Identification and understanding of precautionary legends in the Mexican warning labeling for sweetened beverages

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Abstract

Objective. To evaluate the identification and objective understanding of precautionary legends regarding non-sugar sweeteners (NSS) and caffeine in sweetened beverages (SBs). **Materials and methods.** The labeling questionnaire from the National Health and Nutrition Survey 2021 was administered to Mexican adults over 20 years old. Identification was assessed when the participants reported seeing the legend. Objective understanding was determined by correctly evaluating the nutritional quality of SBs. For this evaluation, 50% of the participants were presented with an image of a sugary drink displaying the precautionary legend, while the other 50% without the legend. **Results.** For the NSS legend, the odds of correctly evaluating the nutritional quality of a SB were higher among participants who identified the NSS legend (OR: 1.62, 95%CI: 1.12,2.34) compared to those who did not. Similarly, the odds were higher when the product was presented with the legend compared to when it was not (OR: 1.23, 95%CI: 1.01,1.51). For the caffeine legend, the odds of correctly evaluating the nutritional quality of a SB were four times higher among participants who identified the legend compared to those who did not (OR: 3.97, 95%CI: 1.98,7.97). **Conclusion.** Greater effectiveness was observed among participants who identified the legends. We recommend implementing strategies to enhance the identification of precautionary legends.

Keywords: food labelling; sweetened beverages; caffeine; non-nutritive sweeteners

Munguía A, Sagaceta-Mejía J, Cruz-Casarrubias C, Durán R, Barquera S, Tolentino-Mayo L. Identificación y comprensión de las leyendas precautorias del etiquetado de advertencia mexicano en bebidas endulzadas. Salud Publica Mex. 2025;67:153-162.
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Resumen

Objetivo. Evaluar la identificación y comprensión objetiva de las leyendas precautorias de edulcorantes y cafeína en bebidas endulzadas (BE). **Material y métodos.** Se aplicó el cuestionario de Etiquetado de la Encuesta Nacional de Salud y Nutrición 2021 a adultos mexicanos mayores de 20 años. La identificación se evaluó cuando los participantes reportaron haber visto la leyenda y la comprensión objetiva se consideró como la evaluación correcta de la calidad nutricional de las BE. Para esta evaluación, a 50% de los participantes se le mostró una BE con la leyenda y al otro 50%, sin la leyenda. **Resultados.** Para edulcorantes, las posibilidades de evaluar correctamente la calidad nutricional de una BE fueron mayores en los participantes que identificaron la leyenda (RM: 1.62, IC95%: 1.12,2.34) en comparación con aquellos que no; y cuando la BE se presentó con la leyenda que cuando no se presentó (RM: 1.23, IC95%: 1.01,1.51). Para cafeína, fueron mayores los momios de evaluar correctamente la calidad nutricional de una BE cuando las personas identificaron la leyenda en comparación con aquellas que no (RM: 3.97, IC95%: 1.98,7.97). **Conclusión.** Se observó una mejor efectividad entre los participantes que identificaron las leyendas precautorias. Se recomienda implementar estrategias para mejorar la identificación de las mismas.

Palabras clave: etiquetado de alimentos; bebidas endulzadas; cafeína; edulcorantes no nutritivos

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The high consumption of sweetened beverages (SBs) is an important public health problem in Mexico, where 6.9% of all-cause mortality among Mexican adults is attributable to their consumption. This translates to over 3 000 deaths each month, with 35.6% of diabetes-related deaths.[1] In 2011, the Mexican population consumed an average of 163 liters of SBs per capita,[2] making these beverages the most consumed unhealthy product across all age groups, including children and adolescents.[3] Although the consumption of free sugars in these beverages has been associated with various health issues, such as weight gain, overweight, and obesity in both children and adults, additional concerns arise from ingredients like non-sugar sweeteners (NNS) and caffeine.[4]

NNS are high-intensity sweeteners commonly used as sugar substitutes or alternatives because they are sweeter than sugar but contribute little or no calories when added to foods.[5] However, adverse health effects have been found linked to their consumption, including metabolic disorders that result in alterations of the intestinal microbiota,[6] decreased insulin sensitivity,[7] and consequently, increased fasting glucose levels, which elevate the risk of diabetes.[8] In children, there is a recognized potential health risk due to the unknown effects of long-term NSS consumption[9] and the habituation to sweet taste,[10] which promotes the intake of sugary foods and beverages.[11]

Regarding added caffeine, Mexican children and adolescents consume high amounts of SBs, particularly soft drinks and cola drinks,[3,12] which are the primary sources of added caffeine in these populations.[13] Caffeine is a well-known central nervous system stimulant, and its consumption has been associated with episodes of hyperactivity, anxiety,[13] alterations in sleep patterns,[14] and headaches in children.[15]

Among the public policies recommended to reduce the consumption of SBs and unhealthy food is the front-of-pack warning labeling system (FOPWL). Chile was the first country to implement this labeling system, achieving favorable results, including a 24% reduction in SBs purchases.[16] This decrease corresponds to approximately 12 fewer calories and 2.7 fewer grams of sugar purchased per capita per day, while purchases of healthier beverages increased by 4.8% (5.7 calories per capita per day).[16] Additionally, FOPWL has encouraged the reformulation of products towards healthier nutritional profiles.[17]

Recognizing the benefits of FOPWL, Mexico implemented its system in October 2020, which includes five warning labels addressing the excess content of calories and nutrients of concern (free sugars, trans fats, saturated fats, and sodium). Mexico also innovated by becoming the first country to included two precaustionary legends to warn consumers about the presence of NSS and caffeine in prepackaged food and beverages. The first legend states, "Contains non-sugar sweeteners, not recommended for children," and the second says, "Contains caffeine, avoid in children" (supplementary table I).[18] Lastly, the regulation establishes that the size of the precautionary legend depends on the size of the warning labels, meaning that if a product does not display a warning label, the size of the legend remains unspecified.[19]

To the best of our knowledge, no studies have evaluated the identification and understanding of these legends in conjunction. Therefore, the aim of this study was twofold: 1) to evaluate the identification and objective understanding of precautionary legends regarding NSS and caffeine in SBs, and 2) to analyze the interaction between the presence of these legends and their identification.

Materials and methods

The current cross-sectional study utilized data from the Mexican National Health and Nutrition Survey 2021 (Ensanut 2021, by its acronym in Spanish), which employed a probabilistic, stratified, and cluster sample design, enabling statistical inferences among populations across nine geographic regions of Mexico. These regions comprised contiguous states with similar population sizes.[20] Detailed information regarding the sampling procedures and methodology has been described in previous publications.[21] The Ensanut 2021 protocol was reviewed and approved (No. CI-450-2021) by the Ethics, Research and Biosafety Commissions of the Mexican National Institute of Public Health. The questionnaire on labeling of packaged food and beverages was administered probabilistically by age group to 8 811 adults aged 20 years or older. Additionally, for the purposes of this study, two analytical samples were generated, one for the evaluation of the NSS legend and another for the caffeine legend.

Identification of precautionary legends

Participants were asked to identify the precautionary legends on their own after being shown an image of a SB (supplementary table II-a)[22] and asked, "Does this product have an excess of any element or nutrient associated with damage to health?". Participants could select more than one option. Identification of the caffeine legend was considered positive if the option "yes, it contains caffeine" was selected, and identification of the NSS legend was considered positive if "yes, it contains sweeteners" was selected. Non-identification was recorded when neither option was chosen. Responses that were missing or uncertain were classified as missing value.

Objective understanding of precautionary legends

Objective understanding was assessed by evaluating participants' ability to correctly judge the nutritional quality of SBs. First, an image of a SB with the caffeine legend was randomly presented to 50% of the participants, while the same image without the legend was shown to the other 50% (supplementary table II-b).[22] Subsequently, all participants were asked "How healthy is this product?"; there were four response options, which were categorized as correct if the drink was evaluated as "very unhealthy" or "unhealthy", and incorrect if evaluated as "healthy" and "very healthy". The same process was followed for the NSS legend with a different sugary drink image (supplementary table II-c).[22] Missing or uncertain responses were classified as missing values.

Sociodemographic variables

Demographic and socioeconomic information was collected through a household questionnaire. Data on participants' sex, age, education, and indigenous population were obtained; age was categorized into range (20-29, 30-39, 40-49, 50-59, and 60 years or older); sex was categorized as men or women; education was categorized as elementary or less, middle school, high school, and college or more. Indigenous population was determined by asking participants if they spoke any indigenous language or dialect.

The area variable was divided based on population density into rural (populations of less than 2 500), urban (2 500-99 999 inhabitants), and metropolitan areas (more than 100 000 inhabitants). The country was divided into nine geographical regions: North Pacific, Border, Central Pacific, North Central, Central, Mexico City, State of Mexico, South Pacific, and Peninsula. The household well-being index (HWI) was generated through principal component analysis, based on housing characteristics (floor, wall, ceiling materials, number of rooms used for sleeping, availability of safe water, and car ownership), the number of household properties (refrigerator, washing machine, microwave, stove, and gas heater), and the number of electronic devices (TV, cable, radio, cellphone, and computer). The HWI was divided into tertiles according to the distribution of the index and classified as low, medium, and high.[21]

Statistical analysis

Frequencies, proportions, and 95% confidence intervals were estimated. Pearson's X^2 tests were conducted to examine differences in distribution by sociodemographic characteristics. Two logistic regression models were used for each precautionary legend to estimate the odds of correct classification of the nutritional quality of a SB. The first model examined the identification versus non-identification (reference) of the precautionary legend, while the second model examined the presence versus absence (reference) of the precautionary legend, adjusted for potential confounders such as sex, age, education, area, HWI, and indigenous population. The second model was additionally adjusted for identification.

Furthermore, we assessed the interaction between the presence of the legend and identification, using the absence of the legend and non-identification of the legend as the reference. Statistical analysis was performed using Stata SE15,* with the survey module to account for the weighting and complex survey design. Statistical significance was set at a p-value of <0.05.

Results

Out of the 8 811 participants surveyed, 7 953 provided responses on the identification of precautionary legends. Of these, 239 were excluded from the analysis of the caffeine legend and 179 from the analysis of the NSS legend due to missing values. This resulted in two analytical samples: one with 7 714 participants for the evaluation of the caffeine legend and another with 7 774 participants for the evaluation of the NSS legend. These samples represent 75 383 627 and 76 120 651 Mexicans, respectively.

Table I presents the sociodemographic characteristics of the Mexican adult population according to the exposure of the precautionary legends, showing a similar distribution across groups.

Table II displays the correct classification of the nutritional quality of SBs according to sociodemographic variables and identification of the precautionary legends. Among participants who did not identify the legends, a greater proportion of women correctly evaluated the nutritional quality of SBs for both precautionary legends (p <0.001). Additionally, those with a higher level of education and higher HWI had a higher proportion of correct answers (p <0.001). In the case of age, a higher proportion of correct classification was observed in the 20 to 29 year age group (p <0.001) and in the 30 to 39 year age group (p= 0.007) among participants who did not identify the caffeine and NSS legends, respectively. The metropolitan area had the highest proportion of correct answers when both precautionary legends were not identified (p <0.05), and only the non-indigenous population that did not identify the

* StataCorp. Stata Stadistical Software 15. Collage Station, TX: StataCorp LLC, 2016.

Table I

Sociodemographic characteristics of the study population by exposure to precautionary legends. Mexico, Ensanut 2021

	Caffeine legend *n= 7 714 N= 75 383 627*		*NSS legend* *n= 7 774 N= 76 120 651*	
	Absent	*Present*	*Absent*	*Present*
Sex				
Men	48.9 (46.3,51.5)	51.1 (48.5,53.7)	49.2 (46.6,51.8)	50.8 (48.2,53.4)
Women	49.2 (47.2,51.2)	50.8 (48.9,52.8)	49.3 (47.4,51.3)	50.7 (48.7,52.6)
Age (years)				
20-29	47.9 (44.4,51.4)	52.1 (48.7,55.6)	48.2 (44.7,51.6)	51.9 (48.4,55.3)
30-39	48.5 (45.2,51.9)	51.5 (48.2,54.8)	48.8 (45.5,52.2)	51.2 (47.8,54.5)
40-49	50.2 (46.7,53.6)	49.9 (46.4,53.3)	50.7 (47.2,54.1)	49.3 (45.9,52.8)
50-59	50.7 (46.9,54.6)	49.3 (45.4,53.2)	50.8 (46.9,54.6)	49.3 (45.4,53.1)
60 or more	48.9 (45.1,52.6)	51.2 (47.4,54.9)	48.6 (44.9,52.3)	51.4 (47.7,55.1)
Education				
Elementary or less	49.8 (46.8,52.8)	50.3 (47.3,53.3)	49.8 (46.8,52.8)	50.2 (47.3,53.2)
Middle school	48.6 (45.7,51.6)	51.4 (48.5,54.3)	49.2 (46.4,52.1)	50.8 (47.9,53.6)
High school	48.6 (45.2,51.9)	51.4 (48.1,54.8)	48.6 (45.3,51.9)	51.4 (48.1,54.7)
College or more	49.3 (46.0,52.5)	50.7 (47.5,54.0)	49.4 (46.1,52.6)	50.6 (47.4,53.9)
Region				
North Pacific	47.5 (42.6,52.4)	52.5 (47.6,57.4)	47.6 (42.7,52.6)	52.4 (47.5,57.3)
Border	48.0 (42.8,53.4)	52.0 (46.7,57.2)	48.8 (43.5,54.0)	51.2 (46.0,56.5)
Central Pacific	53.5 (48.3,58.6)	46.6 (41.5,51.7)	54.3 (49.6,59.0)	45.7 (41.0,50.4)
North Central	49.0 (45.5,52.6)	51.0 (47.4,54.5)	48.9 (45.4,52.5)	51.1 (47.6,54.6)
Central	52.7 (47.8,57.6)	47.3 (42.4,52.2)	52.6 (47.7,57.4)	47.7 (42.6,52.3)
Mexico City	50.0 (46.5,53.6)	50.0 (46.4,53.5)	50.0 (46.4,53.6)	50.0 (46.4,53.6)
Mexico State	46.8 (43.8,49.9)	53.2 (50.1,56.2)	47.0 (44.0,50.1)	53.0 (49.9,56.0)
South Pacifc	49.6 (45.1,54.1)	50.4 (45.9,54.9)	48.9 (44.2,53.7)	51.1 (46.3,55.8)
Peninsula	45.0 (40.8,49.2)	55.0 (50.8,59.2)	46.3 (42.4,50.1)	53.4 (49.9,57.6)
Area				
Rural	47.5 (44.7,50.3)	52.5 (49.7,55.3)	47.1 (44.4,49.8)	53.0 (50.2,55.6)
Urban	50.2 (47.3,53.1)	49.8 (46.9,52.7)	50.5 (47.7,53.4)	49.5 (46.7,52.3)
Metropolitan	49.0 (46.9,51.0)	51.0 (49.0,53.1)	49.4 (47.3,51.5)	50.7 (48.6,52.8)
HWI				
Low	48.2 (45.6,50.9)	51.8 (49.1,54.4)	48.2 (45.6,50.8)	51.2 (49.2,54.4)
Medium	49.2 (46.6,51.8)	50.8 (48.2,53.5)	49.7 (47.2,52.3)	50.3 (47.7,52.9)
High	49.5 (47.1,52.0)	50.5 (48.0,52.9)	49.6 (47.2,52.1)	50.4 (47.9,52.8)
Indigenous population				
Yes	45.2 (38.3,52.3)	54.8 (47.7,61.7)	45.7 (39.1,52.5)	54.3 (47.5,60.9)
No	49.2 (47.7,50.7)	50.8 (49.3,52.3)	49.4 (47.9,50.9)	50.6 (49.1,52.1)

NSS: non-sugar sweeteners
Ensanut: *Encuesta Nacional de Salud y Nutrición*
HWI: household wellbeing index

NSS legend had a relatively higher proportion of correct answers (p <0.001).

As shown in table III, a higher proportion of women correctly evaluated the nutritional quality of SBs for both precautionary legends (p <0.001). For the caffeine legend, a higher proportion of correct answers was found in the 20 to 29-years-old age group (p <0.001), independent of the presence of the legend. For the NSS legend, the highest proportion of correct responses was observed in the 30 to 39-years-old group when the legend was absent (p= 0.020).

Regarding education, it was observed that when both precautionary legends were absent, those with higher education levels had a greater proportion of correct answers (p <0.001). However, when the legends were present, those with a high school education had a higher proportion of correct answers (p <0.001).

The metropolitan area had the highest proportion of correct answers when the legends were absent (p <0.05). In the case of indigenous population, statistically significant differences were observed only in the NSS legend, where non-indigenous population had the highest proportion of correct answers (p <0.001). Finally, it was observed that those with a higher HWI had a greater proportion of correct answers (p <0.01) across all exposure groups.

Figure 1 shows the overall correct classification of the nutritional quality of SBs, according to each precautionary legend. For the NSS legend, a higher proportion of participants correctly classified the nutritional quality of the SB when they identified the legend compared to when they did not (93.3 vs. 88.3%, p <0.001). Similarly, the proportion of participants who correctly classified the nutritional quality of the SB was higher when they identified the caffeine legend, compared to those who did not identify it (99.5 vs. 97.8%, p <0.001). No statistically significant differences were observed with the presence of the legends.

Table IV shows the association between the correct classification and the presence or identification of legends. After adjusting for possible confounding factors, we found that for the NSS legend, the odds of correctly evaluating the nutritional quality of a SB were higher when the product was presented with the legend than when it was not (OR: 1.23, 95%CI: 1.01,1.51, p= 0.044). Likewise, the odds were higher for participants who identified the NSS legend themselves compared to those who did not (OR: 1.62, 95%CI: 1.12,2.34, p= 0.011). In the case of the caffeine legend, in the adjusted model, participants who identified the legend themselves had nearly four times the odds of correctly evaluating the nutritional quality of a SB compared to those who did not (OR: 3.97, 95%CI: 1.98,7.97, p <0.001). No statistically significant differences were observed for the presence of the caffeine legend.

Table IV also presents the interaction between the presence of legends and their identification. There were 2.97 times the odds of correctly evaluating the nutritional quality of a SB when the caffeine legend was both present and identified, compared to when the legend was absent and not identified (OR: 2.97, 95%CI: 1.22,7.21 p= 0.016). In the case of the NSS legend, there were 1.75 times the odds of correctly evaluating the nutritional quality of a SB when the NSS legend was present and identified, compared to when the legend was absent and not identified (OR: 1.75, 95%CI: 1.02,3.02 p= 0.040).

Discussion

This study evaluated the objective understanding of precautionary legends related to NSS and caffeine, focusing on their identification and presence on SBs. Participants who identified the precautionary legends demonstrated a better understanding compared to those who did not. Moreover, comparisons between the presence and absence of the precautionary legends showed improved results when the legends were displayed, except for the caffeine legend. Specifically, the odds of correctly assessing a SB as unhealthy where 23% higher when it displayed the NSS legend compared to when it did not. These odds increased to 62% when the NSS legend was identified by the participants. For the caffeine legend, differences were only observed in identification process, where participants who identified the legend had four times greater odds of correctly evaluating the SB compared to those who did not. When considering the interaction between the presence and identification of the legends, the odds of correctly evaluating the SB were nearly three times for the caffeine legend and nearly two times for the NSS legend when the legends were both present and identified, compared to when they were absent and not identified.

A study in Mexico examined the awareness and use of the precautionary legends among Mexican adults and youth, one month after the regulation was implemented through an online survey; the SB images used were similar to those in our study.[23] The study found that, for NSS legend, adults reported a lower mean perceived healthfulness of the SB compared to when the legend was absent (2.74 vs. 3.17), with a similar pattern observed in young people (mean of 2.04 vs. 2.32).[23] The caffeine legend did not significantly affect adults' perceived healthfulness (p-value= 0.389).[23] The authors suggested that this null finding might be due to the type of drink used to test the legend, as soda is commonly assumed to be an unhealthy beverage. Additionally,

Table II

Correct classification of the nutritional quality of SBs according to identification of the precautionary legends and sociodemographic variables. Mexico, Ensanut 2021

	Caffeine legend				*NSS legend*			
	Did not identify n= 5 781 N= 56 798 322		*Identified n= 1 933 N= 18 585 306*		*Did not identify n= 6 784 N=66 143 194*		*Identified n= 990 N= 9 977 456*	
	%	*p*	%	*p*	%	*p*	%	*p*
Total	97.8		99.5		88.3		93.3	
Sex								
Men	96.6	<0.001	99.4	0.334	84.7	<0.001	89.2	<0.001
Women	98.9		99.7		91.6		96.7	
Age (years)								
20-29	99.5	<0.001	99.8	0.614	87.7	0.007	91.4	0.131
30-39	98.8		99.6		91.4		95.0	
40-49	96.5		99.3		88.7		95.5	
50-59	97.6		98.7		88.5		87.9	
60 or more	96		99.1		84.7		96.1	
Education								
Elementary or less	94.8	<0.001	99.5	0.121	79.9	<0.001	90.3	0.143
Middle school	98.1		99.1		90.0		90.3	
High school	99.2		99.9		90.4		95.8	
College or more	99.5		99.8		93.3		95.1	
Region								
North Pacific	97.9	0.344	99.4	0.43	87.4	<0.001	87.2	0.168
Border	97.5		100		84.6		88.0	
Central Pacific	99.7		100		95.4		98.0	
North Central	98.0		99.8		87.7		84.2	
Central	97.4		100		90.9		95.9	
Mexico City	98.2		98.5		91.2		95.3	
Mexico State	98.3		99.5		91.1		93.8	
South Pacifc	96.9		99.7		90.4		93.9	
Peninsula	96.7		99.1		77.1		93.2	
Area								
Rural	96.4	0.021	99.5	0.839	85.5	0.041	96.7	0.435
Urban	97.6		99.4		88.1		91.8	
Metropolitan	98.5		99.6		89.6		93.3	
HWI								
Low	95.6	<0.001	99.7	0.285	84.0	<0.001	90.8	0.022
Medium	98.4		99.2		88.3		90.1	
High	98.9		99.7		91.6		96.8	
Indigenous population								
Yes	98.3	0.666	99.3	0.671	66.2	<0.001	98.8	0.055
No	97.8		99.5		89.3		93.2	

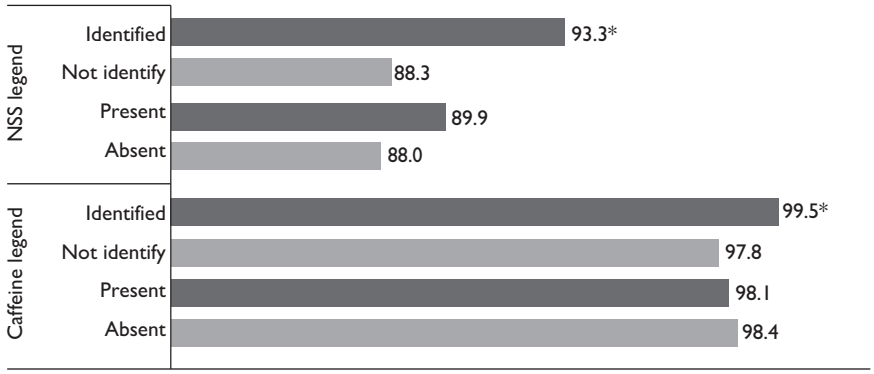
SBs: sweetened beverages
NSS: non-sugar sweeteners
Ensanut: *Encuesta Nacional de Salud y Nutrición*
HWI: household wellbeing index

Table III

CORRECT CLASSIFICATION OF THE NUTRITIONAL QUALITY OF SBS ACCORDING TO SOCIODEMOGRAPHIC VARIABLES AND THE PRESENCE OF PRECAUTIONARY LEGENDS. MEXICO, ENSANUT 2021

	Caffeine legend				*NSS legend*			
	Absent n= 3 813 N= 36 978 788		*Present n= 3 901 N= 38 404 839*		*Absent n= 3 848 N= 37 506 728*		*Present n= 3 926 N= 38 613 922*	
	%	*p*	%	*p*	%	*p*	%	*p*
Total	98.4		98.1		88.0		89.9	
Sex								
Men	97.6	0.001	96.9	<0.001	84.5	<0.001	86.0	<0.001
Women	99.0		99.3		91.1		93.4	
Age (years)								
20-29	99.7	<0.001	99.5	0.011	85.9	0.02	90.4	0.074
30-39	99.3		98.7		91.8		92.3	
40-49	97.3		96.9		88.1		90.8	
50-59	98.5		97.6		89.9		86.9	
60 or more	96.2		97.2		84.0		87.2	
Education								
Elementary or less	95.8	<0.001	95.6	<0.001	78.4	<0.001	83.2	<0.001
Middle school	98.7		97.9		90.8		89.3	
High school	99.3		99.5		88.2		94	
College or more	99.6		98.1		93.7		93.5	
Region								
North Pacific	98.3	0.311	98.3	0.074	88.4	<0.001	86.5	<0.001
Border	99.0		96.9		82.0		87.5	
Central Pacific	99.6		100		94.8		97.1	
North Central	97.3		99.4		85.0		89.8	
Central	97.3		98.8		90.1		93.1	
Mexico City	98.7		97.9		92.4		91.7	
Mexico State	98.6		98.7		92.4		90.7	
South Pacific	97.8		97.4		90.7		91.0	
Peninsula	98.8		96.2		75.0		82.9	
Area								
Rural	97.0	0.007	97.4	0.465	84.1	0.029	88.8	0.705
Urban	97.9		98.1		87.2		89.9	
Metropolitan	99.1		98.5		89.9		90.4	
HWI								
Low	96.7	<0.001	96.5	0.003	83.1	<0.001	86.4	0.003
Medium	98.6		98.6		87.3		89.7	
High	99.3		99.0		92.0		92.7	
Indigenous population								
Yes	99.0	0.387	98.0	0.876	67.9	<0.001	70.8	<0.001
No	98.3		98.2		88.8		90.7	

SBs: sweetened beverages
NSS: non-sugar sweeteners
Ensanut: *Encuesta Nacional de Salud y Nutrición*
HWI: household wellbeing index
p <0.05 indicates a significant difference in the distribution of nutritional quality classification between the categories of sociodemographic variables according to the chi-squared test



* Indicates statistical significance according to the chi-squared test al level p <0.001 between identified vs. not identified
SBs: sweetened beverages
NSS: non-sugar sweeteners
Ensanut: *Encuesta Nacional de Salud y Nutrición*

Figure 1. Overall correct classification of the nutritional quality of SBs, according to the presence and identification of precautionary legends among Mexican adults. Mexico, Ensanut 2021

Table IV
Logistic regression models of SB nutritional quality classification among Mexican adults. Mexico, Ensanut 2021

	Caffeine legend n= 7 714 N= 75 383 627						*NSS legend n= 7 774 N= 76 120 651*					
	Crude			*Adjusted*			*Crude*			*Adjusted*		
	OR	*95%CI*	*p*	*OR*	*95%CI*	*p*	*OR*	*95%CI*	*p*	*OR*	*95%CI*	*p*
Absent legend		Ref			Ref			Ref			Ref	
Present legend	0.88	(0.57,1.36)	0.569	0.83	(0.54,1.27)	0.383	1.21	(0.99,1.49)	0.058	1.23	(1.01,1.51)	0.044
Did not identify legend		Ref			Ref			Ref			Ref	
Identified legend	4.78	(2.38,9.60)	<0.001	3.97	(1.98,7.97)	<0.001	1.84	(1.28,2.66)	0.001	1.62	(1.12,2.34)	0.011
Absent legend + Did not identify legend		Ref			Ref			Ref			Ref	
Present legend + Identified legend	3.63	(1.50,8.77)	0.004	2.97	(1.22,7.21)	0.016	1.89	(1.10,3.24)	0.021	1.75	(1.02,3.02)	0.040

Model adjusted for sex, age, education, area, HWI and indigenous population
SBs: sweetened beverages
NSS: non-sugar sweeteners
Ensanut: *Encuesta Nacional de Salud y Nutrición*
95%CI: 95% confidence intervals

the high consumption of caffeine among the Mexican population, including children, might contribute to the normalization of caffeinated drink consumption,[23] thus diminishing the impact of the caffeine legend. This point is crucial for future experiments, which should consider using different products with precautionary legends.

In contrast, a study conducted in Uruguay explored the effect of a caffeine warning label (CWL) on energy drinks on the purchase intention of young adults.[24] The results indicated that the CWL increased the likelihood of choosing the product, as it was perceived positively due to its associations with energy.[24] While the message in Mexico specifically targets protecting children, and the CWL used in the Uruguayan study only indicated the presence of caffeine, this finding paves the way for future qualitative evalua-

tions to understand the reasons behind the perceived healthiness of products with caffeine legend among different population groups. Additionally, various forms of warning about added caffeine could be explored, such as a declaration of caffeine content (mg) or a warning about high levels of caffeine.[25]

Considering the differences in correct responses based on exposure to legends (present or absent) and sociodemographic characteristics, a higher proportion of correct responses was observed among women, young adults (20 to 39 years old), and those with higher education and higher HWI. In contrast to the findings of the previously mentioned Mexican study, which did not find statistically significant differences among sociodemographic characteristics except for age in NSS legend; the NSS legend was more effective in reducing product perceived healthfulness among adults aged 60 years and older compared to those aged 18-29 years. However, these results are not entirely comparable to ours, as the previous study conducted interactions and adjustments for unbalance variable across experimental groups.[23]

Our results suggest that verifying the identification of warning labels significantly increases the odds of giving correct responses, particularly in the case of caffeine. Moreover, when considering the interaction (presence of the legend + identification), the odds of correct classification increased significantly for both precautionary legends.

These results can be explained by size in which the legends are display in the current market. Products without warning labels often feature precautionary legends in small sizes, as their dimensions are determined based on the size of the warning labels.[19] This may make them difficult to locate. It is also important to note that the design of warnings plays a crucial role in capturing consumers' attention and clearly communicating their intended meaning, which are key factors in their effectiveness.[26] A study in Uruguay found that the octagonal shape and the text "Excess in" decreased the perception of healthfulness.[26]

In that regard, the proposal for the Mexican warning labeling system included a warning label with the text "Contains non-sugar sweeteners, avoid in children";[27] however, due to negotiations during the approval process, the text and shape were changed to a legend,[28] which may place precautionary legends in a lower hierarchy than warning labels. Therefore, it is necessary to explore whether increasing their size or migrating precautionary legends to warning labels would enhances their effectiveness.

Finally, it is important to consider the potential health effects of precautionary legends. It is expected that the FOPWL system, after five years of implementation, could reduce calorie consumption by 36.8 kcal per person per day, with 23.2 kcal specifically from beverages, potentially leading to 1.30 million fewer cases of obesity.[29] Therefore, evaluating the specific effects on the purchase and consumption of additives such as caffeine and NSS, and their health implications, will be necessary. Additionally, strengthening labeling regulation regarding the design of precautionary legends to improve their identification is essential. Moreover, promoting the use of these legends through extensive communication campaigns is important, considering that educational campaigns have primarily occurred on social media,[30] to prevent direct harm from caffeine and NSS and protect vulnerable populations.

Among the strengths of this study is the sample, which is representative of the Mexican adult population, and the fact that exposure to legends was applied randomly. An important contribution of our study is the inclusion of identification in the analysis. Within the limitations of the study, we acknowledge the cross-sectional design, which does not allow us to establish causality; however, this was not the study's objective. Additionally, instead of using real products, we evaluated the legends using images that may not fully represent the real-life situation of products at the points of sale. Nevertheless, the images of the products were based on different SBs with real combinations of legends, warning labels, and advertising. Furthermore, the variables were dichotomized into correct and incorrect responses to facilitate their analysis; however, this could have led to a loss of variability among responses, which may result in a less accurate representation of the relationship with the outcome variable.

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