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Original qualitative research

The bio-food industry's corporate political activity during Health Canada's revision of Canada's food guide

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Abstract

Introduction: We analyzed the bio-food industry's corporate political activity (CPA) during the revisions of Canada's food guide between 2016 and 2019.

Methods: We undertook a content analysis of the websites of 11 bio-food industry organizations and of the briefs that 10 of them submitted to the Canadian House of Commons Standing Committee on Health, as part of this Committee's review of the food guide. Data were classified according to an existing conceptual framework.

Results: We identified 366 examples of CPA used by the bio-food industry during and immediately after the development of the food guide. Most of the industry actors opposed the guide's recommendations. The most common CPA strategies were information management (n = 197), used to create and disseminate information in industry's favour, and discursive strategies (n = 108), used to defend food products and promote the industry's position regarding the food guide. Influencing public policy (n = 40), by gaining indirect access to policy makers (e.g. through lobbying) and becoming active in government decision-making, as well as coalition management (n = 21), by establishing relationships with opinion leaders and health organizations, were also common strategies.

Conclusion: Bio-food industry actors used many different CPA strategies during the revisions of the food guide. It is important to continue to document the bio-food industry's CPA to understand whether and how this is shaping public policy development in Canada and elsewhere.

Keywords: corporate policy activity, commercial determinants of health, bio-food industry, public policy, Canada's food guide, public health

Introduction

Between 2016 and 2019, Health Canada launched revisions of Canada's food guide.¹ The new version encourages people to cook their own food more often, to eat more plant-based foods and reduce their meat consumption, and to limit their intake of highly processed foods.² Another major change is the disappearance of the "milk and alternatives" and "meat and alternatives" categories; these are now

less prominently displayed in the new "protein foods" category.² These recommendations, if adopted by Canadians, will affect the profits of certain segments of the bio-food industry,³ that is, the meat, dairy and ultraprocessed foods sectors.

During the development of the food guide, Health Canada permitted public access to useful and relevant health and safety information on its website. Health Canada also decided against meeting with industry

Highlights

- We examined the Canadian bio-food industry's position on the 2019 Canada's food guide and related corporate political activity (CPA).
- Most bio-food industry organizations opposed the 2019 food guide's recommendations to limit highly processed foods and to favour plant-based foods.
- Bio-food industry organizations used many different CPA strategies.
- The most common strategies were to create and disseminate information in favour of the industry, to defend their food products and to promote their position regarding the food guide.
- This research highlights the importance of monitoring industry's attempt to influence public policy development in Canada.

during the development process^{1,4} to avoid conflict of interest and undue corporate influence. Moreover, the academic experts Health Canada engaged during the revision process had no conflicts of interest with the development and revision of the food guide.¹

There is evidence that the bio-food industry interferes with the development of public food policies worldwide through corporate political activity (CPA).⁵⁻¹¹ CPA is defined as the attempts by corporate actors to shape public policy in ways that would protect or expand their markets or favour their industry's interests.⁶ CPA can

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involve instrumental strategies (industry actions) and discursive strategies (industry arguments).⁸ Instrumental strategies include information management, coalition management, legal actions, direct involvement and influence in public policy. The World Health Organization (WHO) expressed concerns that CPA may limit governments' abilities to develop and maintain effective public health policies.^{12,13}

The bio-food industry (along with other players) had the opportunity to participate in the public consultation phases of the revisions. The House of Commons Standing Committee on Health conducted a brief study of the food guide on 9 November 2017. Two meetings were held on 5 December and 12 December later that year. Two additional meetings scheduled for June 2018 were cancelled. Stakeholders were invited to submit briefs mid-2018. The chair of the Standing Committee sent a letter to the Minister of Health regarding this matter in the summer of 2018. The Minister of Health responded in the fall of 2018, prior to the publication of the new food guide.

A case study examined the correspondence and presentations exchanged between Health Canada and industry and non-industry actors after the release of the 2016 Healthy Eating Strategy.¹⁴ Data for that study were obtained via Health Canada's openness and transparency website, and the study revealed that "industry stakeholders are highly active in their attempts to influence Canadian nutritional policies."^{14,p.1}

As yet, no study has analyzed the bio-food industry's use of CPA strategies during the revisions of national dietary guidelines. The objectives of our research were to (1) study the bio-food industry's CPA during the latest revisions of Canada's food guide; and (2) analyze industry positions concerning the guiding principles proposed by Health Canada during the revisions.

Methods

This single instrumental case study allowed us to conduct a qualitative in-depth analysis of phenomena in their natural context.¹⁵ The issue under consideration was the bio-food industry's use of CPA during Health Canada's revision of Canada's food guide.^{3,5} The bio-food companies that

were studied constituted the units of analysis.

Case study and sample

To develop the food guide, Health Canada reviewed the scientific literature and ran two rounds of public consultations on the items to be considered in the revisions for the Canadian context.¹ The first round occurred between 24 October and 8 December 2016 and focussed on the vision for the guide and general considerations. In response to the feedback from this public consultation, Health Canada proposed three guiding principles that would be used to inform future Canadian dietary public policies¹ (Table 1). Input on these three guiding principles was sought during the second round of public consultations held in the summer of 2017.¹

In addition, the House of Commons Standing Committee on Health held two sessions on the food guide and accepted briefs written by the bio-food industry and from civil society in 2018. Of the 17 submissions, the 10 from the bio-food industry were selected for this study. The other submissions came from public health or nutrition research organizations. Each industry actor submitted one brief, except for the Dairy Farmers of Canada (DFC), which filed two. The Canadian Juice Council (CJC) filed the longest response (43 pages) and the Fisheries Council of Canada (FCC) the shortest (5 pages). None of these actors were food manufacturers; trade associations representing manufacturers submitted responses on behalf of their corporate members.

We also included another key player to better represent the variety of bio-food industry actors in Canada: the Conseil de la transformation alimentaire du Québec (CTAQ) is a provincial association that represents food manufacturers.

The 11 bio-food industry organizations included in our study are listed in Table 2.

Data collection and analysis

The research team collected data from documents published during and immediately after the revision of the food guide, between October 2016 and March 2019. A single team member (MCR) collected these data from October 2018 to March 2019, that is, until two months after the launch of the food guide. We also continued to analyze the websites of the 11 bio-food industry organizations after publication of the food guide in January 2019 to evaluate the effects of the CPA strategies used. Note that we concluded data collection in March 2019 after which date additional data did not significantly contribute to enriching or contradicting our analysis.

We analyzed the content of the briefs written by industry organizations in response to an invitation from the Standing Committee on Health to comment on the food guide recommendations as well as the content of industry websites.¹⁶ Websites of the 11 bio-food industry organizations were searched using the general search function and the keywords "Canada food guide" and "guiding principles." The analysis included the industry organizations' comments on the three guiding principles and Health Canada's recommendations. Documents related to other policies, such as front-of-package labelling, were not included in the analysis.

Once the documents were obtained and extracted on a personal computer, a research team member (MCR) analyzed their content according to a framework developed by the International Network for Food and Obesity/Non-Communicable Diseases Research, Monitoring and Action Support (INFORMAS)¹⁷ that has been used in dozens of countries to classify the bio-food industry's CPA.^{9-11,14,18-27} In this deductive approach to data analysis, we first

TABLE 1
Three guiding principles of the 2019 Canadian food guide

Principle 1	A variety of nutritious foods and beverages is the foundation for healthy eating; Health Canada recommends a regular intake of vegetables, fruit, whole grains and protein-rich foods, especially plant-based sources of protein
Principle 2	Processed or prepared foods and beverages high in sodium, sugars or saturated fat undermine healthy eating
Principle 3	Knowledge and skills are needed to navigate the complex food environment and support healthy eating

TABLE 2
Bio-food industry organizations^a included in our study

Bio-food industry organization	Represented sector
Canadian Juice Council (CJC)	Juices and beverages
Canadian Meat Council (CMC)	Meat
Chicken Farmers of Canada (CFC)	Poultry
Conseil de la transformation alimentaire du Québec (CTAQ)	Processed foods
Dairy Farmers of Canada (DFC)	Dairy products
Dairy Processors Association of Canada (DPAC)	Processed milk products
Egg Farmers of Canada (EFC)	Eggs
Fisheries Council of Canada (FCC)	Fish
Food and Consumer Products of Canada (FCPC)	Processed foods
National Cattle Feeders' Association (NCFA)	Meat
Turkey Farmers of Canada (TFC)	Poultry

^a Of the 17 written briefs submitted to the House of Commons Standing Committee on Health sessions on the food guide, the 10 from the bio-food industry were included in this study. The Conseil de la transformation alimentaire du Québec (CTAQ) was also included to better represent the variety of bio-food industry actors in Canada.

used the framework to code pieces of texts as either instrumental or discursive strategies (Table 3). The CPA strategies were then divided into broad practices, and then into the specific concrete mechanisms through which these practices apply. Each code and the corresponding text were copied and pasted into Microsoft Excel 2019 (Microsoft Corp., Redmond, WA, US). This made it easier to code the material and share it electronically with team members.

To validate the coding, another team member (JCM) reviewed all the information and codes, and proposed changes and revisions as necessary. Finally, the third team member (MM) spot-checked one-fifth of the information and applied codes. The level of interrater agreement was 81%. Following this review, the team discussed the points of divergence to finalize the codification. For each document analyzed, we focussed on how the text was constructed, its general content and how the 11 bio-food industry organizations communicated their positions. Next, we matched the pieces of text to each related guiding principle and identified the actors' positions and discourse regarding the principle's recommendations.

There might be an overlap between the different CPA strategies in the framework we used. In some instances, an example of CPA fitted into two categories—a point the framework authors noted.⁶ Research team members reached agreement on categorization after discussion among themselves.

For the second of our two objectives, we identified recurring topics to do with the bio-food industry actors' positions towards each guiding principle, where relevant. We focussed on the content of the messages, and the way the positions were communicated by the actors. Quotations were grouped by guiding principles. In the final analysis, we identified recurring themes corresponding to the position of the actors for each of the guiding principles when this was relevant. One researcher (MCR) selected the quotations, and the other two researchers (MM and JCM) collaborated in the review and revision of the entire analysis.

Ethical considerations

The research protocol was submitted to the Université de Montréal's Health Research Ethics Committee in Quebec, Canada. Because the data used in this research were publicly available, ethics approval was not required.

Results

Bio-food industry's use of CPA

We analyzed 11 written briefs available to the public via the House of Commons website and 13 documents retrieved from the 11 bio-food industry organizations' websites.

In the relevant documents, we identified 366 examples of CPA during the development of the food guide. The most common CPA strategies documented in our

analysis were information management strategy (n = 197), discursive strategies (n = 108), involvement and influence in public policy (n = 40) and coalition management strategy (n = 21) (Table 4). The information management strategy represents more than half of the examples identified.

The most common information management CPA practices were the suppression, amplification or production of evidence related to the food guide, for example, by discrediting established scientific data and claiming that some doubt remained regarding a particular topic (Table 5). Gaining indirect access to policy makers (for example, through lobbying) and willingness to become active in government decision-making were common practices in the "involvement and influence in public policy" CPA strategy.

The most common discursive strategy arguments used were those that framed the debate on food and health issues in ways that favoured the industry's interests and those that discussed the economic cost of public policies for the industry. For example, some organizations noted the benefits they generated for the Canadian economy in terms of the number of people employed in their respective industries.

The most frequently observed coalition management strategy practice was the recruitment of third parties or relationship building with opinion leaders and health organizations that advocate for the bio-food industry's interests. The practices used were fairly similar across industry sectors, but there was significant variance among some actors in the frequency of specific practices.

The bio-food industry organizations that were most active in their use of CPA were the DFC (n = 87; 23.8% of all CPA), the CJC (n = 73; 19.9% of all CPA) and the National Cattle Feeders' Association (n = 60; 16.4% of all CPA) (Table 5). This is not surprising given that consumption of juices, dairy products and meat would most likely decrease if Canadians adopted the new food guide recommendations, and the associated industry organization may have invested more resources and put greater efforts into their CPA as a result.

TABLE 3
Framework used for analysis of the CPA of the bio-food industry in the context of the Canada's food guide revision process, October 2016–March 2019

	Practices	Mechanisms
Instrumental strategies		
Coalition management	Establish relationships with key opinion leaders and health organizations	Promote public–private interactions with health organizations Support professional organizations, including through funding and/or advertising in their publications Establish informal relationships with key opinion leaders Support the placement of industry-friendly personnel within health organizations
	Seek involvement in the community	Undertake corporate philanthropy Support physical activity initiatives Support events (such as for youth or the arts) and community-level initiatives
	Establish relationships with the media	Establish close relationships with media organizations, journalists and bloggers to facilitate media advocacy
	Constituency fabrication	Establish fake grassroots organizations ('astroturfing') Procure the support of community and business groups to oppose public health measures
	Opposition, fragmentation and destabilization	Discredit public health advocates personally and publicly, e.g. through the media, blogs Infiltrate, monitor the operation and advocacy strategies of public health advocates, groups and organizations Create antagonism between professionals
Information management	Production of information/evidence	Fund research, including through academics, ghost writers, own research institutions and front groups Cherry-pick data that favour the industry, including use of non-peer reviewed or unpublished evidence
	Amplification of information/evidence	Participate in and host scientific events Propose industry-sponsored education
	Suppression of information/evidence	Suppress the dissemination of research that does not fit the industry's interests Emphasize disagreement among scientists and focus on doubt in science Criticize evidence and emphasize its complexity and uncertainty
	Using the credibility of a third party	Fronting: concealing industry links to information/evidence, including through the use of scientists as advisers, consultants or spokespersons
Involvement and influence in policy	Indirect access to policy makers	Lobby directly and indirectly (through third parties) to influence legislation and regulation so that it is favourable to the industry Use the "revolving door," i.e. ex-food industry staff work in government organizations and vice versa
	Incentives	Fund and provide financial incentives to political parties and policy makers (donations, gifts, entertainment or other financial inducements)
	Threats	Threaten to withdraw investments if new public health policies are introduced
	Active in government decision-making	Seek involvement in working groups, technical groups and advisory groups Provide technical support and advice to policy makers (including consultation)
Legal actions	Use legal action (or the threat thereof) against public policies or opponents	Litigate or threaten to litigate against governments, organizations or individuals
	Influence the development of trade and investment agreements	Influence the development of trade and investment agreements so that clauses favourable to the industry are included (e.g. limited trade restrictions, mechanisms for corporations to sue governments)
Discursive strategies		
	Important actor in the economy of the country	Stress the number of jobs supported and the money generated for the economy
	Issues with governance in the process	Demonize the "nanny state"
	Expected cost to the food industry	Policy will lead to reduced sales/jobs Cost of compliance will be high
	Frame the debate on food- and public health-related issues to favour industry interests	Stress the good traits of the food industry Shift the blame away from the food industry and its products, e.g. focus on individual responsibility, role of parents, physical inactivity Promote industry's preferred solutions: education, balanced diets, information, public–private initiatives, self-regulation (reformulation)

Source: Mialon et al. (2015)³⁴

Abbreviation: CPA, corporate political activity.

TABLE 4
CPA strategies used by the bio-food industry organizations in the context of the Canada's food guide revision process, October 2016–March 2019

CPA strategy	Frequency of use in retrieved documents	
	n	%
Information management	197	53.8
Discursive strategies	108	29.5
Involvement and influence in public policy	40	10.9
Coalition management	21	5.8
Total	366	100

Abbreviation: CPA, corporate political activity.

The most frequently used CPA practices identified in our study were suppression of information that did not favour the bio-food industry (n = 98) and amplification of information that the industry agreed with (n = 80) (Table 6). Industry actors criticized established scientific data by pointing out their complexity and uncertainty; they suggested that some of the evidence underlying the dietary recommendations needed to be more recent or more relevant or supported by more evidence. For example, in its brief, the trade association Food and Consumer Products

TABLE 5
CPA practices used by bio-food industry organizations in the context of Canada's food guide revision process, October 2016–March 2019

CPA strategy	CPA practice	CFC	TFC	EFC	NCA	FCC	CMC	DFC	FCPC	DPAC	CJC	CTAQ	Total
Information management	Suppression of information/evidence	4	4	3	20	1	10	33	7	2	10	4	98
	Amplification of information/evidence	4	1	1	18	2	4	20	2	5	18	5	80
	Production of information/evidence	–	–	1	2	–	–	6	1	–	5	1	16
	Using the credibility of a third party	–	–	–	1	–	–	2	–	–	–	–	3
													197
Discursive strategies	Framing the debate on food and public health issues to favour industry interests	2	1	5	7	3	14	6	8	5	6	1	58
	Expected cost to the industry	1	1	–	2	–	1	4	7	2	16	6	40
	Important actor in the economy of the country	–	1	–	–	1	–	1	3	1	2	–	9
	Issues with governance in the process	–	–	–	–	–	–	–	–	–	1	–	1
													108
Involvement and influence in public policy	Indirect access to policy makers	1	–	–	1	–	1	10	4	–	6	–	23
	Active in government decision-making	2	–	–	2	–	–	2	4	2	3	2	17
													40
Coalition management	Third-party recruitment – building relationships with opinion leaders and health organizations	–	–	–	7	–	–	2	–	–	5	–	14
	Opposition, fragmentation and destabilization	2	–	–	–	–	–	2	1	–	–	1	6
	Building a support network	–	–	–	–	–	–	–	–	–	1	–	1
													21
	Total, n (%)	16 (4.4)	8 (2.2)	10 (2.7)	60 (16.4)	7 (1.9)	31 (8.5)	87 (23.8)	37 (10.1)	17 (4.6)	73 (19.9)	20 (5.5)	366 (100)

Abbreviations: CFC, Chicken Farmers of Canada; CJC, Canadian Juice Council; CMC, Canadian Meat Council; CPA, corporate political activity; CTAQ, Conseil de la transformation alimentaire du Québec; DFC, Dairy Farmers of Canada; DPAC, Dairy Processors Association of Canada; EFC, Egg Farmers of Canada; FCC, Fisheries Council of Canada; FCPC, Food and Consumer Products of Canada; NCA, National Cattle Feeders' Association; TFC, Turkey Farmers of Canada.

TABLE 6
Frequency of common CPA practices used by bio-food industry organizations in the context of the Canada's food guide revisions, October 2016–March 2019

CPA practice	CPA strategy	Frequency of use	
		n	%
Suppression of information/evidence	Information management	98	26.8
Amplification of information/evidence	Information management	80	21.9
Framing the debate on food and public health issues to favour industry interests	Discursive strategy	58	15.8
Expected cost to the industry	Discursive strategy	40	10.9
Indirect access to policy makers	Involvement and influence in public policy	23	6.3
Active in government decision-making	Involvement and influence in public policy	17	4.6
Production of information/evidence	Information management	16	4.4
Third-party recruitment – building relationships with opinion leaders and health organizations	Coalition management	14	3.8
Important actor in the economy of the country	Discursive strategy	9	2.5
Opposition, fragmentation and destabilization	Coalition management	6	1.6
Using the credibility of a third party	Information management	3	0.8
Building a support network	Coalition management	1	0.3
Issues with governance in the process	Discursive strategy	1	0.3
Total	–	366	100

Abbreviation: CPA, corporate political activity.

of Canada (FCPC) questioned the scientific basis for the recommendations on added sugars. Similarly, the DFC claimed that the proposed reduction in the quantity of dairy products in a healthy diet was not evidence based.

The most frequently observed practice mechanisms were “criticizing established scientific data by highlighting its complexity and its uncertainty” (under the practice of “suppression”) and “selecting data favourable to the industry” (under the practice of “amplification”), especially the presentation of inaccurate, distorted or exaggerated information without supporting evidence (Table 7). For instance, the DFC’s brief stated “since 2015, the Heart and Stroke Foundation has opposed the idea of setting a threshold or limit for saturated fat and instead argues for a focus on a healthy balanced diet.” In fact, the Heart and Stroke Foundation did not oppose the recommendations as the DFC indicated; the Foundation did not specify a threshold or limit for saturated fat, but said that there was a need to focus on the overall quality of our diet to reduce saturated fat intake.²⁸

We found the most frequently used discursive strategies (n = 108) to be “framing the debate on food and public health issues” (n = 58) and “claiming that there

would be costs to the industry” (n = 40) (Table 5). In the context of Health Canada engaging with academic experts as needed during the review process, rather than through a formal expert committee, the bio-food industry questioned the decision to use fully independent experts not tied to commercial interests. In their brief, the Egg Farmers of Canada (EFC) pointed out that “consultation and dialogue with both food producers and health professionals is an important step to ensure a balance of opinions are heard throughout the process.” The FCPC argued that it would be a disservice to Canadians if the bio-food industry were not contributing its technical, scientific and dietary expertise to the discussion. The FCPC also questioned the scientific basis for excluding the industry. The Canadian Meat Council (CMC) asked that the food industry be involved in the consultations for the revisions of the food guide because it had extensive expertise in nutrition and science, as well as experience in consumer education. This statement adds to confusion, since CMC did participate in the public online consultations, and was therefore involved in the process, contrary to their claims. In that sense, some bio-food industry organizations defended a vision of public health that differed from Health Canada’s approach to policy making. Other actors claimed they had the right to attend the

discussions by positioning themselves as experts who were equally qualified as the independent experts that Health Canada consulted.

In addition, the CJC, the DFC, the FCPC and the CTAQ characterized the guiding principles as potentially detrimental to the economy of the country because of how much the implementation of the food guide would cost industry. These organizations expressed their desire to save jobs in their sectors. In its brief, the CJC accused the government of using its power to harm its economic activities, adding that the government created barriers to innovation and industry growth: “The proposed changes would mean that the Government of Canada is using its authority and spending to specifically attempt to damage the Canadian juice industry, when the most recent scientific evidence does not justify such a position.”

Analysis of the bio-food industry actors’ positions regarding the guiding principles Health Canada proposed for the 2019 food guide

The bio-food industry clearly opposed the proposed approach to the 2019 food guide and the three guiding principles, with each player’s position reflecting their specific interests and economic activities. For

TABLE 7
Frequency of specific CPA mechanisms used by bio-food industry organizations in the context of the Canada's food guide revision process, October 2016–March 2019

CPA mechanism	Related CPA strategy	Frequency of use	
		n	%
Criticizing established scientific data by highlighting its complexity and uncertainty	Information management	82	22.4
Selecting industry-friendly data, including unpublished or non-peer reviewed work	Information management	76	20.8
Promoting solutions preferred by the industry: voluntary initiatives or self-regulation; focussing on energy balance instead of unhealthy diets; education and information instead of talking about the underlining causes of ill health; and public–private partnerships	Discursive strategy	52	14.2
Claiming that there would be unanticipated costs to public health	Discursive strategy	29	7.9
Lobbying elected officials directly or indirectly to influence legislation and regulations to benefit the industry	Involvement and influence in public policy	23	6.3
Funding research, including through researchers, research institutions, ghostwriters and front groups	Information management	17	4.6
Seeking involvement in working groups, technical groups and advisory groups in government	Involvement and influence in public policy	16	4.4
Focussing on disagreements between scientists and sowing doubt in science	Information management	14	3.8
Promoting public–private interactions, especially with public health organizations	Coalition management	12	3.3
Highlighting the number of jobs and the economic benefits generated by the industry	Discursive strategy	9	2.4
Claiming that the proposed recommendations will lead to reduced employment or sales	Discursive strategy	9	2.4
Minimizing the responsibility of the agri-food sector by, for example, placing the blame on a lack of physical activity, arguing for individual responsibility or saying it was the role of parents to ensure good health for their children	Discursive strategy	8	2.2
Discrediting public health professionals personally and publicly	Information management	5	1.4
Preventing the dissemination of scientific work that does not serve industry's interests	Information management	4	1.1
Front: hiding the connections between a piece of information and the industry, including by using paid academics as speakers, consultants or spokespersons	Information management	3	0.8
Claiming that the cost of implementing the guide will be too high for the industry	Discursive strategy	2	0.5
Providing technical support and advice to policy makers	Involvement and influence in public policy	1	0.3
Infiltrating or monitoring the operations and advocacy strategies of public health professionals	Coalition management	1	0.3
Demonizing government action as paternalist	Discursive strategy	1	0.3
Obtaining support from community organizations and other industries to oppose public health measures	Coalition management	1	0.3
Producing and disseminating educational materials funded or developed by the industry	Information management	1	0.3
Total	–	366	100

Abbreviation: CPA, corporate political activity.

example, the CJC focussed on the recommendations for juices, whereas DFC expressed concern about the role of dairy products in the food guide. Their positions did not align with the concepts underpinning the new dietary guidelines, such as the impact of food choices on the environment; nor did they align with the most recent scientific evidence on which the guidelines are based.

Guiding principle 1

Guiding principle 1 states that consuming a variety of nutritious foods and beverages is the foundation for healthy eating and specifically recommends regularly eating vegetables, fruit, whole grains and

protein-rich foods, and especially plant-based sources of proteins. Moreover, although the recommendations are based entirely on health considerations, guiding principle 1 did take into consideration environmental and sustainable development factors.¹

The bio-food industry actors from the meat, egg and dairy sectors criticized the relative prominence of animal proteins in the protein foods group: the National Cattle Feeders' Association highlighted the superior nutritional value of beef over plant-based proteins, while the Egg Farmers of Canada argued that emphasizing protein

sources such as eggs is more important than focussing on plant-based protein sources; the dairy industry objected to the lack of emphasis on milk in the recommendations. The National Cattle Feeders' Association and Chicken Farmers of Canada claimed that plant-based proteins were higher in calories than animal-based proteins, suggesting that following the food guide recommendations would have negative health consequences. Finally, in its brief the DFC stressed that Health Canada must "give appropriate and fair consideration to dairy products, which are in a unique position in relation to the Healthy Eating Strategy and acknowledge that special status."

Industry actors tried to legitimize this position using scientific arguments based on the findings of studies they funded, rather than independent research. When their findings were contradicted, the DFC directly addressed Prime Minister Justin Trudeau and asked that he use his authority and intervene with the Minister of Health, who is responsible for this file.²⁹

Several bio-food industry actors (mainly those in the meat industry) disagreed with the environmental and sustainable development considerations in the guiding principle, with the Turkey Farmers of Canada (TFC) going so far as to request in its brief that “environmental factors be removed.”

Additional examples of arguments used by bio-food industry actors against guiding principle 1 are shown in Table 8.

Guiding principle 2

The CJC, the dairy industry, the FCPC and the CTAQ opposed guiding principle 2, which stated that “processed or prepared foods and beverages high in sodium, sugars or saturated fat undermine healthy eating.” Dairy industry actors and the FCPC were opposed to Health Canada’s recommendation to limit intake of sugar and avoid beverages high in sugars.

The FCPC, the CJC and the CTAQ criticized Health Canada’s recommendation to avoid 100% pure juice, which effectively put an end to the previous recommendation stating that juice was a direct substitute for whole fruit. In its brief, the FCPC stated that “forcing Canadians to replace 100% fruit juice with fresh fruit would increase Canadians’ food costs and ultimately impact the most vulnerable in our society, such as our Indigenous communities.” In this example, the FCPC appealed to emotions by referring to vulnerable populations, since they allude to a risk to a part of the Indigenous population, but did not provide evidence supporting its claims.

The CJC maintained that exclusion of juice from the food guide would have consequences on the health of individuals. In its brief, the CJC claimed that the results of scientific studies they shared did not agree with the evidence on which guiding principle 2 was based. However, the CJC did not differentiate between information Health Canada considered valid (i.e. derived from independent scientific consensus)

and information from sources with industry ties, which would oppose guiding principle 2. The CJC also positioned itself as a legitimate and qualified expert on juices, implying that it should be consulted on the topic. Finally, the CJC pointed out that the juice industry were being discriminated against and that the proposed changes to the food guide could deprive it of future subsidies.

The industry sector in charge of processing was the main opponent to the food guide’s recommendation to avoid processed food. The FCPC noted: “We are very concerned with the prevailing misperceptions... Health Canada’s misunderstanding and a bias towards processed food were demonstrated in their online food guide survey, which further contributed to consumer confusion.”

The CTAQ and the FCPC proposed definitions of “processed foods” that opposed Health Canada’s definition and research findings on the dietary contribution of processed foods, even after the food guide was released, which may confuse the public. Indeed, following the release of the new guide, the CTAQ posted a definition of “processed foods” on its website that contradicts Health Canada’s definition and does not align with established scientific consensus. In addition, they did not distinguish these foods based on their type of processing, describing all types of processing (i.e. minimal, ultraprocessed and levels in between) as if they were the same and with the same impacts on health. The FCPC also requested that the House of Commons Standing Committee on Health ensure that the recommendation being put forward by Health Canada did not misrepresent their products.

Various bio-food industry organizations used arguments appealing to emotions, for example, fear and anxiety to stress the potential consequences of limiting the consumption of foods high in salt, sugar (e.g. juices) and fat for vulnerable populations, such as economically vulnerable pregnant or lactating women or middle class families who, because of tight budgets, might not be able to afford fresh fruits and vegetables. For example:

It is simply not reasonable to expect middle class families and those working hard to join the middle class to be able to afford fresh fruits and vegetables that are not locally grown and

are often out of season. Health Canada should be working to provide dietary guidance to Canadians that still makes it possible for them to join the middle class and provide nutritious food for their families. (CJC, 2018)

Finally, some industry actors noted that there was no formal interdepartmental coordination of public policy to question the process behind the development of guiding principle 2. The FCPC wanted the Healthy Eating Strategy to complement the work and objectives of the Food Policy for Canada, the Agri-Food Economic Strategy Table and the Agriculture and Agri-Food Canada Food Processing Industry Roundtable. This would have benefited the industry as the agriculture, trade and industry sectors would have had a more prominent role in the food guide revisions, despite any other conflicts with public health.

Additional examples of arguments used by bio-food industry actors against guiding principle 2 are shown in Table 9.

Guiding principle 3

Most bio-food industry organizations supported guiding principle 3 that “knowledge and skills are needed to navigate the complex food environment and support healthy eating.” The following excerpt is an example of such support, albeit conditional:

Education is key... This education and communication should be done in collaboration with all stakeholders involved in feeding Canadians in order to have maximum positive impact on our country’s consumers. (TFC, 2018)

Only the CTAQ raised concerns about the results of a survey stating that 87% of Canadians wanted their daily lives to be simpler, which the principle may have contradicted. That support is aligned with our findings on CPA described earlier, where bio-food industry actors are keen to support education and provide people with more information.

Additional examples of arguments used by bio-food industry actors against guiding principle 3 are shown in Table 10.

Discussion

This study revealed some of the strategies used by the bio-food industry to try to

TABLE 8
Examples of arguments used by bio-food industry organizations during the Canada’s food guide revision process regarding guiding principle 1: A variety of nutritious foods and beverages is the foundation of healthy eating, October 2016–March 2019

Industry actor	Example of argument used	Related CPA strategy / Practice
Turkey Farmers of Canada	“Remove Environmental Factors. In the proposed guiding principles for Canada’s food guide, environmental factors have been included. This inclusion of the food environment appears to be beyond the intended scope of the guide. It blurs the Health Canada focus on nutrition and implies that consumers should avoid animal-based proteins, which are needed in a healthy diet... There are more appropriate places to capture the importance of environmental and sustainable agricultural practices than in the food guide.” (TFC, #22)	Information management / <i>Suppression of information or evidence</i>
Chicken Farmers of Canada	“Researchers have developed several methods for evaluating the quality of food protein; it is measured by its amino acids, its digestibility and how well it meets human needs. Plant-based sources of protein contribute additional carbohydrates and fat to a person’s diet, which has an effect on overall caloric intake. For instance, to achieve the same protein as one serving of chicken breast meat (75 g, roasted), one would need to consume (Appendix A): <ul style="list-style-type: none"> • Over 300 g of tofu (2 full 150 g servings, 82 kcal/serving) • 3 cups of quinoa (almost six 125 mL servings, 117 kcal/serving) • Over half a cup of almonds (3 full 60 mL servings, 208 kcal/serving) • Over 350 mL of navy beans (more than 2 full 175 mL portions, 189 kcal/serving) • Just under 350 mL of lentils (almost 2 full 175 mL servings, 190 kcal/serving) The caloric differences alone could contribute to establishing an overall unhealthy weight.” (CFC, #11)	Information management / <i>Amplification of information or evidence</i>
Chicken Farmers of Canada	“There was also significant vegan activist participation and they have been celebrating the updated guiding principles as a great victory.” (CFC, #7)	Information management / <i>Suppression of information or evidence</i>
National Cattle Feeders’ Association	“Calorie-for-calorie, beef is more nutrient dense than plant-based proteins such as peanut butter, tofu, or beans. Healthy and lean animal-based proteins are simply not the same as plant-based proteins. Again, we believe that Canada’s food guide should be easy and simple to follow, and a focus on food groups maintains this ease of use. People buy foods. People do not buy nutrients.” (NCFA, #37)	Information management / <i>Amplification of information or evidence</i>
Egg Farmers of Canada	“When it comes to the revised food guide, our concerns are driven by the unclear positioning of animal and plant-based proteins under the first guiding principle put forward by Health Canada.... A focus on protein sources like eggs that are nutrient-rich is more important than emphasizing plant-based protein food sources alone.” (EFC, #26)	Information management / <i>Suppression of information or evidence</i>
Dairy Farmers of Canada	“The direction proposed by the new food guide is not evidence-based and could have further long-lasting consequences on a sector that has already been placed in a difficult position by this government. Dairy Farmers of Canada asks that Prime Minister Trudeau direct the Minister of Health to do her homework by considering and taking into account all available scientific evidence prior to the release of the new food guide. The health of Canadians, and the health of a vibrant Canadian sector, are at stake.” (DFC, #241)	Involvement and influence in public policy / <i>Indirect access to policy makers</i> Information management / <i>Suppression of information or evidence</i>
Dairy Farmers of Canada	“These changes to Canada’s national health guidelines come at the time when the dairy sector is still reeling from the latest concessions made by the federal government to secure new trade agreements. This would cause further harm to the dairy sector by deliberately diminishing the nutritional value of dairy in the eyes of Canadians—in spite of scientific evidence. Not only will this harm the dairy sector and the hundreds of thousands who depend upon it for their livelihoods, but it also risks harming Canadian consumers by creating confusion about the nutritional value of dairy products.” (DFC, #239)	Discursive strategy / <i>Expected cost to the industry</i>
Dairy Processors Association of Canada	“There is no need to vilify players in the agri-food industries who are able to provide valuable scientific information about the possibility of implementing change and offering solutions as colleagues and partners. The lack of communication to date has fuelled speculation and concerns that may or may not be well founded. We hope that those responsible will recognize this situation and correct it.” (DPAC, #179)	Involvement and influence in public policy / <i>Active in government decision-making</i>

Abbreviation: CPA, corporate political activity.

TABLE 9

Examples of arguments used by bio-food industry organizations during the Canada's food guide revision process regarding guiding principle 2: Processed or prepared foods and beverages high in sodium, sugars or saturated fat undermine healthy eating, October 2016–March 2019

Industry actor	Example of argument used	Related CPA strategy / Practice
Canadian Juice Council	<p>“100% juice is not connected to obesity.</p> <p>Regarding the health of Canadians, the scientific evidence does not support an association between 100% juice and weight status (adiposity) in children aged 2 to 18. As mentioned previously, the research shows that when adults include 100% pure juice as a part of their diet they are often ‘leaner, more insulin-sensitive, and have lower odds of obesity and metabolic syndrome.’ CJC supports giving Canadians the ability to make choices that contribute to a healthy balanced lifestyle, which means continuing to include 100% pure juice within Canada’s dietary guidance regarding fruit and vegetable consumption.” (CJC, #203)</p>	Information management / Amplification of information or evidence
Canadian Juice Council	<p>“Unintended consequences of removing 100% pure juice:</p> <p>Fresh fruits and vegetables are among the most expensive food stuffs purchased in Canada, making it very difficult for low-income families to buy enough of them to meet their needs. Combined with Canada’s unique environment, this means that access to many fresh fruits and vegetables can vary widely across the country. The consistency in availability of 100% fruit juice gives Canadians access to cost-competitive quality nutrition year-round. As Health Canada itself notes, ‘Food choices are not simply a matter of personal choice. There are many interrelated factors that influence our ability to make healthy food choices, including access to and availability of nutritious foods, culture, and the social and physical environment.’” (CJC, # 213)</p>	Information management / Amplification of information or evidence Discursive strategy / Expected cost to the industry
Canadian Juice Council	<p>“The unintended consequences of telling Canadians to avoid 100% pure juice will be magnified for residents of Northern and isolated communities being able to live healthy and balanced lifestyles. This is particularly poignant where the Nutrition North Canada program currently operates, providing improved access to 100% pure juice options that are available in the rest of Canada. In communities where whole fruit and vegetables are rare and expensive, fruit and vegetable juice is considered a critical and cost-effective way of accessing servings of fruit.” (CJC, #197)</p>	Information management / Amplification of information or evidence Discursive strategy / Expected cost to the industry
Food and Consumer Products of Canada	<p>“Recommendations for a revised food guide: Give careful consideration to the scientific basis of the sugar recommendations, and provide a clear rationale for any recommendations for Canada. FCPC is concerned about Health Canada’s decision that free sugars is considered relevant to dietary guidance based on moderate quality evidence, and no consideration of the Canadian context.</p> <p>The determination of a sugar recommendation needs to be suited to a country’s unique requirements, and these requirements depend on many factors such as population age distribution, water fluoridation and other dental health regimes, prevalence of overweight/obesity and quality of the food supply. A ‘one-size-fits-all’ approach is not appropriate. We therefore recommend that any dietary guidance on sugar be based on a sound and clear rationale for Canada.” (FCPC, #158)</p>	Information management / Suppression of information or evidence
Food and Consumer Products of Canada	<p>“We are focused on growing our sector to meet the agri-food export targets identified by the federal government. The goal of increasing exports in our sector by at least \$75 billion annually by 2025 requires a business environment that encourages investment, innovation and growth. The government’s approach and policy proposals pertaining to several initiatives in the Healthy Eating Strategy, however, have not been based on adequate consultation with industry or an understanding of the current operating environment.” (FCPC, #147)</p>	Discursive strategy / Expected cost to the industry
Dairy Farmers of Canada	<p>“There is no rationale or scientific evidence for targeting total sugars as a nutrient of concern for Canadians, or nutrient-rich foods that contain added sugar such as sweetened milk and yogurt.” (DFC, #100)</p>	Information management / Suppression of information or evidence
Le Conseil de la transformation alimentaire du Québec	<p>“It is important to note that this new food guide has been revised without the food industry being able to provide any input. One would have to be out of touch not to have seen that all the communications, influences exerted on Health Canada officials—the entire lobby—involved in developing this new guide were done by nutrition and health professionals, by the various interest or pressure groups representing vegetarian and vegan lifestyles, etc. As Mario Dumont mentioned in his January 25 column, only angelic [sic] criteria and public health objectives prevailed. The new Canada’s food guide reflects an ideology, a vision of perfect nutrition in a perfect world, based on the values and beliefs of its many authors. It also promotes the concept that anything processed is bad.” (CTAQ, #306)</p>	Information management / Suppression of information or evidence Coalition management / Opposition, fragmentation and destabilization

Abbreviation: CPA, corporate political activity.

influence the 2019 Canadian national dietary guidelines. We identified 366 examples of CPA used by 11 bio-food industry actors during the revisions of the food guide.

Our analysis found information management, which involves shaping information to make it more favourable to the industry, to be the most frequently used strategy, with the intent to suppress information

the practice that was used the most, for example, by criticizing established scientific data unfavourable to the industry. Discursive strategies were also widely used, particularly in response to the new

TABLE 10

Example of arguments used by bio-food industry organizations during the Canada’s food guide revision process regarding guiding principle 3: Knowledge and skills are needed to navigate the complex food environment and support healthy eating, October 2016–March 2019

Industry player	Example of argument used	Related CPA strategy / Practice
Le Conseil de la transformation alimentaire du Québec	<p>“Is it realistic to think that people have more time today—or will spend more time—planning meals for the week, shopping and cooking? A very recent survey conducted by Simplii Financial, a subsidiary of CIBC, reveals that: ‘from coast to coast, Canadians agree that it’s time to simplify their lives. Whether it’s getting rid of clutter, managing their email better or spending less time on routine tasks like laundry or grocery shopping, most Canadians (87%) want their lives to be simpler. Canadians feel their lives are too busy, and in many ways; they want to lighten their tasks to have more fun.’ (https://www.newswire.ca/fr/news-releases/moins-c-est-mieux-selon-un-sondage-la-majorite-des-canadiens-souhaitent-simplifier-leur-vie-821556739.html)</p> <p>Are meal planning and cooking time considered enjoyable activities for the majority of Canadians? Is it also realistic to think that our older people are ready for such a change? Is advice such as Enjoy a variety of healthy foods every day or Healthy eating is more than just the food you eat enough to guide the consumer?” (CTAQ, #302)</p>	<p>Information management / Amplification of information or evidence</p> <p>Discursive strategy / Expected cost to the industry</p>

Abbreviation: CPA, corporate political activity.

guiding principles underpinning the food guide’s development.

Our results are consistent with those of Nixon et al.³⁰ who examined the arguments of the food industry, between 2010 and 2012, against regulatory initiatives to curb the obesity epidemic in the USA. The researchers observed that, compared with non-industry players, industry actors attacked the government regulations more often; and the most frequently used defence against government regulations was for the industry to say that “they were part of the solution.”³⁰ This type of argument promotes solutions advocated by the industry, such as self-regulation³⁰ and public-private partnerships,³¹ which produce mixed effects and may even slow down efforts to promote and protect healthy diets. When rejecting certain guiding principles and trying to prevent the adoption of recommendations directly targeting their products, one of the arguments used by bio-food industry actors was to exaggerate the cost of the proposed changes, using an alarmist narrative suggesting that the proposed recommendations will fail and that many undesirable health and economic problems will affect the whole of society. Similar arguments were used by the food industry in France in opposition to the development of a mandatory nutrition front-of-package labelling.⁸ In our study we found that some actors claimed that if the food guide were implemented, it would cause economic loss and ultimately harm society, rather than just the industry. Such arguments can shift the entire narrative away from the problem and prevent the introduction of public policies based on scientific evidence (for example, when the industry pushes for education rather than regulation of their products).

In general, industry actors’ responses to the three guiding principles and the associated recommendations of the food guide focussed on their economic activities and products, which were frequently in conflict with the food guide’s goal: health. The industries’ economic impact analyses did not consider other types of external costs, such as the economic repercussions of ill health on health expenditures and the environmental costs of the consumption of unhealthy diets.^{32,33} In particular, the industry sought to promote its own solutions and “frame the debate on food and public health.” The arguments usually used by public health advocates—that health problems are complex, the protection of vulnerable populations, and the issue of food insecurity^{34,35}—are also used by industry actors to defend their position. In this respect, our findings are consistent with those of Petticrew et al.,³⁶ who reported that the food, beverage and gambling industries used “complexity” arguments to influence public opinion and policy makers and paralyze discussions. Our findings are also consistent with those of Vandenberg et al.,¹⁴ who showed that the Canadian food industry uses CPA to influence food and nutrition policies like those reported internationally.^{8,14} Indeed, there are striking similarities in the practices used by the bio-food industry across countries to undermine public policies.

There are also many similarities with the strategies used by the tobacco and alcohol industries. These industry players have been known to distort public health recommendations to achieve their objectives, namely, protecting or increasing their profits.³⁷ Similarly, bio-food companies use science as a communication tool to obstruct public action, confuse the public

and establish credibility.³⁸ We frequently observed these practices in our case study: Some of the arguments that the industry submitted in their briefs and posted on their websites included industry-sponsored or non-peer-reviewed evidence. There were also instances where the evidence was inaccurate, distorted, exaggerated or omitted.³⁸

The introduction of Health Canada’s new measures to mitigate conflicts of interest and its new policy on transparency made the interventions of the bio-food industry more visible. These measures are recommended by the Lancet Global Syndemic Commission and by WHO to improve governance for the public good and address power asymmetries in the food system.^{39,40} In addition, the United Nations and WHO noted that bio-food actors must support public health efforts—not oppose them—to address the climate crisis and the non-communicable disease epidemic.⁴⁰⁻⁴² Nevertheless, although Health Canada had decided not to meet with industry during the revision process, industry actors were still able to submit their written briefs during the public consultations and on their websites, indicating that the industry’s tactics to influence are an ongoing and complex challenge that can only be limited through surveillance of political activities in order to better protect and focus the development of public policies.

Strengths and limitations

This study contributes to the advancement of knowledge in the field of CPA and commercial determinants of health. Its topic is a relevant and relatively unexplored theme in public health nutrition literature. However, we focussed only on publicly available data on the bio-food industry organizations’ websites and written documents of

those bio-food industry actors who submitted briefs to the House of Commons Standing Committee on Health in response to the Committee's invitation. As such, our assessment does not include information on political campaign donations and other forms of lobbying that also affect policy making in the short and long term.¹⁴

Neither the bio-food industry organizations, nor their corporate members, were contacted to provide additional information or to verify the data we collected. Also, we did not distinguish between the characteristics of the industry organizations, such as the size or financial positions of the companies they represented. Still, we took into account all the actors with sufficient resources to become involved in the public debate on the food guide, and in that sense, did not exclude anyone.

Finally, it may be difficult to generalize the results of our study because the work is based only on a small number of industry actors in a specific context.¹⁵ However, our results are similar to those obtained in other countries, as noted earlier, which increases our confidence in our interpretation of the data.⁶

Conclusion

Public policies must be based on evidence and robust guiding principles without the influence of commercial interests—a challenge that is internationally recognized and to which the Canadian government has responded. Our study shows that the bio-food industry in Canada uses CPA to try to influence policies in their favour. This issue is of considerable importance given that other Canadian public policies, such as food advertising regulations, may have been delayed by the bio-food industry's CPA.¹⁴ It is important to ensure oversight of CPA to maintain public trust in decision-making bodies. Public policies' independence and scientific rigour are the main issues at stake here.

Conflicts of interest

The authors declare that they have no conflicts of interest to report.

Authors' contributions and statement

MCR – Conceptualization, data curation, formal analysis, writing – original draft.

MM – Conceptualization, formal analysis, writing – review & editing, supervision.

JCM – Conceptualization, formal analysis, writing – review & editing, supervision.

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Original quantitative research

Social disparities in alcohol consumption among Canadian emerging adults

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Abstract

Introduction: Young adult drinking is a public health priority, but knowledge of socioeconomic status (SES) indicators and alcohol use among emerging adults (EAs; aged 18–29 years) is primarily informed by college samples, populations in their late teens and early twenties and non-Canadian data. We compared the association of three different SES indicators with monthly heavy episodic drinking (HED), less-than-monthly HED, no HED, and no drinking among Canadian EAs.

Methods: We pooled the 2015 to 2019 waves of the Canadian Community Health Survey to include participants aged 18 to 29 years ($n = 29\,598$). Using multinomial regression, we calculated weighted estimates of alcohol use by education, household income and area-level disadvantage, adjusting for adult roles and sociodemographic characteristics.

Results: Approximately 30% of EAs engaged in monthly HED, whereas 16% did not drink at all in the past year. Compared to those in the lowest household incomes, being in the top income quintile was significantly associated with increased relative odds of monthly HED (e.g. in combined SES model, $RRR = 1.21$, 95% CI: 1.04–1.39). Higher levels of education, being in higher income quintiles and living in less disadvantaged areas were significantly associated with reduced relative odds of no HED and not drinking. Adjusting for adult roles did not substantially change the associations between SES and alcohol use.

Conclusion: Higher SES was associated with HED among EAs, although the magnitude of association was small. Universal prevention measures addressing the affordability, availability and marketing of alcohol could be complemented by interventions targeting EA populations at higher risk of HED.

Keywords: *alcohol drinking, alcohol abstinence, young adult, social class*

Introduction

Canada's low-risk drinking guidelines recommend avoiding binge or heavy episodic drinking (HED), as it is linked to short-term harms such as injury, aggression and violence as well as long-term chronic health problems.¹ HED—usually defined as consuming five standard drinks or more for men and four standard drinks or

more for women within a two-hour period—remains a public health concern among young or “emerging” adults (i.e. aged 18–29 years), given that HED prevalence is highest in this age group.^{2,3} In emerging adult (EA) populations, HED is characterized by age-related escalations and reductions. Many researchers believe these peaks and subsequent reductions are linked to developmental transitions

Highlights

- Approximately 30% of respondents engaged in monthly HED, whereas 16% did not consume alcohol in the past year.
- Being in the highest income quintile was significantly associated with increased relative odds of monthly HED.
- Higher education, higher income and lower neighbourhood disadvantage were significantly associated with reduced relative odds of nondrinking.
- Universal prevention measures addressing the affordability, availability and marketing of alcohol could be complemented by interventions targeting EA populations at higher risk of HED.

into adult social roles such as attending postsecondary or completing formal education, full-time employment, residential independence, getting married, and having children.^{4,7}

Much of what we know about EA alcohol use comes from studies conducted in four-year college or university settings,⁸ with far fewer studies on EA alcohol use originating outside of these settings.⁹ However, trends among undergraduates may not be generalizable to EAs not attending school, as there are important socioeconomic differences between undergraduates and their peers not attending postsecondary institutions.^{9–11} Moreover, recent American

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work suggests that the age at which EAs initiate into and mature out of HED is shifting: more EAs aged 18 and 19 years are delaying HED, but are also engaging in HED later into their twenties than in previous decades.^{12,13} Despite these trends, few studies consider the experience of EAs in their mid-to-late twenties. This gap has implications for prevention efforts: for example, the bulk of EA alcohol intervention research has focussed on undergraduate students, with other youth possibly being missed,¹⁴ and underscores the need to consider nationally representative data across a broader EA age range.

A limitation of current evidence concerns understanding socioeconomic disparities in HED in EAs. SES disparities are seen across many health behaviours, including alcohol consumption. In general, lower-SES groups are more likely to abstain, yet also to drink more heavily than wealthier groups.¹⁵ However, the relationship between SES and alcohol consumption is unclear for EAs; most evidence on SES and alcohol consumption has been limited to adolescents or general adult populations older than 25 years. Part of the reason for this knowledge gap may be that assessing SES among EAs is complicated, as there is often overlap between SES and adult roles. For example, education, income and employment are indicators of SES, but EAs are likely to be in the midst of educational attainment, and income and employment status may evolve accordingly.¹⁶ Furthermore, early or delayed adoption of traditional adult roles may be linked to socioeconomic status; that is, the early onset of adult role milestones is more common among disadvantaged groups, whereas more advantaged groups spend more years in education and thus delay onset of adult roles.¹⁷

In light of shifts in age-related drinking and the evidence gap pertaining to SES in this age group, we examined SES disparities in alcohol consumption patterns—including not drinking—in Canadian EAs. There were two specific questions:

1. How were three different indicators of SES—educational attainment, household income and area-level disadvantage—associated with alcohol consumption among Canadian EAs?
2. How were these three SES indicators associated with alcohol consumption when further adjusted for EA concurrent

adult role status (i.e. attending school full-time, working full-time, living with parents, cohabiting/married, parenting)?

Informed by the literature on alcohol abstinence, we hypothesized that SES indicators would be inversely associated with nondrinking (i.e. those with lower education, household income and area-level advantage would have higher relative odds of nondrinking). With respect to HED, we hypothesized that EAs would be more like the general adult population than adolescents, and that higher SES would be inversely associated with HED. We also expected to see that those living with their parents, those who were married or cohabiting and those who were parents themselves would have higher relative odds of nondrinking, but that students would have higher relative odds of HED.

Methods

Data

Data came from the Canadian Community Health Survey (CCHS), an annual, repeated, cross-sectional survey containing nationally representative data on the health of Canadians. The CCHS collects data on health measures, behaviours and services usage of Canadians aged 12 years and older living in the 10 provinces and three territories. The sampling frame represents approximately 98% of the Canadian population. Our analysis was restricted to respondents aged 18 to 29 years. To increase sample size, we merged three survey cycles from 2015 to 2019.

Study variables

Outcome: drinking behaviour in the past year

CCHS participants were asked about ever (lifetime) alcohol consumption; alcohol consumption in the previous year; and how often they consumed five or more (for women, four or more) alcoholic beverages on one occasion over the past 12 months. The latter measure is a standard threshold for assessing HED.¹⁸ Response options for HED ranged from “never” to “more than once a week.” From these items we created a new variable for past-year alcohol consumption with four mutually exclusive levels: (1) none (no lifetime drinking and no drinking in the past year); (2) no HED (past-year drinkers who did not engage in HED); (3) less-than-monthly

HED (past-year drinkers who engaged in HED less than once per month); and (4) monthly HED (past-year drinkers who engaged in HED once per month or more).

Correlates

We included three groups of predictors representing socioeconomic status (SES), adult roles and sociodemographic factors. SES comprised (1) educational attainment (less than high school diploma, high school diploma, community college/technical school/CEGEP, undergraduate university degree or higher); (2) distribution of household income at the national level (relative to a low-income cut-off that accounts for household size, expressed in population quintiles); and (3) area-level material disadvantage (based on the Material and Social Deprivation Index [MSDI]¹⁹ derived from the 2016 Canadian Census; we used the material deprivation values, expressed as quintiles). The material deprivation values reflect low income, low education and a low employment-to-population ratio at the dissemination area (DA) level.¹⁹ We merged MSDI with CCHS data using a common variable: dissemination area identification codes (dissemination areas are the smallest standard geographic unit available for analysis and cover all of Canada).²⁰

We treated adult roles as binary statuses (yes/no): “full-time student”; “full-time employment” (including self-employment, 30+ hours/week); “cohabiting/married”; “living at home with parents”; “living with children” (in a parental role).

Sociodemographic factors included age (three groups to correspond with early, middle and late phases of emerging adulthood: 18–19, 20–24, 25–29); sex (male, female); ethnoracial and Indigenous identity (White, Indigenous, racialized non-Indigenous); and urbanicity (rural, small, medium or large population centre), as these have been shown to be strong predictors of both drinking behaviour and SES.^{3,21–24} Legal drinking age differs across provinces; thus, we also adjusted for provincial legal drinking age (18 years, 19 years), as well as for survey year (corresponding with the available two-year CCHS cycles: 2015–2016, 2017–2018, 2019).

Analysis

For all analyses, we used the survey and bootstrap weights created by Statistics Canada to obtain nationally representative

estimates. Respondents with missing data for any study variable were excluded from the analytical sample.

We first described characteristics of the overall sample and then those of non-drinkers, and no-, less-than-monthly, and monthly heavy episodic drinkers (Table 1). We next estimated relative risk ratios (RRRs) of no drinking, no HED and monthly HED respectively, compared to less-than-monthly HED, using multinomial logistic regression. Less-than-monthly HED was the reference category, as it was the largest group. In the context of multinomial logistic regression, the relative risk ratio (RRR) denotes ratio of relative risks of exposure (e.g. education, household income) in the outcome groups (e.g. monthly HED, less-than-monthly HED), which is equivalent to odds ratio (OR) or relative odds. We built separate, partially adjusted (for age, sex, ethno-racial and Indigenous identity, urbanicity, legal drinking age and survey year) models for each SES variable (i.e. education, household income and area-level disadvantage), and then added all three SES variables as covariates in a single model (hereafter “combined SES”; Table 2). To address our second research question, we added adult role variables, one at a time, to the combined SES model (Table 3).

Given that drinking behaviours and SES have been found to differ between men and women,²⁵ we tested an interaction between SES and gender in partially adjusted models to determine whether to build gender-stratified models. As CCHS data did not distinguish between biological sex and gender prior to 2021, we used the sex variable as a proxy for gender. We found no statistically significant interactions between any SES indicator and sex; therefore, men and women were modelled together.

All analyses were conducted within the Statistics Canada Research Data Centre using R version 4.0 (R Foundation for Statistical Computing Vienna, AT) and the `svy_vglm` and `survey` packages.

Results

Analytical sample

The final analytical sample consisted of 29 598 respondents, representing a national population of 4 869 039 EAs. We excluded 4624 participants from the analysis due to

missing data. The largest source of missing data was in the category of area-level disadvantage, resulting from linkage with the area-level material disadvantage (MSDI) dataset, which is missing information for certain DAs.¹⁹ The next largest source of missing data was for the category of household income (because the CCHS does not include information on this variable for the three territories), followed by ethnoracial and Indigenous identity. There were some differences between included and excluded respondents with respect to age, sex, ethnoracial and Indigenous identity, attending school, living with parents and urbanicity. Older youth, males, Indigenous and racialized youth, those not attending school full-time, those not living with parents and those in medium population centres were underrepresented in the analytical sample (see [Supplemental Table 1](https://osf.io/pb5wg) at <https://osf.io/pb5wg>).

Descriptive overview of alcohol consumption

The largest number of emerging adults engaged in less-than-monthly HED (32.3%, $N = 1\ 572\ 013$), followed by monthly HED (29.9%, $N = 1\ 455\ 469$), no HED (21.6%, $N = 1\ 050\ 887$) and abstaining from alcohol (16.2%, $N = 790\ 671$; Table 1). Of the 29.9% engaging in monthly HED, almost one-third (29.4%, $N = 428\ 333$) reported binge-drinking every week. Compared to nondrinkers or less-than-monthly heavy episodic drinkers, monthly heavy episodic drinkers were more likely to be male, to identify as White, to be in the highest (richest) household income quintiles, to live in the lowest (least) disadvantaged areas and to be in full-time employment. In contrast, nondrinkers were more likely to be the youngest, to have non-Indigenous racialized identities, to be in the lowest (poorest) income quintiles, to live in the highest (most) disadvantaged areas, to live in large population centres, to be in full-time schooling and to be living at home with parents.

How are different indicators of SES associated with alcohol consumption?

The unadjusted and adjusted associations between SES indicators (education, household income and area-level disadvantage) and alcohol use are shown in Table 2. In the monthly HED (vs. less-than-monthly HED) model, EAs with higher education (relative to no high school diploma) had higher relative odds of monthly HED,

though not statistically significant. Compared to those living in the lowest household income (poorest) quintile, those in the two highest household income quintiles (Q4 and Q5) had higher relative odds of monthly HED (RRR = 1.18 [95% CI: 1.01–1.38] and RRR = 1.25 [95% CI: 1.09–1.44], respectively). Compared to those living in the most disadvantaged neighbourhoods, only those in the least disadvantaged neighbourhood had higher relative odds of monthly HED (RRR = 1.23, 95% CI: 1.05–1.44). Including all SES indicators (education, household income and area-level disadvantage) in a single model resulted in a slight attenuation of associations, and only the highest household income quintile remained statistically significant.

The no HED (vs. less-than-monthly HED) and no drinking (vs. less-than-monthly HED) models suggest that EAs with higher education (e.g. university degree relative to no high school diploma) had lower relative odds of no HED (RRR = 0.59, 95% CI: 0.47–0.74) and no drinking (RRR = 0.26, 95% CI: 0.21–0.33). EAs in higher household income quintiles (relative to the lowest) had lower relative odds of no HED and no drinking (e.g. for those in the richest income quintile, RRR = 0.62 [0.52–1.38] of no HED, and RRR = 0.37 [0.30–0.46] of no drinking). EAs in less disadvantaged quintiles (relative to the most) had lower relative odds of no HED and no drinking (e.g. for those in the lowest area-level disadvantage quintile, RRR = 0.72 [0.60–0.87] of no HED, and RRR = 0.39 [0.31–0.49] of no drinking). Including all SES indicators (education, household income and area-level disadvantage) in a single model resulted in attenuation of their associations with no HED and no drinking, which nonetheless remained statistically significant.

Do SES–alcohol consumption associations change when adult roles are considered?

The associations between SES and alcohol consumption adjusted for adult social roles are shown in Table 3. Two roles were associated with monthly HED: being in a cohabiting or marital relationship (RRR = 0.81, 95% CI: 0.73–0.91) and being a parent (RRR = 0.66, 95% CI: 0.56–0.77). Three roles were associated with no HED: full-time employment (RRR = 0.74, 95% CI: 0.66–0.82), being in a cohabiting or marital relationship (RRR = 1.23, 95% CI:

TABLE 1
Study sample characteristics of Canadian emerging adults aged 18 to 29 years, Canadian Community Health Survey (2015–2019)

		Total weighted sample	Stratified by drinking behaviour			
			No drinking	No HED	Less-than-monthly HED	Monthly HED
			N = 4 869 039	N = 790 671	N = 1 050 887	N = 1 572 013
		column %	column %	column %	column %	column %
Education	Less than high school diploma	7.6	13.6	7.7	5.9	6.1
	High school diploma	37.6	41.3	38.7	37.1	35.2
	College/technical/CEGEP	31.3	24.8	30.5	32.9	33.7
	University degree or higher	23.5	20.3	23.1	24.1	25.0
Household income	Q1 (lowest)	25.5	37.8	29.2	22.4	19.6
	Q2 (medium-low)	19.4	22.1	21.4	18.4	17.5
	Q3 (middle)	19.0	19.0	18.4	19.9	18.3
	Q4 (medium-high)	18.5	12.4	17.2	19.8	21.5
	Q5 (highest)	17.6	8.7	13.8	19.5	23.0
Area-level material disadvantage	Q1 (lowest)	22.3	14.2	20.4	23.8	26.5
	Q2 (medium-low)	18.8	15.1	17.9	19.9	20.4
	Q3 (middle)	19.5	18.8	20.0	19.4	19.6
	Q4 (medium-high)	20.0	21.4	20.4	20.4	18.7
	Q5 (highest)	19.4	30.6	21.4	16.6	14.8
Age (y)	18–19	16.0	24.4	17.1	14.5	12.4
	20–24	40.4	36.2	38.9	41.7	42.6
	25–29	43.5	39.5	43.9	43.9	45.0
Sex	Female	49.1	53.4	51.8	51.6	42.2
	Male	50.9	46.6	48.2	48.4	57.8
Ethnoracial and Indigenous identity ^a	White	63.7	37.4	55.7	70.8	76.1
	Indigenous	5.0	4.2	3.3	5.1	6.5
	Racialized non-Indigenous	31.3	58.4	40.9	24.0	17.4
Attending school full-time	No	69.2	62.4	68.2	69.6	73.2
	Yes	30.8	37.6	31.8	30.4	26.8
Working full-time	No	45.8	64.5	51.1	41.2	36.9
	Yes	54.2	35.5	48.9	58.8	63.1
Living with parents	No	53.0	46.8	55.1	53.1	54.6
	Yes	47.0	53.2	44.9	46.9	45.4
Cohabiting/married	No	74.1	76.5	71.9	73.0	75.7
	Yes	25.9	23.5	28.1	27.0	24.3
Parenting	No	90.8	88.8	88.0	90.9	93.8
	Yes	9.2	11.2	12.0	9.1	6.2
Urbanicity	Rural	13.1	9.5	12.5	13.8	14.5
	Small population centre	10.0	6.7	7.7	11.4	11.9
	Medium population centre	8.3	6.6	7.9	8.6	9.3
	Large population centre	68.6	77.1	71.8	66.2	64.3
Legal drinking age (y)	18	37.1	30.7	35.2	39.3	39.5
	19	62.9	69.3	64.8	60.7	60.5
Year	2015–2016	32.5	28.8	32.9	32.7	34.0
	2017–2018	33.6	32.7	32.9	33.5	34.8
	2019	33.9	38.5	34.2	33.9	31.2

Abbreviations: HED, heavy episodic drinking; Q, quintile; y, years.

Notes: Complete cases. Frequencies are weighted using the survey weights created by Statistics Canada to produce nationally representative estimates of the Canadian population. Column percentages may not add to 100% due to rounding. Unweighted sample size of total analytical sample is n = 29 598; n = 4154 for no drinking; n = 5962 for no HED; n = 9950 for less-than-monthly HED; n = 9532 for monthly HED.

^a The Canadian Community Health Survey asks individuals to self-identify as an “Aboriginal person,” or as belonging to one or more “racial or cultural groups” including: Arab, Black, Chinese, Filipino, Japanese, Korean, Latin American, South Asian, Southeast Asian, West Asian, White. Respondents could also specify another identity.

TABLE 2
Associations between socioeconomic indicators and alcohol consumption among Canadian emerging adults aged 18 to 29 years, Canadian Community Health Survey (2015–2019), N = 4 869 039

		Education		Household income		Area-level disadvantage		Combined SES ^a	
		RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
Monthly HED (vs. less-than-monthly HED) model									
Education	Less than high school	REF						REF	
	High school diploma	0.99	0.82–1.19					0.94	0.78–1.13
	College/technical/CEGEP	1.06	0.89–1.28					1.01	0.84–1.21
	University degree or higher	1.15	0.93–1.41					1.04	0.84–1.29
Household income	Q1 (lowest or poorest)			REF				REF	
	Q2 (medium-low)			1.06	0.91–1.24			1.06	0.91–1.23
	Q3 (middle)			1.00	0.86–1.17			0.99	0.85–1.16
	Q4 (medium-high)			1.18	1.01–1.38			1.15	0.99–1.35
	Q5 (highest)			1.25	1.09–1.44			1.21	1.04–1.39
Area-level material disadvantage	Q5 (highest or most disadvantaged)					REF		REF	
	Q4 (medium-high)					1.00	0.85–1.17	0.98	0.84–1.15
	Q3 (middle)					1.08	0.93–1.26	1.05	0.90–1.23
	Q2 (medium-low)					1.10	0.94–1.28	1.06	0.91–1.25
	Q1 (lowest)					1.23	1.05–1.44	1.18	1.00–1.38
No HED (vs. less-than-monthly HED) model									
Education	Less than high school	REF						REF	
	High school diploma	0.71	0.57–0.88					0.77	0.62–0.96
	College/technical/CEGEP	0.65	0.53–0.80					0.72	0.58–0.89
	University degree or higher	0.59	0.47–0.74					0.69	0.55–0.88
Household income	Q1 (lowest or poorest)			REF				REF	
	Q2 (medium-low)			0.91	0.78–1.07			0.93	0.79–1.09
	Q3 (middle)			0.76	0.64–0.90			0.79	0.66–0.94
	Q4 (medium-high)			0.73	0.62–0.86			0.77	0.65–0.91
	Q5 (highest)			0.62	0.52–0.76			0.67	0.55–0.81
Area-level material disadvantage	Q5 (highest or most disadvantaged)					REF		REF	
	Q4 (medium-high)					0.84	0.70–1.01	0.88	0.74–1.06
	Q3 (middle)					0.88	0.74–1.05	0.94	0.79–1.12
	Q2 (medium-low)					0.80	0.67–0.96	0.87	0.72–1.05
	Q1 (lowest)					0.72	0.60–0.87	0.80	0.66–0.97
No drinking (vs. less-than-monthly HED) model									
Education	Less than high school	REF						REF	
	High school diploma	0.37	0.30–0.46					0.45	0.37–0.56
	College/technical/CEGEP	0.29	0.23–0.37					0.36	0.28–0.45
	University degree or higher	0.26	0.21–0.33					0.38	0.30–0.47
Household income	Q1 (lowest or poorest)			REF				REF	
	Q2 (medium-low)			0.76	0.64–0.91			0.81	0.68–0.97
	Q3 (middle)			0.67	0.55–0.81			0.75	0.62–0.91
	Q4 (medium-high)			0.46	0.38–0.56			0.54	0.44–0.66
	Q5 (highest)			0.37	0.30–0.46			0.47	0.38–0.58
Area-level material disadvantage	Q5 (highest or most disadvantaged)					REF		REF	
	Q4 (medium-high)					0.67	0.55–0.82	0.74	0.60–0.90
	Q3 (middle)					0.64	0.52–0.78	0.72	0.58–0.88
	Q2 (medium-low)					0.55	0.44–0.67	0.64	0.52–0.79
	Q1 (lowest)					0.39	0.31–0.49	0.47	0.38–0.59

Abbreviations: CI, confidence interval; HED, heavy episodic drinking; Q, quintile; REF, reference group; RRR, relative risk ratio; SES, socioeconomic status.

Notes: Weighted multinomial logistic regression using complete case analysis. Models were adjusted for age, sex, ethnoracial and Indigenous identity, urbanicity, provincial legal drinking age and survey year. Bold typeface indicates significance.

^a In the combined SES model, education, household income and area-level material disadvantage were included as covariates.

TABLE 3
Associations between SES, adult roles and alcohol consumption among Canadian emerging adults aged 18 to 29 years,
Canadian Community Health Survey (2015–2019), N = 4 869 039

		Full-time student ^a		Working full-time ^b		Living with parents ^c		Cohabiting/ married ^d		Parenting ^e	
		RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
Monthly HED (vs. less-than-monthly HED) model											
Education	Less than high school	REF		REF		REF		REF		REF	
	High school diploma	0.95	0.79–1.15	0.93	0.77–1.12	0.94	0.78–1.13	0.94	0.78–1.13	0.93	0.77–1.12
	College/technical/CEGEP	1.01	0.84–1.22	0.99	0.82–1.20	1.00	0.83–1.21	1.01	0.84–1.22	1.00	0.83–1.20
	University degree or higher	1.05	0.85–1.30	1.03	0.83–1.27	1.04	0.84–1.28	1.06	0.85–1.31	1.02	0.82–1.26
Household income	Q1 (lowest or poorest)	REF		REF		REF		REF		REF	
	Q2 (medium-low)	1.05	0.90–1.23	1.05	0.90–1.22	1.07	0.92–1.25	1.06	0.91–1.24	1.05	0.90–1.22
	Q3 (middle)	0.99	0.84–1.15	0.98	0.84–1.14	1.01	0.86–1.18	0.99	0.85–1.16	0.98	0.84–1.14
	Q4 (medium-high)	1.15	0.98–1.35	1.14	0.97–1.33	1.18	1.01–1.38	1.15	0.98–1.35	1.13	0.96–1.32
	Q5 (highest)	1.21	1.04–1.39	1.19	1.03–1.38	1.24	1.07–1.44	1.20	1.04–1.38	1.17	1.01–1.35
Area-level material disadvantage	Q5 (highest or most disadvantaged)	REF		REF		REF		REF		REF	
	Q4 (medium-high)	0.98	0.84–1.15	0.98	0.84–1.15	0.98	0.84–1.15	0.98	0.84–1.15	0.98	0.83–1.14
	Q3 (middle)	1.05	0.90–1.23	1.05	0.90–1.22	1.05	0.90–1.23	1.05	0.90–1.23	1.05	0.89–1.22
	Q2 (medium-low)	1.07	0.91–1.25	1.06	0.91–1.24	1.06	0.91–1.25	1.06	0.91–1.25	1.06	0.90–1.24
	Q1 (lowest)	1.18	1.01–1.39	1.17	1.00–1.38	1.17	1.00–1.38	1.17	1.00–1.38	1.16	0.99–1.37
Attending school full-time	Yes	0.91	0.81–1.03								
Working full-time	Yes			1.09	0.98–1.20						
Living with parents	Yes					0.92	0.81–1.03				
Cohabiting/married	Yes							0.81	0.73–0.91		
Parenting	Yes									0.66	0.56–0.77
No HED (vs. less-than-monthly HED) model											
Education	Less than high school	REF		REF		REF		REF		REF	
	High school diploma	0.78	0.63–0.97	0.79	0.63–0.98	0.77	0.62–0.96	0.77	0.62–0.96	0.78	0.63–0.97
	College/technical/CEGEP	0.72	0.58–0.89	0.75	0.61–0.93	0.71	0.58–0.89	0.71	0.57–0.89	0.73	0.59–0.91
	University degree or higher	0.70	0.55–0.88	0.73	0.58–0.93	0.69	0.55–0.87	0.69	0.55–0.87	0.72	0.57–0.91
Household income	Q1 (lowest or poorest)	REF		REF		REF		REF		REF	
	Q2 (medium-low)	0.93	0.79–1.09	0.97	0.83–1.14	0.95	0.81–1.11	0.93	0.79–1.09	0.94	0.80–1.11
	Q3 (middle)	0.78	0.66–0.93	0.82	0.69–0.98	0.81	0.68–0.96	0.79	0.66–0.94	0.80	0.67–0.96
	Q4 (medium-high)	0.77	0.65–0.91	0.81	0.68–0.96	0.79	0.67–0.95	0.77	0.65–0.91	0.79	0.67–0.94
	Q5 (highest)	0.67	0.55–0.81	0.71	0.59–0.86	0.70	0.57–0.85	0.68	0.56–0.82	0.70	0.58–0.85
Area-level material disadvantage	Q5 (highest or most disadvantaged)	REF		REF		REF		REF		REF	
	Q4 (medium-high)	0.88	0.74–1.06	0.89	0.74–1.06	0.88	0.73–1.05	0.88	0.74–1.06	0.89	0.74–1.07
	Q3 (middle)	0.94	0.79–1.12	0.94	0.79–1.12	0.94	0.79–1.12	0.94	0.79–1.12	0.94	0.79–1.13
	Q2 (medium-low)	0.87	0.73–1.05	0.87	0.72–1.05	0.87	0.72–1.05	0.87	0.73–1.05	0.88	0.74–1.07
	Q1 (lowest)	0.81	0.67–0.97	0.81	0.67–0.97	0.80	0.66–0.96	0.80	0.67–0.97	0.82	0.68–0.99
Attending school full-time	Yes	0.92	0.81–1.06								
Working full-time	Yes			0.74	0.66–0.82						
Living with parents	Yes					0.88	0.77–1.01				
Cohabiting/married	Yes							1.23	1.09–1.39		
Parenting	Yes									1.55	1.35–1.79

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TABLE 3 (continued)
Associations between SES, adult roles and alcohol consumption among Canadian emerging adults aged 18 to 29 years, Canadian Community Health Survey (2015–2019), N = 4 869 039

		Full-time student ^a		Working full-time ^b		Living with parents ^c		Cohabiting/ married ^d		Parenting ^e	
		RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
No drinking (vs. less-than-monthly HED) model											
Education	Less than high school	REF		REF		REF		REF		REF	
	High school diploma	0.46	0.37–0.56	0.47	0.38–0.58	0.45	0.37–0.56	0.45	0.37–0.56	0.46	0.38–0.57
	College/technical/CEGEP	0.36	0.28–0.45	0.39	0.31–0.49	0.36	0.29–0.45	0.36	0.28–0.44	0.37	0.29–0.46
	University degree or higher	0.38	0.30–0.48	0.42	0.33–0.53	0.38	0.30–0.48	0.37	0.29–0.47	0.39	0.31–0.50
Household income	Q1 (lowest or poorest)	REF		REF		REF		REF		REF	
	Q2 (medium-low)	0.81	0.68–0.96	0.90	0.75–1.07	0.79	0.67–0.94	0.81	0.68–0.97	0.83	0.69–0.98
	Q3 (middle)	0.75	0.62–0.91	0.83	0.68–1.01	0.73	0.60–0.88	0.75	0.62–0.91	0.77	0.64–0.93
	Q4 (medium-high)	0.54	0.44–0.65	0.60	0.49–0.73	0.52	0.42–0.63	0.54	0.44–0.66	0.56	0.46–0.68
	Q5 (highest)	0.47	0.38–0.58	0.53	0.43–0.67	0.45	0.36–0.55	0.47	0.38–0.58	0.49	0.39–0.61
Area-level material disadvantage	Q5 (highest or most disadvantaged)	REF		REF		REF		REF		REF	
	Q4 (medium-high)	0.74	0.60–0.90	0.74	0.61–0.91	0.74	0.61–0.90	0.74	0.60–0.90	0.74	0.61–0.91
	Q3 (middle)	0.72	0.58–0.88	0.71	0.58–0.88	0.71	0.58–0.87	0.72	0.58–0.88	0.72	0.59–0.88
	Q2 (medium-low)	0.64	0.52–0.79	0.64	0.52–0.79	0.64	0.52–0.79	0.64	0.52–0.79	0.65	0.53–0.80
	Q1 (lowest)	0.48	0.38–0.60	0.48	0.38–0.60	0.48	0.39–0.60	0.48	0.38–0.59	0.48	0.39–0.61
Attending school full-time	Yes	0.96	0.82–1.13								
Working full-time	Yes			0.51	0.44–0.59						
Living with parents	Yes					1.19	1.02–1.39				
Cohabiting/married	Yes							1.18	1.01–1.37		
Parenting	Yes									1.62	1.35–1.94

Abbreviations: CI, confidence interval; HED, heavy episodic drinking; REF, reference group; RRR, relative risk ratio; Q, quintile; SES, socioeconomic status.

Notes: Models adjusted for age, sex, ethnoracial and Indigenous identity, urbanicity, provincial legal drinking age and survey year. Bold type indicates significance.

^a Reference: not attending school full-time.

^b Reference: not working full-time.

^c Reference: not living with parents.

^d Reference: not cohabiting/married.

^e Reference: not a parent.

1.09–1.39) and being a parent (RRR = 1.55, 95% CI: 1.35–1.79). Four roles were associated with no drinking: full-time employment (RRR = 0.51, 95% CI: 0.44–0.59), living with parents (RRR = 1.19, 95% CI: 1.02–1.39), being in a cohabiting or marital relationship (RRR = 1.18, 95% CI: 1.01–1.37) and being a parent (RRR = 1.62, 95% CI: 1.35–1.94). Overall, adjusting for adult roles did not change the association of SES with drinking.

Discussion

This study expands what is known about the social disparities of alcohol consumption among emerging adults aged 18 to 29 in Canada. There were clear socioeconomic gradients. Compared to those with

lower SES, EAs in the highest-income households were more likely to report monthly HED and less likely to report no HED and no drinking in the past year. Likewise, EAs in the lowest area-level disadvantage quintiles were more likely to report monthly HED, and also less likely to report no HED and no drinking. EAs with higher education were less likely to report no HED and no drinking in the past year.

The inclusion of adult roles into models did not meaningfully change the association of SES variables with alcohol consumption. However, some adult roles were also independently associated with alcohol consumption. For instance, EAs in parenting roles or in cohabiting or married

relationships were less likely to report monthly HED and more likely to report no HED and no drinking in the past year. However, those working full-time had the opposite pattern: they were slightly more likely to report monthly HED (not statistically significant) and less likely to report no HED and no drinking. Finally, those living with parents were more likely to report no drinking in the past year. Overall, we found the strongest SES disparities in the models examining no-past-year drinking.

SES and HED in emerging adults

The relationship between socioeconomic status and alcohol consumption has been less clear for EAs²⁶ than for adults or

adolescents. Whereas research on heavy alcohol use in the general population found that those with less education and lower household incomes were more likely to engage in heavy alcohol use,²⁴ among adolescent populations, those from families with higher education, with higher household income and living in wealthier neighbourhoods were more likely to engage in binge drinking.²⁶⁻²⁸ For EA populations, the associations are mixed, and depend on the SES indicator.

SES has been operationalized in different ways across EA studies, making direct comparisons challenging. Some studies have incorporated measures assessing family SES (e.g. parental education, parental income or other indicators of family wealth). These studies suggest that EA HED is associated with higher parental education;²⁹⁻³² however, this measure was not available in the CCHS. Whereas we expected monthly HED to be associated with lower educational attainment as in the general population, we found that education was not meaningfully associated with monthly HED (compared to less-than-monthly HED). It is likely that educational inequalities in drinking only become manifest later into adulthood.

Fewer studies have used measures of personal income or area-level disadvantage. Our finding that higher household income is associated with EA monthly HED complements studies that incorporated either household or personal income into analysis.^{26,33} One possible reason for this association is that these EAs have more disposable income to spend on alcohol.³³ It is also possible that frequent HED is a more accepted practice among EAs in high-income households and networks.²⁶ That we found living in the least disadvantaged (i.e. wealthiest) neighbourhoods positively associated with EA HED complements findings from two studies,^{22,31} but not from two others.^{34,35} Area-level material disadvantage may be linked to alcohol consumption via social norms that might permit or discourage heavy alcohol use (or abstinence), or via availability of alcohol.²³

SES, no HED, and no drinking in emerging adults

We found that no HED and not drinking in the past year was more prevalent among EAs with less education, living in a lower-income household and living in a more

disadvantaged neighbourhood. The no drinking findings are in line with studies in EA populations in Britain, France, the US and Australia.³⁶⁻³⁹ The reasons for the association between lower SES and not drinking are not well understood, although pre-existing poor physical or mental health may influence lifetime abstention.³⁶

It is increasingly recognized that EAs are drinking less than ever before, yet few population studies include nondrinking EAs as a subject of analysis. Nondrinkers in general adult populations are often described as “sick quitters,” considered too different from the population average to be included in analysis, as poor health is shown to underpin both abstaining from alcohol and lower SES.^{36,40} However, in an analysis of nondrinking trends over time among British EAs, Ng Fat and colleagues⁴¹ suggested that nondrinking is becoming more mainstream, with much of the increase coming from young people who never take up drinking at all, despite reporting good health. Nearly all (99%) nondrinkers in our study reported no lifetime consumption; in other words, there were few “former drinkers.”

That we found a similar direction of associations between lower SES and not engaging in HED among drinkers also suggests nondrinking is part of a continuum of drinking behaviour, rather than being an outlier behaviour. Given that Canada has positioned low-risk drinking as a public health goal (and has recently strengthened its low-risk drinking guidelines¹), understanding the characteristics of EA nondrinkers is important. It would be valuable to examine Canadian EA nondrinking trends over time, and to assess if social disparities are narrowing.

Adult roles and drinking

We did not find any association between student status and drinking. The evidence on the relationship between student status and alcohol consumption is mixed: some studies have found that postsecondary students are more likely to engage in HED than their nonstudent peers,^{42,43} with other studies reporting no differences.^{44,45} We add to this literature by finding again no association between student status and alcohol consumption in the Canadian context.

The evidence on the relationship between drinking and employment in EAs is sparse

and inconsistent.^{46,47} Our results indicated that working full-time may be a risk factor for monthly HED in EAs, in line with two previous studies.^{45,48} Full-time employment may increase drinking frequency due to increased income or social opportunities for drinking with colleagues.^{45,46,49} We also found that full-time employment was inversely associated with no HED and not drinking in the past year. These associations differ from studies with general adult populations, which find that HED is associated with unemployment.^{15,24} This suggests that the effect of employment may differ by life stage, and unemployment may become an increasingly meaningful predictor of alcohol misuse as it becomes more impactful on one’s identity and finances with increasing age.

As expected, we found that parenthood and cohabitation/marriage were protective factors against HED and positively associated with nondrinking, which has been well documented in other studies.^{5,36,50-53} We had expected to find living with parents would reduce the odds of monthly HED, as documented in other studies, but our findings were not statistically significant.^{44,54} However, living with parents was positively associated with never drinking in the past year. One proposed mechanism for the increase in EA nondrinking is the growing proportion of EAs continuing to live at home throughout their twenties.⁵⁵

Strengths and limitations

The key strength of this study lies in the methodological qualities of the CCHS, a large national sample including emerging adults who were not students or university educated. However, the study is cross-sectional and so cannot provide evidence of a causal relationship between SES and alcohol consumption. Furthermore, the dataset assessed frequency of HED but not the amounts consumed per HED occasion. Therefore, we did not have a measure of high-intensity drinking (e.g. defined as 8+/10+ drinks in a single sitting for women/men²), which would be worth studying, given that HED is common in this age group. Nor did we account for immigrant status or age of migration (associated with nondrinking and HED);⁵⁶ doing so may have attenuated results. Finally, approximately 12% of the weighted dataset was excluded from analysis due to missing data. This included all respondents from Canada’s three territories;

therefore, the results of this study may not be generalizable to EAs living in the territories.

Implications

We used three SES indicators, as they may reflect different and non-interchangeable resources and life circumstances. As expected, indicators overlapped somewhat, and the direction of associations was the same regardless of SES indicator, although the associations were attenuated when included in combined SES models. We used education as a component of SES in relation to drinking behaviour because education can influence norms and attitudes, whereas household income may influence purchasing ability. Area-level disadvantage may reflect environmental context such as community drinking norms and alcohol availability. Whereas all SES indicators were positively associated with monthly HED, only the highest household income quintile was statistically significant; all SES indicators were inversely associated with not drinking, and these associations were also stronger than in the monthly HED models. One plausible explanation why HED was more prevalent among more socioeconomically advantaged EAs could be that, unlike smoking, HED is not widely regarded as a health risk, nor is it socially stigmatized.⁵⁷

Evidence from this and other research demonstrates that the relationship between SES and HED is not the same among EAs as in the general adult population,⁵⁸ although we found the association between SES and EA nondrinking *does* follow the same trend as in general adult populations. Understanding the role of socioeconomic factors in EAs' drinking behaviour as they adopt adult roles may aid in identifying targets for prevention. A recent scoping review found that most brief alcohol interventions targeting EAs occur within undergraduate settings;¹⁴ our results suggest that preventive initiatives could be extended to EAs in full-time employment.

Declines in EA drinking have been documented across multiple countries.^{39,59} This trend provides opportunities to normalize lighter alcohol consumption, especially in contexts where socializing is linked with cultures of heavy drinking (e.g. starting postsecondary studies, going out with friends or colleagues).⁶⁰ However, the strongest evidence for preventing alcohol-related

harm comes from broad-based policies that target the affordability, physical availability and marketing of alcohol.⁵⁹ Such measures may also sustain lighter alcohol consumption, and are relevant to EAs (who are sensitive to alcohol pricing and targeted by digital marketers)⁵⁹ as well as to adolescents. It is more effective to use a combination of policies addressing alcohol affordability, availability and marketing than any of these measures alone.⁶¹

Although this study did not examine harms, there is increasing recognition of an alcohol-harms paradox—the unequal burden that alcohol-related harms (e.g. hospitalization, death) place on low SES groups despite lower consumption. In the general adult population, people with low SES experience disproportionate harm from a given level of alcohol use.⁶² A nascent body of evidence suggests that this paradox also exists for adolescents^{63,64} and EAs,⁶⁵ whereby lower-SES EAs are more vulnerable to alcohol-based harms such as violence, injury, hospitalization and encounters with police. One explanation as to why lower-SES EAs may be more vulnerable to such harms is because their resources do not afford them the same buffering influence as experienced by their more affluent peers.^{26,31}

Conclusion

SES associations with monthly HED among emerging adults differed from what has been observed in general adult populations, and underscore the importance of multidimensional assessments of SES. EA monthly HED was associated with higher household income. It was also associated, though not significantly, with living in the least disadvantaged neighbourhoods. EA nondrinking and not engaging in HED was associated with lower education, income and neighbourhood advantage. Structural policies addressing the affordability, availability and marketing of alcohol have been shown to be effective in reducing EA drinking. These universal prevention measures could be complemented by targeted approaches directed at EA populations at higher risk of HED.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Authors' contributions and statement

SS, MS—conceptualization. SS—analysis, writing—original draft. SS, MS, TG—writing—review and editing.

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Original quantitative research

Estimating the completeness of physician billing claims for diabetes case ascertainment: a multiprovince investigation

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Abstract

Introduction: Previous research has suggested that how physicians are paid may affect the completeness of billing claims for estimating chronic disease. The purpose of this study is to estimate the completeness of physician billings for diabetes case ascertainment.

Methods: We used administrative data from eight Canadian provinces covering the period 1 April 2014 to 31 March 2016. The patient cohort was stratified into two mutually exclusive groups based on their physician remuneration type: fee-for-service (FFS), for those paid only on that basis; and non-fee-for-service (NFFS). Using diabetes prescription drug data as our reference data source, we evaluated whether completeness of disease case ascertainment varied with payment type. Diabetes incidence rates were then adjusted for completeness of ascertainment.

Results: The cohort comprised 86 110 patients. Overall, equal proportions received their diabetes medications from FFS and NFFS physicians. Overall, physician payment method had little impact upon the percentage of missed diabetes cases (FFS, 14.8%; NFFS, 12.2%). However, the difference in missed cases between FFS and NFFS varied widely by province, ranging from -1.0% in Nova Scotia to 29.9% in Newfoundland and Labrador. The difference between the observed and adjusted disease incidence rates also varied by province, ranging from 22% in Prince Edward Island to 4% in Nova Scotia.

Conclusion: The difference in the loss of cases by physician remuneration method varied across jurisdictions. This loss may contribute to an underestimation of disease incidence. The method we used could be applied to other chronic diseases for which drug therapy could serve as reference data source.

Keywords: *physician billing, administrative data, data quality, health data, national, surveillance*

Highlights

- Some physician visits could be missed because salaried (NFFS) physicians may not shadow bill.
- Data from the Canadian Chronic Disease Surveillance System (CCDSS) were compared to prescription drug data to identify missing diabetes cases.
- How the physician was paid had little impact upon the number and percentage of missed diabetes cases.
- We adjusted the diabetes incidence rates for the missing cases; the largest percentage change between the observed and adjusted rates was for Prince Edward Island (22%) and the smallest was for Nova Scotia (4%).

Introduction

The Canadian Chronic Disease Surveillance System (CCDSS) is a collaborative network of provincial and territorial surveillance systems, supported by the Public Health Agency of Canada (PHAC). The partnership enables the pooling of population-based data on chronic diseases in Canada with the aim of better understanding the disease burden across the country

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to support both health promotion and disease prevention efforts and health resource planning. Through access to administrative health data on all residents who are eligible for provincial or territorial health insurance across the country, the CCDSS is able to generate national estimates of incidence, prevalence and associated trends for over 20 chronic diseases.¹ Administrative health data are extensively used in chronic disease research²⁻¹¹ and disease surveillance.¹²⁻¹⁶

In Canada, physician billing claims are used to remunerate physicians who are paid on a fee-for-service (FFS) basis; these records are also used for various secondary purposes, including disease surveillance. Physicians who are (1) paid a salary, (2) paid on a capitation basis, or (3) paid through some other blended non-fee-for-service (NFFS) mechanism, are frequently required to “shadow bill.”¹⁷ Shadow billing is an “administrative process whereby physicians submit service provision information using provincial/territorial fee codes; however, payment is not directly linked to the services reported. Shadow billing data can be used to maintain historical measures of service provision based on fee-for-service claims data.”^{17,p.iii}

Though the percentage of Canadian physicians paid on a NFFS basis has increased dramatically over the last two decades,¹⁸ the quality and completeness of shadow billing records remains poorly understood.¹⁹ For researchers and government agencies that have historically relied upon high-quality physician billing claims data for disease surveillance, systematic under-recording of clinical encounters or patient characteristics via shadow billing could undermine disease estimations.

Using prescription drug data as the reference standard for identifying diabetes incidence, a 2009 Ontario study reported a relative under-identification of diabetes in the physician billing claims data of patients cared for by NFFS family physicians.² A subsequent study investigated the completeness of capture of physician billing claims for FFS and NFFS physicians in Manitoba.²⁰ The authors found a loss of physician billing claims associated with physician forms of payment, which resulted in some underestimation of diabetes incidence.²⁰ However, to our knowledge, there has been only one multisite study²¹ to examine the impact of physician remuneration

on chronic disease estimation in administrative health data. The purpose of our study was to compare the completeness of capture of incident diabetes among physicians paid by FFS and NFFS methods across multiple Canadian provinces.

Methods

Study design and data sources

The PHAC, in collaboration with all provinces and territories, conducts national surveillance of diabetes to support the planning and evaluation of related policies and programs through the CCDSS.²² The CCDSS Data Quality Working Group collaboratively developed the project protocol and completed the analyses. We undertook a multiprovince cohort study using administrative health data from British Columbia, Saskatchewan, Manitoba, Ontario, Quebec, Prince Edward Island, Nova Scotia and Newfoundland and Labrador (jurisdictions with access to both the physician registry and prescription drug data) covering the period 1 April 2014 through 31 March 2016.

We used five administrative data sources. The first was physician billing claims, which are completed for physician services. These data contain a physician identification number and diagnosis codes recorded using the International Classification of Diseases (ICD), 9th revision, Clinical Modification²³ codes or some variation thereof. The second source was the Discharge Abstract Database (DAD) and MED-ÉCHO, which compile data when a patient is discharged from an acute care facility. These data contain up to 25 diagnosis codes recorded using the ICD, 10th revision, Canadian version (ICD-10-CA²⁴). Our reference standard data source for disease incidence was prescription drug data, which contain information for prescription medications dispensed by outpatient pharmacies. Each record contains the date of dispensation, drug identification number and prescriber identification number. The provincial health insurance registry of each jurisdiction was also used. It contains dates of health insurance coverage as well as demographic information such as date of birth, sex and residential or correspondence postal code. Finally, we used the health care provider registry in each province to describe physicians' characteristics, including specialty and method of payment.

Patient cohort

The patient cohort included all incident diabetes cases identified by prescription drug records among residents aged one year and older in all provinces except Ontario and Newfoundland and Labrador, where data were available for residents aged 67 years and older, and Saskatchewan, where data were available for residents aged 65 years and older.²⁵ The cohort inclusion criteria were: (1) at least one prescription for a glucose-lowering drug identified by the World Health Organization Anatomical Therapeutic Chemical (ATC) code of A10 in the two-year accrual period from 1 April 2014 to 31 March 2016; (2) continuous health insurance coverage during the two-year period before and the two-year period after the index prescription date, that is, the date that a diabetes prescription medication was first identified in prescription drug records during the observation period; and (3) age of two years or older (or 67 years or older in Ontario and Newfoundland and Labrador, and 65 years or older in Saskatchewan) on the index prescription date.

ATC code A10 captures blood glucose-lowering drugs such as metformin and insulins and their analogues, but not supplies such as glucose test strips. To capture incident cases only, individuals were excluded from the study if they had a prescription with an ATC code of A10 within the two-year period prior to their index prescription date. The prescriber identification number associated with the index diabetes medication prescription was linked to the corresponding number in the provider registry to determine physician payment method (i.e. FFS vs. NFFS). Individuals were excluded if the payment method of the provider who made the index prescription was not recorded in the registry and/or if the providers in the provider registry did not match between the CCDSS and prescription drug databases. Women with obstetrical or pregnancy-related diagnosis codes were also excluded.

The cohort was stratified into two mutually exclusive groups: (1) individuals with an index prescription from a FFS physician, and (2) individuals with an index prescription from a NFFS physician. FFS physicians were defined as physicians who received only FFS payments, while NFFS physicians were defined as physicians who received something other than 100% FFS payment.

Denominator

The denominator for the incidence rates included all people with or without diabetes and continuous health insurance coverage during the two-year period before and two-year period after the index prescription date, aged 2 years or older (or 67 years and older in Ontario and Newfoundland and Labrador, and 65 years and older in Saskatchewan) on the index prescription date. The denominator for the diabetes incidence rates was tailored to the specific purpose of this study. Therefore, these rates are not comparable to those in other CCDSS publications.

Outcome measures

Using the patient cohort, we identified whether the individual met the diabetes case definition used by the CCDSS.²⁶⁻²⁸ A case was defined as an individual with one hospitalization or two physician billing claims within two years having an ICD-9-CM²³ or ICD-9²⁹ code of 250 or ICD-10-CA²⁴ code of E10, E11, E13 or E14^{27,28} (diabetes types 1 and 2 could not be distinguished). The sensitivity was 86%, specificity was 97% and positive predictive value (PPV) was 80%.²⁸ We defined the case diagnosis date as either the date of hospital discharge or the date of the second qualifying physician billing claim, whichever came first.

Concordance between the administrative data case definition and the reference standard prescription drug claim was evaluated for patients for whom the case diagnosis date fell within the two years preceding or two years following each patient's index prescription date. To avoid cases of potential gestational diabetes, women aged 10 to 54 were excluded if the qualifying case diagnosis date fell in the 120 days before and up to 180 days following a hospital record containing any obstetrical or pregnancy-related diagnosis codes: ICD-9²⁹ 641-676, V27; ICD-9 CM²³ 641-679, V27; and ICD-10³⁰ and ICD-10-CA²⁴ O10-16, O21-95, O98, O99, Z37.

Statistical analysis

The patient cohort was characterized in terms of age group (1-19, 20-64, ≥ 65 years) and sex. The prescribing physicians were characterized by sex, age group (< 35, 35-60, ≥ 61 years) and specialty (other specialist vs. family physician). All physician characteristics were assessed at the index prescription date. The patient cohort

and their prescribing physicians were described using frequencies and percentages. A χ^2 statistic was used to test for differences in characteristics between the FFS and NFFS groups. All analyses were done for each province and overall.

We determined the percentage of individuals identified in the prescription drug data that did not meet the diabetes case definition in the CCDSS; these were classified as missed cases. This assessment was conducted by province and overall, as well as for subgroups defined by age group.

The crude diabetes incidence rate was estimated by dividing the number of cases found using the CCDSS case definition (among the patient cohort) by the denominator (people with continuous health insurance coverage), multiplied by 100 for each province. These rates were for those aged two years and older (67 years and older in Ontario and Newfoundland and Labrador, and 65 years and older in Saskatchewan), for the provincial population in the observation period from 1 April 2014 to 31 March 2016 using the CCDSS case definition. Incidence rates were adjusted for the number of FFS and/or NFFS cases found from adding missed cases (first, only FFS, then only NFSS, and finally both FFS and NFSS missed cases to the numerator). Crude rates were used to estimate the completeness of physician billings for diabetes case ascertainment because they provide information about the total magnitude of the effect of missing data within a province.

All analyses were conducted using SAS version 9.3 or 9.4.³¹ The SAS code was developed by PHAC's CCDSS operations team, pilot tested by the team in Prince Edward Island and, once finalized, distributed to all participating data centres. The provincial teams then modified the code for their settings, generated the agreed output datasets and submitted them to PHAC, which then pooled the results from all provinces. All counts and related statistics greater than 0 and less than 5 were suppressed to avoid residual disclosure and to provide more reliable estimates. Also, to calculate the rates, all counts were rounded at random using a base of 10, and therefore individual cell values may not add up to the totals.

Results

The overall cohort comprised 86 110 patients (43 770 FFS and 42 350 NFFS; 43 650 males

and 42 070 females) and 17 665 physicians (6054 FFS and 11 611 NFFS; 10 412 males and 7250 females). The provincial patient cohorts ranged in size from 1460 in Prince Edward Island to 31 620 in Ontario (Table 1). About half (50.8%) of patients received their index prescription from a FFS physician. On average, each FFS physician prescribed to 7.2 patients and each NFFS physician prescribed to 3.6 patients (data not shown).

The majority of the patients were 65 years and older, which was anticipated given the composition of the patient cohorts from Saskatchewan, Ontario and Newfoundland and Labrador. The largest number of FFS patients (26 310) were aged 20 to 64, while the largest number of NFSS patients (34 600) were 65 years and older (Table 1). There was almost no difference in the sex distribution of FFS and NFFS patients; however, the type of remuneration method was statistically significantly different in at least one physician age group ($\chi^2 = 123.546$; $p < 0.001$; $df = 2$; data not shown).

According to our definition of FFS remuneration (100% of payments on FFS basis), Manitoba had the largest percentage of FFS physicians (77.1%), while Ontario had the smallest (5.7%; Figure 1). British Columbia had the largest percentage (83.6%) of family physicians classified as FFS physicians, while Ontario had the smallest (0.2%). Nova Scotia had the highest percentage (56.7%) of NFSS physician specialists and Manitoba had the lowest (2.6%; Figure 2).

Individuals identified as a case of diabetes in the prescription drug data who did not meet the CCDSS administrative diabetes case definition were classified as missed. Overall, 13.5% of those diagnosed were missed. Prince Edward Island had the highest rate of missed cases (17.6%) and Nova Scotia had the lowest (4.8%). Quebec data were not shown, as the data by physician remuneration type were not available; however, 19.3% missed cases were observed. For FFS and NFFS physicians, the overall percentages were 14.8% and 12.2%, respectively. However, the differences varied widely by province, ranging from -1.0% to 29.9% in Nova Scotia and Newfoundland and Labrador, respectively. For most provinces, the percentage of missed cases was greater for NFFS than FFS physicians, with the exceptions of Ontario³² and Prince Edward Island. Prince

TABLE 1

Distribution of patients (counts and percentages), by physician remuneration method (fee-for-service vs. non-fee-for-service),^a by age group and by province, fiscal years 2014/15 to 2015/16

Province	1–19 years				20–64 years				≥ 65 years ^b				Age 1+				Total (FFS + NFFS)	Total (%)
	FFS	NFFS	FFS + NFFS	%	FFS	NFFS	FFS + NFFS	%	FFS	NFFS	FFS + NFFS	%	FFS	%	NFFS	%		
British Columbia	260	310	580	2.2	16 090	2 980	19 060	71.3	6 040	1 070	7 110	26.6	22 380	83.7	4 360	16.3	26 750	100.0
Saskatchewan ^b	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2 090	780	2 880	100.0	2 100	72.9	780	27.1	2 880	100.0
Manitoba	330	40	360	2.3	9 110	2 630	11 740	75.6	2 860	580	3 440	22.2	12 290	79.1	3 240	20.9	15 530	100.1
Ontario ^b	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1 600	30 010	31 620	100.0	1 600	5.1	30 010	94.9	31 620	100.0
Prince Edward Island	—	20	20	2.1	100	910	1 010	69.2	60	380	420	28.8	160	10.5	1 310	89.5	1 460	100.1
Nova Scotia	20	40	50	0.9	1 020	820	1 840	33.6	2 180	1 420	3 600	65.7	3 210	58.5	2 280	41.5	5 480	100.2
Newfoundland and Labrador ^b	N/A	N/A	N/A	N/A	—	0	N/A	N/A	2 020	380	2 400	100.0	2 020	84.3	380	15.7	2 400	100.0
Total	610	420	1 020	N/A	26 310	7 330	33 650	N/A	16 850	34 600	51 450	N/A	43 770	50.8	42 350	49.2	86 110	N/A

Abbreviations: FFS, fee-for-service; NFFS, non-fee-for-service.

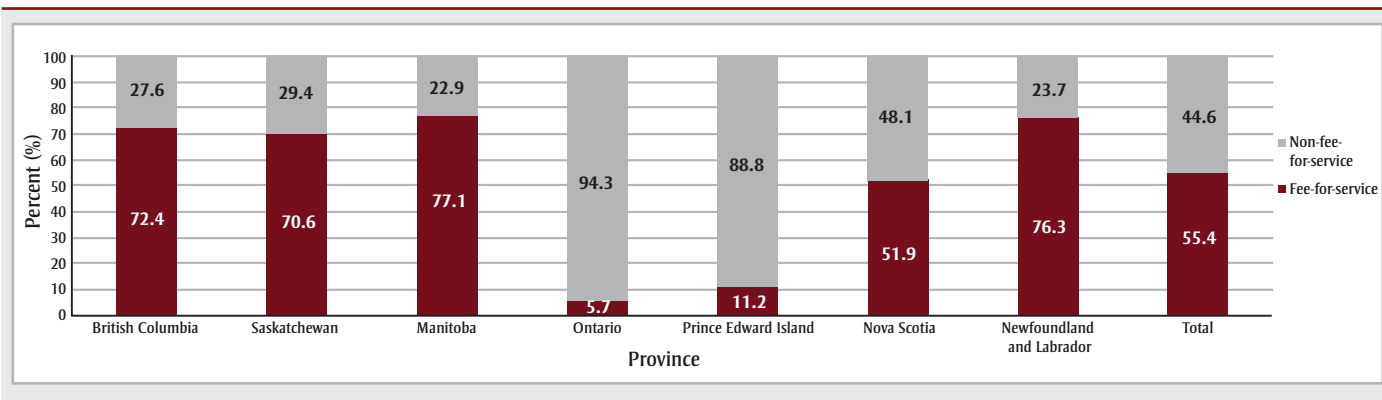
Notes: N/A signifies counts that were not available and could not be calculated. “—” signifies counts greater than 0 but less than 5, which were suppressed and not included in the totals. Percentages were calculated based on non-rounded counts. Counts were randomly rounded to an adjacent multiple of 10.

^a Fee-for-service physicians were paid 100% on a fee-for-service basis. Non-fee-for-service physicians received other forms of payment (less than 100% fee-for-service).

^b For Ontario and Newfoundland and Labrador, data were only available for ≥ 67 years; Saskatchewan data were for ≥ 65 years.

FIGURE 1

Proportion of physicians by remuneration method (fee-for-service vs. non-fee-for-service)^a and by province, fiscal years 2014/15 to 2015/16



^a Fee-for-service physicians were paid 100% on a fee-for-service basis. Non-fee-for-service physicians received other forms of payment (less than 100% fee-for-service).

Edward Island had the highest percentage of missed cases (26.7%) from FFS physicians, while Nova Scotia had the lowest (3.8%). For NFFS physicians, Newfoundland and Labrador had the highest percentage of missed cases (36.8%). Nova Scotia had the lowest percentage of missed cases (4.8%) among NFFS physicians (Figure 3).

For patients aged 1 to 19 years for whom the prescribing physician was remunerated by the FFS method, 50% of the cases were missing in Prince Edward Island. Manitoba had the lowest (15.2%) for this physician type and age group. Prince Edward Island had the highest percentage (22.2%) of missed cases among the 20 to 64 age group, while Nova Scotia had the lowest (5.9%). For those aged 65 years and older, Prince Edward Island had the highest percentage (20.0%) of missed cases, while Nova Scotia had the lowest (2.8%).

For patients aged 1 to 19 years for whom the prescribing physician was remunerated by the NFFS method, British Columbia had the highest percentage (53.3%) of missed cases and Nova Scotia had the lowest (3.2%). British Columbia had the highest percentage (23.1%) of missed cases among the patients aged 20 to 64 for whom the prescribing physician was paid by NFFS methods, while Nova Scotia had the lowest (7.4%). For patients 65 years of age or older for whom the prescribing physician was remunerated by NFFS methods, Newfoundland and Labrador had the highest percentage (36.8%) of missed cases, while Nova Scotia had the lowest (4.2%; Figure 4).

Figure 5 presents the diabetes incidence rates* adjusted for cases missed by both FFS and NFFS methods among those aged one year and older (72% of the denominator), except for in Ontario and Newfoundland and Labrador, where data were reported for residents aged 67 years and older, and in Saskatchewan, where data were reported for residents aged 65 and older. Ontario and Saskatchewan had the highest incidence rate (1.5% for both), adjusted from 1.4% in Ontario and 1.4% in Saskatchewan. Newfoundland and Labrador experienced the lowest incidence rate of 0.43%, adjusted from the observed rate of 0.38%. The largest percentage change between the observed and adjusted rates was for Prince Edward Island (22.5%) and the smallest was for Nova Scotia (4.7%).

Discussion

The aim of this study was to estimate the completeness of the physician billings data for estimating chronic disease. Overall, 13.5% of cases were missed. We determined that the overall percentage of missed cases found among FFS physicians was generally similar to that for NFFS physicians (14.8% vs. 12.2%, respectively). However, differences varied by province; for example in Nova Scotia, the missing rates were very similar for FFS and NFFS (3.8% and 4.8%, respectively); whereas the rates were very different in Newfoundland and Labrador (6.9% and 36.8%, respectively), where physicians do not practise shadow billing.³³

We expected some missed cases among FFS physicians. Some physician billing

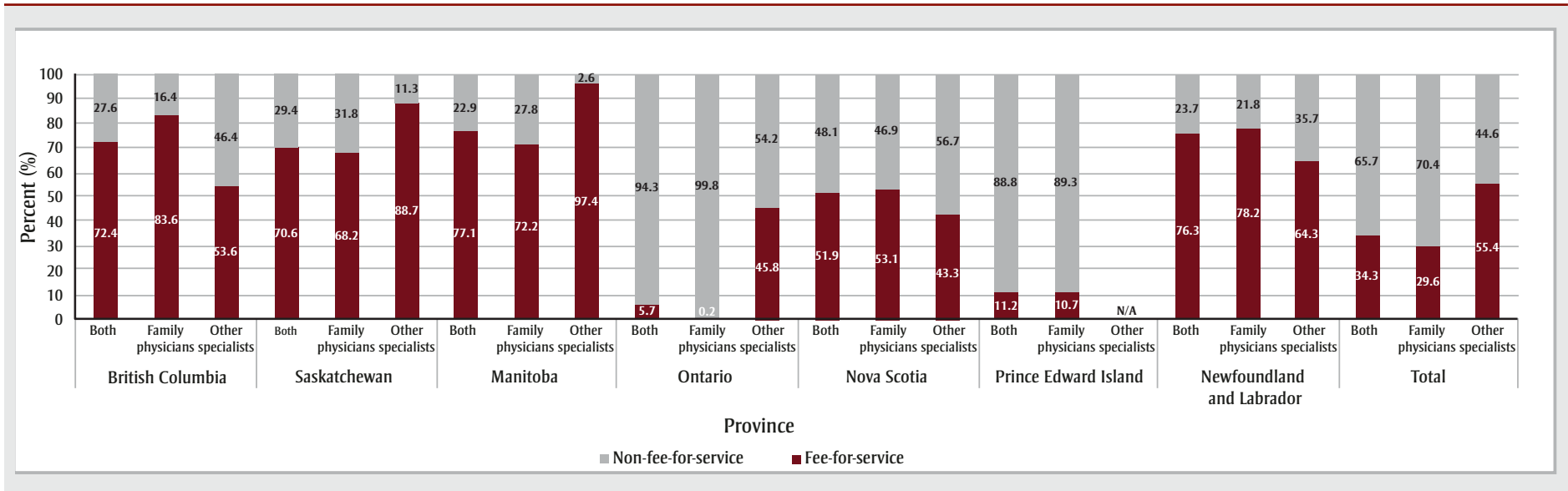
claims may not be captured in claims databases, possibly through administrative error or failure to submit claims. Compared to NFFS physicians, FFS physicians may have seen more patients with other health problems that were not recorded because there was not enough room on the claim form.³² One potential source of discordance between diabetes prescriptions and presence of diagnostic information on physician billing claims is misclassification bias, as some FFS physicians may have a NFFS component to their practice or may have changed to NFFS remuneration. Hybrid payment methods and changes in payments are not always captured in the provincial provider registries and may vary across provinces. Heterogeneity across provinces in the capture of remuneration method and shadow-billed claims was reported in a previously published paper.¹⁹

The percentage of missed cases was higher in the younger physician age groups, compared to older age groups, for both FFS and NFFS physicians, suggesting that the sensitivity of ascertainment differs based on the age of the physicians. Finally, the physicians who prescribed the initial glucose-lowering therapy may not be the primary care provider, or therapy may have been discontinued, or it may have been initiated for reasons other than diabetes.

Our study found similarities and differences with a study conducted in Manitoba.²⁰ Previously, Lix et al. reported that a smaller percentage of FFS physicians' cases were missing a diabetes diagnosis:

* The methods were tailored to the specific purpose of this study; therefore, these rates are not comparable to those in other CCDSS publications.

FIGURE 2
Proportion of physicians by remuneration method (fee-for-service vs. non-fee-for-service)^a and type (family physician vs. other specialist),^b by province, fiscal years 2014/15 to 2015/16

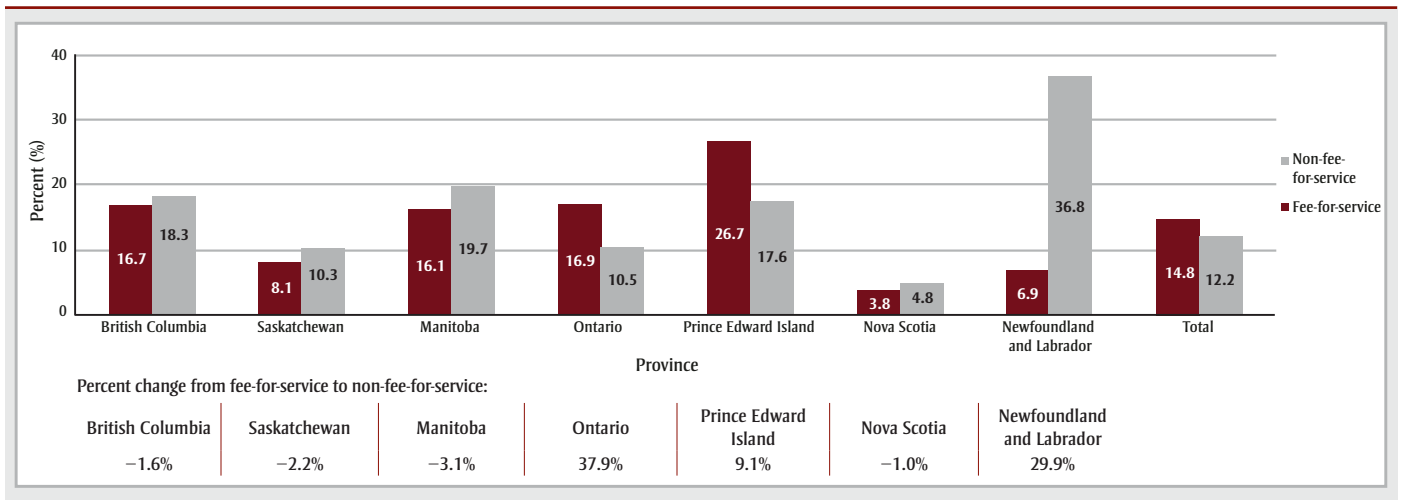


Notes: In Ontario, many family physicians who provide comprehensive care of the type that would be managing patients with chronic diseases such as diabetes are no longer being paid solely on a fee-for-service basis.³²

^a Fee-for-service physicians were paid 100% on a fee-for-service basis. Non-fee-for-service physicians received other forms of payment (less than 100% fee-for-service).

^b Types of physicians include family physician, other specialist, or both.

FIGURE 3
Proportion of missed cases by provider remuneration method (fee-for-service vs. non-fee-for-service)^a
and by province, fiscal years 2014/15 to 2015/16



Notes: Percentages were calculated based on non-rounded counts. Counts were randomly rounded to an adjacent multiple of 10.

^a Fee-for-service physicians were paid 100% on a fee-for-service basis. Non-fee-for-service physicians received other forms of payment (less than 100% fee-for-service).

14.9% vs. 18.7% for NFFS physicians. In our study, the percentage of missed cases among FFS and NFFS physicians was more similar overall (14.8% and 12.2%, respectively), although the percentage remained relatively smaller among FFS physicians in Manitoba (16.1%, compared with 19.7% for NFFS physicians). The Manitoba study also found a higher percentage of missed diagnoses in the younger age group than the older age group. We also found that a greater percentage of FFS patients were younger, whereas a greater percentage of NFFS patients were older. In the previous Manitoba study,²⁰ the percentage change

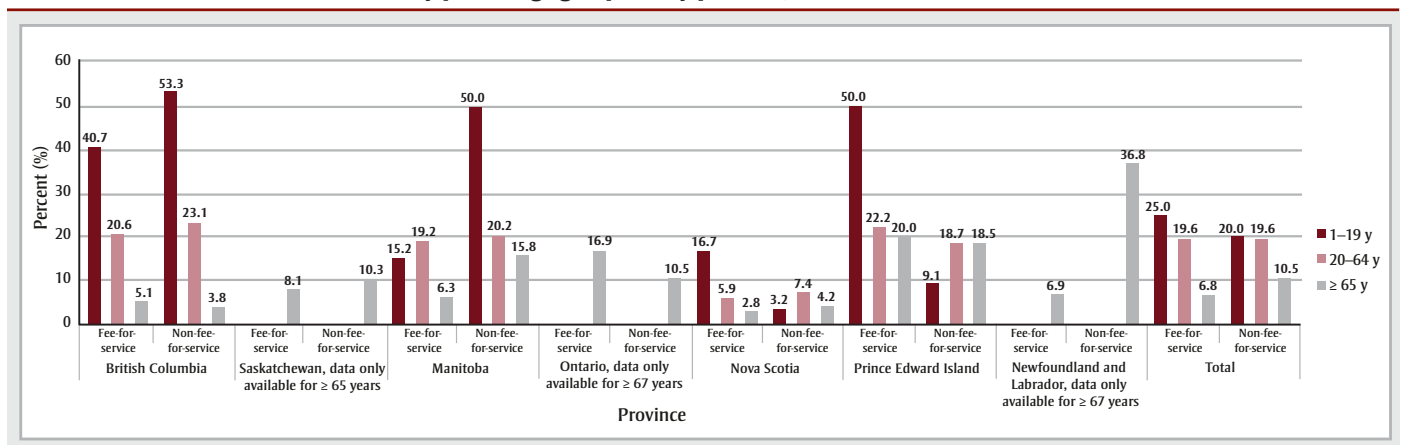
between the observed and adjusted results for cases missed by both FFS and NFFS diabetes incidence rates was 15.8%, while in our study, the percentage change was 20.2% for Manitoba.

Underestimation of disease incidence when using administrative data (i.e. hospital discharge abstracts and physician billing claims) may occur because of different billing practices and policies. For example, if a jurisdiction has a large number of missing cases from NFFS physicians, it may mean that they are not practising shadow billing. Thus, it may be important to monitor missing cases by remuneration

type over time to consider any adjustments or data quality documentation for reporting.

It is also important to consider strategies for adjusting prevalence and incidence estimates for possible underestimation. One strategy may be to use prescription drug data to estimate the physician billing claims records underestimation for disease surveillance, although using this data source alone may not be sufficient.⁵ When prescription drug data were used, for example, based on the CCDSS case definition, we estimated a 0.9% crude diabetes incidence rate in the Manitoba population

FIGURE 4
Proportion of missed cases by provider remuneration method (fee-for-service vs. non-fee-for-service),^a
by patient age group and by province, 2014/15 to 2015/16

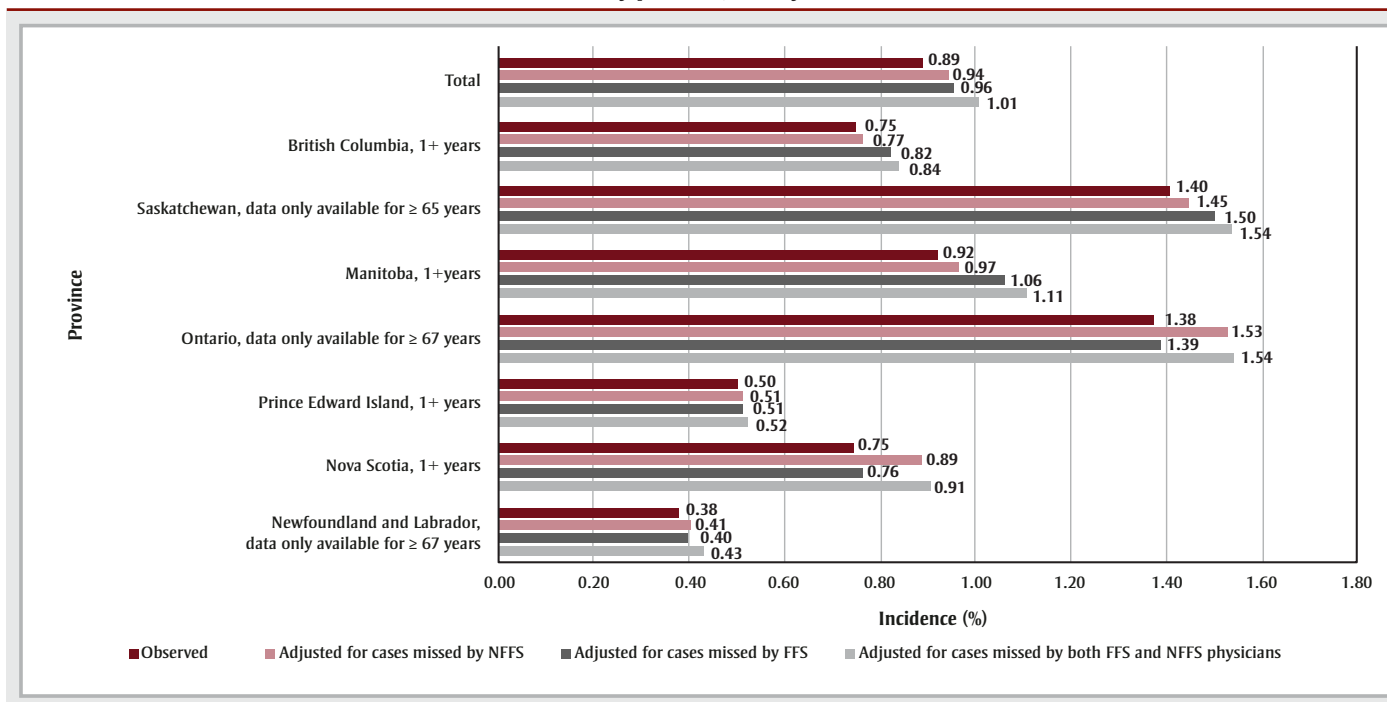


Abbreviation: y, years.

Notes: Missing data: counts were not available and statistics could not be calculated. Percentages were calculated based on non-rounded counts. Counts were randomly rounded to an adjacent multiple of 10.

^a Fee-for-service physicians were paid 100% on a fee-for-service basis. Non-fee-for-service physicians received other forms of payment (less than 100% fee-for-service).

FIGURE 5
Crude observed and adjusted incidence rates^a (%) of diabetes to account for cases missed, by remuneration method (fee-for-service vs. non-fee-for-service)^b and by province, fiscal years 2014/15 to 2015/16



Abbreviations: FFS, fee-for-service; NFFS, non-fee-for-service.

Notes: Percentages were calculated based on non-rounded counts. Counts were randomly rounded to an adjacent multiple of 10. The methods were tailored to the specific purpose of this study; therefore, these rates are not comparable to those in other CCDSS publications.

^a The CCDSS cannot currently accurately differentiate between type 1 and type 2 diabetes over time.

^b Fee-for-service physicians were paid 100% on a fee-for-service basis. Non-fee-for-service physicians received other forms of payment (less than 100% fee-for-service).

aged 1 year and older during the study period (Figure 5). However, when cases identified in the prescription drug data were used to adjust for underestimation, the incidence rate increased to 1.1%.^{*} An additional strategy may be to use other population-based data such as electronic medical records, which are increasingly being adopted in population-based chronic disease research and surveillance studies to adjust for underestimation.³⁴

Strengths and limitations

Our study has several strengths. It included data from multiple provinces, which improves the generalizability of the findings relative to previous single-province studies. Also, it uses data from the CCDSS, which uses a validated standardized case definition for diabetes. Additionally, the method could be applied to other health conditions for which the sensitivity and specificity of prescription drug data for case capture is high.

The study also has limitations. First, cases that were missed may have been overestimated because women of childbearing age with gestational diabetes were not

excluded from the prescription drug databases of British Columbia, Manitoba, Quebec, Prince Edward Island and Nova Scotia (72% of the denominator). However, the overestimation was likely minimal, considering the rate of gestational diabetes³⁵ and considering that a significant proportion of the cohort were either males or aged 65 and over.

Second, physicians were classified as either FFS or NFFS, but many physicians are now paid through blended remuneration schemes or may have changed from one method to another over the study period. However, given that we used only two fiscal years of diabetes prescription information, the possibility of physicians switching payment method during the study period may be minimal.

Third, the results may be sensitive to the definitions used to ascertain missed and non-missed cases. We examined the two-year periods before and after the index prescription date; these periods were chosen to align with the observation period required by the CCDSS diabetes case definition. Previous research has shown that when prescription drug data were added

to the CCDSS diabetes case definition in the adult population, the sensitivity was 90.7%, specificity was 97.5% and PPV was 81.5%,⁵ versus 89.3%, 97.6% and 81.9%,⁵ respectively, without prescription claims. Other research showed that 5.6% of diabetes cases were missed when prescription claims records were excluded³⁶ and Tu et al. found that when a combination of prescriptions for antidiabetic medications and laboratory tests results is used, patients with diabetes can be identified within an electronic medical record (EMR) with accuracy similar to administrative data.⁴ While it is possible that individuals without diabetes might receive a prescription for a diabetes drug, the contribution of these false positives to the percentage of missed cases is unknown.

Fourth, our findings are not applicable to diabetes patients treated with lifestyle modification only, as they are not captured in prescription drug data. Fifth, the completeness of prescription drug data varied as Ontario and Newfoundland and Labrador data were available for patients aged 67 and older and Saskatchewan data for patients aged 65 and older. Sixth, while age-standardized rates were not required

to examine the impact of missing physician billings within a province, readers should use caution for cross-jurisdictional comparisons.

Conclusion

We adopted a population-based approach to assessing the completeness of physician billing claims data for chronic disease surveillance. We relied upon prescription drug data to evaluate completeness; this source is known to be sensitive for diabetes case ascertainment.⁵ Our study showed that when using prescription drug data to assess the completeness of cases in the CCDSS, there is loss of data. Overall, the percentage of missed cases was comparable across physician remuneration methods. However, this varied widely by province. Where it did occur, loss of data may have contributed to underestimation of disease incidence. The method we used could be applied over time and in other jurisdictions to address systematic differences in shadow billing practices, as well as to other chronic diseases for which drug therapy could serve as reference data source.

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Conflicts of interest

The authors have no conflicts of interest to declare.

Authors' contributions

JE—conceptualization, formal analysis, methodology, project administration, validation, visualization, writing—original draft,

writing—review and editing. YJG—formal analysis, methodology, validation. KH—conceptualization, methodology, project administration, writing—original draft, writing—review and editing. SB—conceptualization, methodology, project administration, validation, writing—original draft, writing—review and editing. HG—visualization, writing—original draft, writing—review and editing. LY—formal analysis, methodology. KAMP, AA, MG, PL, YL, YN, JS, RP—data curation, methodology, validation, visualization, writing—review and editing. LML—conceptualization, methodology, supervision, visualization, writing—original draft, writing—review and editing. JMP—methodology, visualization, writing—original draft, writing—review and editing.

Statement

The analyses, conclusions, opinions and statements expressed in this article are those of the authors and do not reflect those of the funding or data sources; no endorsement by PHAC, CIHI, the provincial/territorial governments or the Government of Canada is intended or should be inferred.

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Call for papers: Generating stronger evidence to inform policy and practice: natural experiments on built environments, health behaviours and chronic diseases

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Where we work, learn, play, eat and live has important implications for health. The built environment has been associated with the development of chronic disease, and with health behaviours often seen as critical pathways for this relationship.^{1,2} Built environments refer to components of the physical environment that are human-made or human-modified and include structures and buildings, recreation facilities, green spaces and parks, transportation systems and community design.

Natural experiments are interventions that occur without a researcher's ability to manipulate the intervention or exposure to the intervention.^{3,4} Natural experiments offer the opportunity to evaluate the effects of "naturally occurring" interventions such as changes to the built environment (e.g. creation of a new bike path, park improvements, infrastructure changes to schools or workplaces, construction of a new recreation facility or grocery store) on health behaviours and chronic disease risk. Natural experiments are often more practical for investigating the health impacts of environmental interventions when compared to traditional experimental studies (e.g. randomized controlled trials). Compared to cross-sectional studies, natural experiments provide a means to generate rigorous evidence to better establish causality, as well as to understand the implementation of interventions in "real-world" scenarios.

This special issue answers the 2017 Canadian Public Health Officer annual report's call to further evaluate the health impacts of community design features in Canada.⁵ This special issue resonates with the expanding scholarly and policy-oriented interest in the utility of natural experiments as a critical tool in advancing the body of evidence and for informing interventions to improve public and population health.^{6,7} Specifically, the objective of this special issue on natural experiments is to provide timely evidence to further understand the effectiveness of built environment interventions on health behaviours and chronic disease prevention in a Canadian context.

Health Promotion and Chronic Disease Prevention in Canada: Research, Policy and Practice is seeking relevant topical research articles that present new findings or synthesize/review existing evidence on natural experiments of the built environment (or related policies) that influence health behaviours with implications for chronic disease prevention in Canada.

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- Built environments, including community or neighbourhoods, workplaces, schools, transportation infrastructure, home environments, recreation environments, parks, playgrounds, green spaces, public open spaces, natural environments and seniors' residences.
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Submission deadline: November 30, 2024

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Srugo SA, Ricci C, Leason J, Jiang Y, Luo W, Nelson C. Disparities in primary and emergency health care among “off-reserve” Indigenous females compared with non-Indigenous females aged 15–55 years in Canada. *CMAJ*. 2023;195(33):E1097-111. <https://doi.org/10.1503/cmaj.221407>

