

Awareness of and participation in school food programs among youth from six countries

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International Food Policy Study (IFPS)

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ABSTRACT

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

Objective—To examine self-reported awareness of and participation in free school meal programs, and associations with dietary intake among youth from six countries with differing national school meal policies.

Methods—Data were collected through the 2019 International Food Policy Study (IFPS) Youth Survey, a cross-sectional survey of 10,565 youth aged 10-17 y from Australia, Canada, Chile, Mexico, the United Kingdom (UK), and the United States (US). 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 to one fifth of students in the UK, and approximately 5% in Australia, Canada, and Mexico ($p < 0.001$ for all contrasts). In the US and Chile, more than two thirds of youth with the highest level of food insecurity participated in lunch programs, compared to 45% in the UK, 27% in Canada, and 20% or less 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

25 lunch ($p<0.001$), and higher intake of ‘less healthy’ food in all countries except the US and
26 Chile.

27

28 **Conclusions**—More comprehensive national policies were associated with greater participation
29 in school meals programs, particularly among youth at greatest risk of food insecurity, as well as
30 healthier dietary intake from school lunch.

31

32 **Keywords**

33 Breakfast

34 Children

35 Food insecurity

36 Free school meal

37 Lunch

38 School meal program

39 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 among 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 half of their daily calories while at school.(8,9) Accordingly, the World Health Organization and other agencies have emphasized the importance of school environments in preventing childhood obesity and diet-related non-communicable diseases.(10,11) School-based meal programs represent an opportunity to promote healthy dietary intake and address food insecurity among young people.(7,12) A recent 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 (US), approximately 95% of schools participate in school meal programs (coordinated by the federal US Department of Agriculture), which provide free breakfasts and lunches to eligible students based on low income.^(16–18) In addition, US schools with at least 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 approximately 80% of the most vulnerable groups attending public or public-private schools.⁽²⁰⁾ Mexico offers a hot or cold breakfast program to children in pre-school, primary and middle school from vulnerable and marginalized communities.⁽²¹⁾ In addition to differences between countries, free school meal program availability may differ within countries. In the United Kingdom (UK), 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 years, 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)

While 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 among 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 UK, and the US 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 US and Europe, and typically involve primary school students.(7) Less evidence exists on the impact of these programs in other countries and among older student populations. Likewise, while universal school meal programs have been found to improve dietary intakes among 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, as 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 among children at risk for 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 among youth across six countries (Australia, Canada, Chile, Mexico, UK, and US; a summary of school meal programs in each country is presented in Supplementary Table 1) using the International Food Policy Study (IFPS). The study had three primary hypotheses: 1) the awareness of and participation in school meal programs will be highest in the US 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 six countries (Australia, Canada, Chile, Mexico, the UK, and the US). 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 one 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 ($n = 3,500$) was higher than other countries to provide greater power for subnational tests between provinces unrelated to the current analysis.

A total of 750,034 email 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 US, UK and Australia, Spanish in Mexico, Chile, and the US, as well as French in Canada. The child's parent/guardian received compensation according to their panel's usual incentive 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 programs 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.

159 *Dietary intake during school lunches*

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

168

169 *Socio-demographic characteristics*

170 Sociodemographic measures included age, sex-at-birth (male, female), and ethnicity. Ethnicity
 171 was assessed using country-specific race/ethnicity categories and analysed as a derived variable
 172 to accommodate different measures across countries (majority/minority/unstated). Perceived
 173 income adequacy was assessed with the question “Does your family have enough money to pay
 174 for things your family needs?” (Not enough money/Barely enough money/Enough money/More
 175 than enough money). “*Don’t know*” and “*Refuse to answer*” responses were combined into an
 176 “Unstated” category. Food insecurity experience was assessed based on a 10-item scale
 177 evaluating measures such as the frequency of worrying about food, changes in meal size,
 178 skipping meals, and feeling tired, embarrassed, sad, or hungry due to lack of food. This scale was
 179 designed specifically to assess experiences of food insecurity of school-age children and
 180 adolescents, and has undergone validation across different countries, languages, and cultural
 181 settings.(44) Response options included “never” (0), “1 or 2 times” (1) and “many times” (2). A
 182 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).(45)

Missing values for participants responding to 2-9 items were imputed using single imputation (each item was regressed on the other nine items) and rounded to the nearest integer, while participants responding to 0 items were excluded from analyses.

Analysis

A total of 11,108 youth completed IFPS surveys across the six 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: 1,364; Canada: 3,509; Chile: 1,197; Mexico: 1,475; UK: 1,464; and US: 1,556). 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: 1,344; Canada: 3,442; Chile: 1,178; Mexico: 1,455; UK: 1,426; and US: 1,520).

Data were weighted with post-stratification 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 two-way interaction between lunch program participation and country was added to the model.

All estimates reported are weighted and 95% confidence intervals are reported for adjusted odds ratios. The *p* value threshold for significance was set to 0.05 for all tests. Analyses were conducted using SAS v9.4 (SAS Institute Inc., North Carolina).

RESULTS

Sample characteristics

Table 1 shows sample characteristics overall and by country. Briefly, the average age of participants across countries was approximately 13 years, 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 US, while 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 US and Chile were more likely to report awareness of breakfast programs at their school compared to all other countries ($p<0.001$ for all contrasts), with higher levels in the US versus Chile ($p<0.001$). Mexican youth were less likely to report breakfast program awareness compared to all other countries ($p<0.001$ for all), while youth in Canada were more 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 US were more likely to report participating in school breakfast programs compared to youth from all other countries ($p<0.001$), and Canadian youth were more likely to report participating in breakfast programs than youth in Australia, Mexico, and the UK ($p\leq 0.015$ 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 to 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 programs 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 country. The percentage of youth reporting awareness of lunch programs ranged from 6% in Australia to 75% in the US, while the percentage of youth reporting participation in lunch programs ranged from 4% in Australia to 56% in the US. 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 US were more likely to report lunch program awareness and participation than all other countries ($p < 0.001$), while those in Chile were more likely to report lunch program awareness and participation compared to all other countries except the US ($p < 0.001$). Participants in the UK were more likely to report lunch program awareness and participation than youth from Australia, Canada, and Mexico ($p < 0.001$), and those in Canada 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 two-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 two-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 US ($p \leq 0.002$). Additionally, in Chile and the US, youth from minority ethnic groups more likely to report lunch program participation than those of majority ethnic groups compared to other countries (Chile: $p = 0.001$; US: $p < 0.001$). 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 US ($p \leq 0.036$).

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 US, for which no significant effects were observed. Youth reporting 'many' food insecurity experiences (compared to 'no' and 'few') were significantly more likely to report participating in lunch programs across all countries, except the US ($p \leq 0.010$). A similar pattern was observed among youth reporting 'several' food insecurity experiences (compared to '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 to 'no') in Canada ($p < 0.001$), Chile ($p = 0.032$), and the UK ($p < 0.001$).

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% youth in Chile. Youth who reported participating in school lunch programs were more likely to report fruit and vegetable intake than non-

participants 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 non-participants 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; $P < 0.001$), UK (aOR: 1.76; 95% CI: 1.31, 2.38; $P < 0.001$), and US (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 **Supplementary 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 non-participants (β : 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 (β : 0.931; 95% CI: 0.409,

1.454; $P < 0.001$), Canada (β : 0.588; 95% CI: 0.396, 0.781; $P < 0.001$), Mexico (β : 0.467; 95% CI: 0.101, 0.832; $P = 0.012$), and the UK (β : 0.443; 95% CI: 0.270, 0.616; $P < 0.001$), with no significant association in Chile (β : -0.070; 95% CI: -0.237, 0.098; $P = 0.414$) or the US (β : 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 among children and youth.^(7,46) 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 US and Chile—the two countries with the most comprehensive school meal policies. The implications of these findings are discussed below.

Country differences in awareness and participation in school meal programs

Across all measures, youth in the US and Chile consistently reported greater awareness and use of school meal programs, as hypothesized. For example, approximately half of students in the US and Chile participated in school lunch programs, compared to one fifth of students in the UK, and approximately 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,(47) 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)(48) and Australia (28% breakfast participation vs. 21% breakfast club participation in Victoria, Australia in 2018).(49) In the US, a previous study found that 37% of students received free or reduced priced 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% vs. 56%).(50)

In all six 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 US 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 to 45% in the UK, 27% in Canada, and 20% or less 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 US and Chile, the vast majority of children experiencing food insecurity in our study are not being reached by school meal programs. Previous research suggest 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.(40,51,52)

The pattern of findings between countries is consistent with previous research indicating the importance of national-level food policies.(2,53,54) Among the six countries in the current study,

the US and Chile had the most comprehensive national school meal policies with the greatest coverage across students, compared to less comprehensive national policies in the UK and Mexico, and no national policies in Australia or Canada. In the UK, free school meals were universally available for 4-7 year-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, while approximately one quarter do not have access to water.(55,56) Thus, school meal programs are primarily targeted at a smaller proportion of the most vulnerable students, with ongoing efforts to expand program participation.(21,57) 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 may 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.(54,58–60)

Participation in school lunch programs and healthy versus '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 to students not participating in school lunch

programs. This is consistent with previous research that has found school meals often offer healthier options than meals packed at home.(54) One US study found that students eligible 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.(61)

Free school meals may be particularly beneficial in supporting healthy dietary intake among students of low socioeconomic status or food-insecure homes, who often consume lower levels of fruits and vegetables.(12,54) 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 two ‘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.(62) Notably, the association between school lunch programs and ‘less healthy’ food intake was observed in all countries except the US and Chile—the two countries with the most well-developed national school meal programs. Chile also had a substantially lower overall level of ‘less healthy’ food intake compared to all other countries, which may reflect Chile’s comprehensive school nutrition

standards that restrict the sale of foods high in sugar, sodium, and saturated fat.(63) Australia, Canada, and the UK also have nutritional standards are applied to food sold in schools; however, implementation and compliance with these standards varies across regions.(29,62,64,65) Overall, the findings underscore the importance of comprehensive school nutrition policies that provide healthy foods *and* restrict the availability of unhealthy foods.(58)

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 post-stratification 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-hour or 7-day period, the current measures asking about the previous school lunch require further validation.(66) Additionally, as 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, as measures of school lunch intake only included two 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).(67) In addition to dietary intakes, future studies should also evaluate well-being and learning outcomes (e.g., hunger, attention, educational achievement, or attendance), as these are key goals for school meal programs.(68) 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.(69) Also, future studies should consider the impact of multicomponent policies on nutrition attitudes and behaviours, as well as compliance with existing nutritional standards.(53)(62)

Conclusions

The current study indicates marked differences in free school meal program participation across countries. Participation in breakfast and lunch programs was substantially higher among participants from countries with comprehensive national school meal policies, including the US and Chile. In contrast, few children and youth from countries without national policies, such as

493 Canada and Australia, reported receiving free school meals, including those from households
494 experiencing high food insecurity and low perceived income adequacy. This pattern of findings
495 is particularly notable given that, unlike Mexico, Canada and Australia are high income countries
496 with the resources to adequately fund comprehensive school meal programs. Recently, the
497 COVID19 pandemic has highlighted the importance of school meal programs, particularly
498 among disadvantaged communities, prompting countries such as the UK and New Zealand to
499 expand their school meal programs.(70) Overall, the findings highlight an important gap in
500 efforts to promote child nutrition, health and learning, and an opportunity to reduce a critical
501 source of disparity in child health.

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503

504 Statement of authors' contributions to manuscript:

505 DH, LV, CMW designed and conducted research; KH, DH analyzed data and wrote the paper;

506 SB, CC, SG, GS, LV, CMW, MW reviewed and edited the paper; DH had primary responsibility

507 for final content. All authors have read and approved the final manuscript.

508

509 Data Sharing:

510 Data described in the manuscript, code book, and analytic code will be made available upon

511 request pending review by the Principal Investigator (Dr. Hammond).

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TABLES & FIGURES

Table 1 Weighted sociodemographic characteristics among the overall sample and across countries (N = 10,565)

	Overall (N= 10,565)	Australia (n=1,363)	Canada (n=3,534)	Chile (n=1,198)	Mexico (n=1,446)	UK¹ (n=1,467)	US¹ (n=1,557)
Age (years)							
Mean (SD) ¹	13.4 (2.2)	13.3 (2.2)	13.4 (2.3)	13.5 (2.3)	13.3 (2.2)	13.3 (2.2)	13.5 (2.2)
Sex, % (n)							
Male	50.9 (5,374)	51.1 (697)	50.7 (1,790)	51.0 (611)	50.4 (728)	51.1 (750)	51.2 (797)
Female	49.1 (5,191)	48.9 (666)	49.3 (1,744)	49.0 (588)	49.6 (718)	48.9 (717)	48.8 (760)
Ethnicity,² % (n)							
Majority	75.3 (7,958)	76.5 (1,042)	72.7 (2,570)	83.3 (998)	76.4 (1,105)	81.9 (1,202)	66.9 (1,042)
Minority	23.0 (2,433)	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 (2,151)	19.5 (266)	14.4 (510)	25.0 (299)	25.2 (365)	22.3 (327)	24.6 (383)
Enough money	61.0 (6,444)	62.2 (848)	60.9 (2,153)	64.2 (769)	65.4 (946)	61.2 (898)	53.3 (830)
More than enough money	13.6 (1,440)	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)

¹ SD=Standard deviation; UK=United Kingdom; US=United States.

² 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 =Non-indigenous, minority=indigenous 4) Mexico majority=Non-indigenous, minority=indigenous; 5) UK majority=White, minority=other ethnicity; 6) US majority=White, minority=other ethnicity.

Table 2 Adjusted Odds Ratios (aOR) (95% confidence intervals (CI)) for awareness of and participation in school breakfast and lunch programs among 10 – 17-year-old students (binary logistic regression models; N = 10,565).¹

	Breakfast Awareness		Breakfast Participation		Lunch Awareness		Lunch Participation	
	aOR (95% CI)	<i>p</i> value	aOR (95% CI)	<i>p</i> value	aOR (95% CI)	<i>p</i> value	aOR (95% CI)	<i>p</i> value
Country								
Mexico	Reference		Reference		Reference		Reference	
Australia	2.70 (2.16, 3.37)	<.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)	<.001	1.70 (1.33, 2.17)	<.001	1.62 (1.26, 2.08)	<.001	1.53 (1.13, 2.07)	<.006
Chile	10.02 (8.07, 12.45)	<.001	9.92 (7.73, 12.74)	0.086	18.52 (14.41, 23.80)	<.001	19.49 (14.56, 26.08)	<.001
UK ¹	2.57 (2.06, 3.20)	<.001	1.29 (0.97, 1.72)	0.081	7.52 (5.85, 9.66)	<.001	5.66 (4.19, 7.65)	<.001
US ¹	18.50 (14.79, 23.14)	<.001	8.51 (6.63, 10.92)	<.001	35.80 (27.62, 46.41)	<.001	27.23 (20.36, 36.40)	<.001
Age (year)	0.92 (0.90, 0.94)	<.001	0.88 (0.86, 0.90)	<.001	0.94 (0.92, 0.96)	<.001	0.94 (0.91, 0.96)	<.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
Ethnicity²								
Majority	Reference		Reference		Reference		Reference	
Minority	1.16 (1.03, 1.31)	0.013	1.35 (1.18, 1.55)	<.001	1.40 (1.22, 1.62)	<.001	1.42 (1.23, 1.65)	<.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)	<.001	0.24 (0.19, 0.31)	<.001	0.31 (0.23, 0.41)	<.001	0.22 (0.16, 0.29)	<.001

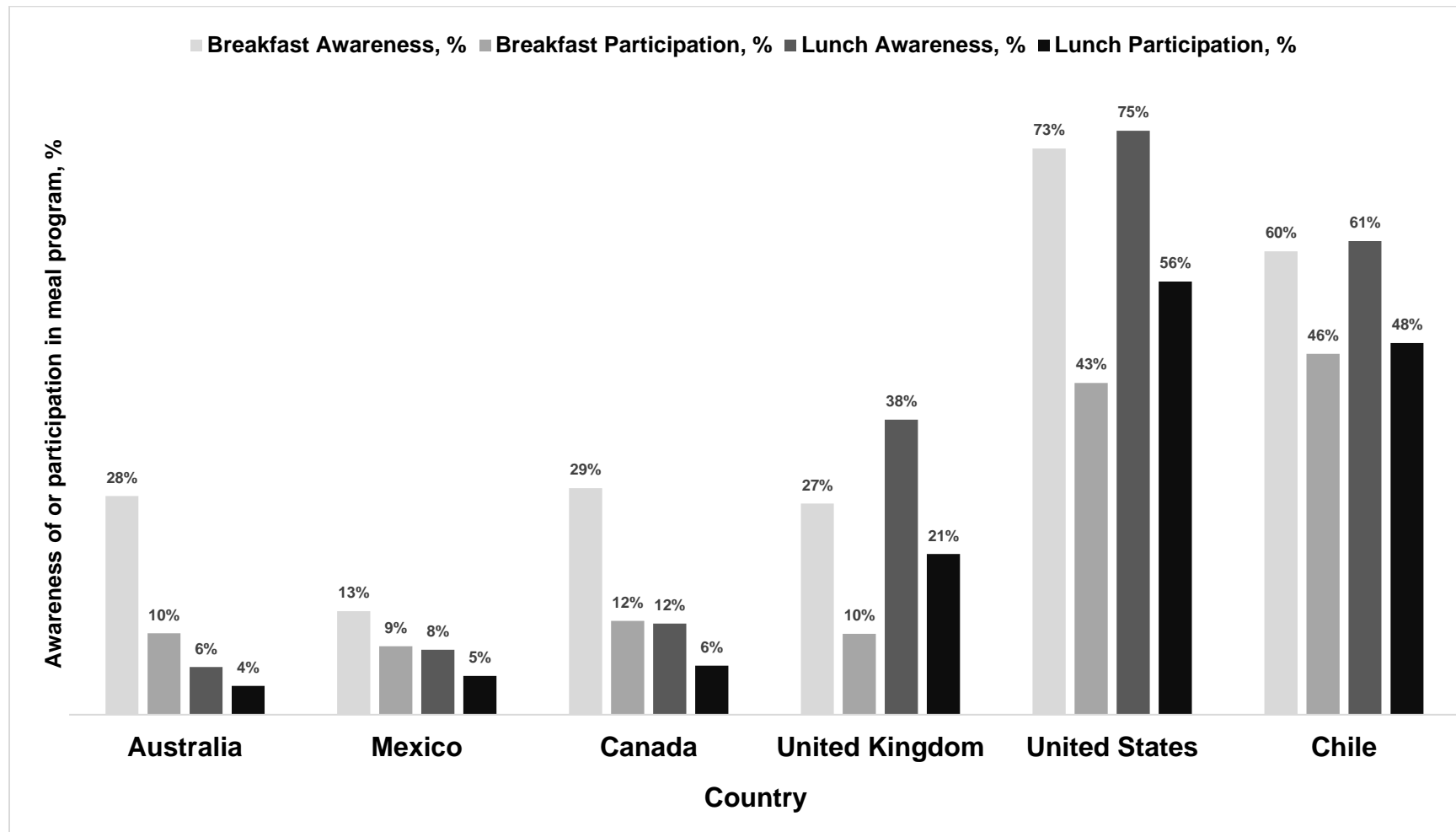
Few food insecurity experiences	0.59 (0.47, 0.73)	<.001	0.37 (0.29, 0.46)	<.001	0.44 (0.33, 0.58)	<.001	0.35 (0.26, 0.46)	<.001
Several food insecurity experiences	0.80 (0.62, 1.04)	0.092	0.60 (0.46, 0.80)	<.001	0.72 (0.52, 0.99)	0.042	0.61 (0.44, 0.84)	0.003
Many food insecurity experiences	Reference		Reference		Reference		Reference	

¹ aOR =Adjusted Odds Ratio; CI=Confidence Interval; UK=United Kingdom; US=United States.

² 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 =Non-indigenous, minority=indigenous 4) Mexico majority=Non-indigenous, minority=indigenous; 5) UK majority=White, minority=other ethnicity; 6) US majority=White, minority=other ethnicity.

Figure 1 Awareness of and participation in school breakfast and lunch programs among 10-17-year-old students, by country

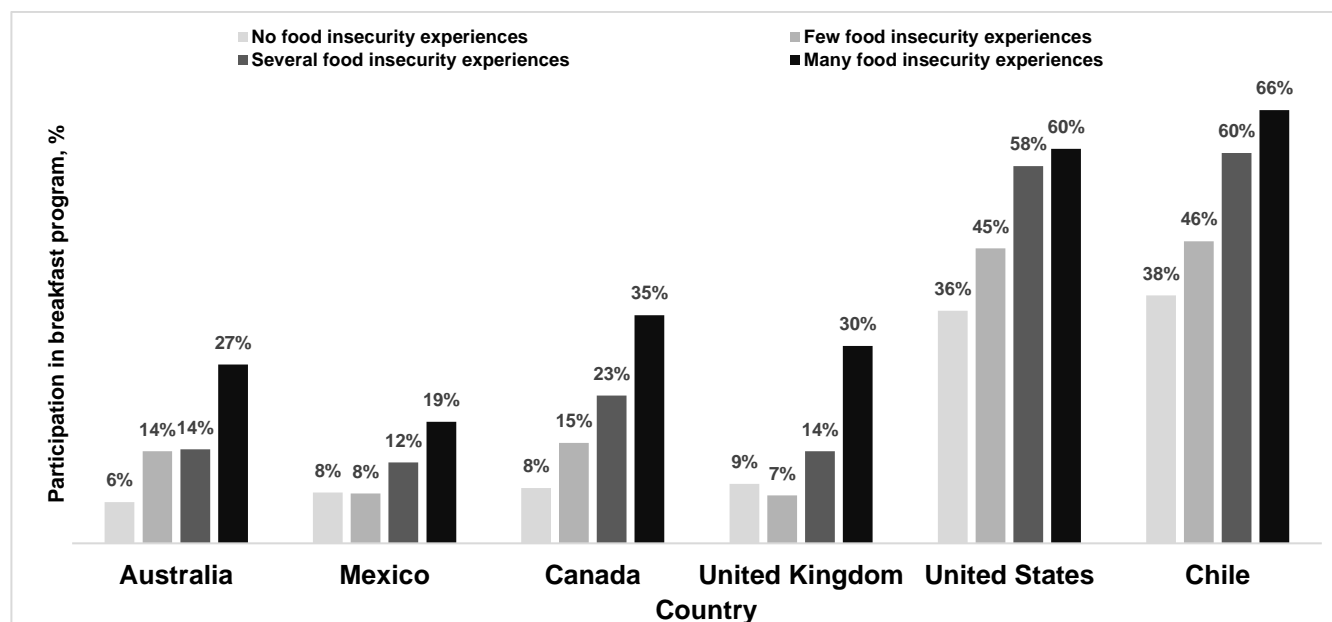
(N=10,565).¹



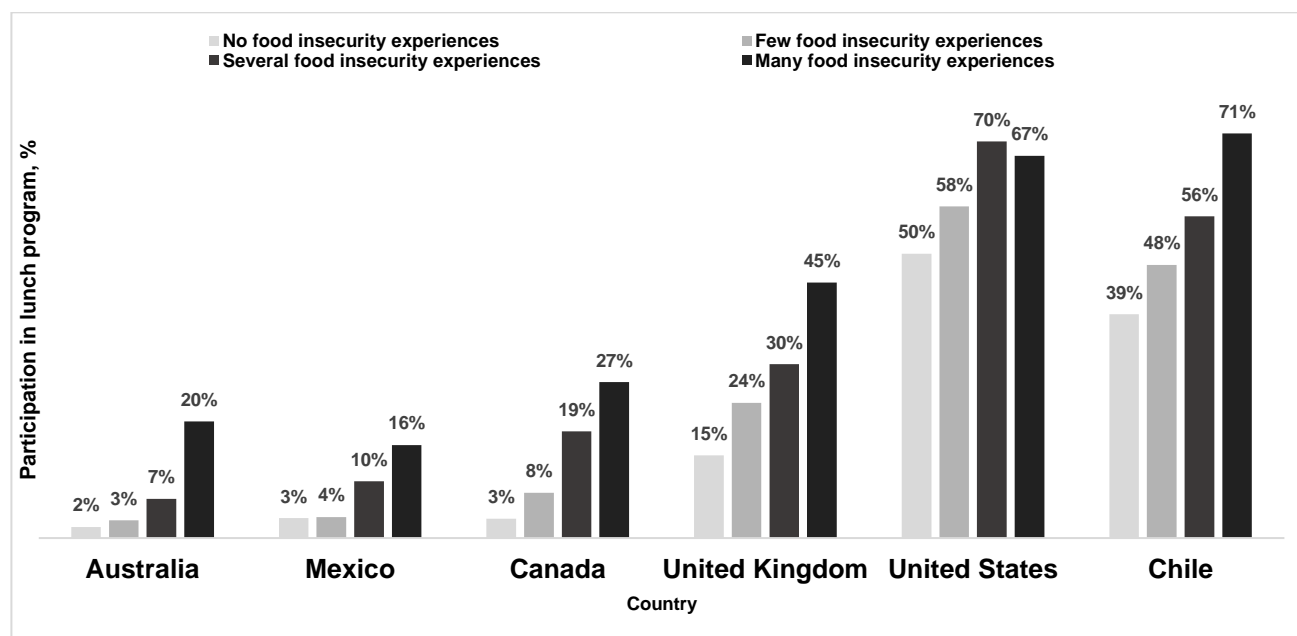
¹ Australia (n=1,363); Mexico (n=1,446); Canada (n=3,534); United Kingdom (n=1,467); United States (n=1,557); Chile (n=1,198).

Fig. 2 Percentage of breakfast and lunch program participation among 10-17-year-old students, by food insecurity experiences and country (N=10,565).¹

A. Breakfast program participation by food insecurity



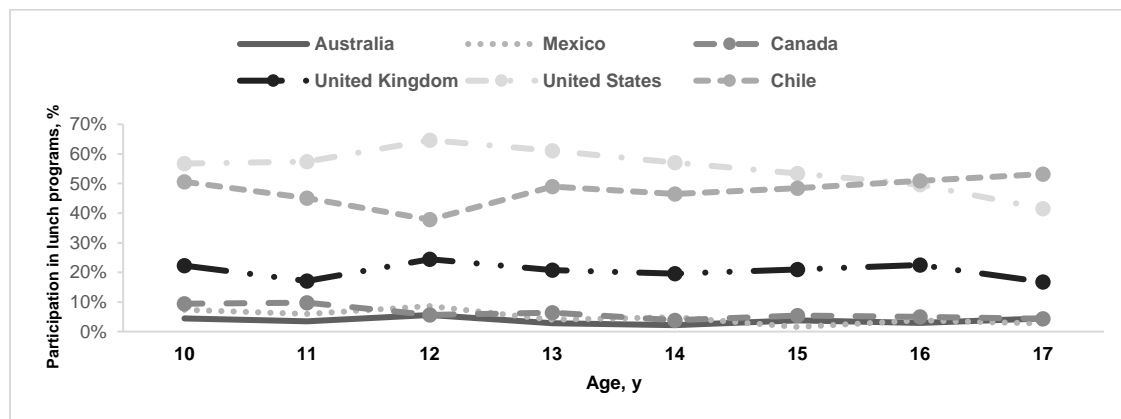
B. Lunch program participation by food insecurity



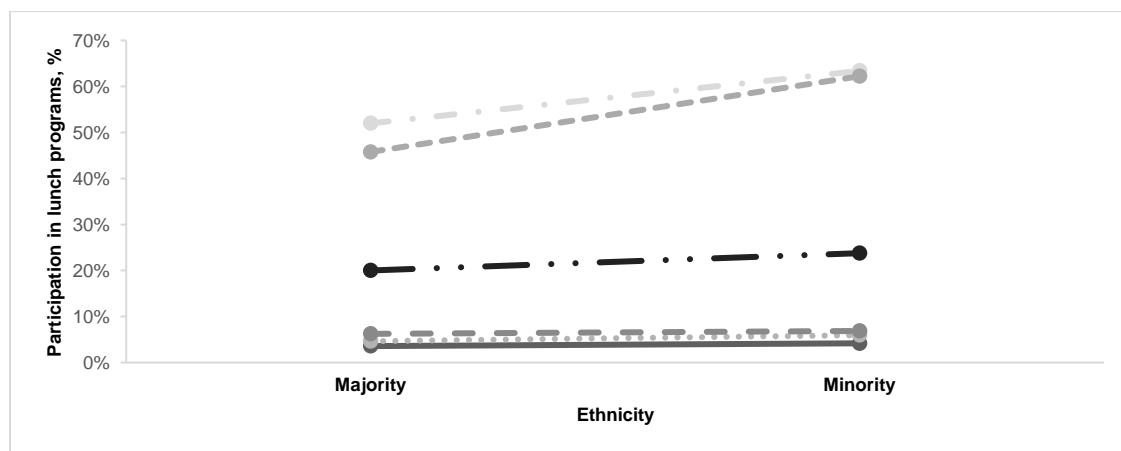
¹ Australia (n=1,363); Mexico (n=1,446); Canada (n=3,534); United Kingdom (n=1,467); United States (n=1,557); Chile (n=1,198).

Figure 3 Percentage of lunch program participation among 10-17-year-old students, by age; ethnicity^{1,2}; perceived income adequacy¹, and food insecurity experiences across country (N=10,565).³

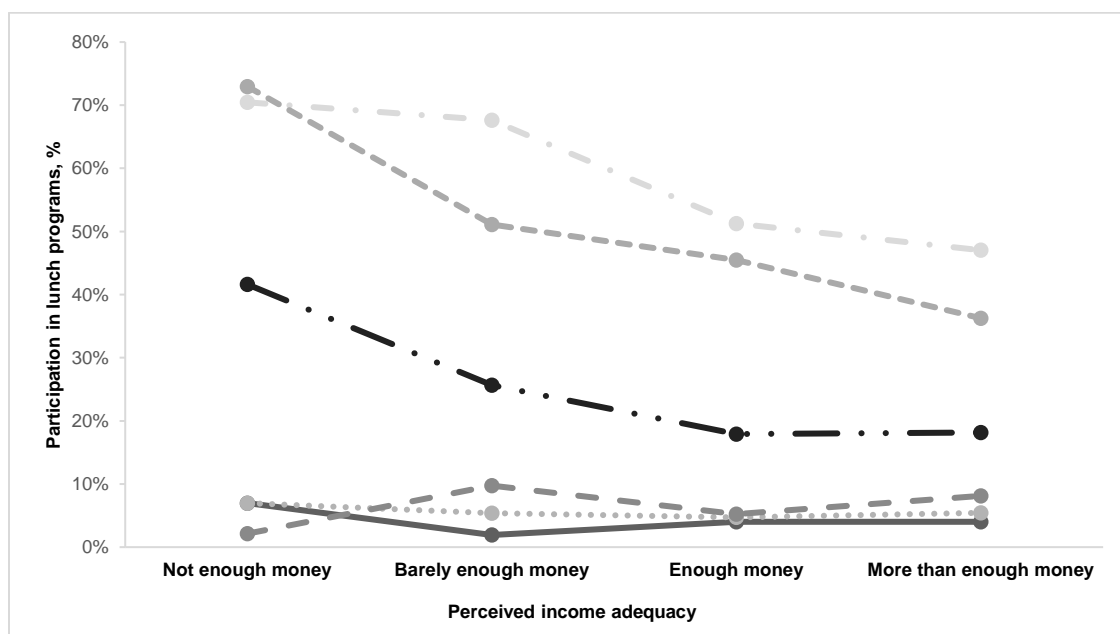
A. Participation in lunch programs across countries by age (% yes)



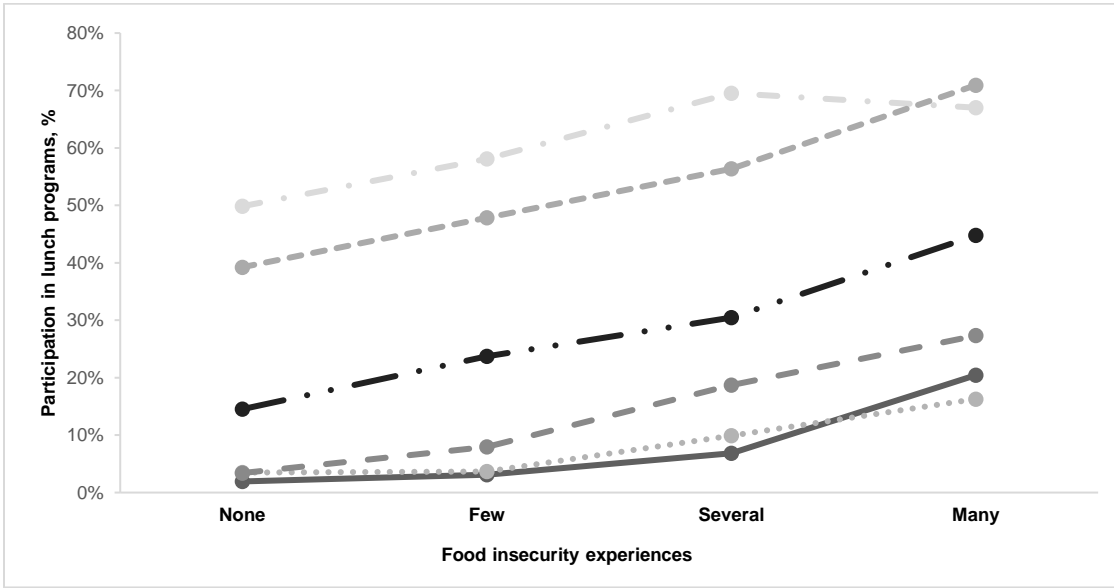
B. Participation in lunch programs across countries by ethnicity (% yes)



C. Participation in lunch programs across countries by perceived income adequacy (% yes)



D. Participation in lunch programs across countries by food insecurity experiences (% yes)



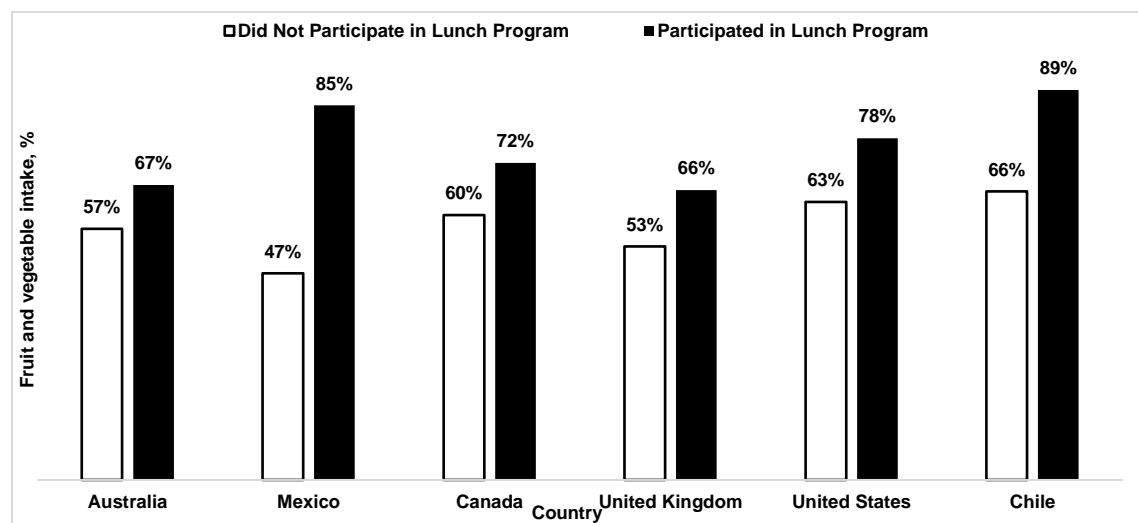
¹Participants responding Not stated (Don't know/refuse to answer) were excluded from Fig. 3 due to small sample sizes.

² 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 =Non-indigenous, minority=indigenous 4) Mexico majority=Non-indigenous, minority=indigenous; 5) UK majority=White, minority=other ethnicity; 6) US majority=White, minority=other ethnicity.

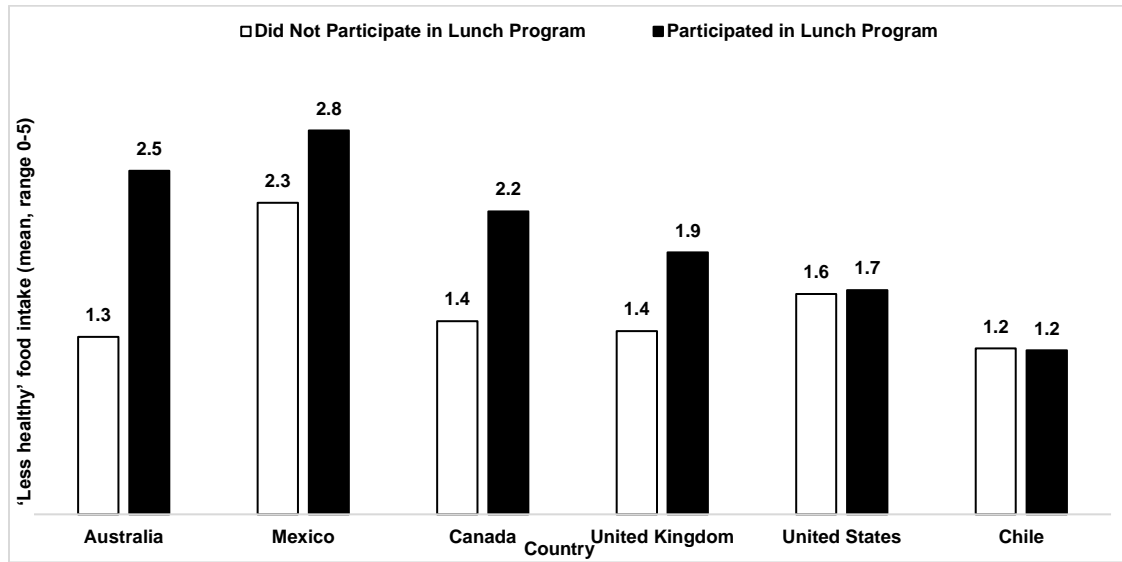
³ Australia (n=1,363); Mexico (n=1,446); Canada (n=3,534); United Kingdom (n=1,467); United States (n=1,557); Chile (n=1,198).

Fig. 4 A) Percentage of fruits and vegetables and B) mean ‘less healthy’ food intake¹ at lunch time among 10-17-year-old students, by lunch program participation and country (N=10,365).²

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



¹ An index of 'less healthy' food intake was created with range of 0-5 (where 0=no 'less healthy' foods and 5=all five '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).

² Australia (n=1,340); Mexico (n=1,425); Canada (n=3,471); United Kingdom (n=1,426); United States (n=1,522); Chile (n=1,181).

Supplementary Table 1 Overview of school meal programs across countries.

NATIONAL POLICY
<p>Australia Australia does not currently have a national school meal program.</p>
<p>Canada Canada does not currently have a national school meal program.</p>
<p>Chile Chile currently has a national school meal program.</p> <p>Students receive daily food rations (breakfast, lunch, and tea time) all year (including vacations), 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 approximately 80% of the most vulnerable groups attending public or public-private schools. (1) In the last few years there has been an enormous focus on improving acceptability of the program (e.g., a culinary lab tests recipes before use).(2)</p>
<p>Mexico Mexico currently has a national school meal program.</p> <p>A hot or cold breakfast program is offered to children in pre-school, primary and middle school from vulnerable and marginalized communities (including indigenous locations).(3) Hot meals include milk, fresh fruit, vegetable, cereal, and a legume or animal portion, while cold meals include a cereal bar, fresh fruit, vegetable, and milk. (3)</p> <p>Resources for implementing school meal programs in the country's nearly 233,000 schools are limited: most schools are half-time and have no infrastructure for hot meals, while approximately one quarter do not have access to water.(4,5) Thus, school meal programs are primarily targeted at a smaller proportion of the most vulnerable students, with ongoing efforts to expand program participation. (3,6) This program currently distributes approximately 6 million daily rations in over 80,000 public schools, with only 50% being hot meals.(6)</p>
<p>UK¹ The UK currently has a national school meal program.</p> <p>Free school lunchtime meals are provided based on financial need; however, as of 2021, a universal infant free school meal program was provided to primary school pupils aged 4-7 years, with some differences in provision in England, Wales, Scotland, and Northern Ireland.(7–9) Free breakfast programs are also provided to primary schools in disadvantaged areas in England,(8) Northern Ireland(9) and Scotland,(10) and are available to all primary schools in Wales.(11) Recently, the COVID-19 pandemic has highlighted the importance of school meal programs, particularly among disadvantaged communities, prompting the UK to expand their school meal program (e.g., providing meals during school holidays).(12)</p>
<p>US¹ The US currently has a national school meal program.</p>

Approximately 95% of schools participate in school meal programs (coordinated by the federal US Department of Agriculture), which provide free breakfasts and lunches to eligible students based on low income.(13–15) Recently, the COVID-19 pandemic has highlighted the importance of school meal programs, particularly among disadvantaged communities, prompting the US to expand their school meal program (e.g., providing meals during summer holidays).(16)

SUB-NATIONAL PROGRAMS

Australia

Some state governments have recently supported free breakfast and/or lunch programs that are targeted to students in need and schools in areas of low socio-economic status.(17) These programs are often delivered in conjunction with community organizations, such as the Victorian School Breakfast Clubs program (which is delivered to students in 1,000 Victorian government schools) (18) and the Western Australia School Breakfast and Nutrition Program (which funds Foodbank to provide healthy breakfasts to over 400 schools across the state).(19)

Canada

Free breakfast, lunch or snack programs exist in some schools—often run by community organizations or charities—with variable coverage rates across regions.(20)

Chile

N/A

Mexico

N/A

UK¹

N/A

US¹

Schools with at least 40% of students from low-income homes can provide universal free school meals to all students in the school.(19)

NUTRITION STANDARDS

Australia

Australia has nutritional standards applied to food sold in schools; however, implementation and compliance with these standards varies across regions.(21,22)

Canada

Canada has nutritional standards applied to food sold in schools; however, implementation and compliance with these standards varies across regions.(20,23)

Chile

Chile has adopted national standards for serving fruits and vegetables provided through school meal programs, including restrictions on less healthy foods derived from the Labelling Law.(24)

Additionally, Chile's comprehensive school nutrition standards restrict the sale of foods high in sugar, sodium, and saturated fat.(25)

Mexico

Mexico has adopted national standards for serving fruits and vegetables provided through school meal programs, including restrictions on less healthy foods.(26)

UK¹

The UK has adopted national standards for serving fruits and vegetables provided through school meal programs, including restrictions on less healthy foods.(27,28)

Additionally, the UK has nutritional standards applied to food sold in schools; however, implementation and compliance with these standards varies across regions.(21)

US¹

The US has adopted national standards for serving fruits and vegetables provided through school meal programs, including restrictions on less healthy foods.(29)

¹ UK=United Kingdom; US=United States.

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Supplementary Table 2 Percentage of ‘less healthy’ food intake during the last lunch on a school day among 10-17-year-old students (N=10,365).

	Overall (N= 10,365) % (N)	Australia (n=1,340) % (n)	Canada (n=3,471) % (n)	Chile (n=1,181) % (n)	Mexico (n=1,425) % (n)	UK³ (n=1,426) % (n)	US³ (n=1,522) % (n)
Sugary drinks	28.9 (2,995)	19.4 (259)	25.4 (882)	24.7 (292)	54.5 (776)	24.9 (356)	28.3 (429)
Fast food	22.3 (2,313)	17.6 (236)	22.4 (776)	10.9 (129)	46.2 (658)	18.7 (266)	16.3 (248)
Sugary cereals	8.6 (893)	4.1 (55)	5.4 (187)	13.8 (163)	11.8 (169)	6.9 (98)	14.5 (221)
Snacks¹	59.2 (6,139)	65.6 (879)	61.3 (2,129)	35.5 (419)	68.9 (982)	53.5 (763)	63.5 (966)
Desserts or treats²	38.6 (3,997)	29.2 (391)	33.4 (1,160)	37.1 (439)	51.9 (739)	43.8 (624)	42.3 (643)

¹ Snacks included crackers, chips or granola bars.² Desserts or treats included cookies, ice cream or candy.³ UK=United Kingdom; US=United States.