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A multi-country comparison of jurisdictions with and without mandatory nutrition labelling policies in restaurants: analysis of behaviors associated with menu labelling in the 2019 International Food Policy Study

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Short title: Menu labelling policies in five countries

Abstract

Objective: To examine differences in noticing and use of nutrition information comparing jurisdictions with and without mandatory menu labelling policies and examine differences among sociodemographic groups.

Design: Cross-sectional data from the International Food Policy Study (IFPS) online survey.

Setting: IFPS participants from Australia, Canada, Mexico, United Kingdom and United States in 2019.

Participants: Adults aged 18-99; n=19,393.

Results: Participants in jurisdictions with mandatory policies were significantly more likely to notice and use nutrition information, order something different, eat less of their order, and change restaurants compared to jurisdictions without policies. For noticed nutrition information, the differences between policy groups were greatest comparing older to younger age groups and comparing high education (difference of 10.7%, 95% CI 8.9 to 12.6) to low education (difference of 4.1%, 95% CI 1.8 to 6.3). For used nutrition information, differences were greatest comparing high education (difference of 4.9%, 95% CI 3.5 to 6.4) to low education (difference of 1.8%, 95% CI 0.2 to 3.5). Mandatory labelling was associated with an increase in ordering something different among the majority ethnicity group and a decrease among the minority ethnicity group. For changed restaurant visited, differences were greater for medium and high education compared to low education, and differences were greater for higher compared to lower income adequacy.

Conclusions: Participants living in jurisdictions with mandatory nutrition information in restaurants were more likely to report noticing and using nutrition information, as well as greater efforts to modify their consumption. However, the magnitudes of these differences were relatively small.

Introduction

Eating from out of home food outlets (OHFO) is common, expected to increase globally over the next decade[1], and associated with poorer dietary quality, increased caloric intake and obesity[2–4] Eating food from OHFOs may lead to weight gain due to larger portion sizes and greater energy density of food from these outlets, which may cause consumers' energy intake to exceed their energy requirements[2]. Furthermore, previous work has found both experts and the general public tend to be poor estimators of their energy intake from restaurants[5,6].

Historically, there have been fewer regulations on labelling the nutritional content of foods purchased at OHFO compared to those purchased in grocery stores. One policy response to help inform consumers about the nutrition content of out of home eating is to include energy labels on menus. Mandatory energy labelling policies may improve diets through various pathways including informing consumers about the energy content of food options to help them make a more informed selection, shifting food choices towards healthier options, and incentivizing the food industry to offer reduced energy versions of their offerings, via reformulation and reduced serving sizes, or introducing new products[7,8]. Menu labelling policies are also thought to be cost effective population level interventions to improve diets, reduce obesity, and prevent associated chronic diseases[9]. Several recent meta-analyses of evaluations of menu labelling interventions found that, although study quality tends to be mixed, energy labels may lead to small reductions in energy intake among adults at a population level, and energy labelling may reduce the amount of energy consumers purchase from restaurants[10–12].

Although there is a vast literature on the effects of menu labelling on behavior, to our knowledge no studies have examined the effects of implemented menu labelling policies in a multi-country context. Several reviews have been published examining the impact of menu labelling policies in "real world" and laboratory settings([7,10,12-18]). However, the majority of studies are small randomized controlled trials, include populations only from the United States, or were implemented in small settings such as a university cafeteria. Evidence from the United States suggests calorie labelling can lead to small improvements in fast food meal quality and small to moderate decreases in calories purchased from supermarkets and fast food restaurants, but reductions in purchases may diminish over time[19–21]. Many studies also lack a comparison group to examine the effects of menu labelling policies[22], and those that do are limited to analyses of individual food service chains or examine policy in individual cities, potentially limiting generalizability of findings[23–25]. Although RCTs are typically assumed to have less risk of confounding than observational studies, it is essential to also understand the effects of policies implemented in the real world, particularly in a large state-wide or even national setting, where 'real world' effectiveness may differ from efficacy in a RCT. In the context of national-level diet surveys, many are conducted too infrequently to be compared with other countries during the same time period or they may capture different diet-related behaviors, which limits comparability[26,27]. Thus, a multi-country approach to evaluating the impacts of food policies addresses current gaps in national monitoring surveys[27].

Mandatory menu labelling has been implemented in national and subnational jurisdictions[28], and this study presents a population-based evaluation to clarify the impacts of real world menu labelling policies. We utilized data from 2019 of the International Food Policy Study (IFPS), a multi-country repeated cross-sectional survey of five upper- and middle-income countries including Australia, Canada, Mexico, the United Kingdom, and the United States. The IFPS allows for comparisons of polices in countries or jurisdictions that have implemented compared to those that have not implemented[27]. The five countries in the IFPS have varying mandatory menu labelling regulations, with some policies mandatory at the national levels, others at the state/province level, and others with no mandatory menu labelling regulations. Thus, this multi-country survey includes large populations that were and were not exposed to mandatory energy labelling regulations at the time of data collection.

The purpose of this study was to examine the prevalence of noticing and using menu labels and the behaviors associated with menu labelling overall and by sociodemographic characteristics, comparing

jurisdictions with and without mandatory menu labelling policies. The first research question was whether there were any significant differences in these behavioral outcomes according to policy status. We hypothesized that jurisdictions with mandatory menu labelling policies would have higher rates of noticing and use of menu labels compared to jurisdictions without. The second research question was whether differences by policy status varied for sociodemographic groups. Given the high agency requirement of menu labelling policies, we hypothesized that variations would exist across sociodemographic groups.

Methods

Dataset

Data are from the 2019 wave of the International Food Policy Study (IFPS), a multi-country repeat cross-sectional study of eating patterns and policy-relevant behaviors and includes data from Australia, Canada, Mexico, the United Kingdom (UK) and the United States (US)[27,29]. These countries were selected for the IFPS survey because of differences in food-related policies prior to the first wave, and the potential for change in policies between subsequent waves (Table 1). The study sample was recruited from Nielsen Consumer Insights Global Panel, which provides standardized recruitment sampling across countries. A random sample of participants aged 18-99 from the Nielsen Consumer Insights Global Panel and their partners' panels were invited by email to complete the IFPS survey[29]. Online surveys were completed between November and December of 2019. Questionnaires and further details about recruitment are available from the International Food Policy Study: Technical Report 2019[29].

Table 1. Categorization of jurisdictions according to presence or absence of mandatory menu labelling policies before 2019 data collection [28]

Country and Policy Status	**Jurisdiction and Year**	**Policy Description**
Australia – Policy Present	5 states/territories: Australian Capital Territory (2013), New South Wales (2011), Queensland (2016), South Australia (2012), Victoria (2018)	Energy content must be presented in restaurant chains with at least 20 state outlets or 50 nationwide outlets
Canada – Policy Present	1 province: Ontario (2017)	Menu labelling requirements for all food premises with >20 locations, with the Healthy Menu Choices Act (HMCA)
United States – Policy Present	National policy fully implemented in 2017 (introduced in 2014)	National menu labelling requirements were announced in 2010 as part of the Affordable Care Act and officially came into force on 7 May 2017. Large chain restaurants (with 20 or more locations) are required to include calorie counts to their menus and menu boards
Australia – No Policy	Western Australia, Tasmania, Northern Territory	Voluntary implementation
Canada – No Policy	All provinces other than Ontario	
Mexico – No Policy	N/A	Packaged foods require warning labels, but there are no restaurant menu labelling laws.
United Kingdom – No Policy	N/A	In April 2022, England introduced mandatory calorie menu labelling for large out-of-home food businesses with more than 250 employees, but these policies were not implemented at the time of data collection for this study

Exposure

Policy status was treated as an indicator variable for either Policy Present or No Policy in the analysis, and Policy Present was defined as having a mandatory menu labelling policy in place during 2019. Table 1 shows the jurisdictions included in this study that did and did not have a mandatory menu labelling policy implemented during 2019. The Policy Present group includes the United States and jurisdictions of Australia and Canada with mandatory labelling regulations (Table 1). In April 2022, England introduced mandatory calorie menu labelling for large out-of-home food businesses, defined as those with more than 250 employees[30]; however, at the time of the data collection for this study, England and Mexico had not implemented menu labelling requirements, and served as 'comparison' conditions. The No Policy group includes Mexico, the United Kingdom, and segments of Australia and Canada without mandatory labelling regulations (Table 1). We separated regions with mandatory labelling policies from areas without in both Canada and Australia. Participants in Canada answered "What province or territory do you live in?" and participants in Australia answered "What state or territory do you live in?" For Canada, responses of Ontario were coded to Policy Present, and all provinces other than Ontario were coded to No Policy (Table 1). For Australia, responses Australian Capital Territory, New South Wales, Queensland, South Australia, Victoria were coded to Policy Present, and responses Western Australia, Tasmania, Northern Territory were coded to No Policy (Table 1).

Outcomes

There are myriad ways in which consumers make food-related decisions. For example, contemporary behavior change theory conceptualizes behavior as a result of interacting capability, opportunity, and motivation[31]. Price, taste, and convenience are also key factors in making food decisions. Other potential psychological mechanisms are involved in eating behavior status quo bias—people eat what is typical and available such as large restaurant portion sizes—simplicity, and energy compensation[32]. The conceptual framework used in the present study assumes in order to make eating decisions, nutrition information must be noticed, then used, and finally used in a particular way. Previous work has examined the rates at which consumers notice and use nutrition information[24]. This study examines several self-reported outcomes related to how mandatory menu labelling policies are theorized to affect behaviors associated with menu labelling. Outcomes measured were: *noticing nutrition labels*, *use of nutrition labels*, *ordered something different*, *ate less of the food they ordered*, *visited different restaurants*, or *ate at restaurants less often*. These measures, as well as sociodemographic characteristics, are defined in Table 2, including the survey questions and coding for the analysis. Responses to *noticed nutrition information* and *used nutrition information* questions refer to the last time the participant visited a restaurant. Reponses to the behavioral impact of labelling questions refer to behaviors that occurred within the last 6 months, and were preceded by the question "In the past 6 months, have you done any of the following because of nutrition information in restaurants? (Select all that apply)" (Table 2). These measures were adapted from previously validated measures and published research[33].

Sociodemographic characteristics

Sociodemographic characteristics including age, sex, education, income adequacy, and ethnicity were included as potential confounders in models. The wording, responses and categories used in analysis of covariates are described in Table 2. Age was categorized into 10-year age brackets, except for the youngest group which included participants aged 18–24 years (Table 2). Because this is a multi-country survey with diverse ethnicities, the most comparable ethnicity measure across all countries was comparing the majority ethnicity to combined minority ethnicities. For income, we used income adequacy as it is associated with economic resources and health and allows for comparability across the multiple countries of the IFPS[34].

Table 2. IFPS 2019 Survey questions and variable categorization

		Response Options	
Concept	**Item wording (where applicable)**	**All**	**Variable Coding**
Outcomes			

Noticed Nutrition Information	The last time you visited a restaurant, did you notice any nutrition information?	No, Don't know, Refuse to answer Yes	No Yes
Used Nutrition Information	Did the nutrition information influence what you ordered?	No, Don't know, Refuse to answer Yes	No Yes
Impact of Labelling	In the past 6 months, have you done any of the following because of nutrition information in restaurants? (Select all that apply)		
Ordered Something Different	Ordered something different	Unselected/left blank Selected	No Yes
Ate Less of Order	Eaten less of the food you ordered	Unselected/left blank Selected	No Yes
Changed Restaurant Visited	Changed which restaurants you visit	Unselected/left blank Selected	No Yes
Ate at Restaurants Less Often	Eaten at restaurants less often	Unselected/left blank Selected	No Yes
Sociodemographic Characteristics			
Sex	What sex were you assigned at birth, meaning on your original birth certificate?	Female Male	Female Male
Age	How old are you?	Numeric: 18-100	18-24 25-34 35-44 45-54 55-64 65-74 75+
Ethnicity	Which of the following best describes your ethnic or racial background?	Country-specific racial and ethnic backgrounds	Minority Majority
Education	What is the highest level of education you have completed?	Below upper secondary / high school completion or lower) Upper secondary / some post-high school qualifications Tertiary / university degree or higher	Low Medium High

Income adequacy	Thinking about your total monthly income, how difficult or easy is it for you to make ends meet?	Neither easy nor difficult, Difficult, Very difficult, Don't know, Refuse to answer	Not Easy
		Easy, Very Easy	Easy

Statistical Analysis

All statistical analyses were conducted using Stata, Version 16. Data were weighted with post-stratification sample weights constructed using a raking algorithm with country-specific population estimates from census data based on age group, sex, region, ethnicity (except in Canada) and education (except in Mexico). A detailed explanation of survey weights can be found at http://foodpolicystudy.com/methods (International Food Policy Study: Technical Report 2019). Sample weights were used throughout the analysis to minimize the influence of differential non-response and selection bias on the representativeness of findings.

There were 20,968 observations in the dataset. Four of the six behavioral survey questions asked about consumer behavior at restaurants within the previous six months. Therefore, we restricted our sample size to only those participants who visited a restaurant in the previous six months, reducing the sample size to 19,617. Ethnicity data was missing for 176 observations, and a further 48 observations were missing education data and were dropped from the analysis, leaving a complete case analysis sample size of 19,393.

Descriptive statistics were used to summarize the outcomes and sociodemographic characteristics of the sample by policy status. To assess whether there were any significant differences in the six binary outcome measures according to policy status, weighted estimates were calculated using a survey-adjusted logistic regression model for each outcome. Policy status was included as an indicator variable (0=no policy, 1=policy), and models were adjusted for covariates selected *a priori*: age, sex, education, income adequacy, and race/ethnicity. The differences by policy status for behavioral outcomes were reported as odds ratios (ORs) with 95% confidence intervals, and statistical differences between policy status groups were tested using Wald tests. Results are also presented as predicted probabilities for all behavioral responses calculated using the margins command in Stata[35], as marginal effects can aid interpretation of magnitude and are more comparable across populations than ORs[36,37]. Predicted probabilities are the probability that the outcome will occur, estimated by the model. Differences in predicted probabilities were calculated using pairwise comparisons of margins[37,38].

To assess whether differences in outcomes by policy status varied across sociodemographic groups, we added two-way interactions between policy and each sociodemographic variable of interest to logistic regression models. Predicted probabilities of all six outcomes were estimated for each level of demographic variable by policy status. Differences by policy status at all levels of each sociodemographic variable were tested using pairwise comparisons of margins[37,38].

Results

Table 3 describes the sample characteristics, stratified by policy status for the 19,393 participants analyzed. The majority of the sample reported high education, majority ethnicity, and not easy income adequacy (i.e., not easy to make ends meet). The distribution of education varied by policy status, with more participants reporting High education in No Policy jurisdictions and more participants reporting Low and Medium education in Policy Present jurisdictions (Table 3).

Table 3. Sample demographic characteristics by policy status (unweighted n; weighted %)

Variable	**No Policy (n=10,737) n (%)**	**Policy Present (n=8,656) n (%)**	**Total (n=19,393) n (%)**
Sex % (n)			

Male	5335 (48.7)	4252 (48.9)	9587 (48.8)
Female	5402 (51.3)	4404 (51.1)	9806 (51.2)
Age % (n)			
18-24	1259 (11.9)	799 (11.8)	2058 (11.9)
25-34	2411 (21.8)	1657 (18.6)	4068 (20.3)
35-44	1938 (17.9)	1495 (17.4)	3433 (17.7)
45-54	1911 (16.0)	1234 (14.3)	3145 (15.2)
55-64	1573 (18.0)	1895 (21.0)	3468 (19.4)
65-74	1369 (12.1)	1253 (13.4)	2622 (12.7)
75+	276 (2.5)	323 (3.5)	599 (3.0)
Ethnicity % (n)			
Majority	9225 (83.3)	6710 (69.7)	15935 (77.1)
Minority	1512 (16.8)	1946 (30.3)	3458 (22.9)
Income Adequacy % (n)			
Not Easy (to make ends meet)	7257 (70.7)	5395 (65.6)	12652 (68.4)
Easy (to make ends meet)	3480 (29.3)	3261 (34.4)	6741 (31.6)
Education % (n)			
Low	2789 (37.2)	2690 (47.3)	5479 (41.8)
Medium	2667 (21.6)	2545 (21.9)	5212 (21.8)
High	5281 (41.3)	3421 (30.7)	8702 (36.5)
Countries			
Australia	466 (4.8)	3387 (38.2)	3853 (20.0)
Canada	2519 (22.0)	1328 (17.3)	3847 (19.9)
Mexico	4047 (38.4)	--	4047 (20.9)
United Kingdom	3705 (34.8)	--	3705 (19.0)
United States	--	3941 (44.5)	3941 (20.3)

Noticing and using nutrition information and changes in behaviors by policy status

Participants in jurisdictions with policies were more likely to *notice nutrition information* compared to jurisdictions without policies (OR = 1.67 (95% CI 1.53 - 1.83)). The predicted probability of noticing nutrition information was 21.2% (20.2 - 22.1%) in jurisdictions with mandatory policies compared to 13.9% (13.1 - 14.7%) in jurisdictions without mandatory menu labelling policies, a significant difference of 7.3% (6.0 - 8.6%) ($p<0.001$). Participants in jurisdictions with policies were more likely to *use nutrition information* compared to jurisdictions without policies (OR = 1.56 (95% CI 1.38 - 1.76)). The predicted probability of *used nutrition information* was 10.6% (9.9 - 11.3%) in jurisdictions with mandatory policies compared to 7.1% (6.5 - 7.7%) in jurisdictions without mandatory menu labelling policies, a significant difference of 3.5% (2.5 - 4.4%) ($p<0.0001$) (Table 4).

Participants in jurisdictions with policies were more likely to *order something different* compared to jurisdictions without policies (OR = 1.17 (1.07 - 1.28)). The predicted probability of ordering something different as a result of nutrition information was 20.2% (19.3 - 21.2%) in jurisdictions with mandatory policies compared to 17.9% (17.0 - 18.7%) in jurisdictions without mandatory menu labelling policies, a

significant difference of 2.3% (1.0 - 3.7%) (p=0.0005). Participants in jurisdictions with policies were more likely to *eat less of their order* compared to jurisdictions without policies (OR = 1.37 (1.23 - 1.52)). The predicted probability of *ate less of order* was 13.2% (12.4 - 14.0%) in jurisdictions with mandatory policies compared to 10.1% (9.4 - 10.8%) in jurisdictions without mandatory menu labelling policies, a significant difference of 3.1% (2.1 - 4.2%) (p<0.0001). Participants in jurisdictions with policies were more likely to *change restaurant visited* compared to jurisdictions without policies (OR = 1.18 (1.04 - 1.35)). The predicted probability of *changed restaurant visited* was 8.1% (7.5 - 8.7%) in jurisdictions with mandatory policies compared to 7.0% (6.4 - 7.6%) in jurisdictions without mandatory menu labelling policies, a significant difference of 1.1% (0.2 - 2.0%) (p=0.013) (Table 4). There was no significant difference in the odds of *ate at restaurants less often* between jurisdictions with and without mandatory menu labelling policies. We also examined the differences in outcomes by country and policy status descriptively, finding similar patterns of greater noticing, use, and behavioral outcomes associated with menu labelling in Policy Present jurisdictions (Supplementary Table 1).

Table 4. Predicted probability weighted estimates for noticing, using, and behavior change from menu labels by policy status in 2019 (n=19,393)

Noticed Nutritional Information	**Odds Ratio (95% CI)**	**Predicted Probability % (95% CI)**
Total Sample	--	17.2 (16.6, 17.8)
No Policy	[Ref]	13.9 (13.1, 14.7)
Policy Present	**1.67 (1.53, 1.83)**	21.2 (20.2, 22.1)
Difference	--	**7.3 (6.0, 8.6); p<0.0001**
Used Nutritional Information		
Total Sample	--	8.7 (8.3, 9.2)
No Policy	[Ref]	7.1 (6.5, 7.7)
Policy Present	**1.56 (1.38, 1.76)**	10.6 (9.9, 11.3)
Difference	--	**3.5 (2.5, 4.4); p<0.0001**
Ordered Something Different		
Total Sample	--	18.9 (18.3, 19.5)
No Policy	[Ref]	17.9 (17.0, 18.7)
Policy Present	**1.17 (1.07, 1.28)**	20.2 (19.3, 21.2)
Difference	--	**2.3 (1.0, 3.7); p=0.0005**
Ate Less of Order		
Total Sample	--	11.5 (11.0, 12.0)
No Policy	[Ref]	10.1 (9.4, 10.8)
Policy Present	**1.37 (1.23, 1.52)**	13.2 (12.4, 14.0)
Difference	--	**3.1 (2.1, 4.2); p<0.0001**
Changed Restaurant Visited		
Total Sample	--	7.5 (7.1, 7.9)
No Policy	[Ref]	7.0 (6.4, 7.6)
Policy Present	**1.18 (1.04, 1.35)**	8.1 (7.5, 8.7)
Difference	--	**1.1 (0.2, 2.0); p=0.013**
Ate at Restaurants Less Often		
Total Sample	--	14.9 (14.3, 15.5)

No Policy	Ref	15.2 (14.4, 16.0)
Policy Present	0.95 (0.86, 1.04)	14.5 (13.7, 15.4)
Difference	--	-0.6 (-1.8, 0.5)

Note: all models adjusted for age, sex, education, ethnicity, income adequacy
Bolded values are statistically significant at the 0.05 level

Interaction results: differences in behavior by sociodemographic characteristics

Next, we examined whether differences between policy groups varied by sociodemographic characteristics. Only those models with significant interactions are presented below in Tables 5-7. For *noticed nutrition information*, the greatest difference between policy groups was seen for 55-64 year olds (difference of 12.6%, 95% CI 9.9 - 15.4; p<0.001) and 65-74 year olds (difference of 9.6%, 95% CI 6.5 - 12.8; p<0.001) (Table 5). These differences were primarily due to lower rates of *noticed nutrition information* for those age groups in No Policy jurisdictions. There was a significantly greater difference between policy groups for high education (10.7%, 95% CI 8.9 - 12.6) compared to low education (4.1%, 95% CI 1.8 - 6.3; p<0.001) participants (Table 5). For *use nutrition information*, the greatest differences between policy groups were again for the oldest groups: with a difference of 4.9% (95% CI 2.9 - 7.0; p<0.001) for 55-64 year olds and a difference of 4.8% (95% CI 2.7 - 6.8; p<0.001) for 65-74 year olds (Table 5). There was a significantly greater difference between policy groups for high education (4.9%, 95% CI 3.5 - 6.4) compared to low education (1.8%, 95% CI 0.2 - 3.5) participants (p=0.006) (Table 5).

Table 5. Predicted probability weighted estimates – % (95% CI) – for models tested with interaction between policy and sociodemographic variables

	Noticed Nutrition Information			**Used Nutrition Information**		
	No Policy % (95% CI)	**Policy Present % (95% CI)**	**Difference % (95% CI)**	**No Policy% (95% CI)**	**Policy Present % (95% CI)**	**Difference % (95% CI)**
Age						
18-24	19.6 (17.1, 22.1)	22.5 (19.2, 25.8)	2.9 (-1.3, 7.0)	11.1 (9.1, 13.1)	12.1 (9.5, 14.7)	1.0 (-2.2, 4.3)
25-34	16.3 (14.5, 18.1)	22.8 (20.5, 25.1)	6.5 (3.6, 9.4)	8.8 (7.5, 10.2)	12.5 (10.8, 14.2)	3.6 (1.5, 5.8)
35-44	14.8 (13.0, 16.6)	20.2 (17.9, 22.4)	5.4 (2.5, 8.2)	8.6 (7.1, 10.1)	11.5 (9.8, 13.3)	2.9 (0.6, 5.3)
45-54	14.2 (12.2, 16.1)	19.0 (16.6, 21.5)	4.9 (1.7, 8.0)	6.8 (5.5, 8.2)	8.7 (6.9, 10.5)	1.9 (-0.4, 4.1)
55-64	9.6 (8.0, 11.3)	22.3 (20.1, 24.5)	12.6 (9.9, 15.4)	4.7 (3.4, 5.9)	9.6 (8.0, 11.2)	4.9 (2.9, 7.0)
65-74	10.5 (8.7, 12.4)	20.1 (17.6, 22.7)	9.6 (6.5, 12.8)	3.6 (2.5, 4.7)	8.4 (6.6, 10.1)	4.8 (2.7, 6.8)
75+	9.2 (5.2, 13.2)	14.4 (10.0, 18.8)	5.2 (-0.7, 11.1)	2.1 (0.4, 3.8)	6.5 (3.6, 9.4)	4.5 (1.1, 7.8)
Education						
Low	14.7 (13.1, 16.2)	18.7 (17.1, 20.4)	4.1 (1.8, 6.3)	7.0 (5.8, 8.1)	8.8 (7.6, 10.0)	1.8 (0.2, 3.5)
Medium	13.6 (12.2, 15.0)	21.6 (19.8, 23.4)	8.0 (5.7, 10.3)	6.0 (4.9, 7.0)	10.0 (8.7, 11.4)	4.0 (2.4, 5.7)
High	13.5 (12.4, 14.5)	24.2 (22.6, 25.8)	10.7 (8.9, 12.6)	8.0 (7.2, 8.8)	12.9 (11.7, 14.1)	4.9 (3.5, 6.4)

For *ordered something different*, the differences between policy groups were directionally different for the majority ethnicity group (difference of 4.7%, 95% CI 3.3 - 6.1; p<0.001) compared to the minority

ethnicity group (difference of -4.8%, 95% CI -8.0 to -1.6; p<0.001). These differences were primarily due to high rates of *ordering something different* for minority groups in No Policy jurisdictions (Table 6).

Table 6. Predicted probability weighted estimates – % (95% CI) – for models tested with interaction between policy and sociodemographic variables

	Ordered Something Different		
	No Policy % (95% CI)	**Policy Present % (95% CI)**	**Difference % (95% CI)**
Ethnicity			
Majority	16.3 (15.5, 17.2)	21.0 (19.9, 22.1)	4.7 (3.3, 6.1)
Minority	24.0 (21.3, 26.6)	19.1 (17.2, 21.0)	-4.8 (-8.0, -1.6)

For *changed restaurant visited*, the difference between policy groups was greater for medium (difference of 3.1%, 95% CI 1.4 – 4.8, p<0.001)) and high education (difference of 2.3%, 95% CI 1.0 to 3.6, p<0.01) compared to low education (difference of -0.9%, 95% CI -2.4 - 0.6) (Table 7). The difference between policy groups was greater for higher income adequacy (difference of 2.9%, 95% CI 1.4 to 4.4) compared to lower income adequacy (difference of 0.3%, 95% CI -0.8 to 1.4) (Table 7).

Table 7. Predicted probability weighted estimates – % (95% CI) – for models tested with interaction between policy and sociodemographic variables

	Changed Restaurant Visited		
	No Policy % (95% CI)	**Policy Present % (95% CI)**	**Difference % (95% CI)**
Education			
Low	7.1 (5.9, 8.2)	6.1 (5.2, 7.1)	-0.9 (-2.4, 0.6)
Medium	6.4 (5.4, 7.4)	9.5 (8.2, 10.9)	3.1 (1.4, 4.8)
High	7.4 (6.6, 8.2)	9.7 (8.7, 10.7)	2.3 (1.0, 3.6)
Income Adequacy			
Not Easy	7.0 (6.3, 7.7)	7.3 (6.6, 8.1)	0.3 (-0.8, 1.4)
Easy	6.8 (5.8, 7.8)	9.7 (8.6, 10.9)	2.9 (1.4, 4.4)

Discussion

To our knowledge, this is the first multi-country examination of national and state/province-level menu labelling policies and associated behaviors. In this online multi-country survey with 19,393 participants conducted in 2019, we find evidence that implementation of mandatory menu labelling in restaurants is associated with a range of behaviors that are on the pathway from exposure to mandatory menu labelling to change in individual purchasing and eating. When differences by sociodemographic factors were present, the greatest differences were seen in those of middle to older age and those with greater socio-economic affluence according to education or perceived income adequacy.

Interpretation and implications of findings

Our study builds on previous work measuring noticing and using nutrition information with a multi-country comparison of jurisdictions where energy labelling on menus was mandatory compared to where it was

not. Jurisdictions with mandatory nutrition labelling policies had higher rates of noticing nutrition information, ordering something different, eating less of what was ordered, and changing restaurants due to nutrition information availability. However, there were no differences between policy groups in frequency of eating out at restaurants. This suggests menu labels may affect behavior within restaurants, but do not affect consumers' decision of whether or not to eat at a restaurant.

Most importantly, these results suggest that mandatory menu labelling policies may be improving behaviors associated with menu labelling at restaurants when comparing jurisdictions with and without mandatory menu labelling policies. These changes are according to our proposed mechanism involving noticing, using, and types of use all leading to changes in calories consumed. There is evidence for the link between noticing labels and behavior change. For example, noticing other types of labels such as traffic light labels has been found to be associated with healthier items purchased[39]. Mandatory menu labelling policies have increased noticing and use of nutrition information in other contexts, but more evidence is needed to understand whether these findings are consistent for older age groups and in other countries and population subgroups[33]. More recent evidence from the United States suggests the small to moderate reductions in calories purchased may diminish over time, potentially reducing the long term public health impact of calorie labels. The present study found significant differences between mandatory and non-mandatory menu labelling jurisdictions for five out of six behavioral outcomes measured, which could potentially lead to improved diets across large populations.

Although noticing and use of nutrition information was greater in jurisdictions with mandatory labelling policies, estimates were relatively low (21.2% noticing and 10.6% using nutrition information), and the differences in behaviors associated with menu labelling are modest. However, these differences could still be meaningful for health when they include millions of people. To improve public health, there may be ways to augment the effects of menu labelling policies. First, menu labelling interventions may be optimized by further helping people notice nutrition information—for example by making the information more prominent via increased size or visual salience[40]. Second, interventions could help people use nutrition information by including associated messaging such as choosing an option with fewer calories to benefit health. For example, evaluative labels may be easier to interpret than numerical labels[41], and adding a recommended daily energy intake alongside menu labels maybe increase their effects[42]. Previous work has also found that motivation to use nutrition information may be a more important barrier than mere nutrition knowledge[43]. Third, additional policies are needed to have a large impact on diets across populations. Mandatory menu labelling may be a component of an effective obesity reduction strategy, but it is unlikely to achieve government targets to reduce obesity without complementary policies as eating behaviors are influenced by numerous complex factors beyond individual decision-making processes.

Although our study suggests mandatory menu labelling policies may play a role in reducing calorie consumption out of home, other mechanisms of action may have more important effects, and mandatory labelling policies alone may not be enough to greatly reduce calorie intake out of home across large populations. Additional messaging about how to use calorie information alongside mandatory menu labelling policies may augment consumers noticing and ability to use this information to make healthier food choices when eating outside the home. People may also lack guidance regarding how to understand and use nutrition information to eat healthier and ultimately improve their health. Some jurisdictions such as New York City have tried to supplement mandated calorie information posted on chain restaurant menus by adding recommended calorie intake per day or per meal, but with no effect[25]. Future work is needed to determine whether other policies that reduce calories consumed out of home are more effective than menu labelling, and more research is needed to understand whether the sociodemographic differences in self-reported behaviors found in this study also exist for dietary intake. Menu labelling may also spur reformulation of products to lower calorie or healthier forms by reducing nutrients of concern. However, calorie labelling in large chain restaurants was associated with minimal changes in calorie content of menu items, primarily consisting of the introduction of new lower calorie items[44].

Differences between policy groups by sociodemographic characteristics

In addition to estimating the differences between policy groups for each of the six behavioral outcomes, we found several differences between policy groups by demographic characteristics. Examining differences between policy groups by age, the youngest age group, aged 18-24 were the mostly likely to eat less of their order compared to other age groups. Among UK diners at catering establishments, younger groups were more interested in menu labelling than older groups[45], and this greater interest could translate into greater use. On the other hand, the greatest differences for noticing and using menu labels were found for the middle and upper-middle age groups. Noticing and using nutrition information were more common for younger age groups living in No Policy jurisdictions, and differences between policy groups were larger for older groups. This finding is supported by a systematic review of nutrition labels on pre-packaged foods that found older adults were less likely to use nutrition labels than middle-aged and young adults[46]. Our study similarly found low noticing and use of nutrition information among older age groups, but living in a Policy Present area reduced some of the disparity.

Examining the differences between policy groups by education, rates of noticing nutrition information, using nutrition information, and changing restaurants were roughly equal in No Policy jurisdictions, but the increases were greater for higher education and majority ethnicity groups in Policy Present jurisdictions (Tables 5 and 6). Differences between policy groups for changing restaurants were also greater in the higher income adequacy group compared to the lower income adequacy group, and the higher income adequacy group was more likely to change restaurants in the Policy Present group (Table 7). This suggests that higher education and higher income groups may be more sensitive to changing restaurants within Policy Present jurisdictions. Indeed, higher comprehension and use of nutritional labels has been found to be associated with higher income and higher education[46]. Higher education and higher income levels were associated with a greater likelihood of ordering something different, changing restaurants, and eating at restaurants less often. The highest income level group was also the most likely to eat less of what they ordered due to noticing nutrition information. This is concordant with the majority of previous evidence which also suggests higher education and income levels are associated with greater use of nutrition labels[46]. Although some other research has not found any convincing evidence of sociodemographic disparities in responses to menu labelling, the present results suggest that menu labelling policies, specifically those containing only numeric information, could potentially widen inequalities in healthy eating and therefore health[47,48]. This insight suggests that other interventions may be needed to support lower education groups through mechanisms other than information-based policies that require significant cognitive demand on individuals. There is evidence that labels can be designed to avoid widening disparities between socio-economic groups. Other types of labels, such as warning labels, may be of greater use for people of low income or literacy, thereby reducing disparities[49]. Therefore, our results suggest the association between label design and socioeconomic disparities should be considered when designing labels for real world policies.

The difference between policy groups was greater in the majority ethnicity group compared to the minority ethnicity group for ordering something different, but these differences were primarily due to high rates of ordering something different for minority groups in No Policy jurisdictions (Table 5). The rates of ordering something different in No Policy jurisdictions for minority groups were closer to the rates found in Policy Present jurisdictions for both minority and majority groups. Previous work from the United States found Black or Hispanic participants were more likely to choose restaurants with menu labelling and to use caloric information compared to White participants[50]. A similar pattern could explain our findings of greater ordering something different in No Policy jurisdictions if minority groups are more likely to seek restaurants that have menu labelling compared to majority groups. These findings suggest that there may be limited additional benefit of mandatory menu labelling policies for minorities if they already using nutrition information at a greater rate than in voluntary jurisdictions. However, further work is needed to determine whether this pattern exists across other populations. Overall, these differential effects of menu labelling in restaurants across groups suggest complementary policies may be needed to support healthy eating and reduce inequalities across more vulnerable socioeconomic groups.

Strengths and limitations

To our knowledge, this is the first multi-country examination of national and state/province-level menu labelling policies and associated behaviors. Using the same survey questions across intervention and comparison policy jurisdictions allows for between-country comparisons that are otherwise more challenging to do between countries with limited capacity to conduct routine national diet surveys[27]. Thus, these results may help provide more generalizable evidence for the effects of menu labelling on self-reported eating behaviors. Weighted IFPS estimates are close to the sociodemographic distributions in the countries studied, although there was a lower recruitment of low education participants from Mexico[27]. Finally, the large study sample of nearly twenty thousand participants increases power to detect differences between policy groups.

Our study does have limitations as we cannot determine the degree to which self-reported behavioral changes translate to changes in dietary intake, obesity, or other health outcomes. There are also some variations in menu labelling policies within our Policy Present and No Policy groups. Although we were able to categorize jurisdictions into either Policy Present or No Policy groups, the mandatory policies in Canada, Australia, and the United States are not exactly the same – for example, businesses with 20 or more locations in Ontario, Canada could refer to businesses with greater density of outlets compared to with 20 or more locations across the United States, given the different density of outlets required to meet the 20 outlet threshold in geographic areas of different size. Thus, our study has some challenges to consistency—variations of exposure (Policy Present in this study) do not differentially affect outcomes (behavioral measures in this study)—a core assumption of causal inference. The cross-sectional nature of a single data collection and a natural experimental design are more vulnerable to confounding bias than randomized controlled trials for demonstrating causal effects, and we cannot eliminate the possibility for residual confounding if some factor other than policy status is driving the differences between groups, such as country differences. Due to the single year of data used, we also cannot determine whether differences observed in 2019 are due to reverse causation: for example, if pre-policy rates of noticing and using menu labels were higher and thereby facilitated policy adoption. Finally, we did not examine all mechanisms through which menu labels could improve population health. Menu labels could improve health through pathways other than the behaviors examined here—for example through product reformulation—which could reduce calorie intakes.

Conclusions

Participants living in jurisdictions with mandatory nutrition information were more likely to report noticing nutrition labels, ordering something different, eating less of what was ordered, and changing restaurants in jurisdictions where nutrition information in restaurants was mandatory. The magnitudes of differences between Policy and No Policy jurisdictions were relatively small. Mandatory menu labelling was associated with greater behavioral differences in more socio-economically affluent groups, which could potentially exacerbate existing inequalities in diet and health. Complementary interventions may be required to optimize mandatory menu labelling interventions by accounting for unequal effects across sociodemographic groups. Further research understanding whether menu labelling has similar inequitable effects on dietary intake will now be valuable.

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Supplementary Materials

Supplementary Table 1. Unweighted prevalence of noticing, using, and behavior change analyzed by country and policy status

Country	Noticed Nutrition Info n (%)		Used Nutrition Info n (%)		Ordered Something Different n (%)		Ate Less n (%)		Changed Restaurant n (%)		Restaurants Less Often n (%)	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Australia – Policy*	2970	417	3191	196	2893	494	3039	348	3125	262	2938	449
n=3387	(87.7)	(12.3)	(94.2)	(5.8)	(85.4)	(14.6)	(89.7)	(10.3)	(92.3)	(7.7)	(86.7)	(13.3)
Australia - No Policy	412	54	444	22	390	76	419	47	435	31	404	62
n=466	(88.4)	(11.6)	(95.3)	(4.7)	(83.7)	(16.3)	(89.0)	(10.1)	(93.3)	(6.7)	(86.7)	(13.3)
Canada – Policy*	911	417	1141	187	1003	325	1151	177	1211	117	1112	216
n=1328	(68.6)	(31.4)	(85.9)	(14.1)	(75.5)	(24.5)	(86.7)	(13.3)	(91.2)	(8.8)	(83.7)	(16.3)
Canada - No Policy	2144	375	2358	161	2132	387	2254	265	2358	161	2095	424
n=2519	(85.1)	(14.9)	(93.6)	(6.4)	(84.6)	(15.4)	(89.5)	(10.5)	(93.6)	(6.4)	(83.2)	(16.8)
Mexico – No Policy	3588	459	3737	310	3033	1014	3617	430	3736	311	3306	741
n=4047	(88.7)	(11.3)	(92.3)	(7.7)	(74.9)	(25.1)	(89.4)	(10.6)	(92.3)	(7.7)	(81.7)	(18.3)
UK – No Policy	3097	608	3435	270	3186	519	3342	363	3460	245	3338	367
n=3705	(83.6)	(16.4)	(92.7)	(7.3)	(86.0)	(14.0)	(90.2)	(9.8)	(93.4)	(6.6)	(90.1)	(9.9)
USA – Policy	2887	1054	3363	578	2956	985	3324	617	3595	346	3355	586
n=3941	(73.3)	(26.7)	(85.3)	(14.7)	(75.0)	(25.0)	(84.3)	(15.7)	(91.2)	(8.8)	(85.1)	(14.9)

*Australia and Canada are separated into policy/no policy groups according to which jurisdictions have mandatory calorie labelling in restaurants. These policy differences are described in Table 1.