

# Awareness of and Participation in School Food Programs in Youth From Six Countries

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## ABSTRACT

**Background:** School-based meal programs can promote healthy dietary intake in youth. However, limited data exist regarding the impact of income-targeted school meal programs across countries, particularly among food-insecure youth.

**Objectives:** We examined self-reported awareness of and participation in free school meal programs, and associations with dietary intake in youth from 6 countries with differing national school meal policies.

**Methods:** Data were collected through the 2019 International Food Policy Study Youth Survey, a cross-sectional survey of 10,565 youth aged 10–17 y from Australia, Canada, Chile, Mexico, the United Kingdom, and the United States. Regression models examined: 1) country differences in awareness of and participation in breakfast and lunch programs; and 2) associations between lunch program participation and intake of fruit and vegetables, and “less healthy” foods during the previous school lunch day.

**Results:** Awareness of and participation in free breakfast and lunch programs varied across countries. Approximately half of US and Chilean students participated in school lunch programs—the countries with the most comprehensive national policies—compared with one-fifth of students in the United Kingdom, and ~5% in Australia, Canada, and Mexico ( $P < 0.001$  for all contrasts). In the United States and Chile, more than two-thirds of youth with the highest level of food insecurity participated in lunch programs, compared with 45% in the United Kingdom, 27% in Canada, and  $\leq 20\%$  in Australia and Mexico. In all countries, youth reporting school lunch program participation were more likely to report fruit and vegetable intake during their previous school lunch ( $P < 0.001$ ), and higher intake of “less healthy” food in all countries except the United States and Chile.

**Conclusions:** More comprehensive national policies were associated with greater participation in school meals programs, particularly among youth at greatest risk of food insecurity, as well as healthier dietary intake from school lunches. *J Nutr* 2022;00:1–13.

**Keywords:** breakfast, children, food insecurity, free school meal, lunch, school meal program, youth

## Introduction

Nutrition is a fundamentally important determinant of child health and wellbeing, with implications for growth, learning, and longer-term risk factors for chronic disease (1, 2). In many countries, dietary quality in children and youth is alarmingly low, with inadequate fruit and vegetable intake combined with high levels of nutrient-poor snacks, fast food, and sugar-sweetened beverages (3). Dietary quality is particularly low among children and youth with lower socioeconomic status (4).

Schools are a critically important food environment for children (5–7). On average, students consume between one-third and one-half of their daily calories while at school (8, 9). Accordingly, the WHO and other agencies have emphasized

the importance of school environments in preventing childhood obesity and diet-related noncommunicable diseases (10, 11). School-based meal programs represent an opportunity to promote healthy dietary intake and address food insecurity in young people (7, 12). A systematic review and meta-analysis of school food policies on dietary habits of preschool, primary, and secondary school students globally reported that school meal standards and direct provision of free fruits and vegetables increased students' daily fruit and vegetable consumption (7).

A majority of countries around the world offer some type of school meal program (1, 13). In a global survey of school meal programs conducted by the Global Child Nutrition Foundation, nearly 300 million children and youth received food in 2018/2019. However, the percentage of children of primary

and secondary school age that received food through school meal programs ranged from 16% across Southeast Asia and the Pacific region to nearly 40% across North America, Europe, and Central Asia (14). The coverage rate reflects differences in whether school meal programs exist and how existing programs are implemented. Some countries, such as Brazil and India, provide universal free school meals to all students of specific ages, whereas other countries have implemented free school meal programs solely for those of low socioeconomic status (15). For example, in the United States, ~95% of schools participate in school meal programs (coordinated by the federal USDA), which provide free breakfasts and lunches to eligible students based on low income (16–18). In addition, US schools with  $\geq 40\%$  of students from low-income homes can provide universal free school meals to all students in the school (19). In Chile, a national program exists in which students receive daily food rations (breakfast, lunch, and tea time) all year depending on the student's social vulnerability. Food is mostly provided at school, although in very specific cases it can also include homes. Program coverage is ~80% of the most vulnerable groups attending public or public-private schools (20). Mexico offers a hot or cold breakfast program to children in preschool, primary, and middle school from vulnerable and marginalized communities (21). In addition to differences between countries, free school meal program availability can differ within countries. In the United Kingdom, free school lunchtime meals are provided based on financial need; however, as of 2021, a universal meal program was provided to primary school pupils aged 4–7 y, with some differences in provision in England, Wales, Scotland, and Northern Ireland (22–24). Free breakfast programs are also provided to primary schools in disadvantaged areas in England (25), Northern Ireland (26), and Scotland (23), and are available to all primary schools in Wales (27). In contrast, neither Australia nor Canada have national school meal programs. Free breakfast, lunch, or snack programs exist in some schools—often run by community organizations or charities—with variable coverage rates across regions (28, 29).

Although comprehensive evaluations are lacking, evidence to date suggests that national-level investment in school meal programs translates into superior coverage. The Global Child Nutrition Foundation survey found positive associations between the percentage of students receiving food, the presence of school meal programs in a country's budget, and the number of years the program had been offered (14). At the individual level, program participation also varies by level of food security: participation in school meal programs is higher in children from food-insecure homes (30).

School meal programs differ based on the nature of food provided (e.g., breakfast, lunch, or snacks), price (regular price, discounted, or free), and whether food is only provided for in-school consumption or also provided for consumption at

home (14, 15). Many, but not all, school meal programs have nutritional standards, which typically focus on providing fruit and vegetables (13), while minimizing less healthy foods. In some cases, nutritional standards for school meal programs have been set at the national level. For example, Mexico, Chile, the United Kingdom, and the United States have adopted national standards for serving fruits and vegetables provided through school meal programs, including restrictions on less healthy foods (31–35).

To date, a majority of studies on school meal programs have been conducted in the United States and Europe, and typically involve primary school students (7). Less evidence exists on the impact of these programs in other countries and in older student populations. Likewise, although universal school meal programs have been found to improve dietary intakes in low-income students (36–40), limited data exist regarding the impact of income-targeted school meal programs on dietary intake (41). Comparative data across countries are even more scarce, because data are not regularly collected and shared across jurisdictions (14). Consequently, there is a need for evidence on participation in school meal programs across countries and cultural contexts, particularly in children at risk of food insecurity (14).

The study reported here examined the self-reported awareness of and participation in free school meal programs, as well as their impact on dietary intake in youth across 6 countries (Australia, Canada, Chile, Mexico, the United Kingdom, and the United States; a summary of school meal programs in each country is presented in **Supplemental Table 1**) using the International Food Policy Study (IFPS). The study had 3 primary hypotheses: 1) the awareness of and participation in school meal programs will be highest in the United States and Chile (countries with the most comprehensive policies) and lowest in Australia and Canada (countries without national school meal programs); 2) students with higher levels of food insecurity will be more likely to report school meal program awareness; and 3) participation in school lunch programs will be associated with higher intake of fruits and vegetables and lower intake of “less healthy” foods at school lunch.

## Methods

Data were collected as part of the 2019 IFPS Youth Survey, a cross-sectional survey of youth aged 10–17 y ( $n = 11,108$ ) from 6 countries (Australia, Canada, Chile, Mexico, the United Kingdom, and the United States). Youth were recruited to complete an online survey through parents/guardians enrolled in the Nielsen Consumer Insights Global Panel and their partners' panels. Parents/guardians with a potentially eligible child were informed about the study, and provided consent for their child's participation. Only 1 child per household was invited. Children were subsequently screened to confirm eligibility, given study information, and provided assent before questionnaire commencement. The target sample size in Canada ( $n = 3500$ ) was higher than other countries to provide greater power for subnational tests between provinces unrelated to the current analysis. A total of 750,034 e-mail invitations were sent to a random sample of adult panelists across countries. The American Association for Public Opinion Research cooperation rate #1 was 76.8%, calculated as the percentage of participants who completed the survey ( $n = 11,108$ ) out of eligible participants who accessed the survey link ( $n = 14,457$ ) (42).

Data collection occurred in November and December 2019. Surveys were conducted in English in Canada, the United States, United Kingdom, and Australia; in Spanish in Mexico, Chile, and the United States; and also in French in Canada. The child's parent/guardian received compensation according to their panel's usual incentive

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This work was supported by an International Health Grant from the Public Health Agency of Canada (PHAC) and a Canadian Institutes of Health Research (CIHR) Project Grant (PJT-162167). The funding agencies played no role in the study design; collection, analysis, or interpretation of data; writing the report; or the decision to submit the report for publication.

Author disclosures: DH has provided paid expert testimony on behalf of public health authorities in response to legal challenges from the food and beverage industry. All other authors report no conflicts of interest.

Supplemental Tables 1 and 2 are available from the “Supplementary data” link in the online posting of the article and from the same link in the online table of contents at <https://academic.oup.com/jn/>.

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structure (e.g., points-based rewards). The study was reviewed by and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE# 41477). A full description of study methodology is available in the 2019 Youth IFPS Technical Report (<http://www.foodpolicystudy.com/methods>) (43).

## Measures

### **School breakfast and lunch programs: awareness and participation.**

Awareness of school breakfast and lunch programs was assessed with proxy measures of “awareness.” Respondents were asked, “Does your school have...a free [breakfast/lunch] program?” with separate questions for breakfast and lunch. If the response was affirmative, participation in a school meal program was assessed by asking: “Do you get food from the [breakfast/lunch] program at your school?” with separate questions for breakfast and lunch, using the response options “Yes,” “No,” “Don’t know,” and “Refuse to answer.” Responses of “Don’t know” were combined with those of “No” for both awareness of and participation in breakfast and lunch programs separately.

### **Dietary intake during school lunches.**

School lunch intake during the previous school day was assessed by asking: “Think about the last time that you ate lunch on a school day. Did you have...?” Yes/No responses were provided for each of 6 categories: fruit or vegetables; sugary drinks; fast food; sugary cereals; snacks like crackers, chips, or granola bars; and desserts or treats like cookies, ice cream, or candy. Responses across all categories except fruit or vegetables were combined to create an index of “less healthy” food intake with a range of 0–5 (where 0 = no “less healthy” foods and 5 = all 5 “less healthy” foods). Sensitivity analyses were also conducted to examine each of the 5 categories separately.

### **Sociodemographic characteristics.**

Sociodemographic measures included age, sex at birth (male, female), and ethnicity. Ethnicity was assessed using country-specific race/ethnicity categories and analyzed as a derived variable to accommodate different measures across countries (majority/minority/unstated). Perceived income adequacy was assessed with the question, “Does your family have enough money to pay for things your family needs?” (Not enough money/Barely enough money/Enough money/More than enough money). “Don’t know” and “Refuse to answer” responses were combined into an “Unstated” category. Food insecurity experience was assessed based on a 10-item scale evaluating measures such as the frequency of worrying about food, changes in meal size, skipping meals, and feeling tired, embarrassed, sad, or hungry due to lack of food. This scale was designed specifically to assess experiences of food insecurity of school-age children and adolescents, and has undergone validation across different countries, languages, and cultural settings. Response options included “never” (0), “1 or 2 times” (1), and “many times” (2). A score of 0–20 was calculated based on respondents’ number of affirmative responses, with a higher number indicating more experiences of food insecurity (0 = “no food insecurity experiences,” 1–6 = “few,” 7–10 = “several,” and 11–20 = “many” food insecurity experiences). Missing values for participants responding to 2–9 items were imputed using single imputation (each item was regressed on the other 9 items) and rounded to the nearest integer, whereas participants responding to 0 items were excluded from analyses.

## Analysis

A total of 11,108 youth completed IFPS surveys across the 6 countries. Participants with missing data for school breakfast and lunch program awareness were excluded (including respondents who indicated they were “not in school”), leaving an analytical sample of 10,565 (Australia: 1364; Canada: 3509; Chile: 1197; Mexico: 1475; United Kingdom: 1464; and United States: 1536). For analyses of school lunch intake measures, 200 additional participants with missing data or those responding “Don’t know” or “Refuse to answer” were excluded, leaving an analytic sample size of 10,365 (Australia: 1344; Canada: 3442;

Chile: 1178; Mexico: 1455; United Kingdom: 1426; and United States: 1520).

Data were weighted with poststratification sample weights constructed using a raking algorithm with population estimates from the census in each country based on age group, sex, region, and ethnicity (except in Canada). Descriptive findings are reported for all outcomes, stratified by country. Four separate binary logistic regression models were conducted to examine differences by country in the awareness of and participation in both breakfast and lunch programs, as well as associations with age, sex, ethnicity, perceived income adequacy, and food insecurity. Two-way interaction variables between country and each of age, sex, ethnicity, perceived income adequacy, and food insecurity were added to the main effects model in a subsequent step.

Regression models examined the association between school lunch program participation and food intake during the lunch on the most recent school day. A binary logistic regression model examined the association between lunch program participation and intake of fruit and vegetables (0 = no, 1 = yes), and a linear regression model examined intake of unhealthy foods during the previous school lunch day (range 0–5 “less healthy” food categories). Country was the primary independent variable in the model, along with age, sex, ethnicity, perceived income adequacy, and food insecurity. In a subsequent step, a 2-way interaction between lunch program participation and country was added to the model.

All estimates reported are weighted and 95% CIs are reported for adjusted ORs (aORs). The *P* value threshold for significance was set to 0.05 for all tests. Analyses were conducted using SAS v9.4 (SAS Institute Inc).

## Results

### **Sample characteristics**

**Table 1** shows sample characteristics overall and by country. Briefly, the average age of participants across countries was ~13 y, and each country contained a slightly higher percentage of male participants, as well as a greater percentage of participants reporting majority ethnicity and having “Enough money.”

### **School breakfast program awareness and participation**

**Figure 1** shows the percentage of participants reporting breakfast program awareness and participation, stratified by country. The percentage of youth reporting awareness of breakfast programs ranged from 13% in Mexico to 73% in the United States, whereas the percentage of youth reporting participation in breakfast programs ranged from 9% in Mexico to 46% in Chile. **Table 2** presents results from the binary logistic regression model for breakfast program awareness and participation across countries and sociodemographic groups.

As shown in **Table 2**, significant differences were observed between countries in breakfast program awareness ( $P < 0.001$ ) and participation ( $P < 0.001$ ). Youth in the United States and Chile were more likely to report awareness of breakfast programs at their school compared with all other countries ( $P < 0.001$  for all contrasts), with higher levels in the United States compared with Chile ( $P < 0.001$ ). Mexican youth were less likely to report breakfast program awareness compared with all other countries ( $P < 0.001$  for all), whereas youth in Canada were marginally more likely to report breakfast program awareness than UK youth ( $P = 0.046$ ). Participation in breakfast programs followed a similar pattern: youth in Chile and the United States were more likely to report participating in school breakfast programs compared with youth from all other countries ( $P < 0.001$ ), and Canadian youth were more likely to report participating in breakfast programs than youth

**TABLE 1** Weighted sociodemographic characteristics in the overall sample and across countries ( $n = 10,565$ )

	Overall ( $n = 10,565$ )	Australia ( $n = 1363$ )	Canada ( $n = 3534$ )	Chile ( $n = 1198$ )	Mexico ( $n = 1446$ )	UK ( $n = 1467$ )	USA ( $n = 1557$ )
Age, y, mean $\pm$ SD	13.4 $\pm$ 2.2	13.3 $\pm$ 2.2	13.4 $\pm$ 2.3	13.5 $\pm$ 2.3	13.3 $\pm$ 2.2	13.3 $\pm$ 2.2	13.5 $\pm$ 2.2
Sex, % ( $n$ )							
Male	50.9 (5374)	51.1 (697)	50.7 (1790)	51.0 (611)	50.4 (728)	51.1 (750)	51.2 (797)
Female	49.1 (5191)	48.9 (666)	49.3 (1744)	49.0 (588)	49.6 (718)	48.9 (717)	48.8 (760)
Ethnicity, <sup>1</sup> % ( $n$ )							
Majority	75.3 (7958)	76.5 (1042)	72.7 (2570)	83.3 (998)	76.4 (1105)	81.9 (1202)	66.9 (1042)
Minority	23.0 (2433)	23.1 (315)	25.4 (897)	14.3 (172)	19.8 (287)	17.3 (254)	32.8 (510)
Unstated	1.6 (173)	0.5 (6)	1.9 (68)	2.4 (29)	3.8 (55)	0.7 (11)	0.3 (5)
Perceived income adequacy, % ( $n$ )							
Not enough money	4.1 (428)	4.7 (64)	2.9 (101)	5.8 (69)	3.4 (50)	4.4 (65)	5.1 (80)
Barely enough money	20.4 (2151)	19.5 (266)	14.4 (510)	25.0 (299)	25.2 (365)	22.3 (327)	24.6 (383)
Enough money	61.0 (6444)	62.2 (848)	60.9 (2153)	64.2 (769)	65.4 (946)	61.2 (898)	53.3 (830)
More than enough money	13.6 (1440)	12.6 (172)	20.5 (724)	4.2 (61)	5.5 (79)	10.9 (160)	16.3 (254)
Not stated	1.0 (101)	1.0 (12)	1.3 (46)	0.9 (11)	0.5 (7)	1.1 (16)	0.6 (9)

<sup>1</sup> Ethnic categories in each country as per census questions asked in each country: 1) Australia majority = only speaks English at home, minority = speaks a language besides English at home; 2) Canada majority = white, minority = other ethnicity; 3) Chile majority = nonindigenous, minority = indigenous; 4) Mexico majority = nonindigenous, minority = indigenous; 5) UK majority = white, minority = other ethnicity; 6) US majority = white, minority = other ethnicity.

in Australia, Mexico, and the United Kingdom ( $P \leq 0.015$  for all contrasts).

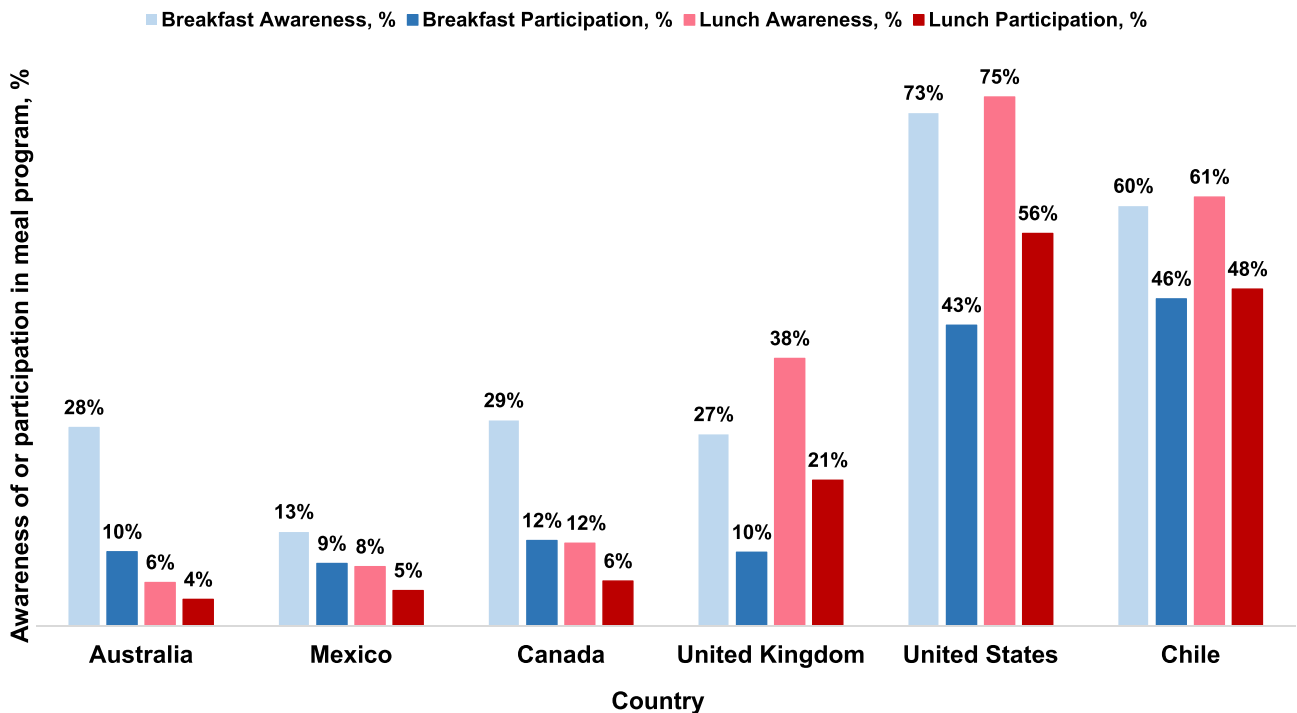
Breakfast program awareness and participation also differed by age and ethnicity. Younger youth and those of minority ethnic groups were more likely to report awareness of and participation in breakfast programs ( $P \leq 0.013$ ). Additionally, youth of majority and minority ethnic groups were each more likely to report breakfast program participation when compared with those of unstated ethnicity ( $P \leq 0.025$ ). Sex was not associated with breakfast program awareness or participation. Regarding income adequacy, significant differences were only observed for breakfast program participation: youth with

“enough” and “barely enough” money were more likely to report participating in breakfast programs than those with unstated income adequacies ( $P \leq 0.041$ ).

As reported in Table 2, results also differed by food insecurity status: higher food insecurity was associated with greater awareness of and participation in breakfast programs for virtually all contrasts. Figure 2 illustrates participation in a breakfast program by food insecurity experiences and country.

#### School lunch program awareness and participation

Figure 1 shows the percentage of participants reporting school lunch program awareness and participation, stratified by



**FIGURE 1** Awareness of and participation in school breakfast and lunch programs in 10–17-y-old students, by country ( $n = 10,565$ ). Australia ( $n = 1363$ ); Mexico ( $n = 1446$ ); Canada ( $n = 3534$ ); United Kingdom ( $n = 1467$ ); United States ( $n = 1557$ ); Chile ( $n = 1198$ ).

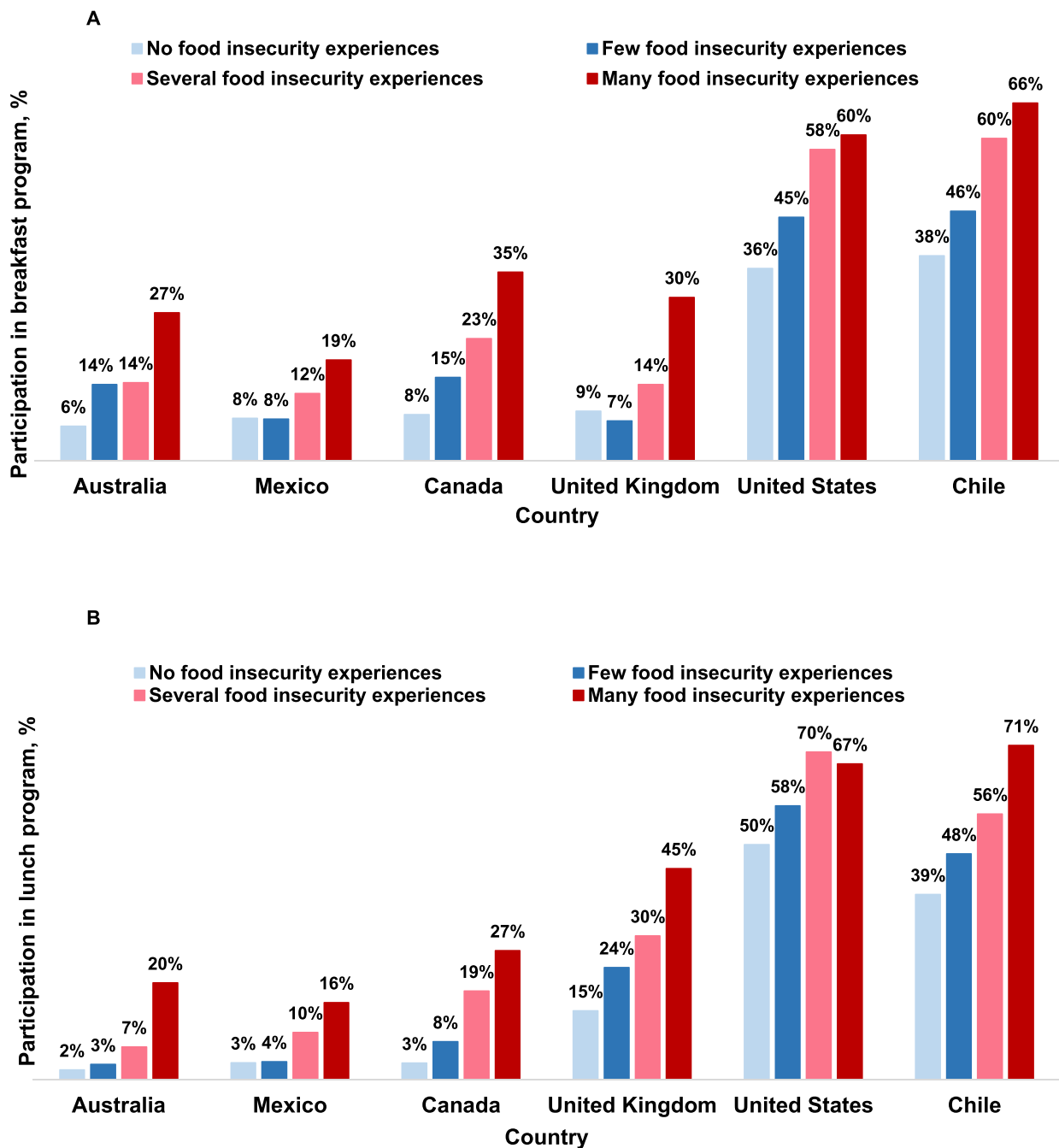
**TABLE 2** Adjusted odds ratios (aOR) (95% CI) for awareness of and participation in school breakfast and lunch programs in 10–17-year-old students (binary logistic regression models; n = 10,565)<sup>1</sup>

Country	Breakfast awareness		Breakfast participation		Lunch awareness		Lunch participation	
	aOR (95% CI)	P value	aOR (95% CI)	P value	aOR (95% CI)	P value	aOR (95% CI)	P value
Mexico	Reference		Reference		Reference		Reference	
Australia	2.70 (2.16, 3.37)	<0.001	1.30 (0.98, 1.74)	0.071	0.74 (0.54, 1.03)	0.074	0.78 (0.52, 1.17)	0.234
Canada	2.98 (2.44, 3.64)	<0.001	1.70 (1.33, 2.17)	<0.001	1.62 (1.26, 2.08)	<0.001	1.53 (1.13, 2.07)	<0.006
Chile	10.02 (8.07, 12.45)	<0.001	9.92 (7.73, 12.74)	<0.001	18.52 (14.41, 23.80)	<0.001	19.49 (14.56, 26.08)	<0.001
UK	2.57 (2.06, 3.20)	<0.001	1.29 (0.97, 1.72)	0.081	7.52 (5.85, 9.66)	<0.001	5.66 (4.19, 7.65)	<0.001
USA	18.50 (14.79, 23.14)	<0.001	8.51 (6.63, 10.92)	<0.001	35.80 (27.62, 46.41)	<0.001	27.23 (20.36, 36.40)	<0.001
Age, y	0.92 (0.90, 0.94)	<0.001	0.88 (0.86, 0.90)	<0.001	0.94 (0.92, 0.96)	<0.001	0.94 (0.91, 0.96)	<0.001
Sex								
Male	Reference		Reference		Reference		Reference	
Female	1.04 (0.95, 1.14)	0.432	0.96 (0.86, 1.07)	0.467	0.92 (0.82, 1.03)	0.144	0.84 (0.74, 0.95)	0.005
Ethnicity <sup>2</sup>								
Majority	Reference		Reference		Reference		Reference	
Minority	1.16 (1.03, 1.31)	0.013	1.35 (1.18, 1.55)	<0.001	1.40 (1.22, 1.62)	<0.001	1.42 (1.23, 1.65)	<0.001
Unstated	0.83 (0.57, 1.21)	0.337	0.52 (0.29, 0.92)	0.025	0.70 (0.43, 1.16)	0.168	0.54 (0.29, 1.03)	0.060
Perceived income adequacy								
Not enough money	Reference		Reference		Reference		Reference	
Barely enough	0.98 (0.77, 1.26)	0.895	1.02 (0.77, 1.35)	0.882	0.92 (0.69, 1.24)	0.583	0.97 (0.72, 1.32)	0.862
Enough money	0.90 (0.70, 1.15)	0.410	1.02 (0.77, 1.35)	0.896	0.92 (0.68, 1.24)	0.594	0.88 (0.65, 1.20)	0.412
More than enough	0.91 (0.69, 1.20)	0.505	0.95 (0.69, 1.32)	0.769	1.13 (0.81, 1.59)	0.474	0.97 (0.68, 1.39)	0.858
Unstated	0.67 (0.39, 1.16)	0.153	0.49 (0.24, 1.03)	0.061	0.52 (0.26, 1.07)	0.076	0.37 (0.17, 0.80)	0.011
Food insecurity experiences								
No food insecurity experiences	0.48 (0.38, 0.60)	<0.001	0.24 (0.19, 0.31)	<0.001	0.31 (0.23, 0.41)	<0.001	0.22 (0.16, 0.29)	<0.001
Few food insecurity experiences	0.59 (0.47, 0.73)	<0.001	0.37 (0.29, 0.46)	<0.001	0.44 (0.33, 0.58)	<0.001	0.35 (0.26, 0.46)	<0.001
Several food insecurity experiences	0.80 (0.62, 1.04)	0.092	0.60 (0.46, 0.80)	<0.001	0.72 (0.52, 0.99)	0.042	0.61 (0.44, 0.84)	0.003
Many food insecurity experiences	Reference		Reference		Reference		Reference	

<sup>1</sup> aOR, adjusted odds ratio.

<sup>2</sup> Ethnic categories in each country as per census questions asked in each country: 1) Australia majority = only speaks English at home, minority = speaks a language besides English at home; 2) Canada majority = white, minority = other ethnicity; 3) Chile majority = nonindigenous, minority = indigenous; 4) Mexico majority = nonindigenous, minority = indigenous; 5) UK majority = white, minority = other ethnicity; 6) US majority = white, minority = other ethnicity.





**FIGURE 2** Percentage of breakfast and lunch program participation in 10–17-y-old students, by food insecurity experiences and country ( $n = 10,565$ ). (A) Breakfast program participation by food insecurity. (B) Lunch program participation by food insecurity. Australia ( $n = 1363$ ); Mexico ( $n = 1446$ ); Canada ( $n = 3534$ ); United Kingdom ( $n = 1467$ ); United States ( $n = 1557$ ); Chile ( $n = 1198$ ).

country. The percentage of youth reporting awareness of lunch programs ranged from 6% in Australia to 75% in the United States, whereas the percentage of youth reporting participation in lunch programs ranged from 4% in Australia to 56% in the United States. Table 2 presents results from the binary logistic regression model for lunch program awareness and participation across countries and sociodemographic groups.

Significant differences in lunch program awareness ( $P < 0.001$ ) and participation ( $P < 0.001$ ) were observed between countries. Participants in the United States were more likely to report lunch program awareness and participation

than all other countries ( $P < 0.001$ ), whereas those in Chile were more likely to report lunch program awareness and participation compared with all other countries except the United States ( $P < 0.001$ ). Participants in the United Kingdom were more likely to report lunch program awareness and participation than youth from Australia, Canada, and Mexico ( $P < 0.001$ ), and those in Canada were more likely to report lunch program awareness and participation than youth from Australia and Mexico ( $P \leq 0.006$ ).

Younger youth ( $P < 0.001$ ) and those of minority ethnicity were more likely to report lunch program awareness and

participation than those of majority and unstated ethnicities ( $P \leq 0.008$ ). Participation in school lunch programs also differed by sex: males were significantly more likely to report participating in lunch programs than females ( $P = 0.005$ ). Participants of unstated income adequacy were least likely to report participating in lunch programs across income adequacies ( $P \leq 0.018$ ). Youth with “more than enough money” were more likely to report awareness of lunch programs at their school than those of “enough money” and “unstated” income adequacies ( $P \leq 0.029$ ).

Figure 2 shows participation in a lunch program by food insecurity experiences and country. Similar to the results observed with breakfast programs, higher food insecurity was associated with greater awareness of and participation in lunch programs for all contrasts.

### **Interactions between country and sociodemographic correlates of school lunch program participation.**

Several 2-way interactions with country were observed, including participation in lunch programs by age [ $F(5) = 3.72$ ;  $P = 0.002$ ], ethnicity [ $F(10) = 18.20$ ;  $P < 0.001$ ], perceived income adequacy [ $F(20) = 29.28$ ;  $P < 0.001$ ], and food insecurity [ $F(15) = 6.05$ ;  $P < 0.001$ ]. Breakfast program awareness and participation, as well as lunch program awareness, followed the same pattern of interaction for all variables, except that ethnicity was not significant for lunch program awareness [ $F(10) = 1.36$ ;  $P > 0.05$ ].

Figure 3 illustrates each of the 2-way interactions. Briefly, participation in lunch programs across countries differed by age and ethnicity. Younger children were more likely to report participating in lunch programs than older children in Canada, Mexico, and the United States ( $P \leq 0.002$ ). Additionally, in Chile and the United States, youth from minority ethnic groups were more likely to report lunch program participation than those of majority ethnic groups compared with other countries (Chile:  $P = 0.001$ ; United States:  $P < 0.001$ ). In Australia ( $P \leq 0.002$ ) and Canada ( $P \leq 0.002$ ), youth with lower income adequacy were less likely to report participating in lunch programs than high-income-adequacy youth, relative to the other countries. In contrast, participants with lower income adequacy were more likely to report lunch program participation in Chile ( $P \leq 0.034$ ) and the United States ( $P \leq 0.036$ ).

Youth with greater levels of food insecurity were significantly more likely to report participating in lunch programs in all countries ( $P \leq 0.044$ ) except the United States, for which no significant effects were observed. Youth reporting “many” food insecurity experiences (compared with “no” and “few”) were significantly more likely to report participating in lunch programs across all countries, except the United States ( $P \leq 0.010$ ). A similar pattern was observed in youth reporting “several” food insecurity experiences (compared with “no” and “few”) in Australia ( $P \leq 0.010$ ), Canada ( $P < 0.001$ ), and Mexico ( $P \leq 0.001$ ), as well as those reporting “few” food security experiences (compared with “no”) in Canada ( $P < 0.001$ ), Chile ( $P = 0.032$ ), and the United Kingdom ( $P < 0.001$ ).

### **Fruit and vegetable intake at lunch**

Figure 4A shows the percentage of youth who reported intake of fruits and vegetables during their most recent school lunch. Across all countries, fruit and vegetable intake was reported by a low of 55.7% of UK youth and a high of 76.5% of youth in Chile. Youth who reported participating in school

lunch programs were more likely to report fruit and vegetable intake than nonparticipants of school lunch programs (aOR = 2.33; 95% CI: 2.01, 2.70;  $P < 0.001$ ), adjusting for country, age, sex, ethnicity, perceived income adequacy, and food security experience level. For models stratified by country, lunch program participants were significantly more likely to report higher fruit and vegetable intake than nonparticipants in Canada (aOR = 1.69; 95% CI: 1.18, 2.43;  $P < 0.005$ ), Chile (aOR = 4.34; 95% CI: 3.07, 6.13;  $P < 0.001$ ), Mexico (aOR = 6.36; 95% CI: 2.93, 13.84;  $P < 0.001$ ), the United Kingdom (aOR = 1.76; 95% CI: 1.31, 2.38;  $P < 0.001$ ), and the United States (aOR = 1.89; 95% CI: 1.45, 2.45;  $P < 0.001$ ), with no significant association in Australia (aOR = 1.52; 95% CI: 0.74, 3.10;  $P = 0.253$ ).

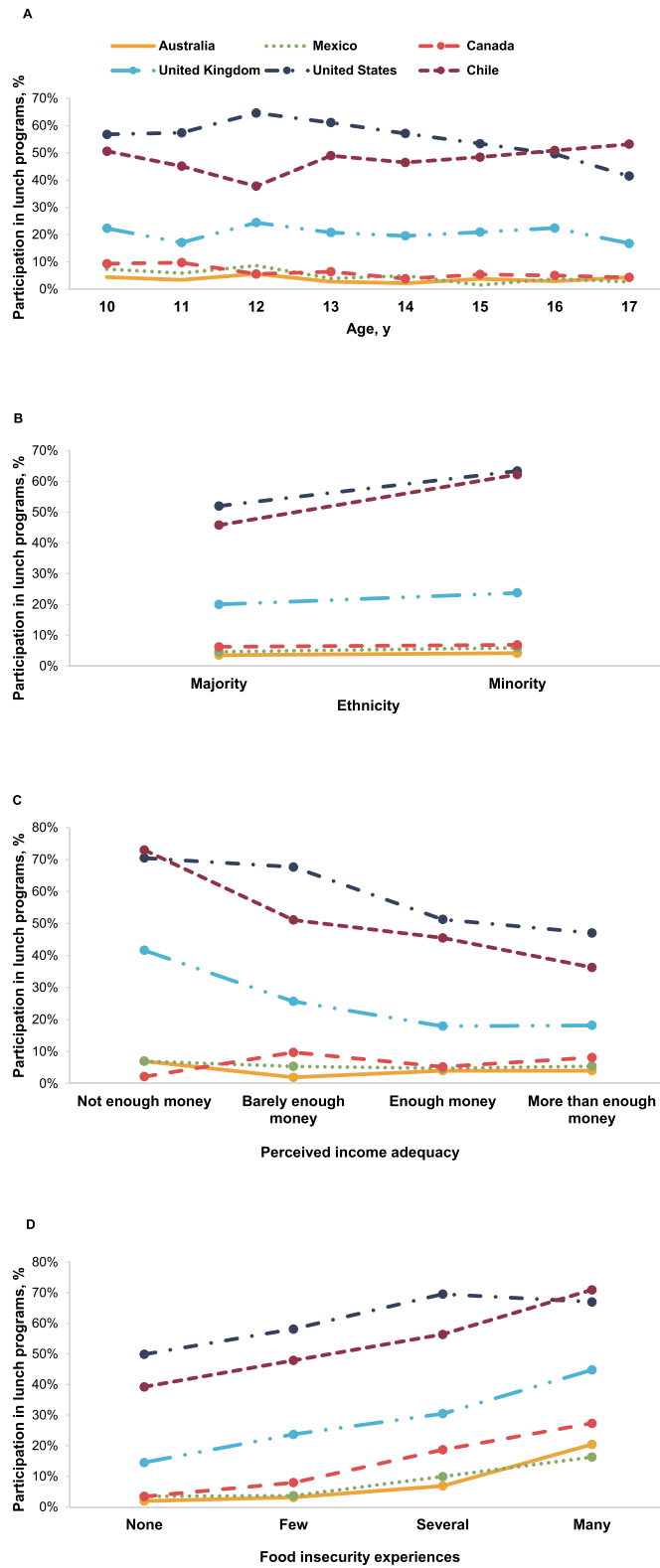
### **“Unhealthy” food intake at lunch**

Figure 4B shows the percentage of participants reporting intake of “less healthy” food during the last time lunch was eaten on a school day, by lunch program participation and country. (Data for each of the 5 types of “less healthy” food intake are presented in Supplemental Table 2.)

Across all countries, an average low of 1.2 and a high of 2.8 “less healthy” foods were reportedly consumed during the last lunch at school by Chilean and Mexican youth who participated in a lunch program, respectively. Similarly, an average low of 1.2 and a high of 2.3 “less healthy” foods were reportedly consumed during the last lunch at school by Chilean and Mexican youth who did not participate in a lunch program, respectively. Overall, youth who reported participating in school lunch programs also reported significantly higher intake of “less healthy” food during school lunch than nonparticipants ( $\beta = 0.210$ ; 95% CI: 0.129, 0.292;  $P < 0.001$ ), adjusting for country, age, sex, ethnicity, perceived income adequacy, and food security experience level. When models were stratified by country, school lunch program participation was associated with a higher intake of “less healthy” food in Australia ( $\beta = 0.931$ ; 95% CI: 0.409, 1.454;  $P < 0.001$ ), Canada ( $\beta = 0.588$ ; 95% CI: 0.396, 0.781;  $P < 0.001$ ), Mexico ( $\beta = 0.467$ ; 95% CI: 0.101, 0.832;  $P = 0.012$ ), and the United Kingdom ( $\beta = 0.443$ ; 95% CI: 0.270, 0.616;  $P < 0.001$ ), with no significant association in Chile ( $\beta = -0.070$ ; 95% CI:  $-0.237$ , 0.098;  $P = 0.414$ ) or the United States ( $\beta = 0.002$ ; 95% CI:  $-0.141$ , 0.145;  $P = 0.977$ ).

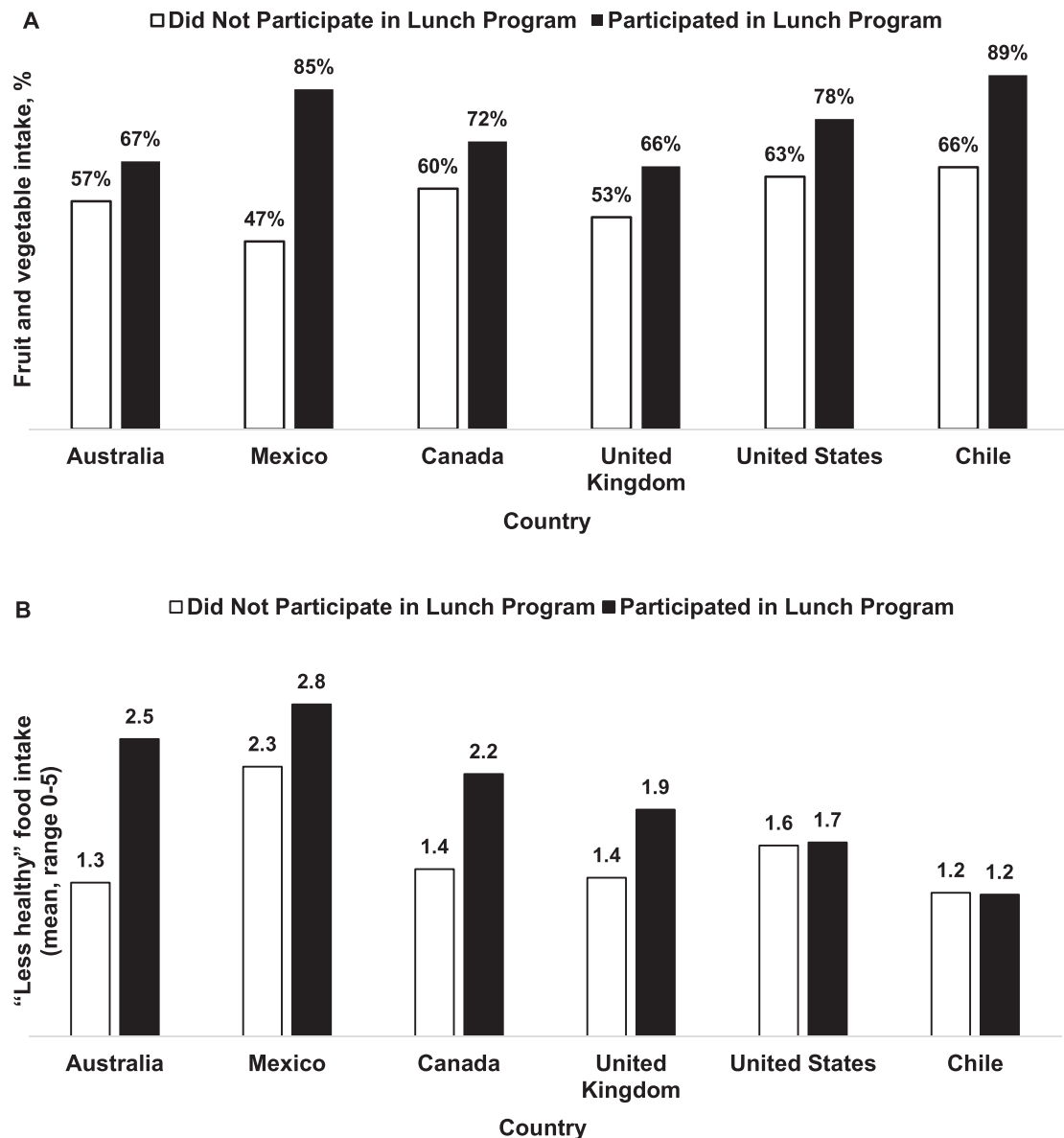
## **Discussion**

School meal programs are an important means of promoting healthy diets and minimizing the impact of food insecurity in children and youth (7, 44). The current study is among the first to directly compare use of free school meal programs across countries, with several notable findings. First, marked differences were observed in student awareness of and participation in school meal programs across countries, including participation among students at greatest risk of food insecurity. As described below, these differences are consistent with the strength of national school meal policies in each country. Second, participation in a school meal program was associated with higher fruit and vegetable intake during school lunch in all countries. Third, participation was associated with a higher likelihood of eating “less healthy” foods in all countries except the United States and Chile—the 2 countries with the most comprehensive school meal policies. The implications of these findings are discussed below.



**FIGURE 3** Percentage of lunch program participation in 10–17-y-old students, by age, ethnicity, perceived income adequacy, and food insecurity experiences across country ( $n = 10,565$ ). (A) Participation in lunch programs across countries by age (% yes). (B) Participation in lunch programs across countries by ethnicity (% yes). (C) Participation in lunch programs across countries by perceived income adequacy (% yes). (D) Participation in lunch programs across countries by food insecurity experiences (% yes). Participants responding “Not stated” (“Don’t know”/“Refuse to answer”) were excluded from the Figure due to small sample sizes. Ethnic categories in each country as per census questions asked in each country: 1) Australia majority = only speaks English at home, minority = speaks a language besides English at home; 2) Canada majority = white, minority = other ethnicity; 3) Chile majority = nonindigenous, minority = indigenous; 4) Mexico majority = nonindigenous, minority = indigenous; 5) UK majority = white, minority = other ethnicity; 6) US majority = white, minority = other ethnicity. Australia ( $n = 1363$ ); Mexico ( $n = 1446$ ); Canada ( $n = 3534$ ); United Kingdom ( $n = 1467$ ); United States ( $n = 1557$ ); Chile ( $n = 1198$ ).





**FIGURE 4** (A) Percentage of fruits and vegetables and (B) mean “less healthy” food intake at lunchtime in 10–17-y-old students, by lunch program participation and country ( $n = 10,365$ ). (A) Percentage of respondents who reported any fruit and vegetable intake during the last lunch on a school day. (B) Mean “less healthy” food intake during the last lunch on a school day. An index of “less healthy” food intake was created with range of 0–5 (where 0 = no “less healthy” foods and 5 = all 5 “less healthy” foods, including sugary drinks; fast food; sugary cereals; snacks like crackers, chips, or granola bars; and desserts or treats like cookies, ice cream, or candy). Australia ( $n = 1340$ ); Mexico ( $n = 1425$ ); Canada ( $n = 3471$ ); United Kingdom ( $n = 1426$ ); United States ( $n = 1522$ ); Chile ( $n = 1181$ ).

### Country differences in awareness and participation in school meal programs

Across all measures, youth in the United States and Chile consistently reported greater awareness and use of school meal programs, as hypothesized. For example, approximately half of students in the United States and Chile participated in school lunch programs, compared with one-fifth of students in the United Kingdom, and ~5% in Australia, Canada, and Mexico. Estimates within each country are generally consistent with previous studies. In Canada, school-based surveys in 2014–15 found that 16% of secondary students participated in a school breakfast program (45), similar to the estimate of 12% in the current study. The current findings are also similar to previous estimates from England (~14% free school meal participation rate in 2011–2012) (46) and Australia

(28% breakfast participation compared with 21% breakfast club participation in Victoria, Australia in 2018) (47). In the United States, a previous study found that 37% of students received free or reduced-price breakfast on a typical school day in 2016–2017, similar to our finding of 43%; however, the reported lunch participation was higher than our estimate (71% compared with 56%) (48).

In all 6 countries, there was evidence that school meal programs are targeted according to need, as was hypothesized for countries with national-level policies. Participation in school breakfast and lunch programs was higher among students from households with higher levels of food insecurity and income adequacy. However, there were marked differences in participation across countries among those in greatest need. In the United States and Chile, more than two-thirds of children

and youth with the highest level of food insecurity received food from free school lunch programs, compared with 45% in the United Kingdom, 27% in Canada, and  $\leq 20\%$  in Australia and Mexico. Participation in school lunch programs was even lower for youth with less severe, but still tangible, experiences with food insecurity. Thus, with the notable exception of the United States and Chile, the vast majority of children experiencing food insecurity in our study were not being reached by school meal programs. Previous research suggests that universal school meal programs not only have broader reach across all socioeconomic strata, but are also more effective in reaching those most in need (40, 44, 49).

The pattern of findings between countries is consistent with previous research indicating the importance of national-level food policies (2, 50, 51). Among the 6 countries in the current study, the United States and Chile had the most comprehensive national school meal policies with the greatest coverage across students, compared with less comprehensive national policies in the United Kingdom and Mexico, and no national policies in Australia or Canada. In the United Kingdom, free school meals were universally available for 4–7-y-olds in 2021, which were not assessed in the current study; however, among the older children and youth included in the IFPS sample, free school meals are typically only available based on financial need. In Mexico, resources for implementing school meal programs in the country's 232,876 schools are limited: most schools are half-time and have no infrastructure for hot meals, whereas approximately one-quarter do not have access to water (52, 53). Thus, school meal programs are primarily targeted at a smaller proportion of the most vulnerable students, with ongoing efforts to expand program participation (21, 54). The low rates of school meal participation in Australia and Canada reflect the lack of national school meal policy in either country. In the absence of national standards, community organizations and local initiatives in these countries often provide free or subsidized food programs; however, the current findings suggest these initiatives are ineffective substitutes for comprehensive national programs. Other factors beyond program awareness and availability might also affect uptake of free school meal programs, including the appeal of menu options, length of the lunch period, and multicomponent interventions that include nutritional education (51, 55–57).

### **Participation in school lunch programs and healthy compared with “less healthy” intake from school lunches**

Participation in free school meal programs was associated with a greater likelihood of fruit and vegetable intake during school lunches, as hypothesized. Students who reported participating in school lunch programs had more than twice the odds of reporting fruit and vegetable intake during their most recent school lunch compared with students not participating in school lunch programs. This is consistent with previous research that found school meals often offer healthier options than meals packed at home (51). One US study found that students eligible for but not participating in free school meal programs consumed less healthy lunches than free school meal participants, including nearly 60% more calories and total fat, twice as much added sugar, and less than half the fruit (58).

Free school meals can be particularly beneficial in supporting healthy dietary intake in students of low socioeconomic status or food-insecure homes, who often consume lower levels of fruits and vegetables (12, 51). In our study, the positive

association between free school meal participation and fruit and vegetable intake at lunch was observed in all countries, but was most pronounced in Chile and Mexico, the 2 “upper-middle-income” countries in the IFPS. Overall, the findings are consistent with the principle that school meal programs are particularly important in countries or regions with higher levels of food insecurity (4).

A high percentage of youth reported consuming “less healthy” foods during the most recent school lunch. In contrast to the original hypothesis, participating in a school lunch program was associated with an increased likelihood of eating “less healthy” food in the previous school lunch. The survey question used to assess intake during the previous school lunch did not specify the source of food; therefore, “less healthy” foods could have been provided through a school meal program, from home, or purchased from a school cafeteria or vending machine (59). Notably, the association between school lunch programs and “less healthy” food intake was observed in all countries except the United States and Chile—the 2 countries with the most well-developed national school meal programs. Chile also had a substantially lower overall level of “less healthy” food intake compared with all other countries, which could reflect Chile's comprehensive school nutrition standards that restrict the sale of foods high in sugar, sodium, and saturated fat (60). Australia, Canada, and the United Kingdom also have nutritional standards applied to food sold in schools; however, implementation and compliance with these standards varies across regions (29, 59, 61, 62). Overall, the findings underscore the importance of comprehensive school nutrition policies that provide healthy foods *and* restrict the availability of unhealthy foods (55).

### **Limitations**

This study is subject to limitations common to survey research. Respondents were recruited using non-probability-based sampling; therefore, the findings do not provide nationally representative estimates. However, quota sampling and poststratification weights were constructed using age group, sex, and region in all countries, as well as ethnicity in all countries except Canada. The prevalence of self-reported overweight and obesity was also similar between the IFPS samples and national benchmark surveys in each country (43). Regarding measures, awareness of free school meal programs was based on respondents' self-report, and availability was not objectively verified. Accordingly, the current estimates should not be interpreted as the number of schools in which free school meal programs are offered; it is likely that some respondents were unaware of programs, particularly those from higher income, food-secure households. Nevertheless, awareness of free school lunch programs is an important outcome in its own right: if a student is unaware of a free program, they cannot participate regardless of need. In addition, school lunch intake was assessed on the “last school day” and is subject to recall biases and errors. Although validated food frequency and dietary recall tools often ask about the past 24-h or 7-d period, the current measures asking about the previous school lunch require further validation (63). Additionally, because the question did not specifically relate to food provided by the lunch program, the “less healthy” food might have come from another source (e.g., vending machine). Furthermore, because measures of school lunch intake only included 2 items outside the “unhealthy” food category (fruits and vegetables), future studies should determine consumption levels for a wider variety

of foods commonly considered to be “healthy” (e.g., lower-fat dairy, less processed, lower-fat meat, poultry, or fish, or nutrient-dense foods including nuts or legumes); however, it must be noted that there is currently no standard definition of “healthy” or “unhealthy” foods (e.g., classifications include nutrient content or level of processing) (64). In addition to dietary intakes, future studies should also evaluate well-being and learning outcomes (e.g., hunger, attention, educational achievement, or attendance), because these are key goals for school meal programs (65). Finally, the age range of the study sample was 10 to 17 and did not include younger primary school children, which could have altered participation rates given a greater emphasis on younger students in some countries. Thus, future research should include younger children as well.

Ideally, future research would combine nationally representative surveys with established dietary recall methods to better examine the reach and healthfulness of free school meal programs. Future studies should examine the impact of school meal programs within the context of overall diet (66). Also, future studies should consider the impact of multicomponent policies on nutrition attitudes and behaviors, as well as compliance with existing nutritional standards (50, 59).

## Conclusions

The current study indicates marked differences in free school meal program participation across countries. Participation in breakfast and lunch programs was substantially higher in participants from countries with comprehensive national school meal policies, including the United States and Chile. In contrast, few children and youth from countries without national policies, such as Canada and Australia, reported receiving free school meals, including those from households experiencing high food insecurity and low perceived income adequacy. This pattern of findings is particularly notable given that, unlike Mexico, Canada and Australia are high-income countries with the resources to adequately fund comprehensive school meal programs. Recently, the COVID-19 pandemic has highlighted the importance of school meal programs, particularly in disadvantaged communities, prompting countries such as the United Kingdom and New Zealand to expand their school meal programs (67). Overall, the findings highlight an important gap in efforts to promote child nutrition, health, and learning, and an opportunity to reduce a critical source of disparity in child health.

## Acknowledgments

The authors’ responsibilities were as follows—DH, LV, CMW: designed and conducted research; KH, DH: analyzed data and wrote the paper; SB, CC, SG, GS, LV, CMW, MW: reviewed and edited the paper; DH: had primary responsibility for final content; and all authors: read and approved the final manuscript.

## Data Availability

Data described in the manuscript, code book, and analytic code will be made available upon request pending review by the Principal Investigator (DH).

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