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Study protocol for CELLAR (COVID-related Eating Limitations and Latent dietary effects in the Atlantic Region): population-based observational study to monitor dietary intakes and purchasing during COVID-19 in four Atlantic Canadian provinces

Catherine L Mah ,[1,2] Karen Foster,[3] Emily Jago,[1] Mohammad Hajizadeh,[1] Gabriella Luongo,[1] Nathan Taylor,[1] Daniel Fuller,[4] Yanqing Yi,[5] Olukorede T Esan,[1] Ryan Lukic,[1] Maria Clarke,[1] Wiesława Dominika Wranik,[6] Julie Kay Brimblecombe,[7,8] Anna Peeters[9]

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For numbered affiliations see end of article.

Correspondence to
Dr Catherine L Mah;
Catherine.Mah@dal.ca

ABSTRACT

Introduction Poor diet is a leading preventable risk for the global burden of non-communicable disease. Robust measurement is needed to determine the effect of COVID-19 on dietary intakes and consumer purchasing, given the widespread changes to consumer food environments and economic precarity. The research objectives are as follows: (1) describe dietary intakes of foods, beverages and nutrients of concern during the COVID-19 pandemic; (2) quantify change in diet during COVID-19 as compared with prepandemic, previously captured in the provincial samples of the population-representative 2015 Canadian Community Health Survey-Nutrition and (3) examine how household purchasing practices predict dietary intakes during COVID-19.

Methods and analyses Observational study of diet, using a population-based stratified probability sampling strategy allocated via dual-frame (landline and cellphone) calls to random-digit dialled numbers, followed by age-sex group quotas. The base population comprises the four provinces of the Atlantic region of Canada, jurisdictions with an excess burden of pre-existing dietary risk, compared with the rest of Canada. Our aim is n=1000 to obtain reliable estimates at a regional level to describe intakes and compare with prepandemic baseline. Data collection entails 12 weeks participation: (1) enrolment with sociodemographics (key dietary risk predictors such as age, sex, gender, pre-COVID-19 income, employment, household composition, receipt of economic relief, rural residence); (2) two 24hour diet recalls using the online ASA-24 Canada 2018 tool; and (3) online uploads of household food purchase receipts over the 12 weeks enrolled. Participation incentives will be offered.

Ethics and dissemination This research protocol received funding from the Canadian Institutes of Health Research (FRN VR5 172691) and ethics review approval from the Dalhousie University Research Ethics Board. Study protocol and instruments and a de-identified dataset will be made publicly available. We will submit the

Strengths and limitations of this study

- The design is a population-based observational study that adopts a multistage probability sampling strategy, covering a full geographic region of Canada (Atlantic region, four Canadian subnational jurisdictions (provinces)).
- The study addresses key methodological gaps in existing nutrition and consumer behaviour surveillance during the pandemic and was the only population nutrition study funded by the Canadian Institutes of Health Research in its pandemic priority competitions in 2020.
- In addition to its use of the robust automated multiple-pass method for 24-hour diet recalls towards the main dietary intake outcome measures, this study adopts novel respondent-level purchasing data to assess how use of consumer food environments predict dietary intake, in secondary analyses.
- A limitation is the potential error introduced from within-person variation in consumer food environment exposures, through cross-sectional data collection over four provinces, implemented over several months of rapidly evolving provincially specific pandemic public health restrictions.
- The relationship between within-person variation in consumer food environment exposures affecting diet and between-person variation is unknown at the population level; this study may provide an empirical contribution to the food environments literature in this regard.

findings to peer-reviewed journals, as well as conferences geared towards scientific and decision-maker audiences.

INTRODUCTION

Diet-related health risk is a looming policy problem during COVID-19

The consumer food environment has been a site of social and economic transformation during the pandemic. Early monitoring by national statistics offices suggested dramatic changes in food purchasing patterns, raising questions about prospective dietary impact.[1 2] Public health requirements to reduce communicable disease transmission risk such as community-wide 'lockdown' periods have the potential to directly and indirectly shape food purchase decision-making in many ways, including geographic access factors such as location, frequency, timing and quantity of food purchase; and alteration of purchase patterns such as stockpiling practices and increased selection of shelf-stable foods.[1] At the same time, a sudden onset of widespread economic precarity and macroeconomic volatility including inflationary pressures has placed a burden on food budgets for many households.[3] Household socioeconomic factors are a primary determinant of food purchasing,[4 5] and it is well established that households in Canada with inadequate economic resources make compromises in both the quality and quantity of food consumed, with serious effects on dietary adequacy and nutrient intake.[6–8] Such dietary constraints predict adverse physical and mental health outcomes, increased healthcare costs[9] and higher all-cause mortality.[10]

Prior to the pandemic, poor diet was the leading baseline preventable risk factor for the global burden of disease, and the second in Canada, with risk distributed unevenly among subnational jurisdictions and vulnerable subpopulation groups.[11–15] Evidence is emerging that some diet-related comorbidities such as type 2 diabetes, hypertension and obesity can worsen outcomes from SARS-CoV-2 infection.[16 17] No published research has yet captured how altered consumption behaviour during COVID-19 affects dietary quality in Canada. Nearly two full calendar years into the pandemic, it is likely that physical (geographic) and economic access to food will continue to be altered if not constrained to varying degrees for many months to come, for the majority of the population. Our capacity to monitor how evolving consumer behaviour shapes dietary risk will be essential to inform economic and social policy responses to COVID-19: for example, for governments, to model the impact of economic relief on diet-related health as mediated by purchasing power; for food businesses, to inform whether further enhancing in-person access or delivery services should be prioritised.

To address the gaps this partial surveillance creates in our understanding of population diet-related health risk, we have designed an observational study of diet during COVID-19 with an emphasis on a probability sample to support population-based risk estimates and/or inferences, as well as the design of future prospective studies as the pandemic continues.

Canada is one of the few countries internationally that does not routinely collect and publish quantitative individual/household food consumption data.[18] Rather, government dietary surveillance is periodic,[19] and consumption monitoring is based only on household expenditure accounts,[20] time use (eg, time spent on cooking, shopping, meals)[21] and retail business sales transactions.[22] These forms of consumption monitoring are designed for economic and social research, however do not record food and beverage items at a sufficiently high resolution to make inferences about the nutritional quality of purchases in the diet. We elected to focus on the region of Atlantic Canada, comprising 4 of 10 provinces in Canada. Provinces in this region face a longstanding excess burden of pre-existing dietary risk, compared with the rest of Canada.[23–25] An Atlantic focus will also have greater immediate relevance to producing knowledge salient to regional food supply chains, and increase feasibility, by leveraging the potential of multidisciplinary networks of existing regional research programmes.

Research objectives

Objective 1

Describe dietary intakes of foods, beverages and nutrients of concern during COVID-19 distancing restrictions in the Atlantic region provinces: New Brunswick (NB), Prince Edward Island (PE), Nova Scotia (NS) and Newfoundland and Labrador (NL).

Objective 2

Quantify change in dietary intakes during COVID-19 as compared with prepandemic baselines for NB, PE, NS and NL, previously captured in the provincial samples of the population-representative 2015 Canadian Community Health Survey (CCHS)-Nutrition.

Objective 3

Examine how purchasing practices predict dietary intakes during COVID-19 in the Atlantic provinces.

METHODS AND ANALYSES

Approach and study design

The following study comprises an observational field nutritional epidemiology study. New primary data collection will capture dietary trends during the pandemic, with design optimised for future prospective studies, longitudinal comparisons and to leverage our research capacity.

Target population/sample size

Our goal is to obtain reliable estimates at an Atlantic region level for the main effect, comparison with prepandemic baseline, the 2015 CCHS-Nutrition (objective 2). The target population for the 2015 CCHS-Nutrition was respondents older than 1 year of age, residing in the 10 provinces. The sampling fractions for the Atlantic

provinces were: NL 22.5%; PE 6.2%; NS 39.7%; NB 31.6% and by age-sex groups that correspond to Dietary Reference Intakes (DRIs).[26] Total population counts for Atlantic region provinces as of the 2016 Census are: NL 519 716; PE 142 907; NS 923 598; NB 747 101. The 2015 CCHS-Nutrition sample for adults 19 years of age and older (19y+) for the Atlantic provinces was 3514. Provincial breakdown was: NL 878; PE 728; NS 1020; NB 888. The target population for our COVID-19 study will be adults 19y+ residing in Atlantic provinces. Our goal is n=1000 for the Atlantic region, accounting for non-response and dropouts, stratified first to provinces by 2016 Census population, then following CCHS-Nutrition[19] to establish an area frame, with dual allocation (landline and cell phone subsamples)[27–29] and finally age-sex group quotas corresponding to the DRIs.

Data collection/timeline

Enrolment

For the main population-based, probability sample, we will recruit by dual-frame calls (landline and cellphone),[27–29] with up to four scheduled callbacks (six for cellphones), via our survey research centre. Sample of random-digit dialled (RDD) phone numbers was purchased via survey research centre supplier and consists of 12 000 RDD numbers and 8000 active cellphone numbers allocated proportionally to provinces based on the 2015 CCHS-Nutrition sampling fractions; approximately three-quarters of phone numbers are preverified (confirmed to be real, in-use numbers) by the survey sample supplier. Ongoing called, completed and recruited sample distribution in relation to base populations will be discussed throughout with a steering committee representing the four provincial governments, including missing/excluded populations and hard-to-reach groups.[30] For each enrolment, an adult (19y+) primary shopper in the household will be asked to take part in 12 weeks of data collection with verbal informed consent, assigned a unique identifier and sociodemographic data and time use screener collected.

Sociodemographic measures were used verbatim from the 2015 CCHS-Nutrition (full instrument and correspondence coding to original survey measures available on request), where available; exceptions are: location of residence (from 2016 Census); gender (self-identified, including non-binary, from Canadian Student Tobacco, Alcohol and Drugs Survey); time use screener (derived from 2015 General Social Survey items) and sector of work (Vapers Panel, Health Canada). Two new sociodemographic questions (with one subitem each) were created to capture receipt of government COVID-19 economic relief by the respondent and the household. Further description of covariates is embedded in methods outlined per research objective.

Diet recalls

In the second month of participation, participants will be prompted via email to complete two online self-administered 24-hour diet recall surveys on non-consecutive days at least 3 days apart, using the ASA-24 Canada 2018 (Automated Self-Administered 24-hour Dietary Assessment Tool Canada 2018, Canadian version is available in English and French).[31] We will follow-up by phone if surveys remain incomplete. ASA-24 is mobile friendly, uses the automated multiple-pass method as per CCHS-Nutrition to improve accuracy of recalls, and outputs de-identified records matched to nutrient composition data.[31] Our team is experienced with ASA-24 use and analysis including hard-to-reach populations.[32 33] Telephone interviewer assistance for diet recalls will be offered.

Food purchase receipts

Methodologies for use of receipt data for capturing comprehensive measures of household purchasing of salience to diet (ie, beyond the grocery till) are still relatively new.[34 35] Consented participants will be prompted weekly via Research Electronic Data Capture (REDCap) web application (https://www.project-redcap.org/) email to upload photographs or screen captures of receipts for all food and beverages purchased (grocery, take-out, eating away from home, online food sources, food subscriptions, alcohol retailers, non-grocery food purchases such as hardware store) by the household for 12 weeks. Each receipt upload will require entry of basic metadata: food outlet name; food outlet type (eg, supermarket, restaurant, etc); access/transportation method (eg, home delivery; walk; bike; public transit; car). All receipts will be de-identified of personal and financial information by one team member; then a second team member will enter the data in a .csv file. Food outlets will be matched to spatial coordinates (lat/long) using our existing datasets of food premises in Atlantic Canada; food items will be matched to the Canadian Nutrient File.[36]

Incentives

We will offer CAD$40 monetary incentive for completion of three major study milestones (total maximum CAD$120): (1) enrolment with sociodemographic survey; (2) completed diet recalls (×2); (3) completed study, with at least one receipt submitted per month.

Measures, covariates and analysis

Objective 1: describe dietary intakes of foods, beverages and nutrients of concern during COVID-19

Outcome: reported COVID-19 dietary intakes

We will estimate daily intakes during COVID-19 of: energy (kcal/day), vegetables (g/day), fruits (g/day), fibre (g/day), processed meats (g/day), sugar sweetened beverages (% daily calories from soft drinks/fruit drinks), protein (g/day), total and saturated fat (g/day), carbohydrate (g/day), total sugar (g/day) and sodium (mg/day). These intakes were selected for significance for the global burden of disease,[15] Canada's Food Guide[37] and population nutrition disparities.[23–25 38]

Covariates

Age and sex (to derive age-sex groupings[26]); self-identified gender (woman, man, non-binary, do not wish to disclose); height and weight (to correct for dietary self-report error, see 'Limitations and mitigation strategies' section); annual gross income in tax filing year 2018 or 2019 (continuous, CAD$/year).

Analysis

We will divide the COVID-19 first diet recall population into quantiles by age-sex, gender and income, and examine the distributions. We will use the second diet recall to account for foods consumed only episodically as per National Cancer Institute method,[39 40] to estimate population-level distributions (all-Atlantic) for intakes of concern (mean, median). We will use sampling weights for unbiased estimates and bootstrap methods to address complexity of sampling design.

Objective 2: quantify change in diet during COVID-19 as compared with prepandemic

Outcome

Reported COVID-19 dietary intakes as per objective 1; note as above these comprise separate analyses per intake of interest/concern, including addressing under-reporting.

Predictor

Baseline 2015 CCHS-Nutrition daily reported dietary intakes (as per objective 1) will be estimated using adult observations from the first diet recall of the CCHS-Nutrition public use microfile (n=3514).

Covariates

As per objective 1 (age-sex, gender, income) plus: time spent on paid work (hour/day, continuous integer); time spent on food shopping (hour/week, continuous integer); receipt of Canada Emergency Response Benefit and other economic relief (yes/no item series, select policies available at study launch); household size (continuous integer); own/rent home (dichotomous).

Analysis

This analysis is based on a case-control design using matched historical controls from the 2015 CCHS-Nutrition population matched on province of residence, age and sex. We will divide the 2015 CCHS-Nutrition population into intake quantiles and examine the distributions, then examine correlation between CCHS-Nutrition and COVID-19 intakes. We will next merge the survey cycles (ours, CCHS-Nutrition) and fit a quantile regression that investigates median, poorest and best quantiles of intake to examine change during COVID-19, using COVID-19/CCHS as a dummy variable, adjusting for covariates. Sensitivity analyses will assess magnitude/distribution of intake differences among those with non-response/missing data for income/economic relief variables.

Objective 3: examine how household purchasing practices predict dietary intakes during COVID-19

Outcome

Reported COVID-19 dietary intakes as per objective 1.

Predictors

We will summarise each respondent's submitted grocery receipts to derive six household measures: proportion of submitted purchases (CAD$) from home-delivery (%, 0–100); proportion of submitted purchases (CAD$) from fruits and vegetables (%, 0–100); average number of unique food outlets accessed per month (mean); average daily cost of diet (mean CAD$/day); average cost of diet from delivery (ie, online shopping) (CAD$/day); average distance travelled to buy food (km/week, derived from summed network distances from food outlets to centroid of residence forward sortation area).

Covariates

As per objective 1 (age-sex, gender, income) plus: occupational sector (categorical); and urban/rural residence (forward sortation area coded to Statistics Canada population centre class).

Analysis

We will fit a series of multivariate regression models to examine associations between purchasing and COVID-19 intakes of concern from objective 1/2.

Patient and public involvement

This study reports quarterly to an advisory group comprising decision makers and other health system knowledge user representatives from provincial government agencies in each of the four jurisdictions involved in the study, who have informed the study design, implementation and knowledge mobilisation, including recruitment, conduct, burden and dissemination considerations. It is anticipated that health system knowledge users will make the most immediate use of the outcomes of the study. Patients and members of the public were not involved in the design nor implementation of the study.

Data sharing

The present manuscript is a study protocol submitted to an open-access publication venue. All study instruments will be shared on the study website and a fully de-identified dataset will be made publicly available at the end of the study.

Limitations and mitigation strategies

Hard-to-reach populations

Hard-to-reach populations[30]: dual-frame random digit dialling[28 29] will be used to reach cellphone-only households, most commonly with younger members (<35 years).[41] Subpopulations facing economic and social barriers who are nutritionally vulnerable may be missed without network oversampling[42]; for rural internet service barriers, mobile friendly and phone interviewer-assisted options will be offered.

Under-reporting of dietary intake

Under-reporting is a well-described source of error in self-report dietary data.[43–46] To address this, we will follow the accepted Huang *et al*[43] method to identify respondents with 'implausible' reported intakes, on the basis of estimated energy requirements (by age, sex, height, weight), to conduct sensitivity analyses.

Within-person versus between-person variation in consumer food environment exposures

A limitation is the secular trend of rapidly evolving public health restrictions associated with the pandemic as it unfolds, for which a substantial proportion of levers fall under provincial jurisdictional control in Canada's system of parliamentary federalism. As such, cross-sectional data collection over four provinces, within even routine periods for nutrition surveillance (eg, 12 months data collection for the 2015 CCHS-Nutrition, Statistics Canada's national population dietary surveillance survey) have likely represented substantial within-person variation in consumer food environment exposures. The relationship between within-person variation in consumer food environment exposures affecting diet and between-person variation is unknown at the population level; this study may provide an empirical contribution to the food environments literature in this regard.

Collinearity in multivariate regression

Correlated errors may exist in assessing associations between purchasing and dietary intake, for example, due to food quantity consumed,[47 48] but at population-level, potential for correlated error should be reduced.[47] We will use centring and model selection in fitting the regression models to reduce collinearity, while limiting the number of covariates overall to avoid overadjustment.

ETHICS AND DISSEMINATION

This protocol describes a Canadian Institutes of Health Research (CIHR)-funded observational study to examine diet across four provinces in Canada constitutive of the Atlantic region using a probability sample allocated to an area frame followed by dual frame (landline/cellphone) random-digit dialled phone numbers, with age-sex population strata quotas, and with consideration to design optimisation for longitudinal and future prospective analyses.

This study received peer-reviewed external grant funding from CIHR in June 2020, and received initial institutional research ethics board review on 25 November 2020 with final amendments and approval to commence data collection as per the protocol described in this manuscript on 2 February 2021. Recruitment is underway.

The study protocol and instruments and a de-identified dataset will be made publicly available. We intend to share the results with provincial and national decision makers, beginning with the government members of the steering group. We will submit the findings to peer-reviewed journal venues for scholarly publication in nutrition and public and population health medicine, as well as national and international conferences geared towards mixed scientific and decision-maker audiences.

We anticipate that COVID-19-related alterations to consumer behaviour and dietary patterns will present a challenging puzzle for researchers and decision makers for many years to come. In particular, the outcomes of this study will be used to interpret four specific areas of consequences from microeconomic and macroeconomic changes that will play an outsized influence in COVID-19's effects on diet-related population health in the short and long term.

The dietary impact of economic precarity of unexpected scale and duration

COVID-19 has resulted in a breadth of economic sectors closing or contracting, some intermittently and some permanently, with an acute loss of household income and stability. Since March 2020, the federal government in Canada has announced an expanding array of economic relief measures. Prior to the pandemic, requiring social assistance was the single strongest predictor of household food insecurity in Canada,[4] beyond low income.[49] Population-based studies demonstrate that dietary intake compromises correspond in magnitude to the severity of food insecurity.[49 50] Statistics Canada has suggested that one in four (26%) Canadians are financially vulnerable to COVID-19 work interruptions and economic precarity, with lone mothers and their children at greatest risk.[51] This group is also well known to be vulnerable to food insecurity.[8 42 52] This study will examine how dietary intake is associated with various forms of economic precarity.

Food price inflation and inequitable impact for vulnerable households

The 2008 global financial crisis is a cautionary example for predicting short-term and long-term consumer impacts of COVID-19. In Canada during the last financial crisis, the all-items Canadian Consumer Price Index (CPI) declined steadily in late 2008; similarly in early 2020, the CPI dropped with onset of the pandemic.[53] Yet analysis of the extended trajectory for food (2007–2012) showed that *food prices rose faster after the 2008 crisis than any other component of consumer spending in Canada*, and this trend appears to be continuing under inflationary pressures during COVID-19.[54] It remains uncertain and moreover contested even among economists how financial markets, supply chains and food prices will evolve with continued COVID-19 volatility. COVID-19 as a financial crisis moreover has many unique economic features including differential risk among certain industrial and health sectors. Uneven pandemic responses among jurisdictions, including vaccination strategies, has also resulted in interjurisdictional variation in economic activity. Past financial crises have indicated that elevated dietary risk is likely to be concentrated in sociodemographic groups already at

risk of dietary compromise, such as low-income households, seniors and residents of rural/remote areas.[54] In our study, we will aim to clarify how certain sociodemographic covariates present an elevated dietary risk.

Typical consumer price monitoring reflects consumption of staple foods, not a healthy diet

Our protocol takes the opportunity to respond to an ongoing and major methodological gap in public health nutrition by testing the integration of respondent-level consumer purchasing measures that can be analysed with dietary intakes. Consumer food environments influence both purchasing and diet, but the precise relationships between the two domains, and the implications for dietary assessment, have not been well elaborated in nutrition studies. For instance, our team has carried out a set of feasibility studies to examine how the CPI corresponds to dietary intakes in the 2015 CCHS-Nutrition population.[55] Economic monitoring through indicators such as CPI tends to be more frequent than nutrition surveillance in most countries, although generally at a level insufficiently disaggregated in terms of food and beverage items to infer consequences for dietary intake. For instance, our analyses, the Canadian CPI match to diet varies by province, with Atlantic provinces faring among the worst; we have also detected CPI gaps for purchases of nutritional concern: snack foods and alcoholic beverages are among the worst (ie, covered poorly by CPI), and these may be precisely intakes of population nutrition concern emerging during the pandemic. Our study aims to offer an empirical contribution on this to inform both economic and nutrition policy making.

Physical access to food environments is restricted, and the long-term consequences for food environments studies is unclear

Prior to the pandemic, Statistics Canada estimated that 12.6% of Canadians bought food online from non-restaurant sources.[56] The effects of COVID-19 on retail trade are only emerging in government monitoring,[57] but large retailers have expressed concern about meeting escalating demand for online/delivery options. Canada is a relatively late-adopter jurisdiction of online food purchasing platforms despite broader indications that the digital food environment is rapidly expanding with significance for diet globally.[58] Exposure to the community food environment (frequency and distribution of food sources in a geographic area) and consumer food environment (marketing aspects, such as availability, promotions and price) are important determinants of diet.[59–66] It is presently unclear how the changes in online grocery shopping will affect dietary risk long-term—recently referred to as a 'double-edged sword'[67] (eg, bulk volume/price promotions on select foods could improve, or worsen, diet quality). Results from our study may help to inform the literature on digital food environment use and measurement.

Strengthening routine population-based nutrition surveillance to inform policy responses

Our study addresses empirical gaps as well as substantial limitations in administrative data available to inform policy in Canada. The design of appropriate policies to mitigate elevated dietary risk during and after COVID-19 faces three major hurdles based on past approaches to nutrition and consumer surveillance: (a) population nutrition surveillance in Canada is conducted only periodically (per decade); (b) Canada does not routinely collect quantitative individual/household food consumption data and (c) Canada lacks economic monitoring platforms that permit analysis of how household consumption is correlated with dietary quality.

For instance, Canada's population-based CCHS-Nutrition has been collected only twice in the last two decades (2004, 2015); the next round will capture only lagged effects of the pandemic. The annual component of the CCHS (current cycle, 2 January to 24 December 2020) has potential to capture health risks at smaller-area geography, but its nutrition content is limited to just two parts: household food insecurity indicator status and a 'screener' measure for daily frequency of fruit and vegetable consumption which presents key limitations as a dietary assessment measure.[19 68] In social data, Statistics Canada's General Social Survey on Time Use is done with a subsample of the Labour Force Survey (current cycle, 2 January to 17 February 2020), but only measures time spent on activities such as cooking and shopping, not food purchase specifically.[21] The Survey of Household Spending captures food purchasing, but only in dollar values (not quantity), with food categories distinct from CCHS.[20] This makes it virtually impossible to infer nutrient content of purchases, or correlation with dietary intakes, and guaranteeing misclassification bias. No routine government infrastructure is currently in place to assess diet-related health during 2020–2021.

As such, our study aims to provide an assessment of population diet to inform decision-makers as they proceed with surveillance efforts, particularly those in our provincial jurisdictions. Residents of the Atlantic provinces have the largest burden of diet-related non-communicable diseases[69] and obesity[70] in Canada. As of 2015–2016, over 1 in 10 residents of NL reported diabetes, the highest proportion in Canada, followed by NS, PE and NB.[69] Age-standardised incidences for specific cancers trend higher in the Atlantic region,[71] as does cardiovascular disease mortality, a leading cause of death.[72] Prior to COVID-19, Atlantic households reported the lowest absolute expenditure on food, and the greatest proportion spent in stores (75.3%).[73] Atlantic provinces have the highest prevalences of food insecurity in Canada, after Nunavut and the Northwest Territories.[4] Census estimates for the region show provincial base populations that face other aforementioned economic risks for dietary compromise (eg, ageing population, rural populations, high prevalence of child and youth poverty). Atlantic provinces routinely report the lowest proportion of households

eating fruit/vegetables 5+ times per day.[74] Detailed population-based studies show Atlantic provincial populations fail to meet national proportions for adequate intakes of several nutrients such as inadequate fibre, as well as consuming excess sodium and unhealthy beverages.[25 75]

In conclusion, our study fills gaps in routine monitoring as well as nutrition research to support the pandemic response. The health consequences of macroeconomic and microeconomic shifts in consumption during COVID-19 have only begun to be elucidated in the public health nutrition literature. This study begins to examine how they affect diet in a robust regional nutritional epidemiology study with a probability sampling strategy. This study will investigate emerging patterns of dietary intakes and adequacy during COVID-19. It supports continued evolution in the public health nutrition literature to refine measures of household purchasing salient to diet, and ultimately to better understand how purchasing behaviour predicts dietary adequacy and diet quality.

Author affiliations
[1]School of Health Administration, Dalhousie University, Halifax, Nova Scotia, Canada
[2]Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada
[3]Department of Sociology and Social Anthropology, Dalhousie University, Halifax, Nova Scotia, Canada
[4]School of Human Kinetics and Recreation, Memorial University, St John's, Newfoundland and Labrador, Canada
[5]Department of Community Health and Humanities, Memorial University of Newfoundland, St. John's, Newfoundland and Labrador, Canada
[6]Faculty of Management, Dalhousie University, Halifax, Nova Scotia, Canada
[7]Department of Nutrition, Dietetics and Food, Monash University, Melbourne, Victoria, Australia
[8]Wellbeing and Preventable Chronic Diseases Division, Menzies School of Health Research, Darwin, Northern Territory, Australia
[9]Institute for Health Transformation, Deakin University, Melbourne, Victoria, Australia

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ORCID iD
Catherine L Mah http://orcid.org/0000-0002-7294-2035

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