments in each AGEB was carried out randomly.

Nutrition undergraduate students were trained by researchers from the National Institute of Public Health (INSP, in Spanish) to collect data at the establishments. They took photographs of each side of all product packages with a smartphone. Information captured included the product name, the FOPL (including HNC), the bar code, list of ingredients, and nutrient facts table. This data was recorded in RedCaP, an online platform that supports simultaneous data entry by multiple users, and then exported in electronic spreadsheets. For each visit to a particular establishment, a checklist was generated with the registered products; if a product had already been registered in another establishment, the product was excluded. Each field worker collected information on the same category of products from all included es-

tablishments. For this analysis, we exclude products in multipacks, those with inconsistences in nutritional information (*e.g.*, missing ingredients lists or discrepancies between reported and estimated energy values), as well as minimally processed foods and culinary ingredients.

The original protocol was approved by the Research, Ethics and Biosafety Committees of the INSP (approved number 1530). Although this study did not involve the use of human data, we consulted the legal representatives of each supermarket chain and/or the manager in charge for authorization to take photographs of products.

Foods and beverages were classified as containing added micronutrients if the list of ingredients reported any micronutrients such as vitamins (*e.g.*, folic acid, cobalamin, ascorbic acid, pyridoxine, etc.), essential minerals (*e.g.*, iron, copper, magnesium, selenium, zinc, etc.) or any statement as "fortified", "enriched", or "added vitamins or minerals". According to Mexican food labeling regulations, any ingredient or additive, including micronutrients and those containing them must be reported in the list of ingredients.[19] For all micronutrients, variations in the ingredient list were considered (*e.g.*, vitamin C and variations such as ascorbic acid or Vit C). Sodium was not considered as an added micronutrient due to its role as a critical nutrient.

HNC were classified according to the harmonized taxonomy of the International Network for Food and Obesity, NCDs Research, Monitoring and Action Support (INFORMAS).[20] For the purposes of this article, we only reported HNC on the FOPL. Nutrition claims include health-related ingredient claims (*e.g.*, "Contains whole grains"); nutrient content claims (*e.g.*, "Contains Vitamin C"); and nutrient comparative claims (*e.g.*, "Contains more calcium than milk"). Health claims include general health claims (*e.g.*, "Low glycemic index"); nutrient and other function claims (*e.g.*, "Magnesium for growth"); and reduction of disease risk claim (*e.g.*, "Prevents osteoporosis"). Other claims such as *Organic* or *Non-GMO* were not reported.

Foods and beverages were grouped according to the NOVA food system classification as: 1) unprocessed or minimally processed foods (such as fresh fruits or vegetables, whole grain cereals, plain milk, and seeds with no added ingredients); 2) processed culinary ingredients (such as salt, sugar or oil); 3) processed foods (such as canned fruits and vegetables, salted seeds or meat with salt for preservation); and 4) ultra-processed products (such as carbonated beverages, ready to eat foods like pizza or hamburgers, pastries and breakfast cereals).[21]

For the nutritional quality assessment, we classified products according to the thresholds of the Mexican FOPL regulation of 2020 (table I).[19] The classification used criteria from the third phase of implementation, which corresponds to the initial approach in Mexico's labeling regulation (the first two stages are transitional). Information on energy and nutrient content was obtained from the nutrition facts table and were reported per 100 grams for food and 100 milliliters for beverages. For the analysis that included nutritional quality, baby foods were excluded according to the nutrient profile model specifications (most nutrient profiles are not designed to evaluate baby foods). Free sugars were estimated using algorithms proposed by the Pan American Health Organization (PAHO) Nutrient Profile Model.[22]

The variables in the study, including food groups, added micronutrients, HNC, and the classifications of "excessive" were categorical. Therefore, frequency and proportions were reported. Additionally, we included 95% confidence intervals (95%CI) to demonstrate precision and facilitate comparisons between categories (*e.g.*, addition of micronutrients vs. no addition). We used generalized linear models to assess the association between the addition of micronutrients, the use of

Table I
Thresholds of the Mexican nutrient profile model from the FOPL regulation (phase 3 of implementation).[19] Mexico, 2020

Group	*Excessive in energy*	*Excessive in free sugars*	*Excessive in saturated fat*	*Excessive in trans fats*	*Excessive in sodium*	*Contains non-sugar sweeteners*
Foods (100 g)	≥275 kcal	≥10% of energy from free sugars	≥10% of energy from saturated fats	≥10% of energy from trans fats	≥1 mg of sodium per 1 kcal or ≥300 mg. For non-caloric beverages: ≥45 mg of sodium	Any amount of non-sugar sweeteners
Beverages (100 mL)	≥70 kcal or ≥8 kcal from free sugars					

The thresholds are applicable to foods and beverages that contain added sugars, fats or sodium
FOPL: front-of-pack labelling

HNC, and nutritional quality (except baby food). For each model, the Mexican nutrient profile model classifications for "Excess in" (calories, free sugars, saturated fats, sodium, and non-sugar sweeteners) was used as the dependent variable. In all models we estimated the coefficients for different combinations of the use of HNC and the addition of micronutrients, including: no HNC and no added micronutrients, exclusive HNC, exclusive added micronutrients, and both. The processing level was used as the adjustment variable (according to the NOVA food classification system, the incorporation of micronutrients through processes such as fortification is allowed in all food categories, regardless of their processing level. However, when micronutrients are added as additives like preservatives, they are more commonly found in ultra-processed products) except for the non-sugar sweeteners model because this threshold is exclusive in ultra-processed products. For all models, a binomial distribution and log link was assumed; thus, the exponentiated coefficients represented prevalence ratios (PR). The analyses were performed using the Stata V.14 statistical package.*

Results

The final analytic sample comprised 14 191 processed and ultra-processed products (table II). According to the list of ingredients, 25% (95%CI: 26.8,28.3) of the products contained added micronutrients. The addition of micronutrients was more frequent in ultra-processed products (27.6%, 95%CI: 26.8,28.3) compared to processed products. The proportion of products with added micronutrients was highest in baby food (92.7%, 95%CI: 88.4,95.7), packaged bread and tortillas (56.7%, 95%CI: 49.8,63.5), and breakfast cereals (47.0%, 95%CI: 42.8,51.3).

In table III shows that the percentage of products displaying HNC was higher for products with added micronutrients compared to those without added micronutrients (55.1%, 95%CI: 53.4,56.7; 27.5%, 95%CI: 26.6,28.3, respectively). By NOVA groups, ultra-processed products with added micronutrients displayed HNC more frequently than those without added micronutrients (56.0%, 95%CI: 54.4,57.7 vs. 29.2%, 95%CI: 28.3,30.1, respectively). This percentage was higher for yogurt and milk-based beverages (92.9%, 95%CI: 89.7,95.3 vs. 43.0%, 95%CI: 38.9,47.2) and baby food (88.1%, 95%CI: 82.8,92.2 vs. 56.3%, 95%CI: 29.9,80.3). By type of claims, nutrition claims (54.6%, 95%CI: 52.9,56.2 vs. 26.9%, 95%CI: 26.0,27.7) and health claims (6.1%, 95%CI: 5.3,6.9 vs. 2.3%, 95%CI: 2.0,2.6) were higher in processed and ultra-processed products with added micronutrients compared to those that were not added.

Table IV describes the percentage of products that displayed HNC classified as "Excess in" stratified by the addition of micronutrients. In all processed and ultra-processed products, the percentage of products classified as excess calories (61.2%, 95%CI: 59.5,64.0), free sugars (55.9%, 95%CI: 35.5,58.2), and those containing non-sugar sweeteners (30.0%, 95%CI: 27.9,32.2) was higher for products with added micronutrients than those without added micronutrients. However, these differences were only consistent for ultra-processed products when stratifying by NOVA categories.

When evaluating the association between the use of HNC, added micronutrients and nutritional quality (table V) the crude models showed that products displaying exclusive HNC (without added micronutrients), the PR for excess energy (PR 0.92, 95%CI: 0.88,0.96), free sugars (PR 0.84, 95%CI: 0.80,0.89), saturated fats (PR 0.72, 95%CI: 0.67,0.77), and sodium (PR 0.70, 95%CI: 0.66,0.75) were lower compared to products without HNC and without added micronutrients. In the fitted models these associations remained consistent. For products containing added micronutrients (but not showing HNC), the association was inverse, mainly for products excessive in energy (PR 1.17, 95%CI: 1.12,1.22), free sugars (PR 1.19, 95%CI: 1.14,1.24), and saturated fats (PR 1.19, 95%CI: 1.12,1.27). When both were present (HNC and micronutrients added), the PR of excess energy and free sugars was 1.11 (95%CI: 1.07,1.16) and 1.09 (95%CI: 1.04,1.15) (respectively) times the PR of products that do not displayed claims and without added micronutrients. However, in the non-sugar sweeteners model, the PR of including these additives was 4.05 (95%CI: 3.64,4.50).

Discussion

Our study found that the addition of micronutrients was more frequent in ultra-processed products (27.6%, 95%CI: 26.8,28.3) compared to processed products. Products with added micronutrients were more frequently excessive in energy, free sugars, and contained non-sugar sweeteners, compared to those without them. Additionally, the percentage of products displaying HNC was higher in those with added micronutrients, mainly in products that exceeded the nutrient profile thresholds. These results suggest that food industries may be adding micronutrients, particularly to ultra-processed products, as a marketing strategy rather than to improve nutritional quality.

* StataCorp. Stata Stadistical Software 14. Collage Station, TX: StataCorp LLC, 2015.

In 2020, Mexico modified the FOPL regulation (NOM-051) to include warning labels on less healthy products. The current NOM-051 establishes that products with warning labels or captions for caffeine and non-sugar sweeteners cannot display health claims. Regarding nutrition claims, if a product displays warning labels, they cannot correspond to the nutrient in excess and cannot be displayed on the front of the package.[19] It is predicted that the NOM-051 will prevent around 40% of unhealthy products and 50% of ultra-processed products in the Mexican market from displaying HNC.[18] However, nutrition claims related to micronutrients may still appear on the back of the packaging of less healthy foods.

Countries such as Chile have implemented warning labels on the FOPL, which prohibit nutrition claims that contradict the warnings (calories, sugars, saturated fat and sodium). However, these regulations do not restrict the use of other nutrition claims, such as those related to fiber or micronutrients. Despite this strategy, warning labels can reduce, but not eliminate, the influence of nutrition claims on consumers' perception of healthiness.[23] For all these reasons, regulation of HNC in accordance with a nutritional profile model

Table II
Percentage of foods and beverages according to the NOVA system that contain added micronutrients and HNC. Mexico City, 2017

Food group	*Total (n)*	*Contains added micronutrients*		*Contains health and/or nutrition claims*	
		%	*95%CI*	%	*95%CI*
Total	14 191	25.0	24.3,25.8	34.4	33.6,35.2
Processed foods	1 705	6.7	5.5,7.9	18.2	16.4,20.2
Fruits and vegetables (canned)	526	15.6	12.6,19.0	5.7	3.8,8.0
Meat and seafood	298	1.3	0.3,3.4	29.9	24.7,35.4
Sweet snacks	152	0.0	-	14.5	9.2,21.0
Salty snacks	348	0.6	0.0,2.1	23.9	19.5,28.7
Bread and other cereals	152	15.1	9.8,21.8	39.5	31.6,47.7
Cheeses	128	0.8	0.0,4.2	14.1	8.6,21.3
Other*	101	2.0	0.2,6.9	8.9	4.1,16.2
Ultra-processed foods	12 486	27.6	26.8,28.3	36.6	35.7,37.4
Yogurt and milk-based beverages	935	39.0	35.9,42.2	62.5	59.3,65.6
Ultra-processed meat	649	4.9	3.4,6.9	21.0	17.8,24.3
Breakfast cereals	555	47.0	42.8,51.3	70.5	66.5,74.2
Seafood	208	13.5	9.1,18.9	32.2	25.9,39.0
Beverages with other-sweeteners‡	948	43.9	40.7,47.1	65.3	62.1,68.3
Sugar-sweetened beverages§	775	37.3	33.9,40.8	40.7	37.2,44.2
Sweet snacks#	3 956	25.5	24.1,26.8	30.1	28.7,31.5
Salty snacks	912	9.0	7.2,11.0	21.1	18.4,23.8
Packaged bread and *tortilla*	215	56.7	49.8,63.5	49.3	42.4,56.2
Cheeses	360	5.8	3.6,8.8	21.1	17.0,25.7
Ready to eat	409	27.6	23.3,32.2	15.7	12.3,19.5
Baby food	218	92.7	88.4,95.7	85.8	80.4,90.1
Soups pastas and creams	326	45.7	40.2,51.3	31.0	26.0,36.3
Other&	2 020	17.5	15.8,19.2	26.8	24.9,28.7

* Includes canned beans and prepared salads
‡ Includes beverages sweetened with artificial or natural non-caloric sweeteners or polyols
§ Includes nectars, fruit drinks with added sugar, energy drinks, sport drinks and powder to prepare beverages
# Includes candies, sweets, desserts and bakery
& Includes prepared flour bakery, prepared cereals, non-sugar sweeteners and ultra-processed culinary ingredients (margarine, seasonings for meat)
95%CI: 95% confidence intervals
HNC: health and nutrition claims

could prevent misleading information on unhealthy products, especially when it comes to positive claims such as micronutrients.

On the other hand, from a public health perspective, the addition of micronutrients in ultra-processed products is a relevant point to discuss. Despite the health risks associated with the intake of ultra-processed, there is no scientific evidence that adding micronutrients to these products improves health conditions.[3]

In June 2020, in response to these concerns, the Ministry of Health in Mexico initiated a public consultation in order to reform the Regulation of Sanitary Control of Products and Services which prohibits the addition of micronutrients in fresh food and in products with warning labels.[24] This initiative generated uncertainty among food companies because, while it could limit marketing associated with the use of micronutrients, it would also restrict their use for technological purposes (*e.g.*, preservation).[24] A potential solution to align with public health principles and prevent misleading information is to regulate the use of HNC related to micronutrients in less healthy foods.[25]

Table III
PERCENTAGE OF PROCESSED AND ULTRA-PROCESSED PRODUCTS THAT USE CLAIMS BY ADDITION OR NOT OF MICRONUTRIENTS. MEXICO CITY, 2017

	With health and/or nutrition claims		*With nutrition claims*		*With of health claims*	
	Addition of micronutrients		*Addition of micronutrients*		*Addition of micronutrients*	
	No	*Yes*	*No*	*Yes*	*No*	*Yes*
	% (95%CI)	*% (95%CI)*	*% (95%CI)*	*% (95%CI)*	*% (95%CI)*	*% (95%CI)*
All processed and ultra-processed	27.5 (26.6,28.3)	55.1 (53.4,56.7)	26.9 (26.0,27.7)	54.6 (52.9,56.2)	2.3 (2.0,2.6)	6.1 (5.3,6.9)
Processed foods	17.7 (15.9,19.7)	25.4 (17.7,34.4)	17.0 (15.2,19.0)	24.6 (17.0,33.5)	1.1 (0.7,1.7)	3.5 (0.9,8.7)
Fruits and vegetables (canned)	4.1 (2.4,6.3)	14.6 (7.8,24.2)	3.6 (2.1,5.8)	14.6 (7.8,24.2)	1.1 (0.4,2.6)	1.2 (0.0,6.6)
Meat and seafood	29.9 (24.8,35.5)	25.0 (0.6,80.6)	28.9 (23.8,34.5)	25 (0.6,80.6)	1.4 (0.4,3.4)	0.0
Sweet snacks	14.5 (9.3,21.1)	0.0	13.2 (8.2,19.6)	- -	2.6 (0.7,6.6)	- -
Salty snacks	24.0 (19.6,28.8)	0.0	23.4 (19.1,28.2)	0.0	0.6 (0.1,2.1)	0.0
Bread and other cereals	34.1 (26.0,42.9)	69.6 (47.1,86.8)	32.6 (24.6,41.4)	65.2 (42.7,83.6)	2.3 (0.5,6.6)	13.0 (2.8,33.6)
Cheeses	14.2 (8.6,21.5)	0.0	14.2 (8.6,21.5)	0.0	0.0	0.0
Other*	9.1 (4.2,16.6)	0.0	9.1 (4.2,16.6)	0.0	0.0	0.0
Ultra-processed foods	29.2 (28.3,30.1)	56.0 (54.4,57.7)	28.6 (27.7. 29.5)	55.6 (53.9,57.3)	2.5 (2.2,2.9)	6.1 (5.3,7.0)
Yogurt and milk-based beverages	43.0 (38.9,47.2)	92.9 (89.7,95.3)	43 (38.9,47.2)	91.2 (87.8,93.9)	2.5 (1.3,4.1)	15.1 (11.6,19.2)
Ultra-processed meat	21.7 (18.5,25.2)	6.3 (0.8,20.8)	20.6 (17.5,24.0)	6.3 (0.8,20.8)	2.8 (1.6,4.4)	0.0
Breakfast cereals	69.7 (64.1,74.9)	71.3 (65.4,76.7)	67 (61.3,72.4)	70.9 (64.9,76.3)	7.1 (4.5,10.7)	11.1 (7.6,15.6)
Seafood	31.1 (24.4,38.4)	39.3 (21.5,59.4)	27.8 (21.4,34.9)	39.3 (21.5,59.4)	3.3 (1.2,7.1)	3.6 (0.1,18.3)
Beverages with other-sweeteners‡	59.4 (55.1,63.6)	72.8 (68.3,77.1)	59.2 (54.9,63.4)	72.8 (68.3,77.1)	4.5 (2.9,6.6)	7.7 (5.3,10.7)
Sugar-sweetened beverages§	28.2 (24.2,32.4)	61.6 (55.7,67.2)	27.2 (23.3,31.4)	61.6 (55.7,67.2)	2.5 (1.3,4.3)	10.4 (7.1,14.5)
Sweet snacks#	26.7 (25.1,28.3)	40.1 (37.1,43.2)	26.6 (25.0,28.2)	39.9 (36.9,43.0)	1.3 (0.9,1.8)	1.4 (0.8,2.3)
Salty snacks	19.9 (17.2,22.8)	32.9 (22.9,44.2)	19.8 (17.1,22.6)	32.9 (22.9,44.2)	1.0 (0.4,1.9)	1.2 (0.0,6.6)
Packaged bread and *tortilla*	47.3 (36.9,58.0)	50.8 (41.6,60.0)	47.3 (36.9,57.9)	50.8 (41.6,60.0)	3.2 (0.7,9.1)	7.4 (3.4,13.5)
Cheeses	20.7 (16.5,25.4)	28.6 (11.3,52.2)	20.1 (15.9,24.7)	28.6 (11.3,52.2)	2.4 (1.0,4.6)	0.0
Ready to eat	17.6 (13.4,22.4)	10.6 (5.6,17.8)	16.9 (12.8,21.7)	9.7 (4.9,16.8)	1.4 (0.4,3.4)	0.9 (0.0,4.8)
Baby food	56.3 (29.9,80.3)	88.1 (82.8,92.2)	31.2 (11.0,58.7)	85.1 (79.5,89.8)	43.8 (19.8,70.1)	10.4 (6.6,15.5)
Soups pastas and creams	16.4 (11.3,22.7)	48.3 (40.1,56.6)	15.8 (10.8,22.1)	48.3 (40.1,56.6)	1.1 (0.1,4.0)	0.0
Other&	23.6 (21.6,25.7)	41.9 (36.7,47.3)	22.7 (20.7,24.8)	41.9 (36.7,47.3)	3.8 (2.9,4.9)	5.4 (3.3,8.3)

* Includes canned beans and prepared salads
‡ Includes beverages sweetened with artificial or natural non-caloric sweeteners or polyols
§ Includes nectars, fruit drinks with added sugar, energy drinks, sport drinks and powder to prepare beverages
# Includes candies, sweets, desserts and bakery
& Includes prepared flour bakery, prepared cereals, non-sugar sweeteners and ultra-processed culinary ingredients (margarine, seasonings for meat)
95%CI: 95% confidence intervals

Table IV

Percentage of processed and ultra-processed products excessive in energy and nutrients of concern that displayed HNC according to the addition of micronutrients. Mexico City, 2017

	All processed and ultra-processed products	*Processed foods*	*Ultra-processed products*
	% (95%CI)	*% (95%CI)*	*% (95%CI)*
Excessive in energy			
With micronutrients added	61.2 (59.5,64.0)	10.3 (2.2,27.4)	62.6 (60.3,64.9)
Without micronutrients added	47.0 (45.2,48.8)	32.6 (27.2,38.4)	48.6 (46.6,50.5)
Excessive in free sugars			
With micronutrients added	55.9 (53.5,58.2)	6.9 (0.8,22.8)	56.7 (54.3,59.0)
Without micronutrients added	39.1 (37.3,41.0)	14.5 (10.6,19.2)	41.7 (39.8,43.6)
Excessive in saturated fat			
With micronutrients added	25.4 (23.4,27.6)	10.3 (2.2,27.4)	25.8 (24.1,27.6)
Without micronutrients added	24.4 (22.8,26.0)	10.6 (7.3,14.8)	25.7 (23.7,27.8)
Excessive in sodium			
With micronutrients added	24.1 (22.1,26.2)	44.8 (26.4,64.3)	23.8 (21.8,25.8)
Without micronutrients added	29.6 (27.9,31.3)	36.9 (31.2,42.8)	28.8 (27.1,30.6)
Contains non-sugar sweeteners			
With micronutrients added	30.0 (27.9,32.2)	-	30.5 (28.3,32.7)
Without micronutrients added	27.8 (26.2,29.5)	-	30.8 (29.0,32.6)

Includes processed and ultra-processed foods, except baby food
All processed and ultra-processed products (with micronutrients added [n= 1 779]); without micronutrients (n= 2 914), processed foods (with micronutrients added [n= 232]); without micronutrients (n= 29), and ultra-processed products (with micronutrients added [n= 1 750]); without micronutrients (n= 2 632)
Nutrient profile was defined according to the Mexican Warning labels nutrient profile model phase 3
95%CI: 95% confidence intervals
HNC: health and nutrition claims

Table V

Association between the use of HNC, added micronutrients and nutritional quality in processed and ultra-processed products from a sample collected in Mexico City, 2017

	Model 1 (crude)		*Model 2 (adjusted)*	
	PR	*95%CI*	*PR*	*95%CI*
Excessive in energy				
Exclusive HNC	0.92	0.88,0.96	0.88	0.84,0.92
Exclusive added micronutrients	1.24	1.19,1.30	1.17	1.12,1.22
HNC and added micronutrients	1.21	1.16,1.26	1.11	1.07,1.16
Excessive in free sugars				
Exclusive HNC	0.84	0.80,0.89	0.81	0.77,0.85
Exclusive added micronutrients	1.29	1.22,1.34	1.19	1.14,1.24
HNC and added micronutrients	1.21	1.15,1.27	1.09	1.04,1.15
Excessive in saturated fats				
Exclusive HNC	0.72	0.67,0.77	0.69	0.64,0.74
Exclusive added micronutrients	1.28	1.20,1.36	1.19	1.12,1.27
HNC and added micronutrients	0.75	0.69,0.82	0.68	0.62,0.74
Excessive in sodium				
Exclusive HNC	0.70	0.66,0.75	0.71	0.67,0.76
Exclusive added micronutrients	1.02	0.95,1.08	1.04	0.98,1.10
HNC and added micronutrients	0.57	0.52,0.63	0.59	0.54,0.64
Contains non-sugar sweeteners				
Exclusive HNC	3.45	3.13,4.80	-	
Exclusive added micronutrients	1.61	1.38,1.88	-	
HNC and added micronutrients	4.05	3.64,4.50	-	

Includes processed and ultra-processed foods, except baby food
In all models, the reference category was products without HNC and without added micronutrients
The model for non-sugar sweeteners did not include processed foods, so this model was not adjusted. For energy, free sugars, saturated fats, and sodium (n= 13 973). For model of non-sugar sweeteners (n= 12 268).
Nutrient profile was defined according to the Mexican Warning labels nutrient profile model phase 3
Model 2 adjusted by NOVA categories
Coefficients were estimated using Generalized Linear Models (binomial distribution and log link) and exponentiated to present prevalence ratios (PR)
95%CI: 95% confidence intervals
HNC: health and nutrition claim

Policymakers need to consider that ultra-processed products are not "real food"; they are edible products and formulations of food substances modified by chemical processes and then assembled into a ready-to consume product.[6] Therefore, ultra-processed products should not be considered as vehicles of micronutrients, mainly in populations with high rates of NCDs, such as Mexico which has mandatory fortification of food such as flours or salt, and subsidies of fortified products such as *Liconsa* milk, to prevent prevalent micronutrient deficiencies in the country.[3]

The strengths of this study include the sample size analyzed, although there is no defined sampling framework for this type of study, the results are close to the total variability of packaged foods in the Mexican market. This study includes some limitations. First, we focused on the use of micronutrients as reported in the ingredient lists, rather than their actual content. However, in most cases, it is not possible to verify the micronutrient content directly from the nutrition facts table. Quantifying the micronutrient content could provide insights into other approaches, such as fortification, and thus contribute to a better understanding of public health discussions, including the fortification of ultra-processed products.[26] Second, the addition of micronutrients could serve technological functions (*e.g.*, conservation, antioxidant, acidity regulator, etc.) and/or nutritional purposes (*e.g.*, fortified foods); our results do not differentiate between these functions but, according to our results, it is likely that the use of HNC is indistinct from the purpose of micronutrient addition. However, the recommendation to restrict the use of HNCs is applicable for both functions, especially in ultra-processed foods to prevent their use when it comes to technological purposes.

In conclusion, the addition of micronutrients in processed and ultra-processed foods is not associated with a better nutritional profile, but rather with the use of HNC as marketing strategy. Improving the regulations of claims related to micronutrients in less healthy foods and beverages could provide clear information for consumers and avoid misperceptions of perceived healthfulness.

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