Examining the Impact of a Nutrition Labelling Program on Menus in a Cafeteria Setting.

by

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A thesis
presented to the University of Waterloo,
in fulfillment of the
thesis requirement for the degree of
Doctor of Philosophy
in
Public Health and Health Systems

Waterloo, Ontario, Canada, 2016
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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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ABSTRACT

Background Diet is an important risk factor for chronic disease and obesity. The growing proportion of dietary intake from food consumed at restaurants and fast food outlets is an important contributing factor to the overall poor diet quality in Canada. Currently, Canadians receive little or no nutrition information when they are making purchases in away-from-home settings. Providing nutrition information on menus is a population-level intervention aimed at improving the dietary choices of consumers in restaurant settings. To date, the evidence for menu labelling is considerably mixed. Although menu labelling appears to increase noticing and use of nutrition information in these settings, the impact of menu labelling on food choices is unclear.

In January, 2011, The Ottawa Hospital implemented a nutrition information program on digital menu boards at the Civic Campus cafeteria, providing information for calories, sodium, saturated fat and total fat for meals or food items on digital menu boards. The program was later implemented at the General campus cafeteria in September, 2012. The implementation provided an opportunity to conduct a quasi-experimental study of menu labelling in a naturalistic setting.

Objectives The objective of the current study is to examine the impact of displaying nutritional information on menu boards on consumer behaviour. Specifically, the study examined: 1) the impact of menu labelling on self-reported noticing and use of nutrition information in the cafeteria, 2) the impact of menu labelling on calories, sodium, saturated fat and total fat purchased, 3) the impact of menu labelling on consumers' ability to estimate the calorie content of meals, and 4) how the impact of menu labelling may vary between population subgroups.

Methods Data were collected from the Civic cafeteria (the "comparison" condition) and the General cafeteria (the "intervention" condition) at three time points: before and 3 months after implementation at the General cafeteria, using the Civic cafeteria as a comparison site, with a one-year follow up. Exit surveys were conducted with approximately 500 patrons at each site during data collection wave, for a total of 3,061 participants. Surveys were approximately 10 minutes in length, and examined food and drink selection and consumption, noticing and perceived influence of nutritional information, and perceived calorie content of meal items, as

well as socio-demographics and nutrition-related attitudes and behaviours. Analyses were conducted using linear regression for continuous outcomes (self-reported nutrients purchased) and logistic regression for binary outcomes (self-reported noticing and use of nutrition information, correct calorie estimation within 50 kcal of objective amount), and included an interaction term between wave and site to examine the impact of the intervention over time.

Results In the first wave of data collection, there was significantly greater awareness and influence of menu labelling in the Civic cafeteria where nutrition information was presented on digital menu boards (75.1% noticed, 25.4% used), compared to the General cafeteria, which provided information inconsistently on paper signs throughout the cafeteria (31.8% noticed, 9.0% used). There were significant increases in the proportion of participants that noticed and used menu labelling at the intervention cafeteria immediately (3-months) after menu labelling was implemented (51.6% noticed, 14.2% used) and at the one-year follow up (51.5% noticed, 16.0% used), compared to the comparison cafeteria ($p<0.05$ for all). Across all waves and sites, approximately one-third of those who noticed nutrition information reported that they used that information to inform their food choice. Hospital staff, those who visited the cafeteria more often, younger participants, those with higher levels of education and income, those who reported using nutrition labels more frequently when shopping for food, and those who knew the estimated energy requirements for calorie intake were all more likely to notice menu labelling ($p<0.05$ for all). The only significant correlate of self-reported use of menu labelling to inform food choice was the frequency of using nutrition labels when shopping for food, whereby those who reported using this information more frequently were more likely to use menu labelling to inform their food choice. Among the entire sample, calories were the most commonly noticed nutrient (39.4% of the entire sample), and participants were equally likely to report purchasing less sodium (5.7%) and fewer calories (5.4%) in response to noticing the nutrition information.

Nutritional information matching self-reported meal items purchased was available for 2,781 participants. At the first wave of data collection, significantly fewer calories (-131 kcal), and less sodium (-323 mg), saturated fat (-2.4 g) and total fat (-9.7 g) were purchased at the Civic cafeteria which had implemented menu labelling as one aspect of an effort to improve the

nutritional quality of food items, including reformulation of some food items ($p<0.001$ for all). From Wave 1 to Wave 2, there were more favourable changes in the calories, sodium, saturated fat and total fat that was purchased at the General cafeteria, which had implemented the digital menu boards with nutrition labelling, compared to the comparison cafeteria ($p<0.05$ for all). When the analysis was conducted from Wave 1 to Wave 3, the effect of menu labelling was significant for saturated fat and total fat ($p<0.05$ for both), but was not significant for calories or sodium. The findings for calories were similar when examined for food purchases only, and there were no significant differences in calories for drink purchases between sites or over time.

When participants were asked to estimate the calorie content of their meal, 12.7% of the sample correctly estimated the calorie content of their meal within ±50 kcal of the objective calorie content, while 23.4% of participants did not know the content and did not provide a guess for at least one item in their meal. Approximately the same proportion of participants overestimated (32.9%) and underestimated (29.4%) the energy content of their meal. There were no differences between sites or over time in the proportion that correctly estimated the calorie content; however, those who noticed menu labelling were more likely to correctly estimate the calorie content of their meal ($p=0.03$). There was also no significant difference in the absolute difference between actual and estimated calorie content between sites or over time. Overall, there were high levels of support for menu labelling among cafeteria patrons for both menu labelling in the hospital cafeterias (95%), as well as in chain restaurants more broadly (91%). When asked, participants mostly commonly wanted to see calories on menu boards (72%), followed by fat (55%) and sodium (49%).

Conclusions The current study was among the first quasi-experimental studies examining menu labelling in Canada, and the first such study in a naturalistic setting using longitudinal data over a longer period. Overall, the results suggest a modest, but positive, effect of menu labelling on the nutritional quality of items purchased, with little effect on estimation of the calorie content of the meal. The intervention had similar impact between population sub-groups. The results provide evidence to inform policy development in Canada as policymakers consider menu labelling regulations at the federal, provincial and municipal level.

ACKNOWLEDGEMENTS

This study was funded the Public Health Agency of Canada, and was supported by funding from a Canadian Institutes of Health Research Vanier Canada Graduate Scholarship and an Ontario Graduate Scholarship. I also extend my gratitude to the CIHR Population Intervention for Chronic Disease Prevention training program, for the valuable mentorship and support over my graduate studies career.

I have many, many people to thank for their support over my PhD years. I'd first like to thank Dr. David Hammond. Dave, you are an inspiring researcher, and an inspiring human being. Thanks for showing us how research can change the world, how to fight the good fight every day, and how it is possible to balance a career with the most important things in life. I can't find the words to say how grateful I am, so I'll just stop. Thank you. I know this is the start of the beginning of our work together.

A big and warm thank you to my committee members, Dr. Rhona Hanning, Dr. Christian Boudreau, Dr. Lori Curtis and Dr. Marie Bragg, who provided a great diversity of perspectives and insight. A particular thank you to Rhona: you have treated me as one of your own students, and I'm grateful for your mentorship.

I would like thank our partners at The Ottawa Hospital, including Frances Furmankiewicz, Jennifer Powley, and Guy Girard, for allowing us to evaluate their innovative and forward-thinking labelling program. A special note to Janet Robinson for the administrative support in procuring the nutrition information and responding to my endless emails and requests.

There are several people who have guided me through my journey, academic and otherwise, that deserve special thanks. To Dr. Shakya at the International Friendship Children's Hospital in Nepal, for convincing me that going back to school would be the best way to make a difference in this world. To Dr. Paul McDonald, for giving me my first taste of population health in my undergraduate years, and for assuring me that the University of Waterloo was where I was meant to be. And a very heartfelt thanks to Dr. Roy Cameron, for your passion for research, and your ongoing belief that my work can make a difference.

Thank you to my inspiring colleagues that have passed through the Hammond Lab lair, with special thanks to Seema Mutti, Erin Hobin, Christine White, Jessie Reid, Samantha Goodman, Christine Czoli, Heather Lillico, Kathy Kotnowski, Cassondra McCrory, Amanda Jones, Cesar Leos-Toro, Samantha Shiplo, Isabelle Bordes, and Rachel Acton. Thanks for putting up with my lab nutrition policies, my poor taste in music, and my inability stop myself from oversharing.

Mom and Dad, thank you for allowing me to move across the country at 17, and again at 23, to pursue my ambitions. You provide endless love and support, and make sure I stay grounded in my mountain roots. On your behalf, I would like to thank the Breslau airport for having a direct flight to Calgary. To Jonny, for reminding me how special it is to be in Grade 22, and for teaching me that sometimes I need to grow down rather than grow up. Thank you for bringing Tracey and Logan into our lives. Thanks to the Mitchells, for always treating me like family even before it was official. And to all the friends and family who have carried me through the highs and lows – I owe you much.

Finally, to Mitch, for being my everything, always.

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1.0 INTRODUCTION

1.1 Diet and health

There is a well-established link between food, nutrition, diet and health. Poor diet is a primary risk factor for many chronic diseases, including heart disease, stroke, diabetes, and some cancers.[1] Unhealthy diet and excess energy intake can also impact intermediate risk factors for chronic disease, including overweight and obesity, elevated blood pressure, abnormal blood cholesterol levels, and insulin resistance.[2] In Canada, poor diet is the leading cause of chronic disease and death, and the rates of nutrition-related chronic diseases and risk factors among adults are high, and in most cases, rising.[3,4] For example, Canadian data from 2008/2009 suggests that almost 7% of Canadians have been diagnosed with diabetes, an increase of 70% since 1998.[5] Almost one in four Canadian adults are living with obesity, and another 37% are overweight, which equates to almost two-thirds of Canadians having an elevated risk of developing chronic disease due to weight alone.[3] Rates of other nutrition-related modifiable risk factors for chronic disease, such as hypertension and high total blood cholesterol are also high, at 27.4% and 41%, respectively. [6,7] In 2011, the burden from unhealthy eating in Ontario alone has been estimated to equate to $2.9 billion dollars in direct healthcare costs, and direct and indirect healthcare costs attributable to overweight and obesity in Canada in 2012 were estimated to be $19 billion.[8,9]

1.1.1 Diet quality in Canada

Currently, very few Canadians meet recommended dietary guidelines. Overall, less than 1% of Canadians have good quality diets that meet Canada's Food Guide criteria, according to the Healthy Eating Index – Canada.[10] More than 85% of Canadian men and 63% of Canadian women exceed the upper limit for sodium consumption, and the average daily sodium intake of 3,400 mg is more than double the recommended adequate intake of 1,500 mg.[11] Only half of Canadians consume five servings of fruit and vegetables on any given day, which is below 7 to 10 servings recommended in Canada's Food Guide and about a quarter of Canadians consumer more fat than the suggested total intake.[12] The overarching poor diet quality among Canadians necessitates interventions to shift dietary habits among consumers in Canada. There is increasing interest in

population-level approaches that have broad reach, in order to influence behaviours of populations, rather than addressing behaviour change among individuals.

1.1.2 Food consumed away from home

Poor diet quality is driven in part by increasing consumption of food away from home. Nearly 28% of the average Canadian's food budget is spent on food away from home, and one-quarter of Canadians consume some food prepared in a fast food outlet on any given day.[12,13] This is consistent with research from other Western nations, including the US, European countries and Australia, which suggest that levels of take-away and fast food consumption are high.[14]

Poor diet quality associated with food away from home is likely due to larger portion sizes, poor nutritional quality and energy-dense food offerings available in most restaurant and fast food settings.[15,16] Restaurant meals in Canada vary widely in their nutritional profiles, even within food categories and food items. For example, pasta entrees from sit-down restaurants in Canada can vary from 400 kcal to 1800 kcal, depending on the restaurant and preparation method.[17] Canadian research also suggests that similar type meals have higher calorie contents in sit-down restaurants compared to fast food restaurants.[17] A study of leading full-service restaurants indicated that the average meal from a restaurant contained 1128 calories, which represents 56% of the average daily recommendation for calories, along with 151% of the sodium (2269 mg), 89% of the total fat (58 g), and 83% of the saturated fat (16 g) recommended in one day.[18] Similar results have been found in studies characterizing foods offered in US sit-down and quick-service restaurants, which suggest that main entrée food items had extremely high levels of sodium and saturated fat, with particularly poor nutritional quality among appetizer food items.[19,20]

Eating away from home has been associated with greater energy intake,[21-25] higher fat intake,[22,25-27] lower intake of vegetables,[26] fruit,[22,25] and an overall decrease in diet quality.[24,25,27] The most recent research from the US suggests that each meal consumed away from home contributed on average an additional 190 kcal to the daily energy intake.[28] These effects are found in both fast

food type and table-service restaurants,[15] and vary according to the type of meal that is purchased.[25,28]

Research from the US has found that greater frequency of eating away from home is associated with deleterious health effects. There are a variety of restaurant settings that consumers can visit, including sit-down type restaurants, fast-food or quick-service restaurants, and cafeteria-style settings. Of particular importance is the association between increased fast food or food-away-from-home consumption and increased weight gain, which has been demonstrated as a causal relationship using prospective cohort designs.[22,29-33] Consumption of food from fast food type restaurants has also been related to other risk factors for chronic diseases, including insulin resistance[29] and an increased risk of developing type 2 diabetes.[34] The contribution of food from fast food restaurants may be particularly detrimental to metabolic outcomes relative to other restaurant foods from sit-down style full-service restaurants. A prospective study from the US found that fast food consumption was associated with less healthy lipid profiles, increased waist circumference, and weight gain whereas consumption in other restaurant settings was not.[35] Different food categories within fast food may also differentially impact health. A cross-sectional study found that more frequent consumption of food from fast food restaurants that primarily serve hamburgers and fries was associated with higher risk of obesity, while frequent food consumption in fast food restaurants that primarily served sandwiches or subs, and frequent use of full-service restaurants was unrelated to health outcomes.[36]

The current restaurant food environment makes it challenging for consumers to know the nutritional quality of the food they consume. Indeed, consumers are very poor at estimating the nutritional content on food items in restaurant settings. The vast majority of consumers underestimate the calorie and sodium content in fast food items.[37-41] The magnitude of this underestimation is often substantial: one experimental study from 2006 found that the actual calorie content of menu items was two-fold higher than consumer estimates.[41] In another example, a study in a fast food court in the US found that 74% of participants underestimated calories they had ordered by an average of 167 kcal, with one-quarter of participants having

underestimated by more than 500 kcal.[38] This study found that the underestimation was only significant when items were expected to be healthy, such as Subway sandwiches, and there was no significant underestimation for items expected to be unhealthy, such a hamburgers, even when the calorie content of the meal was held constant.[38] Similar studies have found that underestimation is greater when items are not consistent with initial expectations of the level of 'healthiness' of a product.[37,39] Typically, underestimation increases as the calorie content of items increases.[37,38] Although poor knowledge of the nutritional content of restaurant meals among the general public may not be surprising, a study of trained nutrition professionals found that fewer than one-quarter of trained dietitians could estimate the calorie content of food items from a popular restaurant chain.[42] Additionally, research has found that the typical 'rules of thumb' that consumers sometimes use to identify which menu items are likely to be high in calories, such as being deep fried, or having a creamy or buttery sauce, may not help consumers distinguish between items that are relatively similar in calorie content.[43] This suggests that the current food environment makes it challenging for consumers to make informed choices based on the nutritional content of food items in settings outside of the home.

1.2 Conceptual framework for nutritional labelling

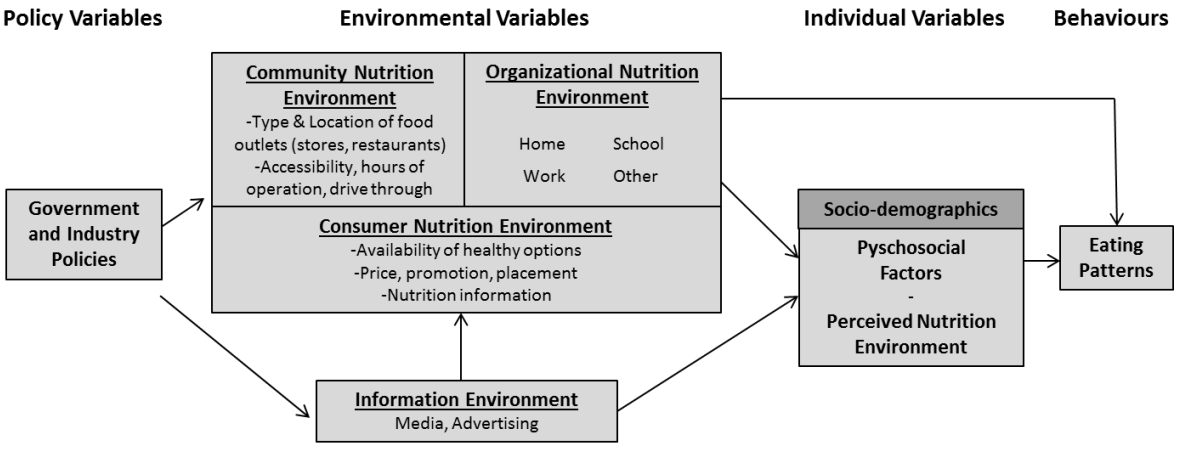
Given the challenge of accurately identifying the nutritional quality of food in restaurant and fast food settings, providing nutrition information at the point-of-sale, also known as menu labelling, may help consumers identify healthy options when selecting food away from home. Nutritional labelling is a prominent policy intervention that has been used in domains, such as packaged food labelling, to inform consumers and promote healthier diets, given it has a broad population reach and scope.

Currently, most nutritional labelling is limited to pre-packaged food items. Mandatory nutrition labelling on pre-packaged food has been implemented in many Western countries, including Canada, USA, European Union member states, Australia and New Zealand.[44] In Canada, the Nutrition Facts table (NFt) has been mandatory on pre-packaged food items since 2003. The NFt provides nutrition information for 13 core nutrients plus calories in a standard food amount, as

well as how much of each nutrient is present in a given serving size as compared to the Daily Value recommended by Health Canada. Evidence suggests that as many as 71% of Canadians report using food labels on prepackaged food to get nutritional information for foods or compare foods when shopping for food items.[45] Research consistently shows that reading nutrition labels is associated with consuming a healthier diet.[46] In Canada, the mandate for nutritional labelling currently only applies to pre-packaged food items and does not include foods served in restaurants, fast food outlets, deli counters, bakeries and other venues which serve food for immediate consumption.

There are several potential avenues through which menu labelling may improve dietary behaviours and overall health among consumers. Conceptually, nutrition labels contribute to a supportive environment within which consumers make their food choices. This is referred to as the *consumer nutrition environment* in a Conceptual Model of Community Nutrition Environments developed by Glanz and colleagues (See Figure 1).[47] The *consumer nutrition environment* describes the physical environment that consumers must navigate, including in restaurants and quick-service food outlets, and is seen as an influential environmental variable that can affect overall eating patterns. This conceptual model acknowledges that individual-level variables, such as socio-demographics and psychosocial factors including knowledge, attitudes and beliefs also operate within the eating behaviour pathway, and may serve as a mediator in the relationship between providing nutrition information in food environments and eating patterns.

FIGURE 1. Conceptual model of Community Nutrition Environments[47]



There are several pathways whereby menu labelling in foodservice venues may help to improve dietary quality among consumers. Refer to Figure 2 for a proposed conceptual model of the potential mechanisms of menu labelling on consumer behaviours and diet quality adapted from the literature. This model is based broadly on a conceptual framework for tobacco warning labels that can be used as a basis for policy evaluation of labelling efforts,[48] and concepts identified in a conceptual model developed by Grunert and Wills outlining nutrition label use from consumer decision-making literature.[49] This conceptual model outlines two potential pathways through which menu labelling may improve dietary patterns.

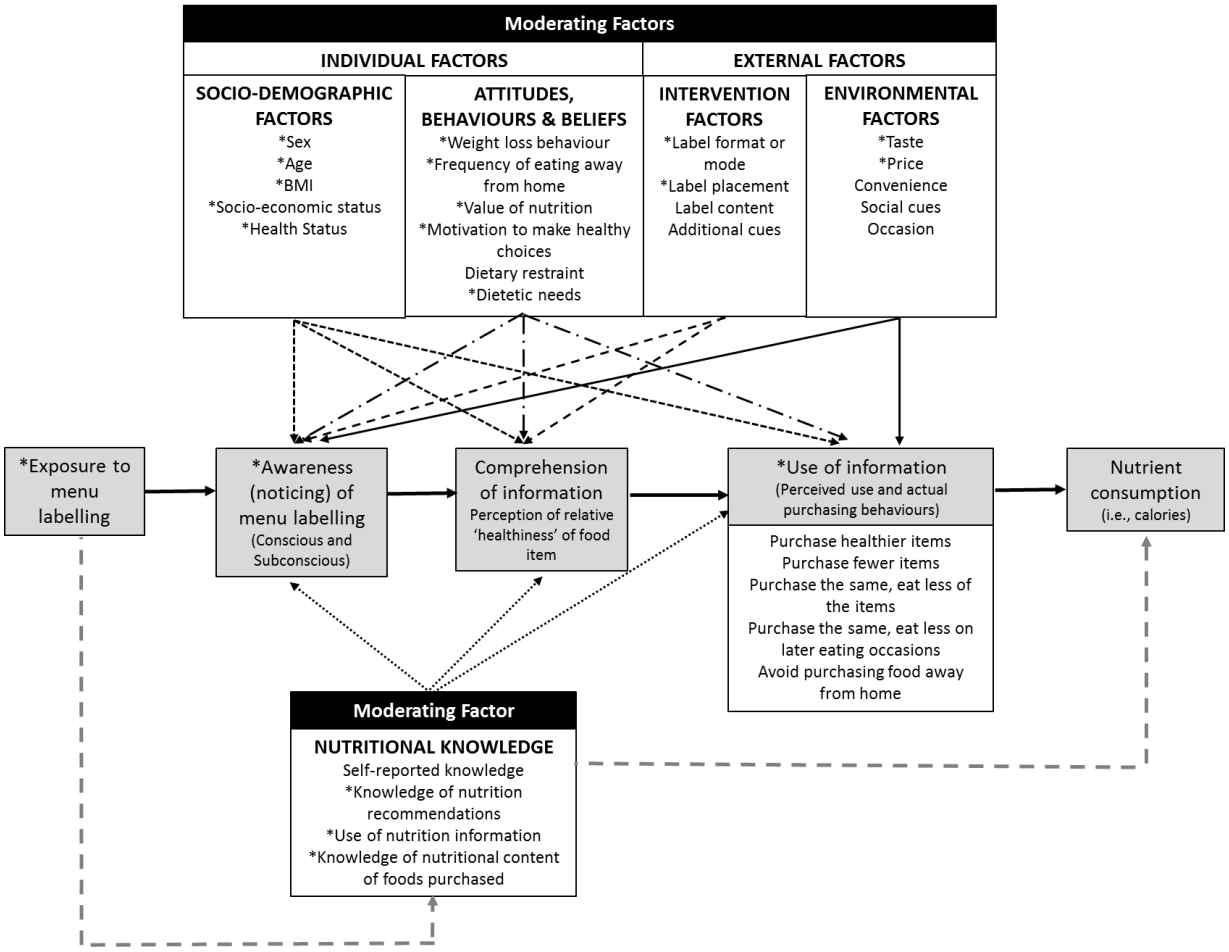
The most direct pathway is where consumers make a healthier choice at the point of sale in a restaurant after being exposed to menu labelling, denoted by the solid black arrows in the conceptual model. In order for this pathway to be successful, consumers exposed to menu labelling must first notice the nutrition information, and then they must understand what that information means to infer a judgement on the relative 'healthiness' of the food item. This judgement then allows consumers to engage in healthier purchase patterns, such as purchasing fewer calories, eating less of the items purchased, or avoiding the 'unhealthy' food altogether. They may also adjust intake for the rest of the day in accordance with how much they consumed at that particular meal. All of these behaviours ultimately may lead to a reduction in calories consumed, and an overall healthier diet. As the model demonstrates, there are a myriad of factors that may moderate this pathway at many potential entry points. These moderating factors relate to individual characteristics, external and internal non-health factors that influence food choices, behavioural factors, nutritional knowledge, and factors relating to the type of menu labelling itself, all of which influence the impact of menu labelling.

The second pathway, denoted by the grey arrows in the conceptual model, suggests that nutrition information on menus may improve overall nutrition knowledge via improving the overall saliency of nutrition information, and in particular, the saliency of calorie information for consumers. This increased knowledge of nutrition may lead to healthier overall nutrition behaviours in other venues (i.e. home, workplace) where nutrition information is and is not

present. Such an effect has been suggested in research among patrons who purchase food in jurisdictions with and without menu labelling.[50]

There is a third pathway not depicted in the conceptual model through which menu labelling may operate, relating to the concept of product reformulation. Adding nutrition information to menus may increase consumer interest in healthier food items, which would in turn increase the demand for healthier food products, and incentivize the food industry to reformulate food products. This would ultimately result in the addition of healthier food items to the food environment, improving overall consumption independent of whether or not consumers actively using nutrition information on menus.

FIGURE 2. Conceptual model of the influences of menu labelling on consumer behaviour*



*Moderating factors denoted with an asterisk represent factors that are examined within the current study.

1.3 Restaurant nutrition information environments in Canada

Consumers currently receive little nutrition information in restaurants in Canada. A recent environmental scan of the top 10 fast food chain restaurants in Ontario found that no restaurants provided calorie information for all menu items on menus or menu boards, 14% establishments provided calorie information for select items, and 26% of establishments provided information for other nutrients on menus or menu boards.[51] In the US, a scan of websites found that 82% of the top 100 chain restaurants provided calorie information on websites, and 25% had the information accessible on mobile devices; however, there was no consistent method for displaying nutrition information on these websites.[52] Research suggests that a very small percentage (<1%) of patrons access and consult nutrition information via brochures or posters before purchasing food when it is available in restaurants.[53] Canada is not alone in the absence of nutrition information from restaurant environments. A survey of major fast food chains in New Zealand suggested that although nutrition information was available in 11 out of 12 chains, <1% of the information was posted on menus and menu boards at the point-of-purchase.[54]

1.3.1 Menu labelling policy in Canada

Canada has yet to implement mandatory menu labelling requirements in any jurisdiction; however, the legislative landscape for menu labelling has undergone significant changes over the past several years. British Columbia was the first to adopt a provincial menu labelling program on a voluntary basis. The BC Ministry of Health launched the *Informed Dining* program in 2012. *Informed Dining* is a voluntary program that provides nutrition information for all standard menu items on request either before or at the point of ordering, including information for calories and 13 core nutrients, and specifically highlights the information for calories and sodium content. Participating restaurants are required to display the program logo in addition to a directional statement that nutrition information is available on request on the menu or menu board, and can voluntarily provide this information at other locations throughout the restaurant.[55] The program does not require displaying actual nutrient amounts on menus or menu boards, and consumers must identify the logo and request information. *Informed Dining* was adopted by Restaurants Canada (formerly Canadian Restaurant and Foodservices Association) in 2013. Information from

the BC Ministry of Health suggests that the program has been implemented in more than 10,000 restaurant outlets across Canada, including 19 national restaurant chains.[55]

In November 2014, the Government of Ontario passed the Health Menu Choices Act.[56] This regulation will mandate nutrition information for calories on restaurant menus with more than 20 outlets province-wide, and will come into effect in January, 2017.[57] The regulations will apply to all menus, including paper and electronic menus, menu boards, drive-through menus, and online menus or apps, as well as advertisements and promotional flyers that advertise the price of items. Although information for both calories and sodium were considered, the current policy only mandates calorie information. The legislation will require a statement regarding the typical calorie content of alcoholic beverages, as well as a contextual statement for the number of calories that are recommended to be consumed per day.[57]

In the absence of mandatory menu labelling policy in Canada, several independent programs have been developed to portray the nutritional quality of food items on menus. The Heart and Stroke Foundation established the Health Check program, which was a voluntary program that allowed participating restaurants to display the Health Check™ symbol next to food items that met the program's nutrient criteria, and was associated with an annual fee should companies choose to become part of the program. The program began winding down in June, 2014 and is no longer available for use in Canadian restaurants.[58] Other independent programs have been implemented by individual franchises. An example of this is the nutrition information at Subway™ chain restaurants, which provides calories and fat content information for selected menu items at the point of sale on menu boards and at the ordering counter, using numbers and logos to identify 'healthier' choices.

1.3.2 Mandatory menu labelling policy

Menu labelling has been introduced as a mandatory policy in several jurisdictions in the United States, the most notable example being New York City's (NYC) regulations implemented in 2008. This legislation required establishments with more than 20 outlets nationwide to post calorie information next to menu items on menus and menu boards in the same size and color

font.[59] Shortly after the introduction of the NYC policy, other US authorities followed suit with mandatory menu labelling policy implemented in more than 30 jurisdictions at the city, county and state level. More recently, NYC also became the first city to implement a mandatory warning logo on restaurant menu items that contained more than 2,300 mg of sodium (or more than the daily limit).[60]

The first national menu labelling regulations will be implemented in the US likely in late 2017, under Section 4025 of the Patient Protection and Affordable Care Act. The regulation will apply to establishments with 20 or more locations, and has three mandatory components: 1) calorie amounts must appear next to the food item on menus and menu boards; 2) menus and menu boards must prominently display the statement "2,000 calories a day is used for general nutrition advice, but calorie needs vary"; and 3) establishments must make additional information available on request for each menu item, including total calories derived from fat, total fat, saturated fat, cholesterol, sodium, total carbohydrates, complex carbohydrates, sugars, dietary fibre, and total protein.[61,62] The Act requires the labelling of certain alcoholic beverages, and includes movie theaters and amusement parks.[62] Additional regulations have been applied to vending machines.[62] The legislation was passed in 2010, and the final rule for the Act was published on December 1, 2014; however, the policy will not be enforced until final Level 1 guidance is issued, which is forthcoming at the time of publication.[62] Mandatory menu labelling policy in chain restaurants has also been implemented in several provinces throughout Australia, requiring the display of the kilojoule content of food items as well as a statement regarding the average recommended daily energy intake of 8700 kj.[63,64] A similar program has been established in South Korea, requiring chain restaurants with 100 or more establishments to display information for energy and four key nutrients (total sugars, protein, saturated fat and sodium) on menus.[63]

1.4 Evidence for menu labelling

A large number of systematic literature reviews have been conducted to date on menu labelling, with mixed reviews on the effects of menu labelling on awareness of menu labelling, self-

reported use of that information, and the influence of menu labelling on food choices. Harnack and French conducted the first review of menu labelling was conducted in 2008, which identified six studies that reported weak and inconsistent effects of menu labelling on food choice.[65-68] This review only included studies that did not evaluate mandatory menu labelling legislation and were implemented experimentally, and the applicability of these findings to real world settings, such as in actual restaurant or foodservice outlets, is unclear.

A review by Swartz and colleagues to summarize research conducted between 2008 and 2011 identified 7 studies, 5 of which were quasi-experimental and 2 of which were experimental. The results suggested that only 2 of 7 studies found reductions in energy consumption among those who had seen nutrition information on menus and concluded that menu labelling did not have the intended effect of promoting lower-calorie selection and consumption among restaurant patrons.[67] This review did include several quasi-experimental studies from jurisdictions with mandatory labelling policy, but these policy experiments were limited to fast food restaurants only and did not explore the effect of menu labelling in other restaurant settings.

Kiszko and colleagues conducted a recent systematic review of studies using quasi-experimental research designs from 2008 to 2013, and found 31 studies that were either experimental or quasi-experimental in nature. They concluded that the evidence for menu labelling remains inconsistent, and that the method of calorie labelling currently used in most jurisdictions did not result in fewer calories ordered at the population level; however, menu labelling was effective among several subsets of the population, including women, those who report noticing the nutrition information, and those who are overweight.[68] The review cites several limitations, including the lack of long-term data on the impact of menu labelling, that the outcome of all of these studies was calories purchased and not calories consumed, and that the diversity in study samples and methodologies makes the generalizability of the findings unclear. Even more recently, VanEpps and colleagues conducted a review of menu labelling in restaurants, which highlighted the importance of the restaurant context for menu labelling, as there appears to be a

differential effect of the type of food service setting on the impact of menu labelling on food choices.[69]

In the past 3 years, 3 studies have conducted separate meta-analyses to examine the impact of menu labelling. Sinclair et al conducted a systematic review and meta-analysis using both experimental and quasi-experimental studies.[66] The meta-analysis was conducted only among the experimental studies, and found that participants who were subject to some form of menu labelling selected 43 fewer calories (p=0.03) and consumed 41 fewer calories (p=0.03). When the results were further subdivided, they found that calorie labelling alone had no significant impact on calorie selection and consumption (31 fewer calories purchased, p=0.35, and 13 fewer calories consumed, p=0.61); however, the interventions that also included contextual such as the recommendations for calorie consumption per day or interpretive information such as colours or symbols appeared to decrease calorie selection by 67 kcal (p=0.008) and consumption by 81 kcal (p=0.007).[66] Studies that took place in a natural setting also found significant mean differences in calories selected, with 53 fewer calories purchased on average (p=0.009). The review also concluded that women were more likely to use menu labels to select and consume lower calorie items.[66] Long and colleagues conducted a meta-analysis including both natural experiments and experimentally manipulated studies, and excluding cross-sectional studies.[70] This analysis found a significant negative association between calories purchased or ordered and menu labelling, with 18 fewer calories purchased per meal or transaction (p=0.02). When stratified by the location of the study, the review found a significant impact of menu labelling in non-restaurant (experimental) settings (-58 calories, p=0.01), but not in actual restaurant settings (-8 calories, p=0.26). The study found high heterogeneity among the studies from non-restaurant settings, and was limited to few studies in actual restaurant settings, which may influence results. Finally, the most recent meta-analysis conducted by Littlewood et al found statistically significant negative associations between menu labelling and calorie consumption when both experimental and real-world studies in restaurants were combined (-100 kcal, p<0.0001).[71] The analysis found significant reductions in calories ordered in both experimental and real-world studies (-75 kcal,

p<0.0001), as well as within real-world settings only (-78 kcal, p<0.001). There was significant heterogeneity in several of the analyses, including the analysis among real-world settings, which makes the findings difficult to interpret. These three reviews had differing conclusions regarding the overall impact of menu labelling, and suggested that menu labelling significantly decreased calories purchased or consumed in some research settings more than others. The discrepancy in the conclusions may be due in part to how recently the systematic review had been conducted, and also to the types of studies that were included in the review. Collectively, the findings of these reviews and meta-analyses can be interpreted as a modest effect, if any, of menu labelling in most settings and for most populations, with differing effects based on individual characteristics, restaurant-level factors, the type and display of information in labels, and the study design used to evaluate the intervention. Therefore, it is important to identify what factors may mediate or moderate the impact of menu labelling, and examine the context in which labelling does and does not have an impact.

1.4.1 Noticing of menu labelling

In order for menu labelling to have an impact on consumer food choice, consumers must first notice the information posted on menus or menu boards. Research from real-world studies in fast food and sit down restaurants and cafeterias with mandatory menu labelling suggests that between 28% and 93% of patrons notice nutrition information when it is posted on menus or menu boards.[64,72-82]

Some studies suggest that there are population subgroups which are more likely to notice menu labelling than others; however, this result does not appear to be uniform across studies. Several studies from fast food restaurants have found that women were more likely to notice menu labelling, [76,79] as were those in younger age categories, [73,80] and those with higher levels of education[79] income,[83,84] or BMI status.[84] An experimental study using fast food menus found that those with more education, those of white ethnicity, and those 15 to 25 years of age were more likely to notice labelling.[85] Finally, a telephone survey from jurisdictions with menu labelling in the US found those with greater education, those with higher income, and respondents who did

not believe that they could eat as much as they want and not gain weight were all more likely to see the nutrition information in restaurants.[79] This body of research suggests that there may be patterns of socio-economic and socio-demographic factors associated with noticing nutrition information on menus.

1.4.2 Self-reported use of menu labelling to inform food choices

Subsequent to having noticed nutrition information, individuals must choose whether or not to use that information to inform their food choice and make healthier food selections. Research from intercept surveys after participants have ordered a meal from a food establishment with menu labelling are fairly consistent in that about one-quarter to one-third of consumers who notice nutrition information report that the nutrition information on menus influenced their food choice;[72-76,79-81,86-88], which accounts for between 10% and 26% of the entire study samples. One study found that this proportion was lower among adolescents in NYC, of whom only 9% of those who noticed the information reported using it.[89] Similarly, another study in fast-food restaurants also found that only 5% of the sample used the nutrition information.[40] Evidence suggests that self-reported use can vary between establishment types; however, the direction of this association is not clear. For example, one study conducted at sit-down restaurants that had implemented a voluntary policy in Pierce County, Washington reported that 59% of those who had noticed and understood the menu labelling had changed their food choice as a result of the information,[77] whereas another study in nearby King County, Washington found that those eating at fast-food restaurants were more likely to report using menu labelling information compared to those at sit-down restaurants.[84] Several studies looking at differences between different types quick-service establishments found that self-reported use was higher at "food chains" and lower at "coffee chains."[76,87]

Representative phone surveys from the US in 2012 found that 57% of the population reported using nutrition information to inform food choices at least sometimes, with the proportion ranging from 49% and 61% between states.[90] Use was highest in New York State, the first jurisdiction to implement any form of mandatory menu labelling.[90] A phone survey among

residents in Toronto found that 69% of those surveyed reported that they used nutrition information when they are eating away from home; however, the sources of this nutrition information are unclear.[91]

There are few consistent patterns of menu labelling use among population subgroups. The literature from real-world settings has typically shown higher levels of self-reported use of menu labelling among women,[76,79,84,87,90,92-96] while one study found higher levels of use among men.[73] The use of nutrition information among different age groups appears to vary, with some studies suggesting higher use among older age groups,[87] others suggesting that middle-aged participants were more likely to use nutrition information,[73] while still others have indicated that those in younger age groups were more likely to be frequent users of menu labels.[95]

There is some evidence that those who eat out more frequently may be less likely to use menu labels,[79,80,92,93] while one study found that those who eat fast food more frequently were more likely to report that they used menu labelling.[79] Other health behaviours have also been associated with using nutrition information from menus, such as those with greater physical activity levels, those who eat more fruits and vegetables and drink less soda, those who were either former smokers or never-smokers, or those whose current weight is higher than their desired weight. [94,95,97,98] Several studies have found more frequent use of menu labelling among those who have overweight or obesity,[79,95] and those who did not believe that they can eat whatever they want and not gain weight.[79]

It has been widely posited that menu labelling will disproportionately influence those with higher socio-economic status. A recent review concluded that those in high socioeconomic positions were more likely to report using menu labelling.[99] Some studies have found higher levels of self-reported use in wealthier neighbourhoods,[87] or among those with higher income levels or education levels,[83,95] while others have found no significant differences between neighbourhoods of different socioeconomic status. [73] A telephone survey with individuals living in cities with menu labelling found that those with higher socio-economic status were more likely to use menu

labelling information.[79] Another telephone survey found higher use among non-white populations.[95] One study conducted only in low-income neighbourhoods in NYC found no effect of menu labelling.[74]

Differential impact of menu labelling between population subgroups is one of the primary criticisms of menu labelling. Critics argue that menu labelling may have a greater impact among those who already have 'healthier' dietary habits and better diet quality, which could contribute to increasing health disparities. The evidence to date does not conclusively point to population subgroups which may be more likely to use menu labelling to inform their food choice, but does suggest that women with higher socioeconomic status and those with healthier lifestyles are more likely than other demographic groups to notice and use menu labels to inform their food choices.

1.4.3 Impact of menu labelling on consumer behaviours

Experimental study designs

The majority of experimental research on menu labelling uses hypothetical choice experiments, which ask participants what food item they might choose. Participants are commonly exposed to several different 'conditions' with varying types of menu labelling, and study designs include within-subject or between-subject comparisons. These studies can be conducted online or in-person. Of the 20 hypothetical choice experiments conducted since 2000, 17 suggest some modest effect consistent with consumers making healthier choices[37,41,97,100-113], while 3 found no influence of nutrition information on food choices.[85,114,115] Some of these experimental studies suggest that the effect of menu labelling on food choice may be moderated by the amount of dietary restraint that individuals exhibit,[110] or expectations of 'healthiness' of the food items or restaurants.[41,107,109] There were potentially important differences between the format of nutrition information: several studies suggest that symbols and other labelling schemes such as physical activity labelling or traffic light labels have more impact than calorie information alone,[101-103] while others do not.[104]

These studies collectively suggest that purchasing intentions may be positively influenced by menu labelling; however, these studies do not have behavioural measures of food selection, and have a limited ability to simulate other real-world factors that influence food choices, including price, convenience and external cues. The lack of external validity among these studies highlights the importance of other study designs, such as those that occur in more naturalistic settings.

Nine experimental studies have been conducted that measure actual purchasing and sometimes consumption with real menu items using experimentally manipulated menu labelling conditions. The studies used various forms of deception in an attempt to conceal the actual study intentions, in order to minimize social desirability bias. Of these nine studies, seven suggest a positive effect of menu labelling on consumption of food items.

Only one experimental study has been conducted in Canada. Hammond and colleagues conducted an experimental trial of menus from Subway with four conditions: 1) control condition, 2) calories only, 3) calorie with a traffic light, and 4) calorie, sodium, fat and sugar with a traffic light. The study found that customers who were given a menu with only calorie information were more likely to recall calorie content of meals and consumed fewer calories compared to those who received no information, by a magnitude of about 96 kcal; however there was no main effect of the type of menu labelling to which the participants were exposed.[116]

Roberto and colleagues found a significant effect of having some labels (either calorie information only or calories plus information regarding daily recommended intake of calories) compared to a condition with no labels, with participants consuming 14% fewer calories.[117] This study also used self-reported dietary recall to assess the amount of food consumed the rest of the day following the menu labelling exposure, and found that when the calories accounting for food consumed at the dinner and after dinner were combined, participants in the calorie labels plus information group consumed 250 fewer calories than other groups; this effect was not significant for the calories information only condition.[117] This is one of the few studies to examine the residual effect of menu labelling on behaviours beyond the immediate food choice, and has

important implications for how menu labelling could impact other food choices throughout the day.

A study by Wisdom et al. had participants order a meal before they entered a fast food restaurant using menus with and without nutrition information and calorie recommendations, which resulted in those who received calorie information only or calorie information with recommendations purchasing around 100 fewer calories.[118] Temple and colleagues had participants order lunch from menus with no labelling, regular Nutrition Facts labels, and traffic light labels, which resulted in decreased energy intake among lean females only, and an increase in purchases of foods labelled 'green' with traffic light labelling.[119] A similar study by the same group also found a significant impact of nutrition labels.[120] A study by Harnack and colleagues testing calorie information on menus found that there no significant differences in purchasing or consumption between those who saw and did not see calorie information.[85] Finally, three experimental studies specifically tested labelling of exercise equivalents compared to calorie labelling or no labelling controls, all of which found fewer calories purchased with exercise labelling. [121-123]

Experimental studies examining menu labelling demonstrate mixed results, likely a result of different study designs, populations, and different formats for presenting nutrition information in experimental menu labelling conditions. Although these results are mixed, they suggest there is an impact of menu labelling some of the time in settings that more closely resemble real-world food choice, among some study populations.

Quasi-experimental study designs

Given the considerable challenge of mimicking a real-world food decision in an experimental setting, recent research has examined the impact of menu labelling policy and programs implemented in real-world restaurant and food service settings. Quasi-experimental research provides a rigorous and naturalistic approach to examine the impact of menu labelling.

Quasi-experimental studies in US jurisdictions that have implemented mandatory menu labelling policy have mixed results. Four studies suggest that there is an overall positive effect on calories

ordered from venues where menu labelling has been implemented, which resulted in decreases in calorie purchasing between 15 and 155 kcal.[50,86,124,125] Several studies comparing jurisdictions with and without menu labelling policy before and after menu labelling was implemented found a null effect of menu labelling, including studies among NYC low-income adults[74,80,89,126] and adolescents,[89] and from sales data from a popular Mexican food chain in the King County, Washington.[127] An additional study found no significant impact of menu labelling in NYC; however 38 fewer calories were purchased when calorie labelling was present, and lack of statistical significance may have been due to a small sample size.[78] An additional three studies found mixed results within the study, with one NYC study reporting a significant result when a model was adjusted for relevant restaurant and individual-level factors,[87] one study from New York State finding an overall significant result that was no longer significant after adjusting for demographic factors,[128] and one study from King County, Washington, that found no significant overall effects, but a significant impact in coffee chains compared to other types of food chains.[76] Notably, these studies all implemented calorie labelling only, all took place in quick-service outlets, and only a few provide contextual information. The only evaluation conducted on menu labelling in Australia to date suggests that the overall impact of the program was significant 6 months post-implementation, with reductions on average of about 124 kcal.[64]

There is an additional category of studies examining voluntary menu labelling, implemented either by research groups conducting quasi-experimental studies with the purpose of testing menu labelling, or by restaurants or groups interested in developing voluntary menu labelling programs. This literature tends to suggest a modest positive effect of menu labelling, with 12 of 17 studies reporting "healthier" food choices when menu labelling interventions have been implemented.[77,81,82,88,129-137] Three studies suggest a null effect of menu labelling schemes on food purchases.[138-140] There were two experimental studies which found that menu labelling increased energy consumption among men,[85,141] and those who do not typically try to control the types or amounts of food they eat consume, also referred to as unrestrained eaters.[141]

Two unique quasi-experimental studies have examined the impact of menu labelling in Canada. The first Canadian study to examine menu labelling was conducted in a university cafeteria by Hammond and colleagues.[81] The study collected longitudinal data from a cohort of students over two waves of data collection, and results indicated that 89 fewer calories were purchases and 95 fewer calories were consumed when menu labelling was posted. The same study sample was also used to examine the impact of menu labelling among those with eating pathologies, as it has been posited that menu labelling may negatively impact those who have disordered eating. The study was a repeat cross-sectional design, and found that there were no changes in emotional states or weight-related behaviours that have been associated with eating disorders, and no changes in the levels of eating disturbances after menu labelling was implemented.[142] Although this study was conducted among young women at risk of developing eating pathologies, the sample in this study did not have clinical eating disorders, and few had disordered eating behaviours that would be of concern.[142] Additionally, the smaller sample size of this secondary study also resulted in a non-significant impact of menu labelling on calories ordered.[142] Olstad and colleagues conducted the second Canadian study, and examined the impact of a traffic light labelling program in a recreation sport facility setting. This study used sales data to examine changes in trends of purchasing green light, yellow light, and red light products, and found that there were significant increases in sales of green light items, and reductions in sales of red light items, with no effect on overall revenues of the concession. [82]

It is important to consider that the format of the menu labelling interventions in these studies varies, which may affect the impact of the interventions. For example, two of the studies that found no impact of menu labelling on food choices used labelling schemes which included symbols only, and did not display any nutrient amounts,[138,140] compared to several of the successful labelling interventions that posted nutrient information for calories alone or in addition to other nutrients. Several of these quasi-experimental studies used formats such as traffic light labels, which provide descriptive information for the nutritional quality of food items to help

guide choices.[82,129,130,132,133,135,136] Some studies suggest that the impact of traffic light labels is greater than calorie labels alone.[129,130]

Finally, studies suggest that there may be a differential impact of menu labelling among population subgroups. For example, a recent review of the literature concluded that there was some evidence of increased impact of menu labelling on food choices among those with higher socioeconomic position; however, the study cited limited and poor quality evidence examining this relationship.[99] Two recent studies suggest that the impact is greater among women.[50,76] Studies that examined the impact of the menu labelling interventions by zip code found that there was a greater decrease in calorie purchasing in restaurants located in areas with higher income and education,[50,76] or areas with less ethnic diversity.[76] Again, this may contribute to health disparities among less advantaged populations, and additional research in the area is warranted. Overall, the literature from quasi-experimental studies is mixed, with some studies showing a significant and meaningful impact of menu labelling, and some finding no effect of labelling on food choices.

1.4.4 Impact of menu labelling among those who report using nutrition information

Self-reported use appears to be associated with the impact of menu labelling. An early study by Bassett and colleagues in NYC before mandatory menu labelling was implemented found that those who reported both seeing and using nutrition information purchased 99 fewer calories than those who saw it and did not use that information.[86] Another recent study from menu labelling in NYC suggested that the proportion of the sample of noticed and used menu labelling drove the effect of menu labelling in the overall sample, as they purchased 400 fewer calories in their meal than those who did not use the information.[72] Similar results have been seen in other quasi-experimental research in restaurants with mandatory menu labelling, with those reporting calorie values suggesting the magnitude of the effect is between 78 and 153 kcal.[76,80,83,87,128] There is one study from NYC immediately after the implementation of the policy in a low-income area, which found that there was no association between self-reported use of menu labelling and decreased calorie consumption compared to those who noticed and did not use or those who did not notice

menu labelling.[74] The frequent finding that those who report using menu labelling do tend to consume fewer calories provides evidence of the accuracy of self-reported use, and suggests that among those who are trying to use menu labelling information to inform their choices, most are able to do so.

1.5 Barriers to using nutrition information on menus

Several studies have attempted to qualitatively assess barriers and facilitators to use of menu labelling in real-world settings. Focus groups from consumers in Philadelphia identified a number of barriers to use, including having low levels of nutrition knowledge, difficulty interpreting the information that is portrayed on menus, low expectations of the nutritional quality of restaurant food, and other influences on consumer choices such as discounts, promotions or social influences that claimed precedence over food choice.[143] This same study found that facilitators to using this information included having greater nutrition knowledge, having sufficient time to read the menu and make food choices, having a strong interest in diet, nutrition and healthy eating, and finally having social influences that supported making healthy food choices a priority.[143] A similar study using focus groups in NYC found that the most frequently cited barriers among consumers were price and time constraints, confusion or lack of understanding of calories in menu items, and prioritizing preference, hunger and habit along with using nutrition information.[144] It appears that the format of menu labelling may play an important role in the levels of use. Both studies suggested that the presentation of the information on menus was not clear and confusing to consumers, which led to decreased use.[143,144]

Many individual-level factors influence food choices, and may serve as barriers to use of menu labelling. These influences can be external, due to the eating and social environment, or can be internal, relating to personal values which guide an individual's choice, including the relative importance of factors such as taste, price, convenience, and nutrition.[65] Factors not related to diet quality (such as taste and price) may take precedence over the nutritional content of food items when purchasing food away from home. Most research suggests that taste is the most important driver of food choice when consuming food away from home, with nutrition ranking as lower

importance.[145-147] Thus it is important to consider that the addition of nutrition information on menus addresses only one factor among many that can influence food choice.

1.6 Impact of menu labelling on calorie estimation

There is evidence to suggest that menu labelling may improve the accuracy of calorie estimation. A study in NYC found that the proportion of consumers who could correctly estimate calories in food items increased 9% before and after implementation of menu labelling policy, from 15% to 24%, with no significant change over time in nearby Newark, with no menu labelling policy implemented.[148] Another study examined differences between Philadelphia with mandatory menu labelling policy, and Baltimore with no menu labelling policy, and found that the majority of consumers underestimated calories, by 216 to 419 kcal, and that calorie estimates were more accurate in Philadelphia after menu labelling was implemented among a subset of the population, including those who made small purchases (improved by 78 kcal) and those with a college education (improved by 231 calories), and gross underestimation of more than 500 kcal was less likely.[149] This study also found that menu labelling results in improved estimations among those with higher education and those who ordered fewer calories, and was poorer among those who purchased combination meals. A study examining the impact of a contextual statement that included the recommendation for calories per day or calories per meal found that consumers made higher, more accurate estimates when they had received the slip with daily recommendations for calorie intake.[150] In contrast, a study among a sample of adolescents at fast food chains in NYC found no significant impact of calorie labelling on the proportion of the sample that underestimated calorie estimation or on mean underestimation.[89] Taken together, the evidence suggests a trend towards improved estimations of the calorie content of food items when calorie labelling is present.

1.7 Impact of menu labelling on product reformulation

In addition to affecting consumer behaviours, menu labelling may also influence the restaurant industry to reformulate menu items. It has been hypothesized that restaurants affected by menu labelling legislation may reformulate menu items to have ‘healthier’ nutrition profiles, in order to

post lower calorie information for menu items that may be more attractive to consumers. The results of research examining the impact of menu labelling on changes to the nutritional profile of restaurant foods to date are mixed. One recent study of the top 400 chains in the US between Spring 2010 (when the Affordable Care Act was passed), and Spring 2011 suggests that there was no significant change to the nutrient profiles of restaurant items over that period.[151] A similar study examined nutritional profiles of menu items in restaurants from King County Washington 6 months after menu labelling was implemented in 2009 and again 18 months post implementation. The study found that energy content of menu items was significantly lower at 18 months post-implementation (by 41 kcal), as well as significant decreases in sodium and saturated fat content, and these decreases were consistent among menu items with both 'healthier' and 'less healthy' profiles.[152] A study of the top 66 chains in the US found no change in mean calorie content of menu items from 2012 to 2014; however, there were significant declines in the average calorie content of newly introduced menu items from 2012 to 2013 by approximately 71 kcal and from 2012 to 2014 by approximately 69 kcal.[153] Given that all of the above mentioned studies examined the changes in menu profiles over periods when there was no enforcement of national-level legislation due to the delay in the final Level 1 guidance of the Affordable Care Act, the limited change in the nutritional content of menu items may not be surprising. When a study used similar methods to examine differences in the calorie content of meals in restaurants that voluntary provided menu labelling in anticipation of the Affordable Care Act compared to those that did not, the mean calorie content per item in restaurants which posted calorie information on menus contained around 140 fewer calories than restaurants that did not voluntarily post this information before it was required, and this trend was similar for new menu items.[154] There is some evidence that menu labelling may lead to healthier reformulation of food products; further research is needed to examine the influence of menu labelling on the nutritional profile of restaurant food after labelling is implemented throughout the US and in other jurisdictions with national scope.

1.8 Impact of menu labelling on body weight

It is difficult to assess the impact of menu labelling policy on changes to body weight or health, given that menu labelling policy is occurring simultaneously with other factors that are likely to influence body weight, such as other public policies or programs, changes to awareness of obesity or obesity-related conditions, as well as the possibility of general secular trends towards healthier lifestyles. There is, however, some preliminary evidence that menu labelling may be significantly associated with decreases in BMI. A recent modeling exercise conducted by the US National Bureau of Economic Research found that in those counties and states that had implemented menu labelling policy, there is evidence of a decrease in BMI. More specifically, the decrease in BMI was significant among all men, with a greater impact among those men who were classified as overweight or having obesity, and among women who were classified as overweight only. [155]

Only one quasi-experimental study to date has examined the effect of menu labelling on body mass index. The study by Nikolaou and colleagues examined changes in body weight when a calorie labelling intervention was implemented in a university cafeteria over the course of a school year. The study found that fewer participants gained weight when the menu labelling intervention was implemented, and there was a lower average weight gain in the year when menu labelling had been implemented.[137]

1.9 Policy support for menu labelling

Evidence suggests that there are high levels of public support for menu labelling among consumers,[156] with some suggestion that females may be more likely to support menu labelling than males.[157] In Canada, support for menu labelling has been estimated at around 70%.[158] A separate survey from Canada found that 90% of consumers in Canada believe that getting nutritious food when eating out of the home was ‘somewhat’ or ‘very’ important, and 78% of consumers believed that they would use nutrition information at least sometimes if it were posted in more accessible locations.[91]

2.0 STUDY RATIONALE AND OBJECTIVES

2.1 Rationale

The primary objective of the current study was to explore consumer use of nutrition information when it is posted on menu boards. Although policy decisions are imminent in several Canadian jurisdictions considering menu labelling regulations, there is a lack of evidence to guide this decision-making process. The current study has the capacity to inform a number of regulatory bodies considering menu labelling legislation. Health Canada hosts a Federal/Provincial/ Territorial (F/P/T) Task Group on the Provision of Nutrition Information in Restaurants and Foodservices, which convened a Think Tank on Menu Labelling in March 2011. The Think Tank identified critical evidence gaps, and concluded that there was insufficient evidence to inform menu labelling policy in Canada. This research directly responds to evidence gaps identified in the Think Tank, including 1) the actual impact of nutrition information on consumer behaviour, 2) how population subgroups differ in the way they use nutrition information on menus, 3) what types of labelling consumers want or prefer, 4) how the impact of nutrition information on menu items changes with repeated exposure, and 5) a lack of Canadian data and reliance on data from the US.[159] The results of this work will inform the F/P/T Task Group as they continue to consider menu labelling recommendations or regulations in Canada. A recent Senate report from the Senate Committee on Social Affairs, Science and Technology made specific recommendations supporting the implementation of menu labelling federally.[160] The government of British Columbia may also use this work to inform choices around policy design and implementation as the *Informed Dining* menu labelling efforts continue to evolve.

Much of the evidence from menu labelling to date stems from the United States, and there is scant literature examining menu labelling in the Canadian context. Importantly, there are very few published quasi-experimental studies in actual Canadian restaurant environments examining the impact of menu labelling on consumer behaviours. Given there are differences in food cultures between the US and Canada, evidence of the impact of menu labelling among the Canadian population is critical. As an example, Americans spend 50% of their food dollar on

food away from home, compared to 28% of the Canadian food dollar.[13,161] Similarly, the US has a higher prevalence of obesity, with 34.4% of Americans living with obesity compared to 24.1% of Canadians.[162] Thus, evidence specific to the Canadian setting is critical. The use of a quasi-experimental study design in a real-world setting over time will provide a critical piece of evidence that may be more generalizable to actual behaviours compared to the experimental studies conducted among Canadians to date.[104,105,116] The use of a comparison group in a pre-test-post-test study design adds additional rigour to the study design.[163] No Canadian menu labelling research to date has used a comparison group.

This study will also complement other research in the area if menu labelling. The study is able to address several limitations that have been identified in the literature. First, the study has the ability examine the use of menu labelling over a longer time period, using multiple time points, which has been little examined in the literature to date.[164] Evidence on the longer-term impact of menu labelling may support or disprove theories of consumer fatigue or increases in knowledge and use over time. Second, the study will help to establish which population subgroups may be more prone to use menu labelling, and will provide some evidence to deduce whether menu labelling will increase health disparities. The results will also help to inform groups that may need to be targeted in messaging or programs to enhance noticing and use of menu labelling should menu labelling be implemented. Finally, the menu labelling intervention implemented in the cafeterias at The Ottawa hospital is one of the most comprehensive menu labelling initiatives and includes information for calories, sodium, saturated fat and total fat. This provides an opportunity to examine the labelling of different nutrients and how the information is used by consumers.

2.2 Research questions

The study seeks to examine the impact of menu labelling on consumer behaviours. Specific research questions include:

1a) Do participants report noticing nutrition information when it is posted on menu boards?

1b) Does noticing nutrition information vary by population subgroups?

2a) Do participants use nutrition information on menu boards to make select foods lower in calories, fat and sodium?

2b) Does use of nutrition information on menu boards to inform food choices vary by population subgroups?

3a) What is the impact of displaying nutrition information on menu boards on purchasing of calories, sodium, saturated fat and total fat?

3b) Does the magnitude of the impact on purchasing vary by population subgroups?

4) Does providing nutrition information on menu boards improve consumers' estimation of the calorie content of food items?

5) What type of nutrition information is most salient to consumers?

3.0 METHODS

3.1 Study Design

A quasi-experimental study was conducted at two hospital cafeterias using a pre-test post-test design with a comparison group. Surveys were conducted with cafeteria patrons at Civic and General Campuses of The Ottawa Hospital in three 'waves' of data collection. Using a repeat cross-sectional approach, independent samples were recruited at each wave. Participants could participate in more than one wave of data collection; however, their data was not linked to previous survey waves.

The first wave (Wave 1 (W1)) of data collection occurred between August/September 2011, approximately 8 months after the program had been implemented at the Civic cafeteria. General cafeteria did not have any digital menu boards with menu labelling during Wave 1, but had inconsistent information provided on paper signage in some cafeteria areas, as described below. The second wave (Wave 2 (W2)) of data collection occurred in November/December 2012, approximately 2 months after the digital menu boards had been implemented at the General cafeteria. In Wave 2, additional advertising was added to the digital menu boards at both Civic and General cafeterias. The third wave (Wave 3 (W3)) occurred between August/September 2013 to examine the long-term impact of the program. This data allowed for comparison of the changes at the General cafeteria (the 'intervention' site) to the changes at the Civic cafeteria (the 'comparison' site) over the same time period. See Figure 3 for study design.

FIGURE 3. Study design demonstrating a pre-test post-test with a comparison group

	Wave 1	**Wave 2**	**Wave 3**
Civic cafeteria	**X**	x	x
General cafeteria	**O**	x	x

X = menu labelling implemented on digital menu boards with no advertising
x = menu labelling implemented on digital menu boards with advertising
O = minimal and inconsistent menu labelling on paper signs

3.2 Intervention description

The Ottawa Hospital provides bilingual hospital services to a community of approximately 1.2 million people annually at three campuses (Civic, General and Riverside). In 2010-2011, 2011-2012, and 2012-2013, The Ottawa Hospital had around 12,000 staff, 1,200 physicians and 1,600 volunteers. Over the same time period, the hospital saw around 47,000 patient admissions annually.[165-167]

The Ottawa Hospital has two large cafeterias (The Tulip Café at the Civic campus, and Café 510 at the General campus) that serve staff, patients, and members of the public who visit the hospital. At the time of the study, the Nutrition and Foodservices team was responsible for food provision for both in-patients as well as the public cafeterias, and had readily-available nutrition information for most food products created and sold for both the cafeterias and in-patients. Nutritional analysis was conducted using the using C-Bord Nutrition Service Software (C-Bord Group Inc., NY) and information obtained from food providers.

In June of 2010, Food Service Directors from hospitals across Ottawa met to discuss the creation of a '*Hospital Check*' nutrition program to promote the provision of healthy food options to retail customers. The group created a set of nutrition standards, modelled after the Heart and Stroke Foundation's Health Check™ Nutrition Criteria for Food Service [reference available upon request], the Ontario School Food and Beverage Policy,[168] Nutrition Standards for Vending Machines Eat Smart! Recreation Centre Program,[169] and the Sodium Targets for Food Products set out by Health Canada.[170]

On January 3, 2011, The Ottawa Hospital Civic Campus ("Civic") opened the newly renovated Tulip Café, which provided digital menu boards with prominent displays of nutritional information at the point-of-sale, featuring information on calories, saturated fat, total fat, and sodium (see Figure 4 and 5).

Components of the program included:

- A health logo (an apple with a check mark) for items that meet the developed nutritional standards. (See Figure 4).
- A 'Healthier Menu Plus Santé' at the entrance to the cafeteria highlighting healthier menu items available on the menus. (See Figure 6a and b)
- An educational campaign (flyers and pamphlets) promoting the program at the entrance to the seating area cafeteria. (See Figure 7)
- Removal of deep fryers, and improvement of the nutritional profile of some menu items to increase the number of items that met the *Hospital Check* criteria.

There were a total of five digital menu boards in the Civic cafeteria. The menu boards provided nutritional information for soups and salads, pizza and pastas, grill items, and entrées and paninis, as well as the 'Healthier Menu Plus Santé' screen.

During the first wave of the study (Wave 1), the General Campus cafeteria ("General") had some nutritional labelling, and provided calorie, sodium, saturated fat, trans fat and total fat information for a limited selection of items using 8.5 X 11 inch paper signs throughout the cafeteria. There was also nutritional information provided at the entrance to the cafeteria for some items on brightly colored signs. Daily visual scans of the cafeteria during the Wave 1 study period showed that the information provided in the cafeteria was only available for select items, and was not available for these items on a consistent basis (see Figures 8, 9, 10 & 11).

The nutritional information program with digital menu boards was implemented at the General Hospital Campus in Café 501 on September 27, 2012. At that time, four digital menu boards were implemented in the cafeteria providing nutrition information for soups and salads, pizza and pasta, grill items and entrées and paninis (See Figure 12 and 13). The screens provided nutrition information for calories, sodium, saturated fat and total fat for some but not all of the food items available in the cafeteria, and were identical to the screens provided at the Civic cafeteria. The screens also displayed commercials for particular combination meals available for purchase with

no accompanying nutrition information for these items. The commercials displayed for 10-20 seconds, followed by 10-20 seconds of displaying the menu items and nutrition information (see Figure 14). Importantly, these commercials were also added to the digital menu board screens at the Civic cafeteria during the same time period (Wave 2).

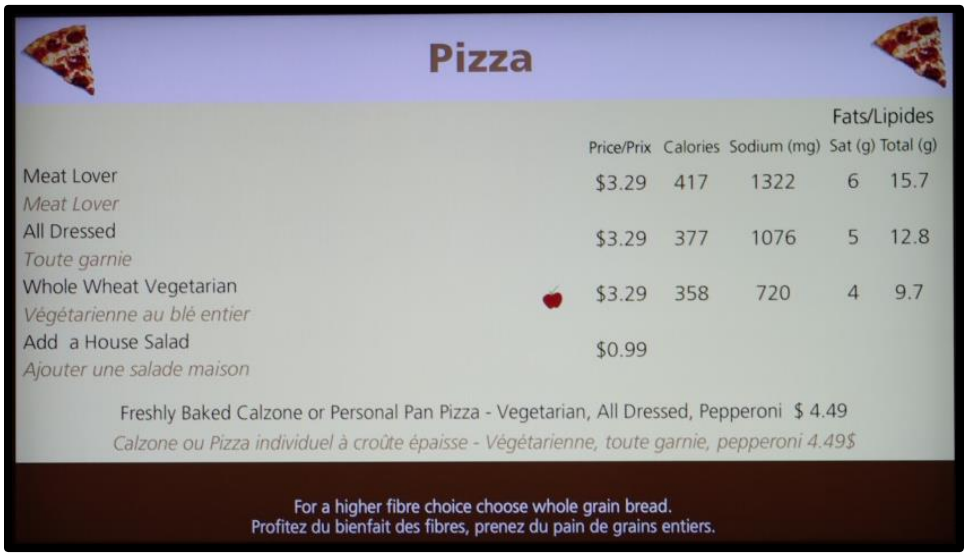
The implementation of the nutrition program at Civic coincided with renovations to the cafeteria. These changes were also accompanied by changes to the food offerings, partly due to the public display of nutrient profiles on menu labelling, and also a desire to offer healthier choices in a healthcare setting[171] As a result, there were overall differences in the average nutrient profiles offered between sites during Wave 1 data collection. Importantly, there were no systematic changes made to the menu offerings at the General cafeteria or the Civic Cafeteria between Wave 1, Wave 2 and Wave 3 of data collection, however there were some inevitable adjustments to recipes during that time at both sites that resulted in some changes to food available at the cafeteria. (See Table 1 for approximate differences in average calories offered between sites during Wave 1 for some food categories).

TABLE 1. Approximate differences in average calories offered for food categories between waves at both sites (kcal)

	Civic			**General**		
	Wave 1	**Wave 2**	**Wave 3**	**Wave 1**	**Wave 2**	**Wave 3**
Paninis	377	411	411	579	457	457
Entrée	441	456	467	553	630	643
Grill	366	360	354	503	501	444
Salad Bar	494	494	494	568	568	568
Sandwiches	446	470	456	518	519	511
Soups	120	115	115	120	119	115
Pizzas	402	403	401	400	400	400

FIGURE 4. An example of the menu boards posted at the Civic Cafeteria in Wave 1 (2011)

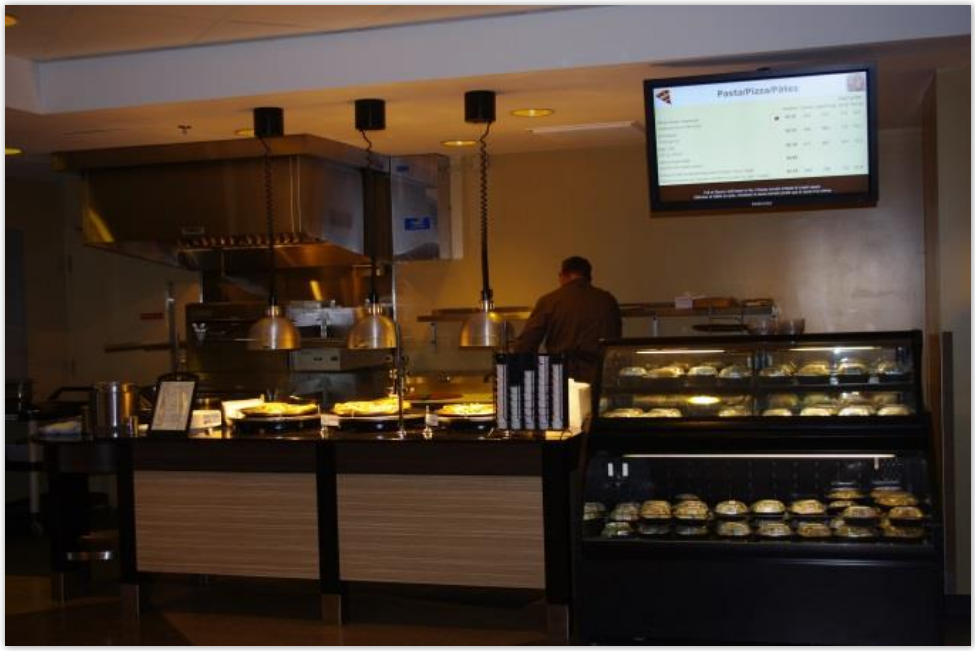
(Note the *Hospital Check* apple icon next to the Whole Wheat Vegetarian pizza)



FIGURES 5a & 5b. Civic cafeteria with digital menus boards posted in Wave 1, 2 and 3 (2011, 2012 and 2013)

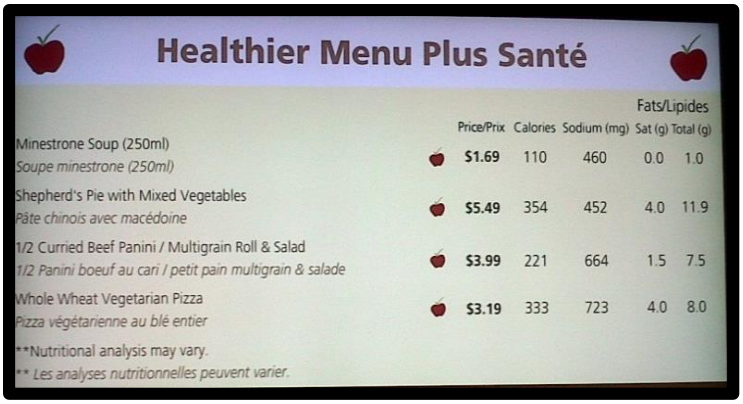
a)

b)



FIGURES 6a & 6b. An example of the Healthier Menu Plus Santé posted at the entrance to the Civic Cafeteria in Wave 1, 2 and 3 (2011, 2012 and 2013)

a)



Healthier Menu Plus Santé

	Price/Prix	Calories	Sodium (mg)	Fats/Lipides Sat (g)	Fats/Lipides Total (g)
Minestrone Soup (250ml) *Soupe minestrone (250ml)*	**$1.69**	110	460	0.0	1.0
Shepherd's Pie with Mixed Vegetables *Pâte chinois avec macédoine*	**$5.49**	354	452	4.0	11.9
1/2 Curried Beef Panini / Multigrain Roll & Salad *1/2 Panini boeuf au cari / petit pain multigrain & salade*	**$3.99**	221	664	1.5	7.5
Whole Wheat Vegetarian Pizza *Pizza végétarienne au blé entier*	**$3.19**	333	723	4.0	8.0

**Nutritional analysis may vary.
** *Les analyses nutritionnelles peuvent varier.*

b)

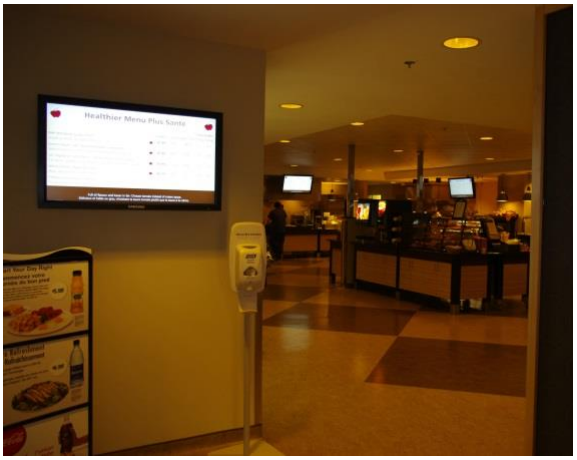


FIGURE 7. Information posted at the entrance to the Tulip Cafeteria seating area, including brochures, a screen with information on the Health Check logo, and healthy eating information

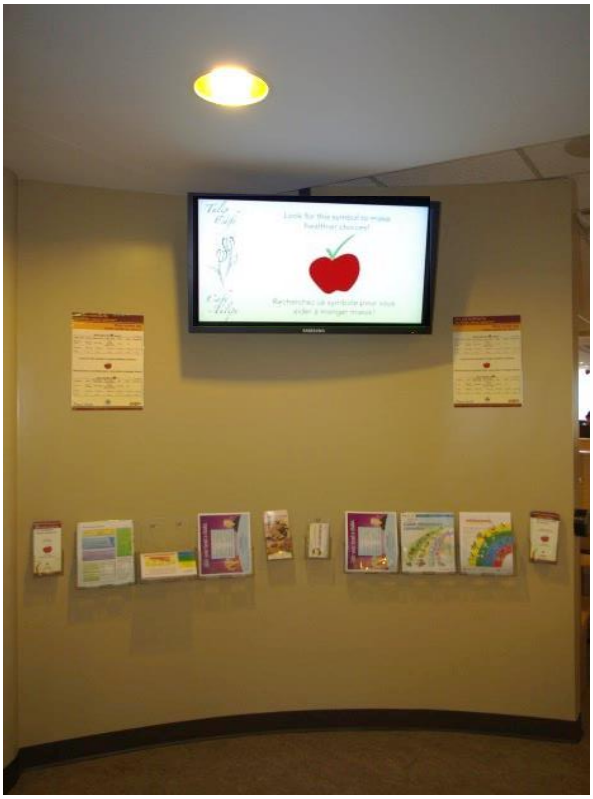
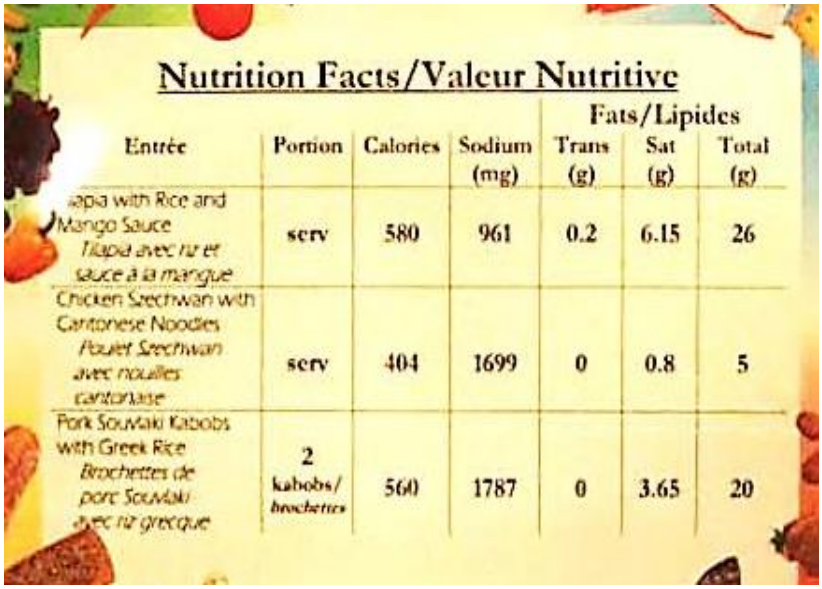


FIGURE 8. An example of the paper signs with nutrition information posted on 8.5" X 11" sheets for some items throughout the General Cafeteria in Wave 1 (2011)



Nutrition Facts/Valeur Nutritive

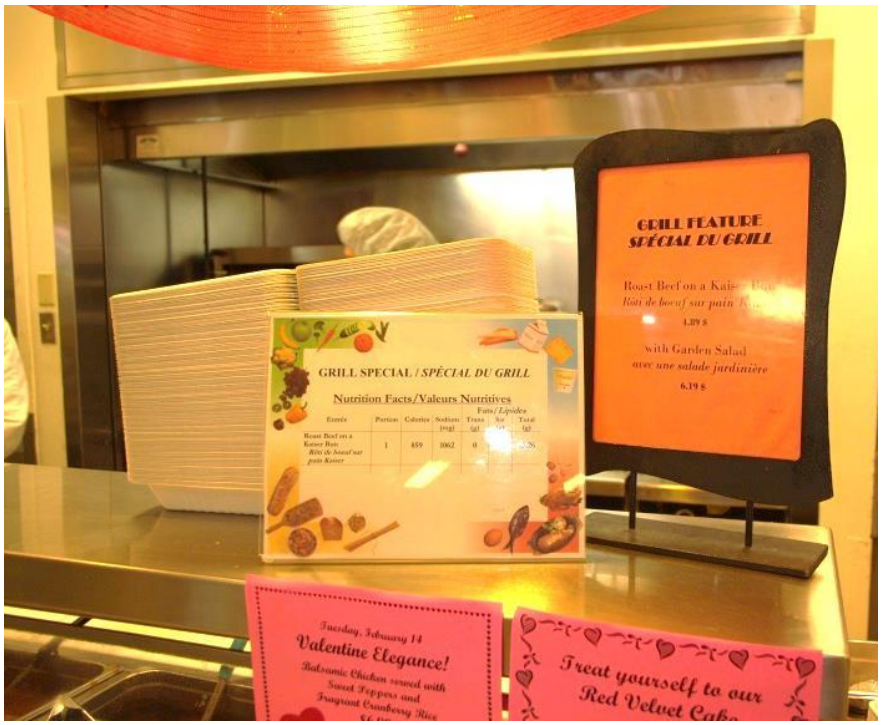
Entrée	Portion	Calories	Sodium (mg)	Fats/Lipides Trans (g)	Sat (g)	Total (g)
...apia with Rice and Mango Sauce *Tilapia avec riz et sauce à la mangue*	serv	580	961	0.2	6.15	26
Chicken Szechwan with Cantonese Noodles *Poulet Szechwan avec nouilles cantonaise*	serv	404	1699	0	0.8	5
Pork Souvlaki Kabobs with Greek Rice *Brochettes de porc Souvlaki avec riz grecque*	2 kabobs/ *brochettes*	560	1787	0	3.65	20

FIGURES 9a & 9b. Images of the nutrition information posted at the General Cafeteria in Wave 1 (2011)

(Note than only one sign contains nutrition information (far left))

a)

b)



FIGURES 10a & 10b. Examples of other signage posted throughout the General Cafeteria in Wave 1 (2011)

(Note that most of these signs contain information pertaining to items available and price, and few signs contain information regarding the nutritional content of the food items pictured)

FIGURE 11. Nutrition information available at the entrance to the General cafeteria during Wave 1 (2011) in English and French for select menu items

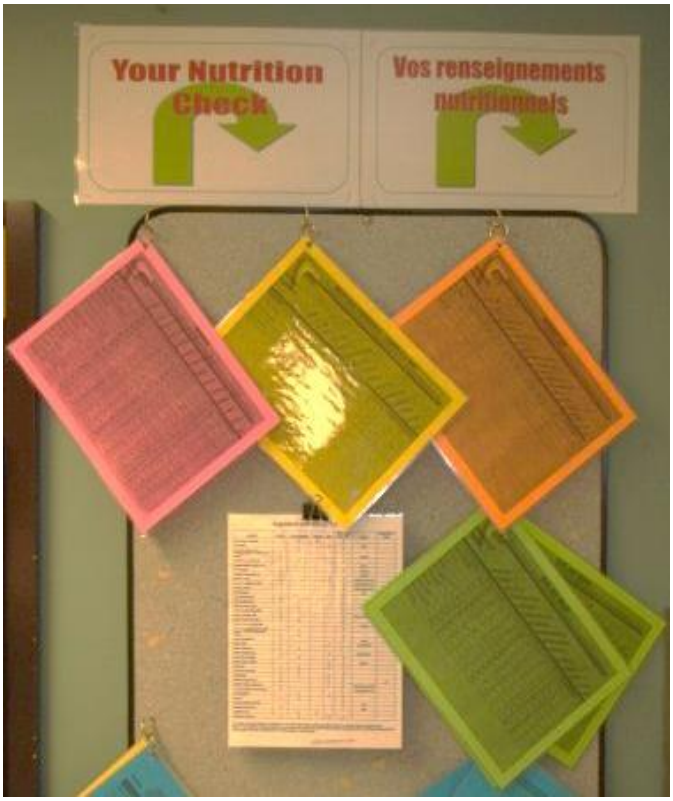
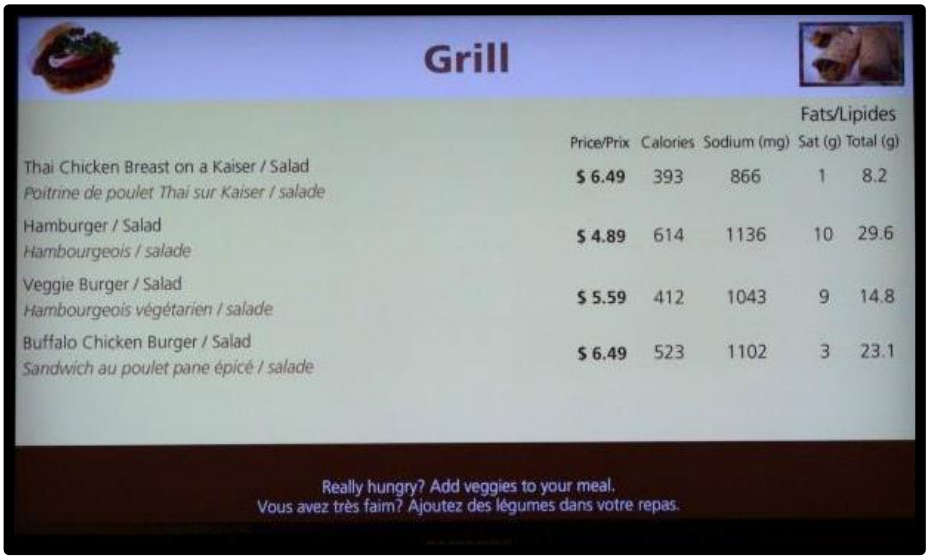


FIGURE 12. Digital menu boards provided at the General cafeteria during Wave 2 and 3 (2012 and 2013)

(Note that these menu boards are identical in layout to the Civic cafeteria menu labelling program implemented in 2011)



FIGURES 13a and b. Images of the General cafeteria with digital menu boards in Wave 2 and Wave 3 (2012 and 2013)

a)

b)

FIGURE 14a and b. Examples of advertisements shown at approximately 20 second intervals at both Civic and General cafeterias in Wave 2 and Wave 3 (2012 and 2013)

a)

b)

3.3 Protocol

In order to minimize self-selection bias, participants were recruited using a standard intercept technique, whereby trained interviewers were stationed at the exit of the cafeteria seating areas, and approached each patron that passed a landmark as they exited the cafeteria. Participants were invited to take part in a 10-minute survey on food consumption in cafeterias. Computer-assisted personal interviews were administered using iPads. The survey was offered in English and French. Due to technical issues, French surveys were only offered from September 7 onwards in Wave 1, and were offered the entire study period in Wave 2 and 3. Interviews were on average 7

minutes and 32 seconds in length (SD=129 seconds) in Wave 1, 9 minutes 47 seconds (SD=204 seconds) in Wave 2, and 11 minutes 58 seconds (SD= 216 seconds) in Wave 3. A short introductory script was used to introduce the survey and ensure that individuals met eligibility criteria.

In appreciation for participation in the study, participants were provided the opportunity to enter a draw for a $100 gift card from Chapters/Indigo. One draw was conducted at each cafeteria per wave, for a total of 6 draws. The approximate odds of winning the gift card were 1 in 500.

3.3.1 Pre-testing

Pilot testing was conducted with six individuals at an on-campus eatery at the University of Waterloo in July, 2011. Interviews were conducted to ensure that questions had clear instructions for the research assistants, and to ensure clarity of the survey measures. Interviews were conducted by Lana Vanderlee using a paper-based version of the survey.

3.3.2 Interviewer training

Research Assistants were recruited via list-serv email communications to relevant undergraduate and graduate university programs in the Ottawa area, as well as on local job boards. Interviewers were required to be fluent in English, with a good command of French. Two days of interviewer training took place to ensure consistency between research assistants over time. Training was conducted by Lana Vanderlee and David Hammond. The first day of training included a review of interviewer conduct, an overview of the survey measures, and a practice session in English and optionally in French with other interviewers. The second day of training included additional practice surveys with other interviewers, followed by deployment in the field. Interviewers were subtly monitored during the first several interviews to ensure that all study protocols were being followed in the field, and the first two to three interviews had a short debrief immediately following completion of the survey to identify any problem areas or provide clarification. Any interviews during which mistakes occurred that may have jeopardized the survey results were removed from the dataset.

At each data wave, two site supervisors were hired to act as a coordinator on site at The Ottawa Hospital cafeterias. On-site support was also provided by partners from The Ottawa Hospital.

3.3.3 Eligibility criteria

Individuals were eligible for the study if they were 18 years of age, had purchased food in the cafeteria on the day of the survey, could speak and understand English or French, and had not completed the survey in the current wave of data collection. Participants were eligible to participate if they had ordered food and were taking this food with them as 'take out' to eat at a later time.

In Wave 1, a total of 1,013 individuals completed surveys. In Wave 2, a total of 1,096 individuals completed surveys. In Wave 3, a total of 1,077 individuals completed the survey. A total of 7, 36 and 27 interviews were conducted in French in Wave 1, 2 and 3, respectively. In Wave 1, 10 individuals were excluded from the final sample due to incomplete surveys or inconsistent responses, as identified by comments from the interviewers, for a total of 1,003 completed surveys. In Wave 2, 14 individuals were excluded for a total of 1,082 completed surveys. In Wave 3, 15 individuals were excluded for a total of 1,062 completed surveys. An additional 66 individuals were removed from the dataset due to incomplete sociodemographic information in the standard covariates that were adjusted for in the analyses (ethnicity=30, age=22, education = 5, label use=10, cafeteria frequency = 4 [note, several participants had missing data for several variables]). Finally, 20 individuals were removed from the dataset due to missing secondary covariate information (frequency of eating out=1, healthy decisions in restaurants in the previous month=7, self-reported general health=5, perceived weight=6, physical activity=1). Thus, the total sample size was 3,061 (n=980 in Wave 1, n=1,038 in Wave 2 and n=1,043 in Wave 3).

There were significant differences in the proportion of excluded participants by wave (Wave 1= 2.3%, Wave 2=4.1%, Wave 3=1.8%, $X^2_{(df=2)}$=11.53, p=0.003), but not by site (p=0.72). Participants who were removed were more likely to be female (3.5% females vs. 1.6% males, $X^2_{(df=1)}$=9.44, p=0.002), and were no more or less likely to notice or use menu labelling (p=0.26 and p=0.63, respectively).

Response rates were calculated according to the American Association for Public Opinion Research, Response rate #4.[172] In Wave 1, the response rate was 25.9% at the General cafeteria and 29.1% at the Civic cafeteria. In Wave 2, the response rate was 20.5% and 20.2% at General and Civic cafeterias, respectively. In Wave 3, the response rate was 13.2% at the General and 19.8% at the Civic cafeteria.

3.4 Survey Measures

A full copy of the English questionnaire is available in Appendix 1. Measures were adapted from previously used literature, when possible. When measures were not accessible or available, questionnaire items were developed by the research team.

3.4.1 Socio-demographic information

Personal demographic information included age, gender, education level (high school or less, some college or university, completed college or university, or graduate or professional school), income level, and ethnicity.

3.4.2 Consumer demographics

Consumer type was identified (staff, visitor, in-patient, out-patient, medical student, or other). Frequency of visits to the specific cafeteria through the question "Have you ever eaten in this cafeteria before today?", as well as the frequency of eating at the cafeteria (never, less than once per week, once per week, two or three times per week, or four or more times per week). Frequency of consuming food away from home was examined through the question "In a typical week, how often do you eat out for lunch or dinner at restaurants, fast food outlets, drive-through or cafeterias, including this cafeteria?" (never, less than once per week, once per week, two or three times per week, or four or more times per week).

3.4.3 Food selection

Foods purchased were identified through six open-ended questions:

1) What was the main food item you ordered today?

2) Did you modify or add anything to this item, for example adding extra cheese or asking for no sauce?

3) Did you choose any additional side dishes with this meal?

4) Did you purchase a drink?

5) Was this diet or low-calorie, or regular?

6) Did you purchase a dessert or any other snack items?

In Wave 1, researchers found it difficult to match nutrition information to some responses recorded by research assistants due to a lack of detail elicited from the interviews, which may have been due to poorer response from participants or lack of probing from interviewers. Therefore, in Wave 2 and 3, a series of drop-down commands with all menu items were programmed into the survey for interviewers to include additional prompts and collect more detailed food order information, when possible.

To examine the amount of food consumed, participants were first asked "Did you eat all of your meal today?" If the respondent had not finished their entire meal, they were asked how much of each food/drink item they had consumed (one quarter, one half, three quarters, or the entire item). Main items and side items were asked separately. Items were coded as "take out" if the respondent was taking the item with them to consume at a later time.

Nutritional content of food items was provided by The Ottawa Hospital, using C-Bord Nutrition Service Software (C-Bord Group Inc., NY) and information obtained from food providers. For food items that did not have accessible nutrition information from The Ottawa Hospital, comparable information was obtained from the Canadian Nutrient File. Individuals who did not report details on portion or serving size were assumed to have selected the most commonly sold value as per Ottawa Hospital sales data, or as the item was listed on the menu the day the survey was completed. For entries that did not contain sufficient detail to elicit the specific item sold (for example, 'pizza' or 'soup'), an average was assigned proportionate to Ottawa Hospital sales data specific to each site. It was assumed that meals came as they appeared on the menu, unless detail was otherwise provided in the participant's description. For example, if only the main item was

reported by a participant, it was assumed that the side items that appeared on the menu accompanied the main food item, as cafeteria staff reported that it would be extremely atypical for the cafeteria to serve only the main entrée item with no accompanying sides. This may bias towards a conservative estimate of food items purchased, as this assumption would increase the number of calories in the meal.

There was insufficient detail to assign individualized nutritional information for salad bar purchases. Salad bar purchases were assigned a category average for calories, sodium, saturated fat and total fat. Averages were based on the volume of each salad bar item sold within a one-week period and divided by the number of salad bar purchases over the same period. Data specific to each site were collected over a one-week period upon conclusion of the study in Wave 1. Salad bar purchases were also assigned average nutritional content for salad dressing unless there was information for the type of salad dressing purchased. The same value for salad bar purchases was assumed in Wave 1, 2 and 3. When salads were described as a 'side salad' or ordered with a meal, they were assigned the nutritional content of a typical side salad for each site. Although this approach introduces some measurement error at the level of individual respondents within each site, it should not bias comparisons across sites.

Food consumption was measured by multiplying the nutritional content of the food item by the participant's description of how much of the food item he or she had eaten (25%, 50%, 75% or 100%).

Receipt analysis

In order to provide some validation of the self-report measures used in this study, a receipt analysis was conducted among a subset of the study population. In Wave 3 only, participants were asked to provide a receipt to verify the items they had purchased for that meal. If participants provided a receipt, they were asked if the receipt contained only items they had ordered for themselves, or if it was for multiple persons. If the receipt contained items for multiple persons, the participant was asked to identify which items they had ordered for

themselves. Receipt information for the participant's items was recorded by the research assistant.

Matching between self-reported items ordered and items identified on the receipt was assessed by two independent raters. When there was disagreement between raters, each case was discussed until consensus was reached. The information provided on the receipts from the cafeteria were typically a low level of detail. For example, an item line said "soup", but no information for type of soup is printed on the receipt. Thus, responses were coded for level of 'matching'. Items were considered a 'match' if they were a 'perfect match' or a 'category match'. A match was considered a 'perfect match' when there was the same phrasing in the self-report as the receipt line (e.g., "chicken fingers" on both). A match was considered a 'category match' when the detail in the self-report fit within the most specific level of detail provided in the receipts (e.g., "pepperoni pizza" in self report and "pizza slice" on receipt). For meals that were considered "combination meals", if the main food items was an exact match and 2 side items were identified, this was considered a category match as well (e.g., if the receipt described tilapia/brown rice/salad and the respondent had reported they purchased tilapia/white rice/vegetables) as this would have been entered the same by the cafeteria workers at the checkout (using the same button on the cash register program). Finally, some items always came with a side item, and were therefore only considered a match if the side item was self-reported, regardless of the detail on the receipt.

The receipt analysis was conducted twice. First, analysis examined matching among items that were self-reported. Second, the same method examined the self-reported information in addition to the assumptions that were made according to the nutritional analysis plan described above (e.g., if only the main item was reported, it was assumed that the side items that were listed on the menu that day were also ordered). This provided an estimate of how accurate participants' self-report was, and how accurate this was when compared to the assumptions used in the analysis plan.

3.4.4 Factors influencing food choice

Respondents were asked about the influence of taste, price and nutrition on food selection, using a 10-point scale from not at all important to very important. The order of taste, price and nutrition was randomized across participants. To understand specific dietary restrictions, respondents were asked "Do you have any food allergies, dietary needs or conditions that influenced your meal choice?" with an open response field (Waves 1 and 2 only).

3.4.5 Menu label noticing and impact

A series of questions were asked to examine menu label noticing and impact:

1. **Did you notice any nutritional information anywhere in the cafeteria?**
   If yes to question 1 above:
2. **Where was this information located?**
3. **What type of nutritional information did you notice?**
4. **Did the nutritional information presented influence which food or drink items you selected for your meal?**
   If yes to question 4 above:
5. **What influence did the nutritional information have?**
6. **Was there one type of information that influenced your meal choice more than others?** *[only included respondents who mentioned more than one type of nutrition information in question 3 above]*

Note that in order for participants to have used menu labelling, they had to have noticed the information beforehand; participants who did not notice labelling were not asked if that information had influenced their food choice. In this analysis, 'use' is defined as those who both noticed and were influenced by menu labelling information.

3.4.6 Estimated calorie content

To examine the extent to which calorie labelling improved nutritional knowledge of menu items, participants were asked "Approximately how many calories were in the _____ that you just ordered? *If you are not sure, please provide your best estimate"* with an open response field. This question was asked separately for each food item (each main, side, drink, and other item separately).

3.4.7 Nutritional knowledge and behaviours

In Waves 1 and 2, a general measure of nutritional knowledge and calorie understanding was assessed: “On average, how many calories should an adult consume per day to maintain a healthy weight?” with an open response field. In Wave 3, the question was changed to “On average, how many calories should YOU consume per day to maintain a healthy weight, given your age and level of physical activity?” Dieting behaviour was measured through a yes/no question asking “During the past year, have you been on a popular weight-loss diet (such as Weight Watchers, Atkins Diet, etc.) or *actively tried to lose weight?”* Finally, to examine common consumer behaviours using nutrition labelling on pre-packaged food which may pertain to the use of nutrition information in restaurant settings, respondents were first asked “When shopping for food for you and your family, do you look at the nutrition information provided on the package? (never, sometimes, usually or always).

3.4.8 Perceptions and attitudes

Perceptions of food choices were examined through the question, “Overall, do you think your meal choice today was a healthy choice?” with a yes or no response. To examine the impact of menu labelling on trying to choose healthier food items, respondents were asked: “In the past month, have you made an effort to choose healthier food items when you are eating in this cafeteria?” and “In the past month, have you made any effort to choose healthier food items when you are eating at sit-down restaurants, fast food outlets, drive-throughs or cafeterias?”

3.4.9 Health status

A total of five questions were asked about health status. Perceived health was measured through the question, “In general, how would you rate your overall health?” (poor, fair, good, very good and excellent). Perceived weight was examined, asking “Do you consider yourself overweight, underweight, or just about right?” Participants were also asked to self-report their height and weight to calculate body mass index (BMI). General physical activity levels were measured by asking “Over a typical or usual week, on how many days do you engage in moderate to vigorous

physical activity, such as brisk walking, bike riding, jogging or cross-country skiing, for a total of at least 30 minutes per day?" (none [zero] days, 1 day, 2-3 days, 4 or more days, or every day).

3.4.10 Support for menu labelling

To establish levels of support for menu labelling in Wave 1 and Wave 2, respondents were asked "Overall, do you think it is a good idea for Ottawa Hospital to have nutritional information on menus in the cafeterias?" Respondents were also asked a more general question of support for menu labelling: "Do you think that *all* fast food and other chain restaurants should list nutrition information on menus and menu boards?" Participants were also asked about support for health logo or symbols: "Do you think it is a good idea to put a logo or symbol beside food items on menus to indicate healthier options?" Finally, participants were asked about specific types of nutrition information, if any, they would like to appear on menus: "What nutritional information, if any, would you like to see displayed on menu boards?" with an open response field. The support questions were not asked in Wave 3.

3.4.11 Questions specific to Wave 2 and 3

Several questions were added at Wave 2 and Wave 3 that were not included in Wave 1. These include a question about the type of meal, asking "Would you describe this as your breakfast, lunch, dinner, snack or other?" Participants were also asked if they had participated in the survey during the previous waves.

3.5 Ethical clearance

The study received ethics clearance from a University of Waterloo Research Ethics Committee (ORE File #17196) and the Ottawa Health Science Network Research Ethics Board (Protocol #2011567-01H).

3.6 Analysis

The study used a non-equivalent (pre-test post-test) control group design, to allow for comparison of changes that occurred in the intervention site (General cafeteria) to the changes that occurred at the comparison site (Civic cafeteria) before and after the intervention was implemented. In the current study, the intervention was already implemented at the comparison site, and thus it will not be referred to as the 'control' site. The use of a comparison site allowed the study to measure and control for changes that may have occurred over time at both sites, due to secular changes or other confounding factors unrelated to the intervention that are assumed to act equally on both sites over time. The comparison site (Civic cafeteria) acted as a proxy for change over time, and it is assumed that the changes that occurred over time at this site would also have occurred at the intervention site (General cafeteria), from which it can be inferred that any differences between the sites in the outcome variables are due to the intervention.

Analyses were conducted using SPSS v.22 (Illinois, US) and SAS University Edition (North Carolina, USA). Pearson chi-square tests were used to test statistical significance of proportions, and t-tests were used to examine mean differences for continuous variables. The criterion for determining statistical significance was a probability level ("p" level) of less than 0.05, unless otherwise specified. The Benjamini-Hochberg procedure was used to decrease the false detection rate when examining variables with multiple comparisons. The procedure decreases the threshold for a significant p-value according to the number of comparisons being examined, in order to reduce the likelihood of false-positives.[173]

Logistic regression models were used to examine binary outcomes, and linear regression models were used to examine continuous outcomes. Models contained indicator variables for site (Civic cafeteria or General cafeteria) and time (Wave 1, Wave 2 or Wave 3). Each model testing differences over time included an interaction term between Wave and Site, which serves as the indicator for effect of the intervention. The use of an interaction term compares the change that occurred at the intervention site (General cafeteria) compared to the change at the comparison site (Civic cafeteria), and identifies if there was a change after the intervention that was greater

than one would have expected due to secular changes. Effect coding was used to examine individual contrasts within the interaction variables.

The conceptual model identified a number of individual-level variables that were proposed to moderate the relationship between exposure to menu labelling and use of that information. A standard set of covariates selected *a priori* were forced into each model to examine whether or not these factors were associated with the key outcomes in the study. Standard covariates included consumer type (staff, visitor or patient), frequency of eating at the cafeteria (never, less than once per week, once per week, 2-3 times per week, or 4 or more times per week), age (18 to 34 years, 35-44 years, 45-54 years, or 55 or more years), gender (male or female), education (high school or less, some college or university, completed college or university, or graduate or professional school), income (0 to less than $40,000, $40,000 to $80,000, more than $80,000, or not reported), ethnicity (White or other) and BMI status (BMI less than 18.5 or 'underweight', BMI 18.5-24.99 or 'normal' weight, BMI 25.0-29.99 or 'overweight,' BMI 30.0 or more and 'obese,' and not reported), and frequency of nutrition label use when shopping for food (never, sometimes, usually, or always).

A second set of covariates were considered 'exploratory' and were tested for inclusion in each of the models. These characteristics, which included a range of knowledge, attitudes, beliefs and behaviours, were also identified in the conceptual model as potential moderators to use and impact of menu labelling. Secondary covariates were tested using a stepwise forward selection technique. Stepwise selection begins by including the variable with the smallest probability for the test statistic that meets the entry criteria. Subsequent variables are added that meet the entry criteria, and variables are removed if the test statistic becomes larger than the criteria for removal, until there are no more variables that meet the criteria for inclusion or exclusion in the model. For linear models, entry and elimination were based on the probability of the *F* statistic. For logistic regression, entry was based on the significance of the score statistic, and removal was based on the probability of the likelihood ratio statistic based on the maximum partial likelihood estimations. For all models, the criteria for entry and elimination were a based on a

probability level of 0.05. Stepwise selection allows for examination of variables that independently predict the outcome of interest while eliminating variables that do not significantly contribute to the overall prediction; however, the technique is also limited in that it only allows for examination of these variables in combination with other variables in the model and does not examine independent associations.[174]

Secondary predictor covariates to be tested include frequency of eating outside the home (never, less than once per week, once per week, two or three times per week, or four or more times per week), having tried to eat healthy food items when eating outside of the home in the past month (no or yes), estimation of the estimated energy requirements (EER) for adults between 1550-3000 kcal (incorrect or correct), general health (poor, fair, good, very good, or excellent), dieting behaviour in the past year (no or yes), perceived weight (overweight, underweight, or just about right), and engagement in moderate to vigorous physical activity (zero days, one day, two to three days, four days or more, or every day). 'Correct' estimates for the estimated energy requirements were in line with the upper and lower amounts for the ages and sex of participants from Canada's Food Guide.[175]

Goodness-of-fit for logistic regression models were tested using the Hosmer-Lemeshow test, and models were considered a good fit if the significance level of the test was greater than 0.05. For model checking of linear regression models, Q-Q plots of the model residuals were visually examined for normal distribution to check that the distributional assumption was met. When assumptions were not met, transformations were tested and the results and implications are discussed.

3.6.1 Hypotheses

Hypothesis 1a:

i) Calories will be most salient to participants, whereby participants will be most likely to notice calorie information. Few participants will notice the health logo on menus.

ii) In Wave 1, participants at the Civic cafeteria will be more likely to notice menu labelling than participants at the General cafeteria.

iii) At the General cafeteria, participants in Wave 2 will be more likely to notice menu labelling than in Wave 1. At the Civic cafeteria, participants will be less likely to notice menu labelling in Wave 2 than in Wave 1, due to the addition of advertisements to the digital menu board screens. The increase in noticing menu labelling between Wave 1 and Wave 2 will be greater at the General cafeteria compared to difference between Wave 1 and 2 at Civic cafeteria.

iv) There will be a sustained increase in noticing of menu labelling at the General cafeteria from Wave 1 to Wave 3 compared to the changes in noticing at the Civic cafeteria. There will be no significant differences in noticing menu labelling between Wave 2 and Wave 3 at either site.

v) When comparing intervention mode, participants will be more likely to notice menu labelling when they are exposed to menu labelling on digital menu boards with no advertisements, compared to when they are exposed to paper signage or digital menu boards with rotating advertisements.

Hypothesis 1b:

i) Noticing menu labelling will be greatest among women, those with high socio-economic status, younger participants, those who were White, and those who read nutrition labels more frequently when shopping for food.

Descriptive statistics were conducted to examine what proportion of participants noticed each of the nutrients listed on the menu boards (calories, sodium, saturated fat, total fat and the health logo). Descriptive analysis also examined the most common behaviours associated with the influence that the nutrition information had on food choice (selected items with less calories, fat, saturated fat and sodium, or more calories, fat, saturated fat and sodium, selected or avoided

health logo, or other influences), and which type of information influenced their meal choice more than others.

A binary logistic regression was conducted using "noticing" as the outcome variable (0=did not notice labelling, 1=noticed labelling) including the standard set of covariates, and tested for other significant secondary covariates using stepwise selection. Differences between sites over time were examined using a wave by site interaction variable, and effect coding was used to examine specific contrasts within the interaction variable. The model was conducted among all participants. To test for differences in the influence of variables over time and between sites, separate models tested two-way interactions between wave and model covariates, and site and model covariates by entering each interaction into the model individually. Three-way interactions between wave and site and model covariates were also entered into the model individually to test for significance.

Hypothesis 2a:

i) In Wave 1, participants at the Civic cafeteria will be more likely to use menu labelling than participants at the General cafeteria.

ii) At the General cafeteria, participants in Wave 2 will be more likely to use menu labelling than in Wave 1, while at the Civic cafeteria, participants will be less likely to use menu labelling in Wave 2 than in Wave 1. There will be a greater increase in use of menu labelling between Wave 1 and Wave 2 at the General cafeteria compared to the difference at the Civic cafeteria.

iii) There will be a sustained increase in the use of menu labelling from Wave 1 to Wave 3 at the General cafeteria compared to the changes in use of information at the Civic cafeteria. There will be no significant differences in the proportion of consumers who use menu labelling between Wave 2 and Wave 3 at either site.

iv) Among participants who notice menu labelling, there will be no difference in the proportion of consumers who use menu labelling between any of the sites or waves.

v) When comparing the intervention modes, participants will be more likely to use menu labelling when they are exposed to menu labelling on digital menu boards with no advertisements, compared to when they are exposed to paper signage or digital menu boards with rotating advertisements. When conducted among only those who noticed menu labelling, there will be no difference in the proportion of those who use menu labelling between intervention modes.

vi) The most common influence of menu labelling will be to select fewer calories.

Hypothesis 2b:

i) Among the entire sample, the use of menu labelling will be greatest among women, those with higher socioeconomic status, and those who use nutrition labels more frequently when shopping for food. The results will be similar among those who noticed menu labelling.

A binary logistic regression was conducted with "use" as the outcome variable (0=did not use labelling, 1=used labelling) including the standard set of covariates, and stepwise selection testing for secondary covariates. Differences between sites over time were examined using a wave by site interaction variable, and effect coding was used to examine specific contrasts within the interaction variable. The model was conducted among all participants. As a reminder, only those who noticed information were asked if they had used that information. Thus, a separate model was conducted among only those who noticed menu labelling, using the same covariates as above. To test for differences in the influence of variables over time and between sites, a separate model tested two-way interactions between wave and model covariates, and site and model covariates by entering each interaction into the model individually. Three-way interactions between wave and site and model covariates were also entered into the model individually to test for significance.

Hypothesis 3a:

i) In Wave 1, participants at the Civic cafeteria will purchase fewer calories, and less sodium, saturated fat and total fat than those at the General cafeteria.

ii) There will be a greater decrease in purchasing of calorie, sodium, saturated fat and total fat from Wave 1 to 2 at the General cafeteria than at the Civic cafeteria.

iii) There will be a sustained effect of menu labelling on calories and nutrients purchased from Wave 1 to Wave 3 at the General cafeteria compared to the changes at the Civic cafeteria. The decrease in purchasing of calories, sodium, saturated fat and total fat will remain stable at the General cafeteria and at the Civic cafeteria from Wave 2 to Wave 3.

Hypothesis 3b:

i) Those who reported using nutrition labelling will purchase fewer calories than those who do not report using nutrition labelling. There will be no difference in calories purchased among those who notice and do not notice nutrition labelling.

ii) The intervention will be more effective among women, those with higher socioeconomic status, those who use nutrition labels more frequently when shopping for food, and those who rated nutrition as more important.

To examine *Hypothesis 3a and b*, four linear regression models were generated with outcomes of calories, sodium, saturated fat and total fat purchased. Models included the standard set of covariates and stepwise selection tested for inclusion of secondary predictor covariates. A wave by site interaction term was included to test for differences between and within sites over time, using effect coding to examine specific contrasts within the interaction.

To test *Hypothesis 3bi*, the same models were conducted including the covariates identified in the previous analysis step, but excluded variables for site and wave. One model included a variable

for noticing menu labelling, and a second model included a variable for use of menu labelling, to test for the effect of noticing and use of nutrition labelling on calorie consumption.

For *Hypothesis 3bii*, the same models were repeated with interaction terms combining each covariate with wave, and each covariate and site, as well as 3-way interaction terms for each covariate with wave and site. Only significant results for three-way interaction terms are described.

Hypothesis 4a:

i) There will be a greater increase in the number of correct estimates of the calorie content of the entire meal, food and drink items from Wave 1 to Wave 2 and from Wave 1 to Wave 3 at the General cafeteria compared to the Civic cafeteria.

ii) Participants' accuracy in estimations of the entire meal will have a greater improvement from Wave 1 to Wave 2 and from Wave 1 to Wave 3 at the General cafeteria compared to the Civic cafeteria.

iii) There will be a greater decrease in gross underestimation at the General cafeteria from Wave 1 to Wave 2 and Wave 3, compared to the change in gross underestimation at the Civic cafeteria.

Hypothesis 4b:

i) Participants who reported having noticed menu labelling will be more likely to correctly estimate calorie content than those who did not notice, as will females, those with higher socioeconomic status and those who knew the estimated energy requirements for calorie intake.

Analyses were conducted for the entire meal, as well as for food items and drink items separately. Accuracy scores for calorie estimation were calculated by subtracting the actual

calorie content from the participant-estimated calorie content. Descriptive statistics were used to examine the proportion of participants who accurately estimated calorie content ±50 kcal of the correct response, as well as the magnitude of over and underestimation for the entire meal by dividing the number of calories that were over and under-estimated by the number of calories in the entire meal.

Logistic regression models were generated using the outcome of "correct estimation within ±50 kcal" (0=incorrect, 1=correct) and were conducted for the entire meal, food items, and drink items, separately. Those who did not provide an estimate were coded as incorrect. The model included the standard set of covariates and secondary covariates identified using stepwise selection, and included indicator variables for site, wave and a wave by site interaction to examine differences between and within sites over time, as well as a continuous variable for the total number of calories purchased for the meal, food items, or drink items, respectively. The model was conducted among Wave 1 and Wave 2 participants only (n=1,844) and across all 3 waves (n=2,781). The same model was also conducted including three way interactions between wave, site and the independent covariates to examine differences in the impact of the intervention between population sub-groups. A separate model examined differences in correct estimation among subgroups, and included the same covariates as the previous model and also included a covariate for noticing nutrition information.

In line with previous research that suggests that consumers substantially underestimate calorie content of menu items, a logistic regression model was conducted using "gross underestimation" as the outcome (0=did not grossly underestimate, 1=grossly underestimated). Gross underestimation was defined as any underestimation greater than 50% less than the calorie content of the meal. The model adjusted for standard covariates and testing for inclusion of secondary covariates using stepwise selection as well as total calories purchased. This analysis was conducted for the entire meal only.

Finally, a linear regression model was generated using the absolute value of under or over-estimation as the outcome variable, including standard covariates and testing for secondary

covariates. If the test statistic was negative, this would suggest that accuracy of estimation had improved because the difference between the absolute value and the estimated value was getting smaller. Testing for removal of outliers for estimated calories that were greater than 3000 kcal was conducted to examine their influence on model fit, similar to previous research in the area.[40] This analysis was conducted for the entire meal only.

4.0 RESULTS

4.1 Sample characteristics

Participant's demographic data, health behaviour information, and nutrition ratings were collected via self-report.

4.1.1 Primary socio-demographic characteristics

Table 2 describes the socio-economic and demographic characteristics of the sample that are included in all models as the standard covariates, stratified by wave and site. The majority of participants were hospital staff, and had completed college or university; nearly half of the sample had an annual income of more than $80,000. Most of the sample was White (79%), slightly more than half of the sample was female, and around one-third were less than 35 years while one-third were more than 55 years. The majority of the sample (55%) were living with overweight or obesity, and more than half the participants usually or always looked at nutrition information when shopping for food.

There were significant differences between waves within sites and between sites within waves for several of the variables, as denoted in superscript letters in Table 2. Specifically, there were significant differences between waves at the Civic cafeteria in the type of consumer, the frequency of visiting the cafeteria, the age and ethnicity of participants, BMI, and use of nutrition labels. There were significant differences between waves at the General cafeteria in the consumer type, annual household income, and ethnicity. Notably, there were fewer staff in successive waves at the Civic cafeteria, and more staff in successive waves at the General cafeteria. There was an increase in low income respondents at the Civic cafeteria in Wave 3 compared to Wave 1, while there was an increase in high income respondents over the same period at General cafeteria. There were greater proportions of White participants in Wave 2 and 3 than Wave 1.

There were also significant differences in the samples between sites in Wave 1 by annual household income and ethnicity, in Wave 2 by the use of nutrition labels when shopping for food, and in Wave 3 by the type of consumer, frequency of visiting the cafeteria, participant age, and BMI. There were no significant differences in gender or education between waves or sites.

TABLE 2. Sample characteristics of exit survey participants stratified by site and wave (N=3061) %(n)

	Civic			General				
	Wave 1 (n=489)	**Wave 2 (n=488)**	**Wave 3 (n=507)**	**Wave 1 (n=491)**	**Wave 2 (n=550)**	**Wave 3 (n=536)**	**X^2**	**p-value**
Consumer type [a b e]								
Staff/Medical Student	57.5 (281)	56.4 (275)	47.9 (243)	53.4 (262)	51.3 (282)	61.2 (328)	[a]: 79.2	<0.001
Visitor	28.6 (140)	34.2 (167)	38.1 (193)	31.0 (152)	36.7 (202)	25.6 (137)	[b]:54.6	<0.001
Out- or In-patient	7.8 (38)	9.2 (45)	14.0 (71)	10.2 (50)	11.3 (62)	12.7 (68)	[e]:24.4	<0.001
Not reported	6.1 (30)	0.2 (1)	0.0 (0)	5.5 (27)	0.7 (4)	0.6 (3)		
Frequency of visiting the cafeteria [a e]								
Never	27.4 (134)	24.6 (120)	29.6 (150)	24.2 (119)	20.9 (115)	21.3 (114)	[a]:16.6	0.035
Less than once per week	19.6 (96)	23.8 (116)	26.0 (132)	21.4 (105)	27.1 (149)	25.7 (138)	[e]:13.2	0.01
Once per week	17.2 (84)	16.6 (81)	15.2 (77)	14.5 (71)	14.2 (78)	16.4 (88)		
2-3 times per week	20.9 (102)	24.0 (117)	19.9 (101)	22.0 (108)	23.8 (131)	22.6 (121)		
4 or more times per week	14.9 (73)	11.1 (54)	9.3 (47)	17.9 (88)	14.0 (77)	14.0 (75)		
Gender								
Male	41.9 (205)	40.8 (199)	41.4 (210)	39.5 (194)	40.5 (223)	41.2 (221)		
Female	58.1 (284)	59.2 (293)	58.6 (297)	60.5 (297)	59.5 (327)	58.8 (315)		
Age [a e]								
18-34 years old	30.5 (149)	27.0 (132)	25.8 (131)	30.5 (150)	32.0 (176)	34.7 (186)	[a]:15.8	0.015
35-44 years old	15.3 (75)	16.8 (82)	19.1 (97)	18.7 (92)	17.3 (95)	17.2 (92)	[e]:12.4	0.006
45-54 years old	28.4 (139)	25.0 (122)	20.9 (106)	22.8 (114)	20.7 (114)	21.6 (116)		
55+years old	25.8 (126)	31.1 (152)	34.1 (173)	27.9 (137)	30.0 (165)	26.5 (142)		
Education level								
High school or less	13.5 (66)	14.1 (69)	14.2 (72)	14.9 (73)	13.6 (75)	12.9 (69)		
Some college or university	9.6 (47)	7.8 (38)	10.3 (52)	11.0 (54)	9.8 (54)	9.9 (53)		
Completed college or university	56.0 (274)	56.6 (276)	49.7 (252)	52.3 (257)	52.4 (288)	49.3 (264)		
Graduate or professional school	20.9 (102)	21.5 (105)	25.8 (131)	21.8 (107)	24.2 (133)	28.0 (150)		

a indicates significant differences between waves at Civic at a significance level $p<0.05$
b indicates significant differences between waves at General at a significance level $p<0.05$
c indicates differences within Wave 1 between sites at a significance level $p<0.05$
d indicates differences within Wave 2 between sites at a significance level $p<0.05$
e indicates differences within Wave 3 between sites at a significance level $p<0.05$

TABLE 2 (continued). Sample characteristics of exit survey participants stratified by site and wave (N=3,061) %(n)

	Civic			General				
	Wave 1 (n=489)	**Wave 2 (n=488)**	**Wave 3 (n=507)**	**Wave 1 (n=491)**	**Wave 2 (n=550)**	**Wave 3 (n=536)**	**X^2**	**p-value**
Income level [b c]								
$0-$40,000	12.9 (63)	14.8 (72)	16.8 (85)	17.5 (86)	16.0 (88)	19.2 (103)	[b]:25.2	<0.001
$40-80,000	26.6 (130)	32.0 (156)	30.2 (153)	27.9 (137)	29.1 (160)	24.6 (132)	[c]:11.6	0.009
$80,000 +	48.7 (238)	43.4 (212)	46.0 (233)	38.9 (191)	40.9 (225)	48.5 (260)		
Not reported	11.9 (58)	9.8 (48)	7.1 (36)	15.7 (77)	14.0 (77)	7.6 (41)		
Ethnicity [a b]								
White	76.3 (373)	83.0 (405)	80.9 (410)	74.3 (365)	80.0 (440)	81.2 (435)	[a]:7.2	0.027
Other	23.7 (116)	17.0 (83)	19.1 (97)	25.7 (126)	20.0 (110)	18.8 (101)	[b]:8.0	0.018
Body Mass Index [a e]								
Underweight (BMI <18.5)	1.6 (8)	1.0 (5)	1.2 (6)	3.1 (15)	1.3 (7)	2.1 (11)	[a]:21.6	0.006
Normal Weight (BMI 18.5-24.9)	36.2 (177)	37.5 (183)	37.5 (190)	36.9 (181)	39.8 (219)	42.7 (229)	[e]:14.5	0.006
Overweight (BMI 25.0-29.9)	32.3 (158)	34.8 (170)	34.7 (176)	31.8 (156)	33.6 (185)	32.8 (176)		
Obese (BMI 30 +)	20.4 (100)	21.7 (106)	23.7 (120)	18.1 (89)	17.3 (95)	16.6 (89)		
Not reported	9.4 (46)	4.9 (24)	3.0 (15)	10.2 (50)	8.0 (44)	5.8 (31)		
Label use [a d]								
Never	14.5 (71)	13.5 (66)	18.5 (94)	13.4 (66)	17.8 (98)	14.0 (75)	[a]:13.5	0.036
Sometimes	27.2 (133)	26.4 (129)	28.2 (143)	25.9 (127)	23.1 (127)	26.1 (140)	[d]:15.4	0.001
Usually	23.9 (117)	19.3 (94)	21.7 (110	23.8 (117)	26.7 (147)	23.7 (127)		
Always	34.4 (168)	40.8 (203)	31.6 (160)	36.9 (181)	32.4 (178)	36.2 (194)		

a indicates significant differences between waves at Civic at a significance level p<0.05
b indicates significant differences between waves at General at a significance level p<0.05
c indicates differences within Wave 1 between sites at a significance level p<0.05.
d indicates differences within Wave 2 between sites at a significance level p<0.05
e indicates differences within Wave 3 between sites at a significance level p<0.05

4.1.2 Secondary behavioural characteristics and attributes

Table A1 in Appendix 2 outlines the proportion of participants with each of the behavioural characteristics that were tested as secondary covariates in all of the models, stratified by wave and site, and the results are summarized below.

Eating behaviours

Of the entire sample, approximately one-third ate outside the home once per week or more, and the vast majority (78.9%) indicated that they had tried to make healthy choices when eating out in the previous month.

Weight perceptions and dieting

Almost one-third of the sample had engaged in some form of dieting in the past year. Of the entire sample, just less than half (46.7%) considered themselves overweight, and about half considered themselves 'about the right weight'.

Health-related measures

When asked to report their general health, 38.8% of participants were in 'good' health, and 42.1% were 'very good' or 'excellent' health. Of the sample, 11.3% were not active for 30 minutes per week, and almost half of the sample (48.7%) reported that they engaged in moderate or vigorous physical activity at least 4 days per week.

Knowledge of calorie recommendations

Around half of participants (52.2%) correctly stated the estimated energy requirement for calories to be somewhere between 1550 kcal and 3000 kcal. Estimates ranged from 3 to 30,000 kcal; the median response was 1800 kcal, and the mode was 2000 kcal. Of those who estimated (n=2,687), 38.3% underestimated (fewer than 1550 kcal) and 2.2% overestimated (more than 3000 kcal); 12.2% of the entire sample declared that they did not know and did not provide an estimate.

4.1.3 Type of meal consumed

In Waves 2 and 3, participants were asked if they considered their meal to be breakfast, lunch, dinner, a snack or another type of meal. This question was not asked in Wave 1, and therefore data are not available. Across Waves 2 and 3, the majority of the participants had purchased lunch (64.4%), followed by dinner (16.8%), a snack (11.7%), breakfast (5.9%), and other meals (1.2%). Commonly reported 'other' occasions included brunch, or a combination of meals. A breakdown of the meal type in Waves 2 and 3 can be found in Table 3. There were no significant differences between sites in Wave 2; however, there were significant differences between sites in Wave 3, with a greater proportion of participants who consumed breakfast and lunch, and fewer who consumed dinner or snacks, at the General cafeteria ($X^2_{(df=1)}$=10.95, p=0.027). There were significant differences between waves at the Civic cafeteria, with a higher proportion consuming lunch in Wave 3 ($X^2_{(df=2)}$=10.58, p=0.032), and at the General cafeteria with a greater proportion of participants consuming lunch in Wave 3, and fewer consuming snacks ($X^2_{(df=2)}$=14.06, p=0.007).

TABLE 3. Type of meal consumed by exit survey participants in Wave 2 and 3* (n=2,081) %(n)

	Civic		**General**	
	Wave 2 (n=488)	**Wave 3 (n=507)**	**Wave 2 (n=550)**	**Wave 3 (n=536)**
Breakfast	7.6 (37)	3.7 (19)	4.9 (27)	6.9 (37)
Lunch	60.7 (296)	65.5 (332)	61.1 (336)	69.4 (372)
Dinner	19.7 (96)	16.4 (83)	17.3 (96)	13.8 (74)
Snack	10.0 (49)	13.0 (66)	14.5 (80)	9.0 (48)
Other	2.0 (10)	1.4 (7)	2.2 (12)	0.9 (5)

*Data not available for Wave 1

4.1.4 Dietary needs of participants

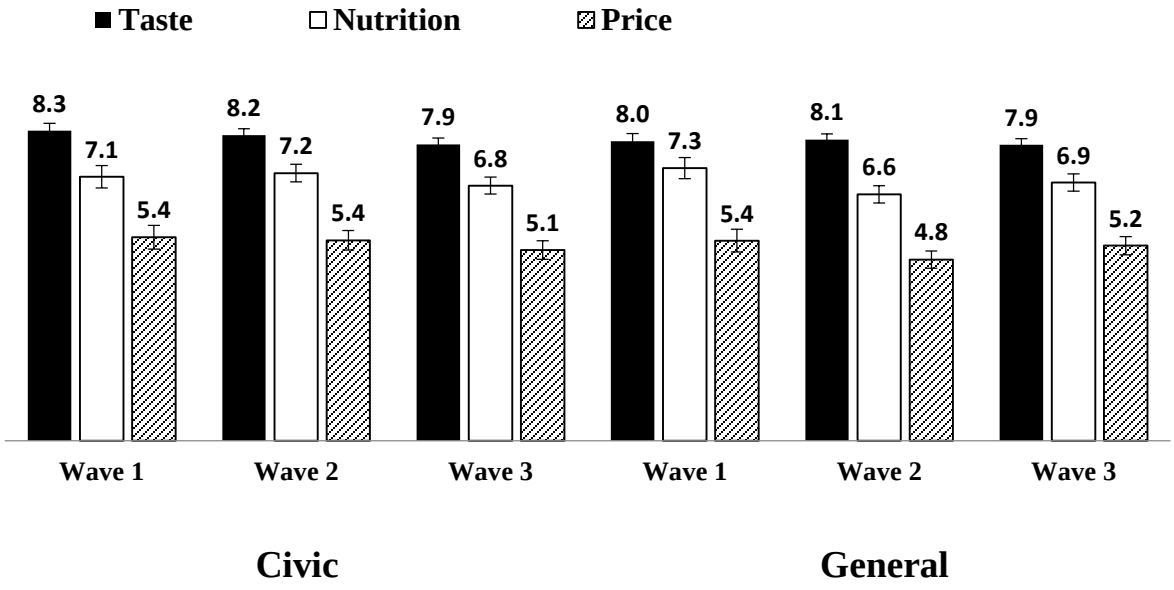
In Waves 1 and 2, participants were asked if they had any special dietary needs, such as allergies, diabetes, hypertension or other conditions related to diet. The question was not asked in Wave 3,

and therefore data are not available. Approximately 21.5% of the sample in Wave 1 and Wave 2 had dietary needs, which did not change significantly between waves.

4.1.5 Relative importance of factors related to food choices

Participants were asked the relative importance of taste, price and nutrition regarding their purchase in the cafeteria using a Likert scale of 1 to 10. Figure 15 shows the importance of each of these factors by wave and site. There was a reduced sample size in Wave 1, due to a technical error in which the first 322 participants were not asked the question.

FIGURE 15. The rated importance of taste, nutrition and price in participants' food choices using a Likert scale of 'not at all important' (0) to 'very important' (10) (n=2,736). Data are presented as means ± SEM.



Across sites and waves, taste was the most important factor for participants in selecting their food item, followed by nutrition and price. There were significant differences between waves in the ratings of importance for taste ($F_{(df=2)}$=3.85, p=0.022), but not for nutrition ($F_{(df=2)}$=2.82, p=0.060) or price ($F_{(df=2)}$=2.63, p=0.072). There were no significant differences between sites for taste ($F_{(df=1)}$=2.59, p=0.11), nutrition ($F_{(df=1)}$=1.36, p=0.24), or price ($F_{(df=1)}$=2.59, p=0.11).

4.1.6 Previous participation in and awareness of the survey

In Wave 2, 8.0% of the sample reported that they had taken part in the study in the past, and in Wave 3, 10.6% reported that they had taken part in the past. When asked if they were aware of the study before they participated in it, 17.2% reported that they were aware of the study in Wave 1, 23.9% in Wave 2, and 31.4% in Wave 3.

4.2 Noticing of menu labelling

4.2.1 Self-reported noticing of menu labelling

Figure 16 displays the raw proportion of participants who noticed any form of nutrition information in the cafeteria in each wave. Significance of trends are discussed in the analysis throughout the section.

FIGURE 16. Proportion of participants who reported that they noticed nutrition information at each wave (N=3,061)

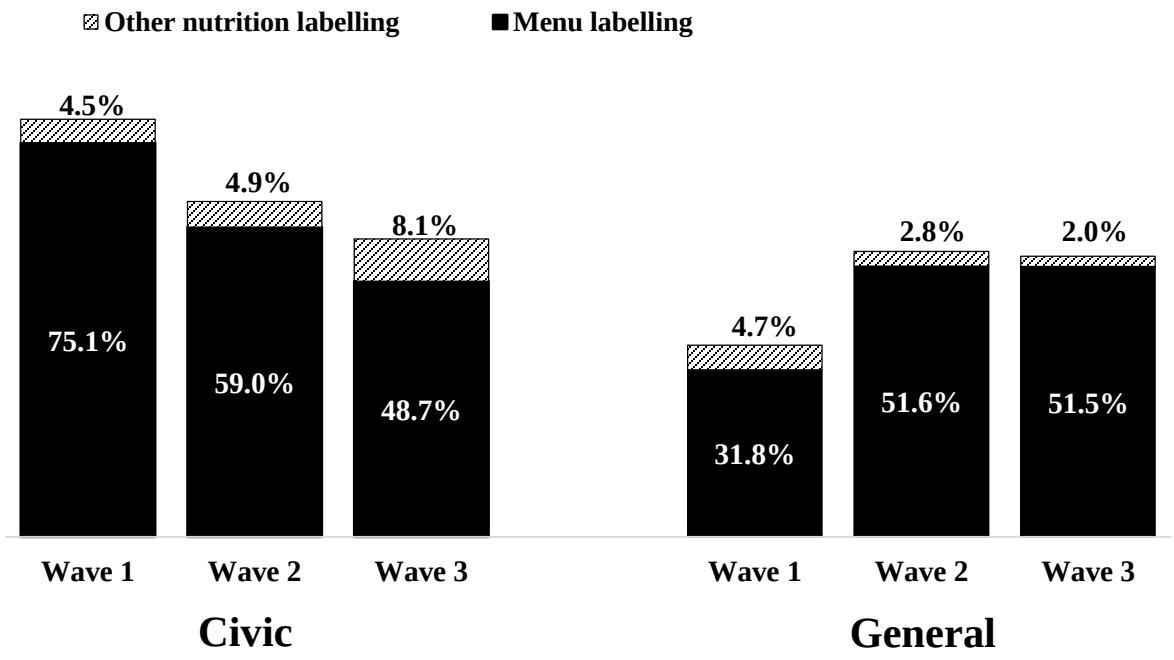


Table 4 shows the location within the cafeteria where participants noticed nutrition information. Participants were considered to have noticed menu labelling specifically if they noticed nutrition information either on the digital menu board or on a sign, as these were the only responses in which nutrition information was posted immediately next to the food items. In Wave 1, the most commonly recalled location for nutrition information was on a digital menu board at the Civic cafeteria (72.8%) and on a sign at the General cafeteria (31.7%). In Waves 2 and 3, the most

commonly recalled nutrition information was on digital menu boards at both Civic and General cafeterias.

TABLE 4. Location where nutrition information was noticed by participants (N= 3,061)* %(n)

	Wave 1		Wave 2		Wave 3	
	Civic	**General**	**Civic**	**General**	**Civic**	**General**
Digital menu board	72.8 (356)	0.0 (0)	57.2 (279)	50.4 (277)	46.9 (238)	46.6 (250)
On a sign	2.9 (14)	31.8 (156)	2.3 (11)	1.8 (10)	2.6 (13)	3.0 (32)
Entrance to cafeteria	6.3 (31)	2.0 (10)	3.7 (18)	0.2 (1)	11.4 (58)	0.4 (2)
Food packaging / wrapper	0.4 (2)	1.2 (6)	0.6 (3)	1.1 (6)	1.6 (8)	2.1 (11)
Pamphlet	0.4 (2)	0.4 (2)	0.2 (1)	0.2 (1)	0.2 (1)	0.2 (1)
Other	0.4 (2)	1.8 (9)	1.4 (7)	2.7 (15)	1.6 (8)	0.9 (5)
Did not notice any nutrition information	20.4 (100)	63.5 (312)	36.1 (176)	54.4 (299)	43.2 (219)	53.5 (287)

*Participants could have noticed more than one location, and thus numbers do not necessarily align with Figure 16.

4.2.2 Types of nutrition information noticed

If participants reported that they had noticed any nutrition information from any source, they were then asked what types of nutrition information they had noticed. It was hypothesized that calories would be the nutrient that was noticed most frequently, and that few participants would notice the health logo (*Hypothesis 1ai*). Table 5 denotes the type of nutrition information that participants reported noticing. Overall, the most commonly recalled type of nutrition information was calories (39.4%), which was consistently most common across all waves and sites. The next most commonly noticed type of information was for sodium (25.5%), followed by fat (20.9%), and saturated fat (3.2%). Other common types of information that were reported from the sources of nutrition information included sugar or carbohydrates, serving size or portion size, *trans* fat, protein, ingredients, presence of gluten, and fibre, among others.

TABLE 5. Type of nutrition information noticed in the cafeteria by participants (N=3,061) %(n)

	Wave 1		Wave 2		Wave 3	
	Civic	General	Civic	General	Civic	General
Calories	51.3 (251)	22.8 (112)	42.8 (209)	41.5 (228)	36.9 (187)	41.0 (220)
Sodium	37.0 (181)	16.9 (83)	27.3 (133)	22.7 (125)	24.3 (123)	25.4 (136)
Fat (total)	33.3 (163)	11.9 (58)	22.5 (110)	19.1 (105)	18.9 (96)	20.1 (108)
Saturated fat	3.9 (19)	0.2 (1)	2.9 (14)	2.7 (15)	5.7 (29)	3.7 (20)
Health logo (apple icon)	6.5 (32)	0.0 (0)	3.9 (19)	4.7 (26)	4.9 (25)	2.2 (11)
Other	14.1 (69)	9.2 (45)	6.8 (33)	5.3 (29)	9.3 (47)	6.5 (35)
Did not notice any nutrition information	20.4 (100)	63.5 (312)	36.1 (176)	54.4 (299)	43.2 (219)	53.5 (287)

*Participants could have noticed more than one type of nutrition information, and thus numbers do not necessarily align with Figure 16.

4.2.3 Differences in noticing menu labelling between sites and over time

A logistic regression model was used to examine noticing of menu labelling, (1=noticed menu labelling, 0=did not notice menu labelling), adjusting for the standard set of covariates and testing for the inclusion of secondary covariates using stepwise selection among all participants (N=3,061). A wave by site interaction variable was included to examine trends between sites and over time, which were examined using contrasts within the interaction variable. The final model adjusted for all primary variables and knowledge of estimated energy requirements for calorie intake. Interactions between wave and the standard covariates, and site and the standard covariates, as well as three-way interactions between wave, site and the standard covariates were also tested in the model to examine if the influence of the variables changed over time or across sites among the population sub-groups. The full results from the logistic regression model can be found in Table 6.

TABLE 6. Logistic regression results examining the effect of a wave and site interaction and individual characteristics associated with self-reported noticing of menu labelling (N=3,061)

	Wald X^2	Odds ratio	95% CI	*p*-value
Wave	4.53			0.10
Site Civic vs. General	93.76			<0.001
Wave X Site interaction	107.6			<0.001
Wave 1 vs 2 at Civic cafeteria		0.48	0.36-0.64	<0.001*
Wave 1 vs 3 at Civic cafeteria		0.34	0.26-0.45	<0.001*
Wave 2 vs 3 at Civic cafeteria		0.71	0.55-0.92	0.01*
Wave 1 vs 2 at General cafeteria		2.46	1.88-3.21	<0.001*
Wave 1 vs 3 at General cafeteria		2.34	1.79-3.06	<0.001*
Wave 2 vs 3 at General cafeteria		0.95	0.74-1.22	0.69
Civic vs. General in Wave 1		0.14	0.11-0.19	<0.001*
Civic vs. General in Wave 2		0.72	0.56-0.94	0.01*
Civic vs. General in Wave 3		0.97	0.75-1.25	0.80
Difference in Δ between Wave 1 vs 2 at Civic vs General		5.15	3.49-7.59	<0.001*
Difference in Δ between Wave 1 vs 3 at Civic vs General		6.89	4.69-10.13	<0.001*
Difference in Δ between Wave 2 vs 3 at Civic vs General		1.34	0.93-1.92	0.12
Consumer type	23.14			<0.001
Staff/Medical Student vs. Visitor		0.67	0.54-0.83	<0.001*
Staff/Medical Student vs. Out- or In-patient		0.53	0.40-0.71	<0.001*
Staff/Medical Student vs. Not reported		0.83	0.47-1.46	0.52
Visitor vs. Out- or In-Patient		0.79	0.60-1.04	0.096
Visitor vs. Not reported		1.25	0.71-2.20	045
Out- or In-patient vs. Not reported		1.57	0.86-2.87	0.14
Frequency of visiting the cafeteria	17.60			0.001
Never vs. < once per week		1.19	0.94-1.50	0.15
Never vs. Once per week		1.24	0.94-1.63	0.14
Never vs. 2-3 times per week		1.62	1.25-2.10	<0.001*
Never vs. 4 or more times per week		1.63	1.22-2.14	0.001*
< once per week vs. Once per week		1.04	0.81-1.34	0.76
< once per week vs. 2-3 time per week		1.36	1.08-1.72	0.01*
< once per week vs. 4 or more times per week		1.37	1.05-1.79	0.022
Once per week vs. 2-3 times per week		1.31	1.02-1.69	0.037
Once per week vs.4 or more times per week		1.32	0.99-1.76	0.061
2-3 times per week vs. 4 or more times per week		1.01	0.77-1.31	0.97
Gender Female vs. Male	1.19			0.28
Age	28.66			<0.001
18-34 years old vs. 35-44 years old		0.80	0.62-1.01	0.062
18-34 years old vs.45-54 years old		0.73	0.58-0.92	0.008*

	Wald X^2	Odds ratio	95% CI	*p*-value
18-34 years old vs.55+ years old		0.55	0.44-0.68	<0.001*
35-44 years old vs. 45 – 54 years old		0.92	0.72-1.18	0.51
35-44 years old vs. 55+ years old		0.69	0.54-0.87	0.002*
45-54 years old vs. 55 years old		0.75	0.60-0.93	0.008*
Education level	10.33			0.016
High school or less vs. Some college or university		1.70	1.23-2.34	0.001*
High school or less vs. Completed college or university		1.23	0.96-1.57	0.11
High school or less vs. Graduate or professional school		1.20	0.90-1.59	0.22
Some college or university vs. Completed college or university		0.72	0.55-0.95	0.019*
Some college or university vs. Graduate or professional school		0.71	0.52-0.96	0.025*
Completed college or university vs. Graduate or professional school		0.98	0.80-1.19	0.81
Income level	18.53			<0.001
$0-$40,000 vs. $40-80,000		1.69	1.32-2.16	<0.001*
$0-$40,000 vs.$80,000 +		1.59	1.24-2.03	<0.001*
$0-$40,000 vs. Not reported		1.50	1.10-2.05	0.011*
$40-80,000 vs. $80,000 +		0.94	0.78-1.14	0.54
$0-$40,000 vs. Not reported		0.89	0.67-1.17	0.40
$80,000 + vs. Not reported		0.94	0.72-1.23	0.67
Ethnicity Other vs. White	0.20			0.66
Body Mass Index	5.32			.26
Label use	10.79			0.013
Never vs. Sometimes		1.24	0.96-1.59	0.096
Never vs. Usually		1.37	1.06-1.78	0.016*
Never vs. Always		1.48	1.16-1.88	0.002*
Sometimes vs. Usually		1.11	0.89-1.38	0.35
Sometimes vs. Always		1.19	0.98-1.46	0.081
Usually vs. Always		1.07	0.88-1.32	0.50
Knowledge of EER Incorrect vs. Correct	8.55	1.27	1.08-1.48	0.003

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

Differences between sites

It was hypothesized that participants at the Civic cafeteria would be more likely to notice menu labelling than at the General cafeteria in Wave 1 (*Hypothesis 1aii*). In Wave 1, those who were at

the General cafeteria were significantly less likely to notice nutrition information than those at the Civic cafeteria (OR=0.14, p<0.001). Participants were also significantly less likely to notice menu labelling at the General cafeteria in Wave 2 (OR=0.72, p=0.01), but not in Wave 3.

Differences in Wave 2

It was hypothesized that noticing menu labelling would be more likely in Wave 2 than Wave 1 at the General cafeteria, and less likely at the Civic cafeteria, and that there would be a greater increase at the General cafeteria compared to the change that occurred at the Civic cafeteria (*Hypothesis 1aiii*). Participants at the General cafeteria were significantly more likely to notice menu labelling in Wave 2 than in Wave 1 (OR=2.46, p<0.001), and participants at the Civic cafeteria were significantly less likely to notice menu labelling in Wave 2 than in Wave 1 (OR=0.48, p<0.001). The interaction was significant, suggesting that there was a significant difference between the change that occurred at the General cafeteria compared to the Civic cafeteria from Wave 1 to Wave 2 (OR-1.92, p<0.001).

Differences in Wave 3

Across all waves, it was hypothesized that there would be a greater increase in noticing at the General cafeteria compared to the changes in noticing at the Civic cafeteria, with no changes between Wave 2 and 3 at either site (*Hypothesis 1aiv*). There was a significant interaction between the change from Wave 1 to Wave 3 at the General cafeteria compared to the Civic cafeteria (OR=6.89, p<0.001). This was the result of a significant increase from Wave 1 to Wave 3 at the General cafeteria (OR=2.34, p<0.001), and a significant decrease in noticing menu labelling from Wave 1 to Wave 3 at the Civic cafeteria (OR=0.34, p<0.001). There was a significant decrease in noticing from Wave 2 to Wave 3 at the Civic cafeteria (OR=0.71, p=0.01), with no significant difference at the General cafeteria, and the difference between these changes was not statistically significant.

4.2.4 Differences in noticing menu labelling between population subgroups

It was hypothesized that noticing of menu labelling would be significantly higher among women, those with higher levels of education, younger participants, those of White ethnicity, and those

who read nutrition labels more frequently when shopping for food (*Hypothesis 1bi*). The results from the regression model in section 4.2.3 were used to examine which population sub-groups may be more likely to notice menu labelling (see Table 6, above). To summarize, type of consumer, frequency of visiting the cafeteria, age, education level, income level, frequency of label use when shopping for food, and knowledge of the estimated energy requirements were all significant in this model. Statistically significant individual contrasts can be found in Table 6. There were several general trends. Staff noticed menu labelling more often than patients and visitors. There were greater levels of noticing among those who visited the cafeteria more frequently compared to those who had never visited the cafeteria. Younger people generally noticed menu labelling more so than older participants, with the oldest age group the least likely to notice menu labelling. There was some trend towards greater noticing of menu labelling among those with higher education levels, and those who had the lowest levels of income were less likely than any other income group to notice menu labelling. Finally, those who usually or always using labels when shopping for food were more likely to notice menu labelling than those who never use labels. The only significant secondary covariate in the model was knowledge of recommended calorie intake, whereby those who knew the correct recommendation for daily calorie intake were more likely to notice nutrition labelling. There were no significant differences by gender, ethnicity, or BMI. Table 7 shows the proportion of participants that noticed menu labelling broken down by socio-demographic characteristics.

TABLE 7. Proportion of participants that noticed menu labelling by socio-demographic characteristics across all sites and waves (N=3,061) %(n)

	Noticed menu labelling % (*n)*
Consumer type	
Staff/Medical Student	61.8 (1033)
Visitor	43.4 (430)
Out- or In-patient	35.9 (120)
Not reported	53.8 (35)
Frequency of visiting the cafeteria	
Never	41.8 (314)
Less than once per week	49.3 (363)
Once per week	57.0 (273)
2-3 times per week	62.2 (423)

	Noticed menu labelling % (*n)*
4 or more times per week	59.2 (245)
Gender	
Male	51.6 (646)
Female	53.7 (972)
Age	
18-34 years old	59.8 (553)
35-44 years old	56.3 (300)
45-54 years old	54.9 (389)
55+years old	42.0 (376)
Education level	
High school or less	39.4 (167)
Some college or university	56.0 (167)
Completed college or university	54.3 (875)
Graduate or professional school	56.2 (409)
Income level	
$0-$40,000	41.9 (208)
$40-80,000	55.4 (481)
$80,000 +	56.3 (765)
Not reported	48.7 (164)
Ethnicity	
White	52.8 (1282)
Other	53.1 (336)
Body Mass Index	
Underweight (BMI <18.5)	40.4 (21)
Normal Weight (BMI 18.5-24.9)	53.4 (630)
Overweight (BMI 25.0-29.9)	53.2 (543)
Obese (BMI 30 +)	52.3 (313)
Not reported	52.9 (111)
Label use	
Never	44.5 (209)
Sometimes	52.8 (422)
Usually	54.8 (390)
Always	55.3 (597)

Interactions between wave and the standard covariates, and site and the standard covariates, as well as three-way interactions between wave, site and the standard covariates were also tested. No significant differences were found for either two-way or three-way interactions.

Influence of the importance of taste, price and nutrition on noticing menu labelling

It was also hypothesized that noticing would be higher among those who rate nutrition as more important in their food choice (*Hypothesis 1bi*). As a significant proportion of participants did not have this information in Wave 1 due to a technical error (n=332), this analysis was conducted

independently to maintain sample size. The regression model from section 4.2.3 was again conducted including continuous variables for the importance of taste, price and nutrition in making their food choices for this particular purchase. Neither nutrition (OR=1.02, 95% CI 0.99-1.05, p=0.29), nor taste (OR=1.00, 95% CI 0.95-1.04, p=0.84), nor price (OR= 1.01, 95% CI 0.98-1.04, p=0.60) were significant in the model.

4.2.5 Comparison of intervention mode on noticing menu labelling

After Wave 1 at the Civic cafeteria, 20-second rotating advertisements were added to the digital menu boards. It was hypothesized that the mode of delivering the menu labelling intervention would have a significant effect on the number of participants that noticed of the menu labelling, such that participants would be more likely to notice menu labelling when it was provided on digital menu boards with no advertisements (*Hypothesis 1av*). Logistic regression was conducted using the outcome of noticing menu labelling and including a three-level variable for "intervention mode", re-categorized as follows: 1=digital menu board with no advertisements (Civic, Wave 1), 2=paper signage (General, Wave 1), and 3=digital menu board with advertisements (Civic and General, Wave 2 and 3). The model adjusted for the standard covariates and knowledge of estimated energy requirements (N=3,061). Those who were exposed to digital menu boards with no advertisements were more likely to notice menu labelling than those who were exposed to paper signage (OR=7.14, 95% CI 5.26-9.09, p<0.001) and those who were exposed to digital menu boards with advertising (OR=2.70, 95% CI 2.04-3.45, p<0.001). Those exposed to digital menu boards with advertisements were also more likely to notice menu labelling than those who were exposed to paper signage (OR=2.63, 95% CI 2.08-3.23, p<0.001). Results of the logistic regressions analysis are available in Table A2 in Appendix 2.

4.2.6 Effect of meal type and special dietary needs on noticing menu labelling

Models were conducted to examine if the type of meal purchased or having special dietary needs were factors that influenced noticing of menu labelling.

Meal type

Exploratory analysis was conducted to examine if there were differences in noticing of menu labelling between the type of meal that was being ordered in Waves 2 and 3 only, as data were not available for Wave 1. A variable was added to the logistic regression model in section 4.2.3 for meal type (breakfast, lunch, dinner or snack/other), in Waves 2 and 3 participants (n=2,081). There was an overall significant effect of meal type ($X^2_{(df=4)}$ =22.95, p<0.001). Those who had purchased snacks were significantly less likely to notice menu labelling than those who were eating breakfast (OR=0.45, 95% CI 0.28-0.72, p<0.001), lunch (OR=0.50, 95% CI 0.37-0.67, p<0.001) and dinner (OR=0.49, 95% CI 0.34-0.70). When the same model was conducted excluding the variable for meal type, there were no changes in the significance trends for the wave by site interaction variable or in any of the covariates added to the model. The Results of the logistic regression model are available in Table A3 in Appendix 2.

Special dietary needs

The same model was conducted including a variable for special dietary needs or allergies among participants in Waves 1 and 2 only. The dietary needs variable was not significant in the model ($X^2_{(df=1)}$=0.52, p=0.47). When the dietary needs variable was removed from the model, there were no changes in the significance of the wave by site interaction variable, and the only standard covariate that became significant in the model was income, which changed from significance level of p=0.06 to p=0.041. The results of the logistic regression model including the dietary needs variable can be seen in Table A4 in Appendix 2.

4.3 Use of menu labelling

4.3.1 Self-reported use of menu labelling to inform food choices

If participants noticed nutrition information, they were then asked if that information influenced their food choice, and led them to purchase healthier foods. Figure 17 shows the proportion of participants at each wave and site that reported that they had used the information to guide their food choice among the entire sample, and Figure 18 shows the same proportion among those who noticed menu labelling only.

FIGURE 17. The proportion of participants that self-reported they had used menu labelling among the entire sample (N=3,061)

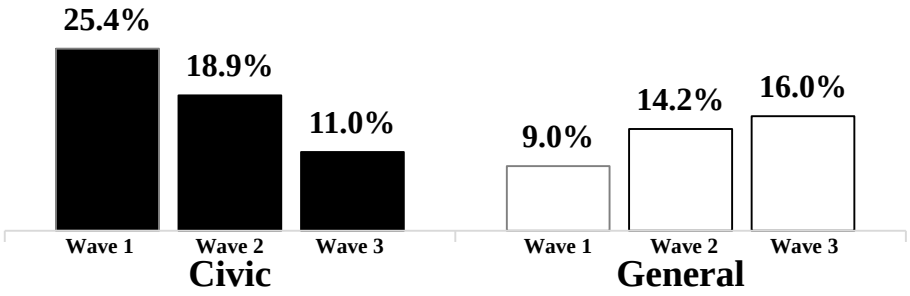
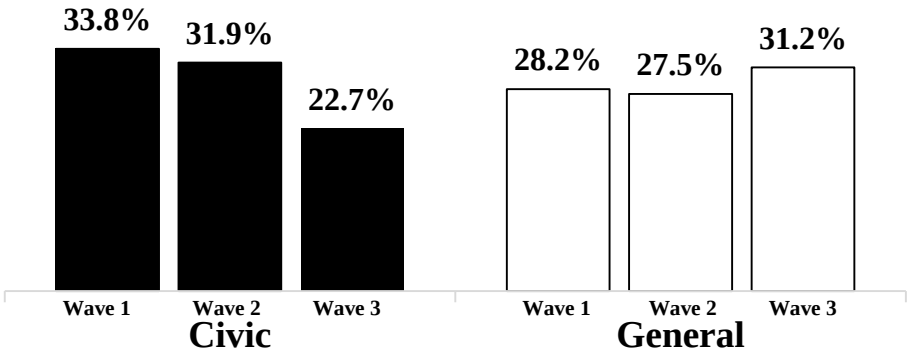


FIGURE 18. The proportion of participants that used menu labelling among those who noticed menu labelling (n=1,618)



4.3.2 Influence of menu labelling on nutritional quality of food choices.

Participants reported how the nutrition information had influenced their food choices. It was hypothesized that selecting fewer calories would be the most common influence of menu labelling (*Hypothesis 2avi*). Overall, 5.7% of the sample reported that they had selected items with less sodium, 5.4% selected fewer calories, 2.6% selected less fat, while 5.0% reported that they selected items that were generally 'healthier.' Less than 1% selected items that had more calories, fat or sodium. The results for all the various ways that the menu labelling influenced consumer decisions can be found in Table A5 in Appendix 2.

For participants that reported having noticed more than one nutrient, they were asked if any nutrient had influenced their decision more than others. Among these participants, calories was most frequently the most influential (30.2% of those who noticed more than one nutrient, 3.5% of the entire sample), followed by sodium (24.2% of those who noticed more than one nutrient, 2.8% of the entire sample), while 26.8% of those who noticed more than one nutrient considered all nutrients they noticed similarly (3.1% of the entire sample). The entire table reporting which nutrients were most influential among those who noticed multiple nutrients can be found in Table A6 in Appendix 2.

4.3.3 Differences in use of menu labelling between sites and over time

A logistic regression model was conducted among the entire sample, with "use" as the outcome variable (1=used menu labelling, 0=did not use menu labelling), and included indicator variables for wave and site, as well as a wave by site interaction variable, adjusting for standard covariates and testing for secondary covariates using forward stepwise selection among all participants (N=3,061). In this model, those who did not use menu labelling either 1) could have reported they did not notice menu labelling, 2) could have reported they noticed menu labelling and were no influenced by that information, or 3) could have reported that they didn't know if they used the menu labelling. There were no secondary covariates that were significant in the model. Interactions between wave and the standard covariates, or site and the standard covariates, as well as three-way interactions between wave, site and the standard covariates were tested in the

model to examine if the influence of the variables changed over time or across sites. There was a significant three-way interaction between wave, site and income, and the model presented includes this interaction. Full results from the logistic regression results available in Table 8.

TABLE 8. Logistic regression results examining the effect of a wave and site interaction and individual characteristics associated with self-reported use of menu labelling (N=3,061)

	Wald X^2	Odds ratio	95% CI	*p*-value
Wave	3.09			0.21
Site Civic vs. General	14.22			<0.001
Wave X Site interaction	19.32			<0.001
Wave 1 vs 2 at Civic cafeteria		0.66	0.44-1.00	0.051
Wave 1 vs 3 at Civic cafeteria		0.39	0.24-0.62	<0.001*
Wave 2 vs 3 at Civic cafeteria		0.58	0.36-0.96	0.03*
Wave 1 vs 2 at General cafeteria		1.77	1.10-2.83	0.02*
Wave 1 vs 3 at General cafeteria		1.66	1.01-2.75	0.047
Wave 2 vs 3 at General cafeteria		0.94	0.59-1.49	0.80
Civic vs. General in Wave 1		0.26	0.17-0.41	<0.001*
Civic vs. General in Wave 2		0.70	0.45-1.09	0.11
Civic vs. General in Wave 3		1.13	0.67-1.90	0.64
Difference in Δ between Wave 1 vs 2 at Civic vs General		2.66	1.43-4.95	0.002*
Difference in Δ between Wave 1 vs 3 at Civic vs General		4.29	2.18-8.47	<0.001*
Difference in Δ between Wave 2 vs 3 at Civic vs General		1.61	0.82-3.17	0.17
Consumer type	8.82			0.03
Staff/Medical Student vs. Visitor		0.68	0.50-0.92	0.01
Staff/Medical Student vs. Out- or In-patient		0.61	0.39-0.94	0.02
Staff/Medical Student vs. Not reported		1.11	0.56-2.21	0.77
Visitor vs. Out- or In-Patient		0.90	0.59-1.37	0.61
Visitor vs. Not reported		1.64	0.80-3.33	0.18
Out- or In-patient vs. Not reported		1.83	0.84-3.96	0.13
Frequency of visiting the cafeteria	2.30			0.68
Gender Female vs. Male	0.008			0.93
Age	4.05			0.26
Education level	6.73			0.08
Income level	4.64			0.20
Ethnicity Other vs. White	2.58			0.11

	Wald X^2	Odds ratio	95% CI	*p*-value
Body Mass Index	2.85			0.58
Label use	119.01			<0.001
Never vs. Sometimes		2.04	1.22-3.43	0.007*
Never vs. Usually		4.88	2.97-8.02	<0.001*
Never vs. Always		7.11	4.40-11.49	<0.001*
Sometimes vs. Usually		2.39	1.74-2.38	<0.001*
Sometimes vs. Always		3.48	2.61-4.65	<0.001*
Usually vs. Always		1.46	1.14-1.86	0.003*
Wave X Income	3.46			0.75
Site X Income	3.18			0.36
Wave X Site X Income	13.10	1.46	1.14-1.86	0.04

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

Differences between sites

It was hypothesized that participants in Wave 1 would be more likely to use menu labelling at the Civic cafeteria compared to the General cafeteria (*Hypothesis 2ai*). In Wave 1, those at the General cafeteria were significantly less likely to use menu labelling than those at the Civic cafeteria (OR=0.26, p<0.001). There were no significant differences in the use of menu labelling between sites in Wave 2 or Wave 3.

Differences in Wave 2

It was hypothesized that at the General cafeteria, participants in Wave 2 would be more likely to use menu labelling than in Wave 1, with greater changes between waves at the General cafeteria than the Civic cafeteria (*Hypothesis 2aii*). At the General cafeteria, participants were significantly more likely to use menu labelling in Wave 2 than in Wave 1 (OR=1.77, p=0.02). There was no change in the likelihood of using nutrition information at the Civic cafeteria from Wave 1 to Wave 2. The interaction was significant, suggesting that the difference between the change in use of menu labelling at the Civic cafeteria and the General cafeteria from Wave 1 to Wave 2 was statistically significant (OR=2.66, p=0.002).

Differences in Wave 3

It was hypothesized that there would be an increase in using nutrition information from Wave 1 to Wave 3 at the General cafeteria compared to the changes at the Civic cafeteria, and that there would be no significant changes from Wave 2 to Wave 3 at either cafeteria (*Hypothesis 2aiii*). There was no significant change at the General cafeteria from Wave 1 to Wave 3 after adjusting for demographic factors, and a significant decrease at the Civic cafeteria (OR=0.39, $p<0.001$). The interaction term was significant, suggesting that the difference in the change from Wave 1 to Wave 3 at the Civic compared to the General cafeteria was significant (OR=4.29, $p<0.001$). There was a significant decrease between Wave 2 and 3 at the Civic cafeteria (OR=0.58, $p=0.006$) with no significant change at the General cafeteria, and the interaction was not significant.

4.3.4 Differences in use of menu labelling between population subgroups

It was hypothesized that the use of menu labelling would be greatest among women, those with higher levels of education, and those who use nutrition labels more frequently when shopping for food, as well as those who stated that nutrition was more important for their food choice. This was hypothesized among the entire sample as well as among those who noticed menu labelling only (*Hypothesis 2bi*).

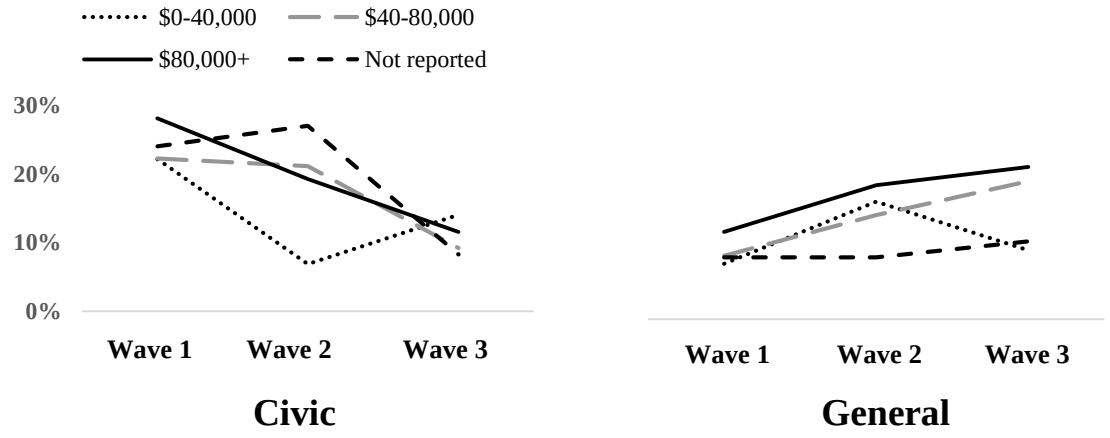
The results of the regression in section 4.3.3 were used to examine statistically significant differences between socio-demographic groups in the proportion that used menu labelling (see Table 8, above). After adjustment for multiple comparisons within variables using the Benjamini-Hochberg procedure, the only significant individual characteristic was the use of labels when shopping for food, in which greater frequency of label use when shopping was associated with higher use of menu labelling. Table 9 shows the proportion of participants that used menu labelling in each of the characteristics tested.

TABLE 9. Proportion of participants that used menu labelling by socio-demographic characteristics across all waves and sites (N=3,061) %(n)

	Used menu labelling
Consumer	
Staff/Medical Student	19.0 (317)
Visitor	11.7 (116)
Out- or In-patient	10.2 (34)
Not reported	20.0 (13)
Frequency of visiting the cafeteria	
Never	12.2 (92)
Less than once per week	14.3 (105)
Once per week	17.5 (84)
2-3 times per week	19.7 (134)
4 or more times per week	15.7 (65)
Gender	
Male	14.4 (180)
Female	16.6 (300)
Age	
18-34 years old	17.1 (158)
35-44 years old	17.4 (93)
45-54 years old	16.8 (119)
55+years old	12.3 (110)
Education level	
High school or less	9.9 (42)
Some college or university	14.4 (43)
Completed college or university	15.5 (249)
Graduate or professional school	20.1 (146)
Income level	
$0-$40,000	11.9 (59)
$40-80,000	15.1 (131)
$80,000 +	18.0 (244)
Not reported	13.6 (46)
Ethnicity	
White	17.9 (113)
Other	15.0 (367)
Body Mass Index	
Underweight (BMI <18.5)	13.5 (7)
Normal Weight (BMI 18.5-24.9)	17.2 (203)
Overweight (BMI 25.0-29.9)	15.1 (154)
Obese (BMI 30 +)	15.4 (92)
Not reported	11.4 (24)
Label use*	
Never	4.3 (20)
Sometimes	8.9 (71)
Usually	18.4 (131)
Always	23.9 (258)

Interactions between wave and the standard covariates, or site and the standard covariates, as well as three-way interactions between wave, were also tested. No significant differences were found for two-way interactions. There was a significant three-way interaction between wave, site and income, which is shown in Figure 19.

FIGURE 19. Differences in use of menu labelling among those in different income categories



There was a sharp decrease at the General cafeteria from Wave 2 to 3 in the lowest income group ($0 - $40,000) compared to an increase among those in the $40,000 to $80,000 annual income group, the $80,000+ income group, and those who refused to answer, which was the opposite of the trend at the Civic cafeteria ($p<0.05$ for all). The trends were not significantly different between Wave 1 and Wave 2 or Wave 1 and Wave 3 between any groups.

Influence of the importance of taste, price and nutrition on using menu labelling

Variables rating the importance of taste, price and nutrition were included as independent variables in the logistic regression model in Section 4.3.3. When these were included, those who rated nutrition as more important were more likely to use menu labelling (OR=1.33, 95% CI 1.25-1.41, $p<0.001$), and those who valued taste as more important were less likely to use menu labelling (OR=0.92, 95% CI 0.86-0.98, $p=0.009$). There was no significant effect of the ratings for the importance of price (OR=1.00, 95% CI 0.96-1.05, $p=0.80$).

4.3.5 Use of menu labelling among those who noticed menu labelling

It was hypothesized that there would be no significant differences in the proportion of participants that used menu labelling among those who noticed menu labelling between any waves or sites (*Hypothesis 2aiv*). The same model as Section 4.3.3 was conducted solely among those who noticed menu labelling, with "use" as the outcome variable (1=used menu labelling, 0=did not use menu labelling) (n=1,618). The results from the overall model across all waves and sites with the interaction variables are presented in Table 10. The wave by site interaction term was not significant (p=0.052), suggesting that there were no differences in use of menu labelling by wave or site among those who noticed menu labelling.

TABLE 10. Logistic regression results examining the effect of a wave and site interaction and individual characteristics associated with self-reported use of menu labelling among those who noticed menu labelling (n=1,618)

	Wald X^2	Odds ratio	95% CI	*p*-value
Wave	2.76			0.25
Site Civic vs. General	0.13			0.72
Wave * Site interaction	5.91			0.052
Consumer type	0.78			0.85
Frequency of visiting the cafeteria	2.84			0.59
Gender Female vs. Male	0.07			0.80
Age	1.06			0.79
Education level	3.48			0.32
Income level	1.98			0.58
Ethnicity Other vs. White	4.78	0.73	0.55-0.97	0.029
Body Mass Index	4.43			0.35
Label use	103.01			<0.001
Never vs. Sometimes		1.80	1.05-3.09	0.032*
Never vs. Usually		4.46	2.66-7.49	<0.001*
Never vs. Always		6.63	4.00-10.97	<0.001*
Sometimes vs. Usually		2.48	1.78-3.47	<0.001*
Sometimes vs. Always		3.68	2.70-5.01	<0.001*

	Wald X^2	Odds ratio	95% CI	*p*-value
Usually vs. Always		1.49	1.13-1.95	0.005*
Healthy decisions in the past month No vs. Yes	6.27	1.48	1.09-2.00	0.012

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

Differences between socio-demographic groups among those who noticed menu labelling

The results from the logistic regression model were used to examine individual correlates of menu labelling use among those who noticed menu labelling only (n=1,618) (see Table 10, above). Similar to the model among the entire sample, those who used food labels more frequently when shopping for food were more likely to use menu labelling (p<0.001). In this model, those who were not of White ethnicity were also more likely to use menu labelling, as were those who were trying to make healthy decisions when eating out of the home in the past month.

4.3.6 Effect of intervention mode on use of menu labelling

It was hypothesized that those who saw digital menu labelling with no advertisements would be more likely to use menu labelling among the entire sample, but this difference would not be significant among those who noticed menu labelling (*Hypothesis 2av*). A logistic regression was conducted with the outcome of "use" of menu labelling, including the three-level indicator variable for intervention mode (digital menu board with no advertisements, paper signage, or digital menu board with advertisements), adjusting for standard covariates and testing secondary covariates for inclusion using stepwise selection (N=3,061). Those who were exposed to digital menu boards with no advertisements were significantly more likely to use menu labelling than those exposed to paper signage (OR=3.85, 95% CI 2.56-5.56, p<0.001) and those exposed to digital menu boards with advertising (OR=1.96, 95% CI 1.52-2.50, p<0.001). Those who were exposed to digital menu boards with advertisements were also more likely to use menu labelling

than those who were exposed to paper signage (OR=1.96, 95% CI 1.37-2.78, p<0.001). Full logistic regression results for the model are available in Table A7 in Appendix 2.

When the same logistic regression model was run among only those who noticed nutrition information (n=1,618), there was no significant effect of label type on the proportion who used menu labelling ($X^2_{(df=2)}$=4.97, p=0.08). Full results for this logistic regression model are available in Table A8 in Appendix 2.

4.3.7 Effect of meal type and special dietary needs on use of menu labelling

Separate models were conducted to examine if the type of meal purchased or dietary needs were factors that influenced use of menu labelling.

Meal types

Exploratory analysis was conducted to examine if there were differences in the use of menu labelling between the types of meals that were purchased. The same model used in section 4.3.3 was conducted including an indicator variable for meal type (breakfast, lunch, dinner, snack, or other), adjusting for wave, site, the standard set of covariates among Wave 2 and 3 participants only. Due to small numbers in the 'not reported' category of consumer type, those with missing data for this variable were excluded for this analysis, and the sample size for the analysis was 2,073 participants. There was a significant effect of meal type ($X^2_{(df=4)}$ = 22.96, p<0.001). After adjusting for other variables, participants were more likely to use menu labelling at lunch than at snacks (OR=2.70, 95% CI 1.54-4.76, p<0.001) and more likely at dinner than at breakfast (OR=2.52, 95% CI 1.25-5.06, p=0.009) or snacks (OR=3.45, 95% CI 1.89-6.25, p<0.001). Full results for the logistic regression model are available in Table A9 in Appendix 2. When the same model was run with and without meal type, there were no differences in the significance level of the main predictors (wave, site, or the wave by site interaction) or any of the standard covariates in the model.

Special dietary needs

The same model used in section 4.3.3 was conducted with a variable for having special dietary needs among Wave 1 and Wave 2 participants only. There was no significant association between having a dietary need and using menu labelling ($X^2_{(df=1)} = 0.03$, p=0.87). When the same model was run with and without a variable for dietary needs, there were no differences in the significance level of the main predictors or any of the standard covariates included in the model. Full results for the logistic regression model are available in Table A10 in Appendix 2.

4.4 Meal purchases and nutrient outcomes

For the analysis of meal purchases, information that was sufficient to identify all the food and beverage items purchased was available for 90.9% of all participants (n=2,781). There were no significant differences in the proportion of those who provided complete nutrition information for food purchases between wave ($X^2_{(df=2)}$=1.69, p=0.43) or site ($X^2_{(df=1)}$=1.62, p=0.20). Females were more likely to provide sufficient information ($X^2_{(df=1)}$=7.62, p=0.006), as were those of White ethnicity ($X^2_{(df=1)}$=7.25, p=0.007) and those who use nutrition labels more often when shopping for food ($X^2_{(df=3)}$=9.34, p=0.025). There were no significant differences in the proportion of those who provided sufficient nutrition information between age groups ($X^2_{(df=3)}$=1.73, p=0.63), income level ($X^2_{(df=3)}$=0.97, p=0.81), education level ($X^2_{(df=3)}$=3.20, p=0.36), BMI ($X^2_{(df=4)}$=2.83, p=0.59), consumer type ($X^2_{(df=3)}$=1.29, p=0.73), or frequency of visiting the cafeteria ($X^2_{(df=4)}$=5.25, p=0.26).

4.4.1 Receipt analysis

In Wave 3 only, participants were asked to provide a receipt to verify the items they had purchased for that meal. A total of 83 participants (7.8% of the Wave 3 sample) provided receipts. This low response rate was expected, as most customers do not obtain a receipt for their purchase at the cafeterias, and participants had already disposed of food trays that may have contained receipts. Among those with a receipt, the majority of the receipts (81.2%) only contained items purchased for the participant, and 18.8% of receipts had items that had been purchased for others as well as the participants.

Matching between the receipt data and the self-report data was assessed by two independent raters, and when there was disagreement, the results were discussed until consensus between the two raters was reached. In 62.7% of cases, the receipts and self-report matched for all food and beverage items ordered. At times, the self-report did not include all information and assumptions were made in the nutritional analysis (e.g., if only the main item was reported, it was assumed that the side items that were listed on the menu that day were also ordered); when these assumptions were made, 72.3% of receipts and the data used in the nutritional analysis matched.

Of those receipts that were not matching, there was a fairly equal distribution of the direction of misreporting; 9.6% of receipts (n=8) had more items reported in the self-report, 8.4 %(n=7) had more items reported in the receipt, and 7.2% (n=6) had items that did not match at all. The proportion of unmatched receipts and self-reports was much higher (61.1%) among those participants who shared receipts with another individual compared to receipts for a single patron (15.4%), suggesting that the methodology of recording the receipt information for only those items that were for the participant may have been challenging when receipts included food items multiple people.

4.4.2 Proportion of meals consumed

Participants were asked if they finished their meal, and if not, what proportion they consumed, or if the item was take-out and would be consumed later. The results from the measures concerning self-reported consumption of meal items can be found in Figure 20 and 21.

FIGURE 20. The proportion of participants that reported they had finished their meal (n=2,781)

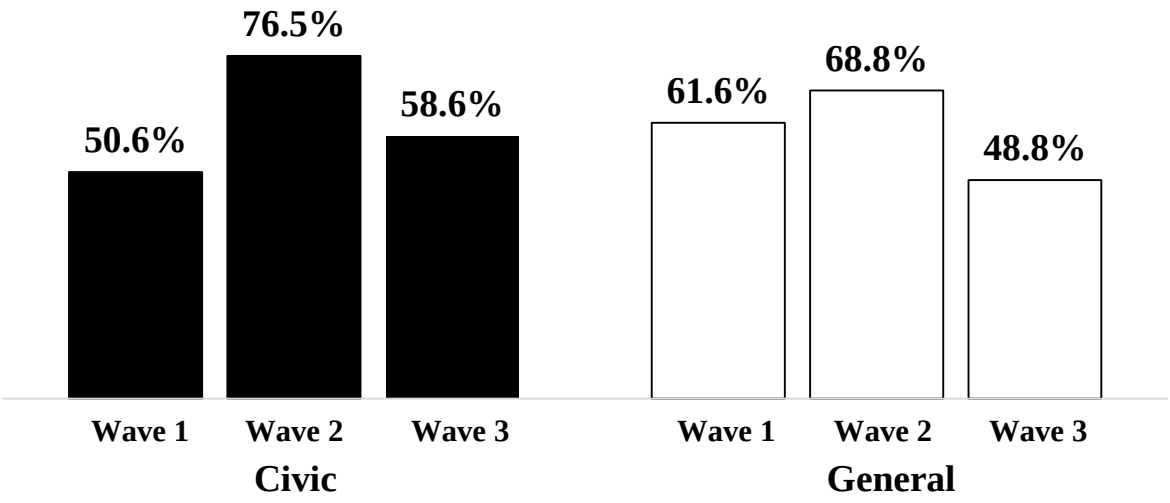
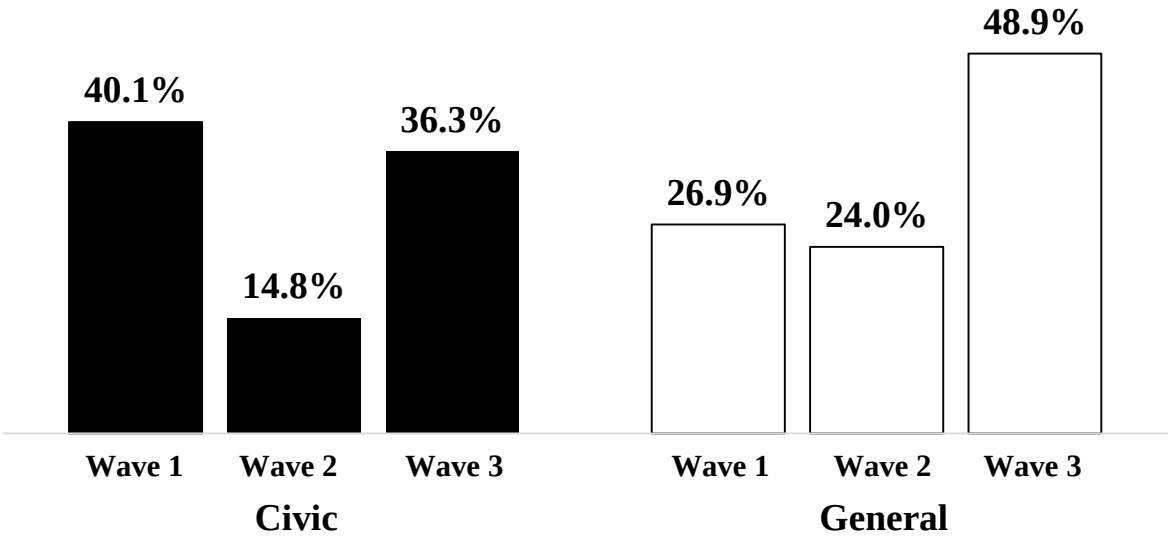


FIGURE 21. The proportion of participants that reported they had take-out (n=2,781)

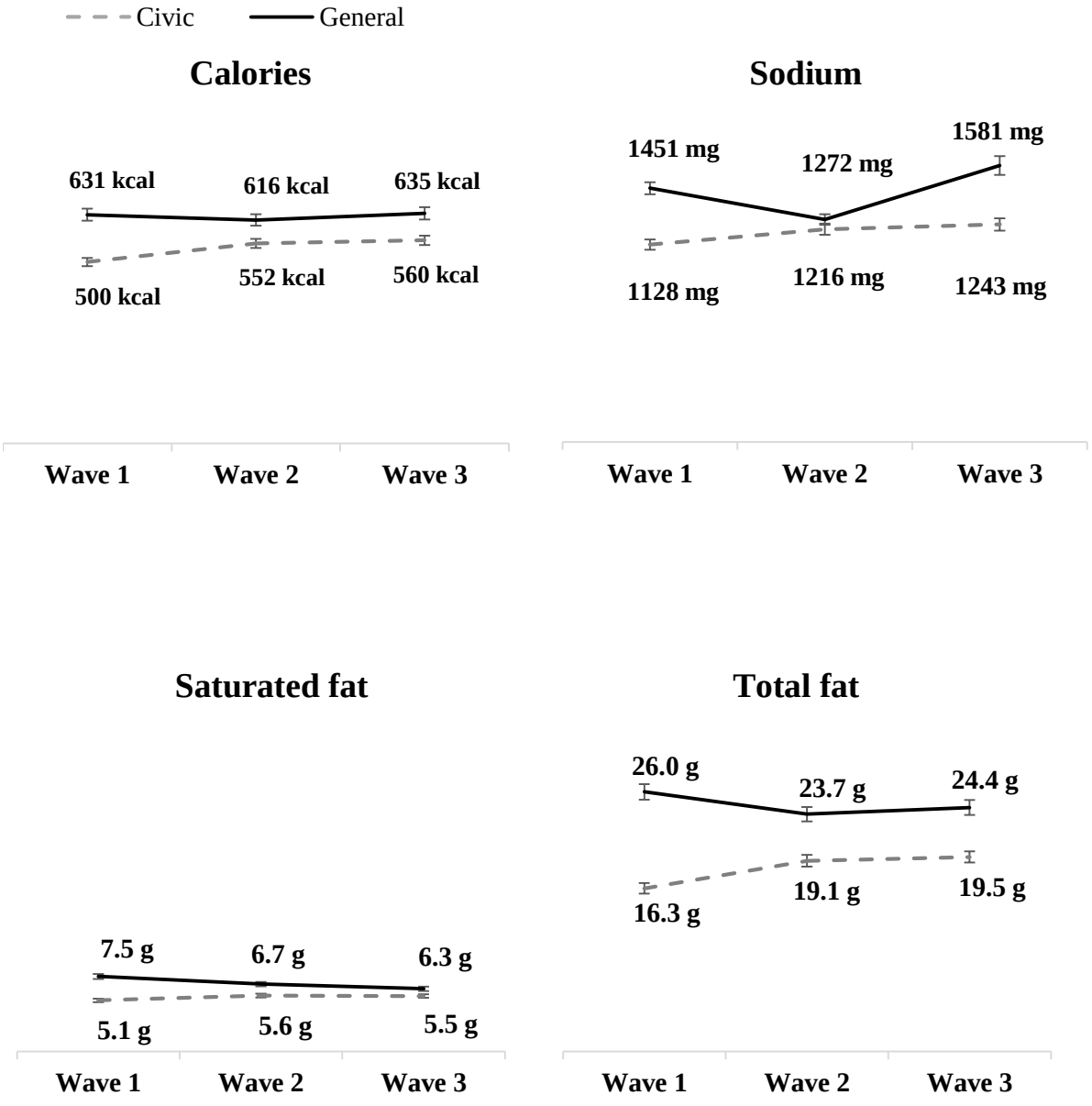


Overall, most participants (60.9%) finished their meal; however, there were significant differences in the proportion of participants that finished their meal between waves at both Civic ($X^2_{(df=2)}$= 66.03, p<0.001) and General ($X^2_{(df=2)}$ = 40.55, p<0.001) and between sites in Wave 1 ($X^2_{(df=1)}$= 11.09, p=0.001), Wave 2 ($X^2_{(df=1)}$= 6.82, p=0.009) and Wave 3 ($X^2_{(df=1)}$= 8.61, p=0.003). Of those who did not finish their meal, a large proportion had at least one item which they were consuming as 'take-out,' which did not have information on how much of the item was ultimately consumed. Excluding those with takeout, very few participants consumed less than the entire meal (<10%, on average). There were large differences in the proportion of participants that had items that they consumed as take-out between waves at Civic ($X^2_{(df=2)}$= 77.44, p<0.001) and General ($X^2_{(df=2)}$= 79.58, p<0.001) and between sites in Wave 1 ($X^2_{(df=2)}$= 17.51, p<0.001), Wave 2 ($X^2_{(df=2)}$= 12.54, p<0.001) and Wave 3 ($X^2_{(df=2)}$= 15.26, p<0.001). Given the large proportion of participants for whom at least some items were take-out (for which the amount consumed cannot be calculated), as well as inability to detect what 'part' of a food item was not consumed (which may differ in nutrient amounts), the analysis in this dissertation will solely examine purchasing behaviours.

4.4.3 Nutrients purchased across waves and sites

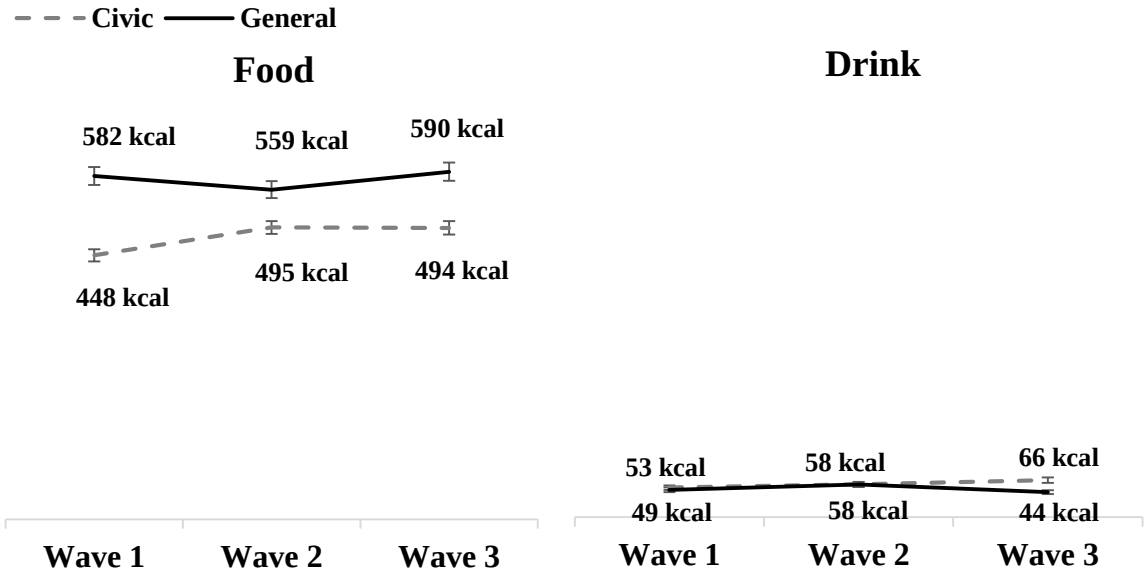
Average calories, sodium, saturated fat, and total fat purchased can be found in Figure 22.

FIGURE 22. Mean calories, sodium, saturated fat, and total fat purchased at each wave and site (n=2,781). Data are presented as means ± SEM.



For calories only, purchases were considered for food and drinks separately. The results can be found in Figure 23.

FIGURE 23. Calories purchased food and drink items separately at Civic and General cafeterias among those who had complete nutritional data for all items ordered (n=2,781). Data are presented as means ± SEM.



Linear regression models were conducted among all participants, using the outcome of 'total calories/sodium/saturated fat/total fat purchased,' adjusting for standard covariates and testing secondary covariates for inclusion using stepwise selection. Full results from the linear models can be found in Tables A11 to A14 in Appendix 2. The same model was conducted among purchases of food and drink items separately for calorie outcomes only, the results of which are available in Table A15 and A16.

Differences between sites

It was hypothesized that participants at the Civic cafeteria would purchase fewer calories, and less sodium, saturated fat and total fat than those at the General cafeteria in Wave 1 (*Hypothesis 3ai*). In Wave 1, those at the Civic cafeteria purchased fewer calories (β=-127.44, 95% CI

-167.37 – -87.51, p<0.001), adjusting for standard covariates, general health status and dieting behaviour in the past year. Those at the Civic cafeteria also purchased less sodium, adjusting for standard covariates (β =-323.81, 95% CI -426.02 – -221.60, p<0.001), less saturated fat, adjusting for standard covariates and general health (β =-2.38, 95% CI -2.96 – -1.79, p<0.001) and less total fat, adjusting for standard covariates (β =-9.60, 95% CI -11.45 – -7.74, p<0.001).

There was an overall significant wave by site interaction for food items (p=0.02) but not for drink items (p=0.17). For food items, there was a significant difference in calories purchased, whereby those at the Civic cafeteria purchased fewer calories than those at the General cafeteria (β=-131.19, 95% CI -168.08 – -94.31, p<0.001).

Differences in nutrients purchased in Wave 2

It was hypothesized that there would be greater decrease in purchasing of calories, sodium, saturated fat and total fat at the General cafeteria from Wave 1 to Wave 2 compared to the change at the Civic cafeteria (*Hypothesis 3aii*). There was a significant increase in calories purchased at the Civic cafeteria (β=51.80, 95% CI 11.44-92.17, p=0.01) and no significant change at the General cafeteria (p=0.37), which resulted in a significant interaction at the General cafeteria from Wave 1 to Wave 2 compared to the change at the Civic cafeteria during the same time (β=-69.51, 95% CI -125.10 – -13.91, p=0.01). For sodium, there was a significant decrease from Wave 1 to Wave 2 at the General cafeteria (β=-190.46, 95% CI -290.07 - -80.85, p<0.001), and no significant change at the Civic cafeteria, which also resulted in a significant interaction, adjusting for general health and dieting behaviour in the past year (β=--279.65, 95% CI -421.95--137.34, p<0.001). For saturated fat, the interaction was also significant (β=-1.24, 95% CI -2.05 - -0.43, p=0.003), with no change at the Civic cafeteria and a significant decrease at the General cafeteria (β=-0.73, 95% CI -1.30 - -0.17, p=0.01), adjusting for general health. Finally, there was also a significant interaction for total fat, adjusting for general health (β=-5.03, 95% CI -7.61 - -2.44, p<0.001), with a significant increase at the Civic cafeteria (β=2.84, 95% CI 0.97-4.72,

p=0.003) and a significant decrease at the General cafeteria (-2.18, 95% CI -3.99 – -0.38, p=0.02).

When conducted for food and drink items separately for calories purchased only, there was a significant interaction for food items only (β=--70.76, 955CI -122.12 - -19.40, p=0.01), whereby there was no change in calories purchased at the General cafeteria from Wave 1 to Wave 2 (p=0.17), compared to a significant increase at Civic cafeteria (β=-45.54, 95%I 8.25-82.82, p=0.02), adjusting for standard covariates and general health. There was no significant difference in drink purchases between Wave 1 and 2.

Differences in nutrients purchased in Wave 3

It was hypothesized that there would be a significantly greater effect of menu labelling from Wave 1 to Wave 3 at the General cafeteria compared to the changes that occurred at the Civic cafeteria (*Hypothesis 3aiii*). There was no significant difference in the change between Wave 1 and Wave 3 at the Civic cafeteria compared to the General cafeteria for calories (p=0.19), or sodium (p=0.47). There was a significant difference in the change in saturated fat (p<0.001) and total fat (p=0.001) purchased from Wave 1 to Wave 3 at the General cafeteria compared to the change at the Civic cafeteria.

For food items only, there was no significant difference in the change in calories purchased between Wave 1 to 3 in General compared to the Civic cafeteria (p=0.34), nor for drink items.

4.4.4 Differences in the impact of menu labelling between sociodemographic groups

It was hypothesized that the intervention would be more effective among women, those with higher levels of education, those who use nutrition labels more frequently when shopping for food, as well as those who rate nutrition as a more important factor in their food choice (*Hypothesis 3bii*). Three-way interactions with wave, site and socio-demographic variables were tested in a linear regression model for the outcome of calories purchased in the entire meal only.

There was a significant interaction between site, wave and BMI ($F_{(df=8)}$=2.11, p=0.03); however, there were no significant contrasts after using the Benjamini-Hochberg procedure to adjust for multiple comparisons.

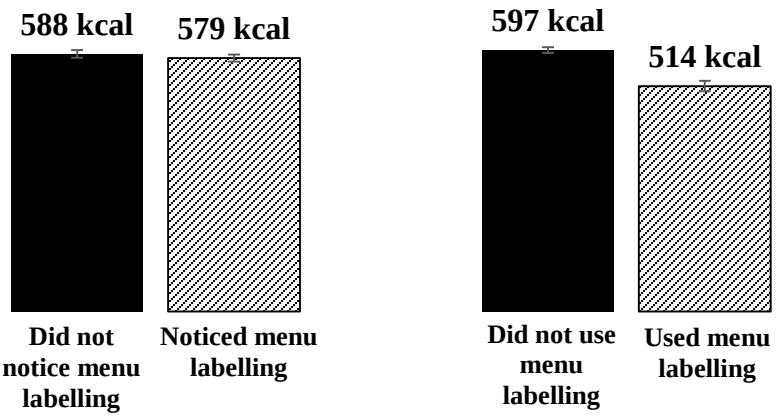
Importance of factors that influence food choice on calories purchased

The model was again conducted with the outcome of calories purchased, and including a variable for the importance of the taste, price and nutrition (n=2,490). Higher ratings of the importance of nutrition were associated with fewer calories purchased (β=-12.90, 95% CI -17.78 – -8.03, p<0.001). There were no significant associations between calorie purchases and price (p=0.054) or taste (p=0.56).

4.4.5 Differences in calories purchased between those who did and did not notice and use menu labelling

The differences in calorie consumption among those who noticed and used menu labelling can be found in Figure 24. It was hypothesized that those who reported that they had used the information would purchase fewer calories, with no significant difference in calorie purchasing among those who noticed and did not notice menu labelling (*Hypothesis 3bi*). The same model as section 4.4.3 was conducted and included a binary indicator variable for noticing menu labelling. There was no significant difference in calorie consumption among those who noticed menu labelling (p=0.47). Linear regression results for the model are available in Table A17 in Appendix 2. In the same regression model replacing the variable for noticing with a variable for self-reported use of menu labelling, those who reported they used menu labelling consumed significantly fewer calories (β=-47.32, 95% CI -79.60 – -15.05, p=0.004). Full results from the linear regression model are available in Table A18 in Appendix 2.

FIGURE 24. Differences in calories purchased among those who reported that they did or did not notice or use menu labelling (n=2,781). Data are reported as means ± SEM.



4.5 Impact of menu labelling on calorie estimation

Participants were asked to estimate the calorie content of each of the food and beverage items they ordered; if they were not sure, they were asked to provide their best guess. Estimates for food and beverage items were summed to create an overall estimate for the meal, as well as for food and beverages separately. There were 2,781 participants for whom there was nutritional information for the entire meal that could be compared to the estimated calorie content of the meal. A total of 2,084 had estimates for their entire meal that could be matched with complete nutrition information for all meal items, which included 2,171 with matching information for all food items, and 1,255 participants with matching nutritional information for all beverage items (note: not all participants ordered a drink). If a participant reported a range, his or her estimate was not included in the analysis, and the response was coded as incorrect.

Average calorie estimates could only be calculated for those who provided an estimate; those who responded 'Don't know' for any food or beverage item were excluded from any analysis of actual estimates. Given that 23.4% of the sample did not know and did not provide a guess for at least one item in their meal, the main estimation analysis is conducted using a binary variable of "correct" or "incorrect" so as not to exclude these participants from the analysis.

4.5.1 Correct estimations of calorie content within 50 kcal

As selected *a priori*, a value of 50 kcal above or below the actual amount of calories was considered 'correct.' This value of 50 kcal was approximately 10% of the average meal in this study. This value was slightly lower than other research, which has used estimations within ±100 kcal, given that the average calories purchased in this study were considerably lower than most studies conducted in other fast food settings.[148,149] Sensitivity analyses were conducted to examine if patterns varied when an outcome of ±50 kcal or ±100 kcal was used, and there were no differences in the pattern of results. Results are presented for estimates within 50 kcal of the actual amount purchased. The proportion of those with correct estimations among those who had complete nutritional data for items purchased across waves and sites is shown in Table 11.

TABLE 11. Calorie estimates among those who had nutrition data for comparison

		Civic			General		
	OVERALL %(n)	**W1** (%)	**W2** (%)	**W3** (%)	**W1** (%)	**W2** (%)	**W3** (%)
ENTIRE MEAL (n=2,781)							
Underestimated	29.4 (818)	22.3	29.6	26.1	29.1	32.6	36.3
Correct within ±50 kcal	12.7 (352)	17.1	15.5	14.6	7.7	10.5	10.7
Overestimated	32.9 (915)	29.8	36.0	37.4	27.8	34.1	32.0
Don't know	23.4 (651)	30.7	18.5	18.0	35.4	22.4	16.1
Other incorrect response	1.6 (45)	0	0.5	3.8	0	0.4	4.9
FOOD ONLY (n=2,783)							
Underestimated	30.9 (859)	21.8	31.2	29.2	30.7	33.9	37.7
Correct within ±50 kcal	13.1 (363)	18.3	14.6	14.6	8.1	11.5	11.3
Overestimated	34.1 (949)	31.6	37.6	39.2	28.7	35.7	31.5
Don't know	20.5 (571)	28.3	16.4	13.1	32.5	18.7	15.0
Other incorrect response	1.5 (41)	0	0.2	3.8	0	0.2	4.5
DRINKS ONLY (n=1,567)							
Underestimated	16.7 (261)	17.6	15.3	12.7	16.4	16.3	21.9
Correct within ±50 kcal	48.4 (759)	49.0	56.6	54.7	43.3	49.8	37.0
Overestimated	14.9 (234)	11.8	13.7	12.0	12.6	12.8	26.3
Don't know	19.0 (297)	21.6	12.9	17.8	27.7	21.1	13.3
Other incorrect response	1.0 (16)	0	1.6	2.9	0.0	0.0	1.5

Of the overall sample, 12.7% correctly estimated their meal within 50 kcal of the actual meal content. When food and drink items were examined independently, 13.1% of participants estimated within 50 kcal of the calorie content of food items, and 48.4% correctly estimated the content within 50 kcal of drink items. The proportion of those who reported that they did not know the content of their meal decreased over time at both cafeterias.

4.5.2 Effect of menu labelling on correctly estimating calorie content

It was hypothesized that there would be a greater increase in correct estimates of the calorie content of meals over time at the General cafeteria compared to the Civic cafeteria, and that the effect would remain consistent in Wave 3 (*Hypothesis 4ai*). To test this, logistic regression was conducted among participants who had complete nutritional data for all meal items, using the outcome of 'correct response' within 50 kcal of the correct answer (±50 kcal) (0=incorrect, 1=correct), including indicator variables for wave and site as well as an interaction variable

between wave and site, adjusting for standard covariates and testing secondary covariates using stepwise selection, and also including a variable for total calories ordered.

The model was first conducted for the entire meal among Wave 1 and Wave 2 participants only (n=1,844). The interaction term was not significant (X^2=1.23, p=0.27), suggesting that there was no significant difference between the two sites in the change in the likelihood of correctly estimating the calorie content of the meal between Wave 1 and Wave 2. The same analysis was then conducted across all three waves (n=2,781), in which the interaction term between wave and site was also not significant (X^2=2.17, p=0.33). Logistic regression results are available in Table A19 and A20 in Appendix 2.

Separate logistic regression analyses were run for food and drink items. For food items, there were no differences in the trends in the Wave 1 and 2 analysis or in the analysis across all three waves. There were no differences in the trends for Wave 1 and 2 for drink items; however, there were a number of different trends when all three waves were pooled. In particular, there was a significant decrease in correct estimates for beverages at the General cafeteria in Wave 3, compared to Wave 1 (p<0.001) and Wave 2 (<0.001), which resulted in a significant interaction compared to the changes that occurred at the Civic cafeteria from Wave 1 to Wave 3 (p<0.001) and from Wave 2 to Wave 3 (p<0.001). Full results from the logistic regression models for all three waves can be found in Table A21 and A22 in Appendix 2.

4.5.3 Differences in correct estimation of calories among population subgroups.

It was hypothesized that those who noticed menu labelling would be more likely to correctly estimate calorie content than those who did not notice menu labelling, as would females, those with higher levels of education, and those who knew the estimated energy requirements (*Hypothesis 4bi*). A logistic regression was conducted using 'correct estimation' as the outcome variable (± 50 kcal), including a variable for noticing menu labelling, standard demographic covariates and testing for secondary covariates, and including a continuous variable for the

number of calories in the meal (n=2,781). The results from this model can be found in Table A23, Appendix 2.

The proportion that correctly estimated among sub-groups for which the effect was significant can be found in Table 12. Generally, those who noticed menu labelling (p=0.03), females (p=0.02), those with higher income (p=0.01) and those who knew the estimated energy requirements (p=0.006) were more likely to correctly estimate the calorie content of their meal. The number of calories in the meal was also negatively associated with correctly estimating calorie content of the meal (p<0.001). Three-way interactions between wave, site and the independent covariates were conducted to examine if there were differences in the effect of the intervention. There was only one significant three-way interaction between the frequency of visiting the cafeteria and wave and site; however, the interaction was not statistically significant after adjustment using the Benjamini-Hochberg procedure.

TABLE 12. Type of calorie estimates for the entire meal among population subgroups for variables that were statistically significant in the logistic regression model (n=2,781) %

	Under-estimate	Correct	Over-estimate	Don't know	Other incorrect response
NOTICING MENU LABELLING*					
Noticed	28.4	14.4	34.9	20.8	1.6
Did not notice	30.5	10.7	30.7	26.3	1.8
GENDER*					
Male	30.2	10.3	32.8	25.2	1.6
Female	28.8	14.4	33.0	22.1	1.7
KNOWLEDGE OF ESTIMATED ENERGY REQUIREMENTS (EER)*					
Correct	30.4	14.5	38.6	14.7	1.8
Incorrect	28.2	10.6	26.6	33.1	1.4
INCOME*					
$0-$40,000	31.3	10.1	31.3	25.1	2.2
$40-80,000	29.6	10.4	33.9	23.7	2.3
$80,000 +	28.9	15.7	34.3	19.8	1.3
Not reported	27.9	9.8	26.9	34.8	0.7

*Significant at p<0.05 in overall logistic regression (see Table A19 in Appendix 2).

4.5.4 Magnitude of over and underestimation

In order to understand the magnitude of under and overestimation, estimation was expressed as a proportion of the total calories of the meal. Results are shown in Table 13. Similar to the estimate above with an absolute value of 50 kcal above or below the actual calorie amount for the meal, 11.5% of the sample estimated within 10% (above or below) the actual calorie amount.

TABLE 13. Meal calorie estimations as a proportion of calories ordered by Wave and site (n=2,084) %

		Civic			General		
	Overall (%)	**W1 (%)**	**W2 (%)**	**W3 (%)**	**W1 (%)**	**W2 (%)**	**W3 (%)**
Don't know / No answer	**25.1**	30.7	18.9	22.0%	35.4	22.8	21.2
<-100%	**0.1**	0.0	0.0	0.0	0.0	0.6	0.0
-100% to -50%	**7.7**	3.6	8.7	6.8	9.0	8.6	9.4
-50% to -10%	**21.9**	20.5	21.6	20.3	19.6	22.0	27.2
-10% to 10%	**11.5**	13.8	14.1	12.5	7.4	12.1	9.2
10% to 50%	**14.8**	13.6	15.9	18.0	11.5	14.6	15.3
50% to 100%	**9.5**	7.6	10.9	10.4	7.7	10.1	9.9
>100%	**9.4**	10.2	9.8	10.0	9.3	9.2	7.9

4.5.5 Impact of menu labelling on gross underestimation

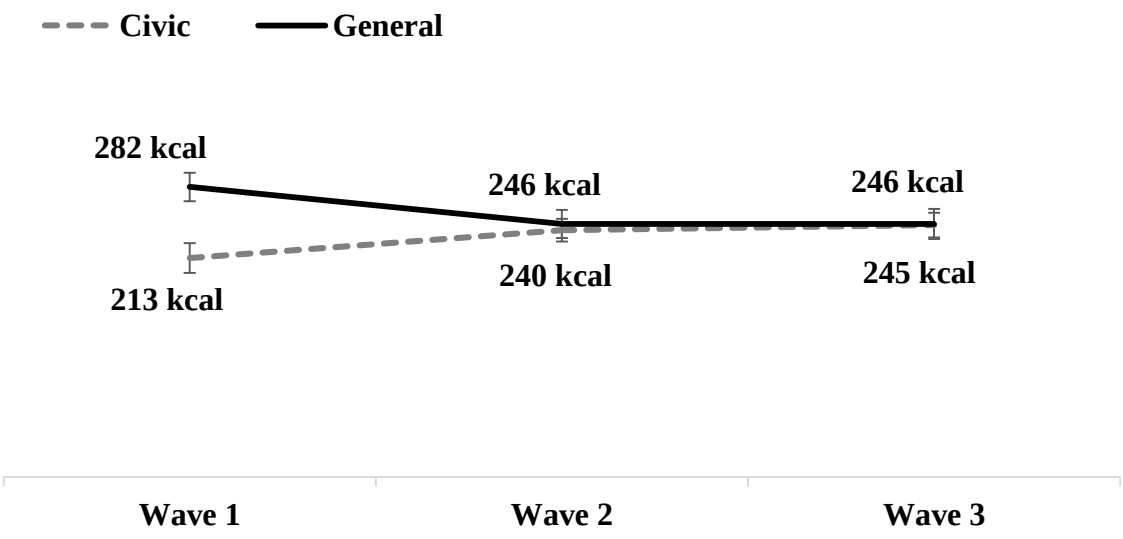
Previous research has identified a problem of gross underestimation, whereby consumers believe that the calories that they have ordered are significantly lower than the actual calorie content of the meal. It was hypothesized that that there would be greater decreases in gross underestimation at the General cafeteria between Wave 1 to Wave 2 and 3 compared to the change at the Civic cafeteria (*Hypothesis 4aiii*). To examine changes in gross underestimation over time, a variable was created for gross estimation, defined as underestimating the calorie content of the meal by greater than 50% of the actual calorie content of that meal. A logistic regression model was conducted using 'gross underestimation' as the outcome variable (1=gross underestimation, 0=other) adjusting for the standard covariates and testing for secondary covariates and total calories purchased (n=2,084). In this study, the average proportion of participants that grossly underestimated any items was around 8% (see Table 13 above). The overall effect of the

interaction variable in the model was not significant (p=0.14). Full results of the logistic regression are available in Table A24, Appendix 2.

4.5.6 Accuracy of estimations compared to actual calorie amount purchased

The absolute value of the difference between estimated and actual calories can be seen in Figure 25, and can be used to examine changes in the accuracy of calories estimates. It was hypothesized that there would be a greater improvement in accuracy over time at the General cafeteria compared to the Civic cafeteria, and thus lower absolute value of the difference between estimated and actual calories (*Hypothesis 4aii*).

FIGURE 25. The mean absolute amount that calorie estimates were incorrect by in each wave and site, excluding extreme estimates greater than 3000 kcal and estimates of 0 kcal (n=2,071). Data are presented as means ± SEM.



A linear regression model was conducted using the absolute value of the difference between estimated calories and actual calories across all 3 waves, including the indicator variables for wave, site and a wave by site interaction, adjusting for the total calories purchased as well as standard covariates and testing for secondary covariates (n=2,084). When the linear regression

was conducted, q-q plots identified non-normal distribution. To increase the normality of the distribution, a total of 13 extreme values were removed, 3 of which estimated that there were 0 kcal in their meal, and 10 of which estimated that there were more than 3000 kcal in their meal, similar to methods used in previous research.[40] Transformations were tested to see if the fit of the model could be improved. The outcome of the model was transformed using a square root function, at which point the q-q plot suggested a better fit; however, there were no differences in the significance of any of the covariates included in the model, and thus results are reported for the non-transformed model for the sake of interpretation.

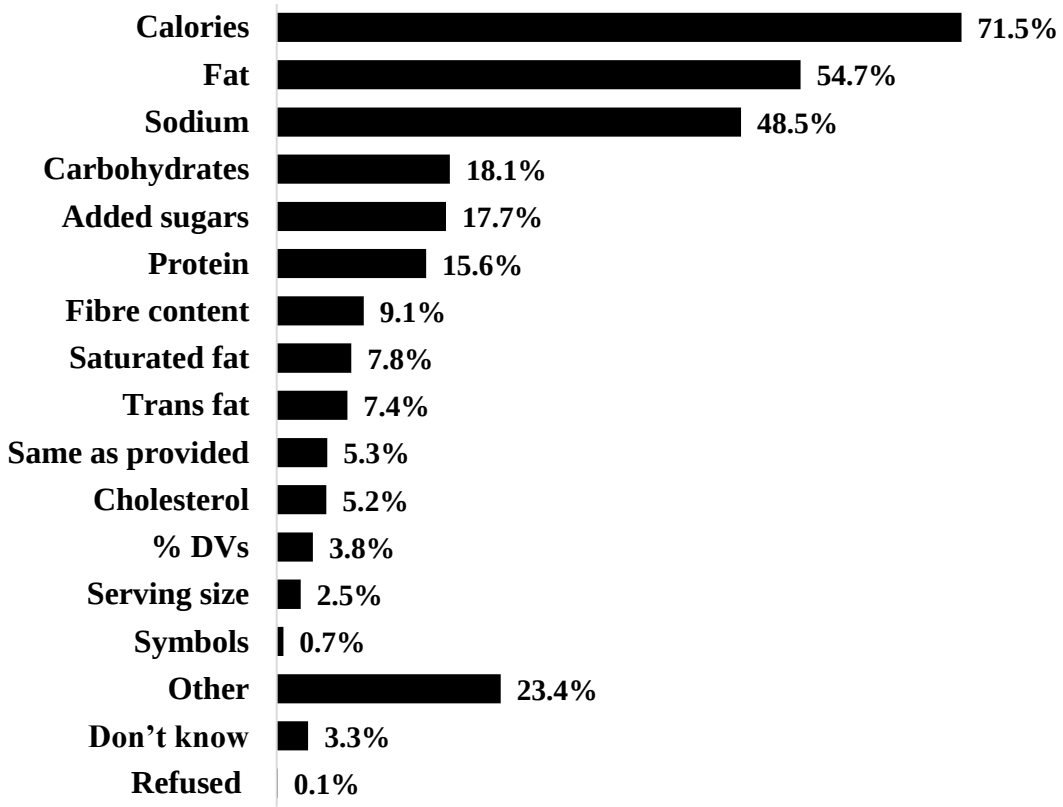
In this model, the wave by site interaction was not significant (X^2=2.15, p=0.10), after adjusting for standard covariates, self-reported general health, as well as the number of calories purchased for the meal. Results from the linear regression can be found in Table A25, Appendix 2.

4.6 Policy Support for Menu Labelling

In Waves 1 and 2, several questions examined policy support for menu labelling (n=2,018). When asked about policy support for menu labelling specific to The Ottawa Hospital, 95% of participants were supportive of providing nutrition information in cafeterias at The Ottawa Hospital, which did not significantly differ between waves or sites. When asked about support for menu labelling in all restaurants, 91% of participants were supportive of menu labelling in all fast food and chain restaurants, which also did not differ between waves or sites. There slightly less support for providing a health logo to indicate healthy options on menus (83%).

When asked what nutrition information participants would like to see displayed on menus, calories were the most common response (71.5%), followed by fat (54.7%) and sodium (48.5%). Full results can be found in Figure 26.

FIGURE 26. Types of nutritional information that participants would like to see on menus or menu boards (n=2,018)



5.0 DISCUSSION

The current study provides evidence on the effect of menu labelling on consumer's awareness and use of nutrition information, as well as the impact of menu labelling on consumers' food purchasing behaviours and overall understanding of the calorie content of their meals. This is the first study in Canada to evaluate a 'natural experiment' in a public setting over a longer time period, and provides evidence to inform menu labelling policy in Canada.

5.1 Noticing of menu labelling information

In the conceptual model of menu labelling adapted for this study (see Section 2.5.1, Figure 2), awareness of nutrition information is the first barrier that must be overcome for menu labelling to have any impact on health behaviours. The current study found that providing comprehensive menu labelling on digital menu boards in the cafeteria setting increased the proportion of participants that noticed menu labelling, and approximately 60% of patrons reported noticing nutrition information when it was present. Levels of noticing menu labelling in this study were consistent with most,[64,72-82] but higher than some,[64,72-82] of the calorie labelling research from the US and Australia. The large proportion of menu board space dedicated to nutrition information in this intervention may have led to higher rates of noticing menu labelling. The proportion that noticed labelling in this study was slightly lower than a recent Canadian study on menu labelling in a university cafeteria,[81] and was considerably higher than Canadian research in a community recreation centre that implemented traffic light labelling,[82] likely due to differences in the labelling format and the proportion items that were labelled between the settings.

The current study found a significant increase in noticing menu labelling over time at the General cafeteria. At the Civic cafeteria, very high levels of noticing were observed in the first wave of data collection; however, noticing waned over time. The sustained increase in noticing nutrition information on menus at the General cafeteria provides support for the hypothesis that levels of noticing nutrition labelling would increase and remain constant over time (*Hypothesis 1aii-1aiv)*. The decline in noticing at the Civic cafeteria deserves particular attention. Noticing may have decreased following the initial promotion of the program when it was first opened, as well as

decreased novelty of the program over time. The decrease in noticing menu labelling at the Civic cafeteria from Wave 1 to Wave 2 may also be due to the addition of rotating advertisements to the digital menu boards: nutrition information was rotated with advertisements in 20 second increments. The rotating ads would have decreased the 'dose' of, or overall exposure to, menu labelling; however, this does not explain the downward trend in noticing from Wave 2 to Wave 3. This study is not able to rule out the possibility of consumer fatigue or consumer habituation, which may have led to lower levels of consumer noticing at 32 months post-implementation at the Civic cafeteria, compared to only 11 months post-implementation at the General cafeteria. If consumers were already aware of the nutritional value of the food items for sale in the cafeteria, they may have been less likely to pay attention to that information in subsequent visits. Indeed, the only study to have looked at menu labelling over a five-year period suggests that the proportion of individuals that notice menu labelling decreased over a longer time period.[176]The trends over time at both cafeterias may suggest that the proportion of those who noticed menu labelling were leveling out; however, additional research waves would be needed to confirm this.

The conceptual model in this study proposed that the mode (or format), content and placement of menu labelling moderates the proportion of participants that notice and understand menu labelling. In the current study, there were significantly higher levels of noticing of menu labelling in the cafeteria with uninterrupted menu labelling on the digital menu boards compared to the other modes of menu labelling, which is consistent with *Hypothesis 1av*¸ highlighting the importance of information being clearly and consistently labelled in a location easy for consumers to locate.

The format of menu labelling in this intervention was unique. The menu labelling at The Ottawa Hospital cafeterias provided nutrition information for four nutrients (calories, sodium, saturated fat and total fat), which is more comprehensive than most menu labelling regulations that require calorie information only. In this example of menu labelling, the increased menu 'real estate' dedicated to nutrition information may have increased the proportion of those who noticed the nutrition information on the menu compared to menus that solely provide calorie information.

Conversely, the large amount of nutrition information on the menu may also have diluted the effect of the intervention for any one single nutrient, as there may have been more information than the participants were able to process in the short period in which they make their food choices. Additionally, items that had contradictory nutrition information (e.g., low calories and high sodium) may have led consumers to have led to dissonance and confusion in which food items were indeed the 'healthiest'. Previous menu labelling research has found that adding nutrition information for multiple nutrients on a menu decreased the likelihood of correctly recalling the calorie contents of their meal compared to when they were only shown calorie information on a menu.[116]

There were several characteristics of the natural experiment examined in this study that make these results unique to other studies. First, labelling was not provided for all food items: only a portion of the main food items that were for sale were labelled, and there was no labelling of drinks, desserts, salad bar items, or some of the side items. Additionally, there were unusually high levels of labelling in Wave 1 at the General cafeteria, which was meant to serve as the baseline or comparison condition in this experiment. This likely attenuated the effect of menu labelling compared to a true baseline with no labelling, which is the case for most food outlets.

The study also found support for *Hypothesis 1ai*, as calorie information was the most common type of information noticed by participants. A smaller, though substantial, proportion of patrons noticed sodium information, with fewer participants noticing total fat and saturated fat information. Higher rates of noticing calorie information may not be surprising, given that calories were the first listed nutrient, immediately next to the price on the menu board. As mentioned above, consumers have a limited capacity for information, and thus may not have been able to notice and process all of the information provided on the menu board. It is interesting to note that calorie information was the most commonly requested type of nutrition information on menu boards, which may have resulted in cafeteria patrons having a greater interest in calorie information, which may have led to increased awareness of seeing that information in the cafeteria.

In support of *Hypothesis 1ai*, very few participants noticed the health logo. Experts have suggested that non-numerical labelling formats may be more effective at communicating the nutritional quality of food items when eating out of the home, such as the use of logos, rating systems, or traffic-light labelling.[100,177,178] Additionally, other methods of providing context for calorie information, such as labelling the amount of exercise or physical activity equivalent to the calorie content of a menu item, have been suggested as a means to communicate the calorie content of items.[101,121,123,179,180] The low levels of noticing the health logo in the current study may be a result of an unfamiliar logo being used in the program, compared to more well-known and identifiable health logos. Research into the efficacy of the now-defunct Health Check restaurant program found extremely high levels of recognition among Canadian restaurant patrons, despite very low levels of noticing and use of the logo to inform food choices.[181] Although few respondents identified a health logo when asked what type of nutrition information they would like to see on menus, there were still high levels of support for providing a logo to help identify 'healthier options' on the menu.

Furthermore, the conceptual model identified label placement as a factor that could influence noticing and comprehension of nutrition information. In Wave 1 at the General cafeteria, nutrition information was available at the entrance to the cafeteria on brightly colored signs, and yet only 2% of participants noticed nutrition information at the entrance to the cafeteria. Previous research has also found that fewer participants access nutrition information when it is provided on posters or available in brochures, which many voluntary policies currently promote.[53] This finding highlights the importance of posting nutrition information directly on menu boards.

5.2 Use of menu labelling to inform food choices

The proportion of participants that used menu labelling at the General cafeteria increased over time, compared to a decrease in the proportion that used menu labelling at the Civic cafeteria, which provides general support for *Hypotheses 2ai-2aiii*. There was, however, a decrease in use of menu labelling between Wave 2 to 3 at the Civic cafeteria, contrary to one aspect of *Hypothesis 2aiii*. Importantly, when this analysis was run only among those who noticed menu

labelling, approximately one-third reported that they have used that information, and there were no significant differences in this proportion between sites or waves, demonstrating support for *Hypothesis 2aiv*. The consistency of these findings among those who noticed menu labelling supports the conceptual model's suggestion that noticing nutrition information on menus was indeed a precursor to using menu labelling, and was the driving force behind the levels of varying levels of use among the overall sample in this study.

The proportion of participants that reported that they used nutrition information among those who noticed information is in line with the vast majority of menu labelling research: approximately one-quarter to one-third of those who notice nutrition information use that information to inform their food choices.[72-76,79,80,86-88] It is notable that there was a significant decrease in use of menu labelling among those who noticed menu labelling at the Civic cafeteria from Wave 2 to Wave 3. The reasons for this are unclear; however, this proportion is still similar to rates of use among those who noticed menu labelling in other research.

Similarly to the findings for noticing, there was increased use of menu labelling when information was provided uninterrupted on digital menu boards with no advertising, among the entire sample. There were no significant differences between these conditions among those who noticed this information, which supports *Hypothesis 2av*. This demonstrates that the mode of menu labelling likely plays a greater role in increasing consumer awareness of menu labelling, with less direct effect on the likelihood of participants using that information to inform their food choices.

Purchasing items with less sodium and fewer calories were the most commonly reported influences of menu labelling, which provides partial support for *Hypothesis 2avi*. The high reported use of sodium information is important in the Canadian legislative context. There has been recent debate as to whether or not sodium labelling should be included in menu labelling regulations in the province of Ontario. Hypothetical menu labelling research conducted in an online setting has suggested that sodium labelling is widely supported by Canadians and can improve the nutritional quality of food choices beyond that of calorie labelling alone.[105] Other

research has found that fewer individuals use sodium information when it is available on menus.[124] New York has recently passed legislation requiring a logo indicating high sodium levels in restaurant foods in addition to calorie labelling.[60] In the current sample, sodium was the second most sought-after type of nutrition information on the menu, after calories. The current study suggests that consumers may be as likely to use sodium information as calorie information to inform food choices.

Experts have suggested that individuals may use menu labelling, or particularly, calorie labelling, to purchase higher calorie items as a means of increasing the "value" of their purchase. In the current study, negligible levels of participants engaged in this type of behaviour. When participants who used menu labelling were asked how the information had influenced their food choice, only 7 participants, or less than 1% of the entire sample, reported that they had purchased more calories, and only 1 participant reported that they had selected more sodium. This is similar to other studies which found that very few patrons, if any, would use calorie labelling to increase the number of calories ordered.[75,79,96] Among this sample, there was no evidence that menu labelling led to purposeful increases in energy-dense purchases.

5.3 Individual factors associated with noticing and using menu labelling

The conceptual model for menu labelling used in this study includes a number of individual-level factors that may moderate the impact of menu labelling on consumer noticing and use of that information. A number of significant differences between socio-demographic groups were hypothesized, based on previous menu labelling research and the general nutrition labelling literature. There was some support for the hypotheses that those with higher levels of education or income would be more likely to notice menu labelling. This is consistent with a recent review comparing the effect of menu labelling between low and high socio-economic status groups.[99] The study found support for the hypotheses that there would be higher noticing of nutrition information among those who use labels when shopping for food, as well as those with greater knowledge of calories. This provides support for some, but not all, of *Hypothesis 1bi*, as there were no significant associations between noticing and ethnicity or gender. The current study

found that staff were more likely to notice menu labelling in the cafeteria. Given that the majority of the staff work in the health care field, it is not surprising that they may be more attuned to nutrition information, and also may have had greater levels of exposure to the menu labelling intervention over time than other groups. This study also found that younger participants were more likely to notice menu labelling, which has been seldom reported elsewhere,[79] and the reasons for this are unclear.

For self-reported use of menu labelling, there were no differences across socio-demographic characteristics. This is in contrast to a recent review that concluded that self-reported use is typically lower among those of lower socio-economic status.[99] The reason for this discrepancy is unclear. In the current study, the only characteristic associated with increased use of menu labelling was how frequently one used nutrition labels when shopping for foods. Few studies include this explanatory variable when modelling predictors of menu labelling. One experimental study that examined the relationship between use of grocery labels and use of menu labels found that there was a greater effect of menu labelling among those who reported they used grocery nutrition labels.[97] Two hypothetical choice studies examining menu labelling have found that motivation to use nutrition information on menus, identified through measures such as the use of the Nutrition Facts table, resulted in intentions to purchase fewer calories.[37,106] This is consistent with the conceptual model, which suggests that those who are motivated by health or nutrition may be more likely to use, and therefore benefit from, from this type of intervention. In the current study, this finding was significant even after adjusting for sociodemographic differences, suggesting that motivation or interest in nutrition plays a large role in influencing food choice, and is consistent with previous research examining motivation and food choice in the packaged food domain.[46] It was also hypothesized that those who placed a higher importance on nutrition when making their food choice would be more likely to use menu labelling. In this study, those who rated nutrition as more important were more likely to use menu labelling, with no significant association with noticing menu labelling. This again likely represents consumers' motivation to make healthy decisions. It is not particularly surprising that those who are motivated to use nutrition information in stores are more likely to use this information in restaurant settings as

well, or that those who think nutrition is important are likely to access nutrition information to inform their food choices.

The study tested for differences in the impact of menu labelling on noticing and use between population subgroups using three-way interactions between the socio-demographic covariates, wave and site. The results indicate that the changes in noticing and use of menu labelling were the same across groups, with one exception. There was an aberrant trend when the use of menu labelling was stratified by income groups, whereby the noticing among the low income group at the General cafeteria significantly tailed off in Wave 3. The reasons for this decline among this group are unclear; however, the overall similarity in these results suggests that menu labelling would have similar impacts across demographic groups.

There was an inverse relationship between the ratings of the importance of taste and the use of menu labelling. This study, consistent with others, found that taste was indeed the most important factor that influenced food choice.[145] Other research has also suggested that consumers may perceive healthier food as less delicious or tasty.[182] Changing perceptions around the taste of healthy food may be important to counteract the potential paradoxical effect that food labelling may have for consumers who perceive healthy food as less desirable.

Similarly, there were few differences between population subgroups in use of menu labelling among those who noticed labelling. There was some indication that those who use nutrition labels more frequently when shopping for food, as well as those who were trying to make healthy decisions when they were eating outside of the home, were more likely to use menu labelling. This is consistent with the findings from the overall sample, and supports the conceptual model's suggestion that motivation plays a critical moderating role in the pathway to improved food choices in restaurants with menu labelling. This study suggests that menu labelling may be particularly helpful to those who are trying to make healthier food choices when they are eating outside of the home. These findings did not support *Hypothesis 2b.*

Interestingly, there were no gender differences for noticing or use of menu labelling, contrary to the study's hypotheses and other menu labelling literature.[37,76,79,87,90,93-96,183] This is also contrary to the literature on nutrition labels on packaged food, which suggests that women are more likely to report that they use nutrition information.[46] Most of this research does not include measures of motivation, such as our measure for use of nutrition labels when shopping for food, which may be a stronger predictor of use than gender alone.

When applied to the conceptual model, the results suggest that there are several individual-level factors that moderate the relationship between menu labelling and noticing of this information, and few socio-demographic factors that moderate the use of menu labelling. There were a number of individual-level factors included in the conceptual model that were not significant in any of the models tested, such as weight-loss behaviour, frequency of eating outside of the home, or having specific dietary needs. Examining the link between these secondary behaviours and menu labelling was not a main research objective of this study, and more extensive measures may be needed in order to examine whether or not these factors may influence use of menu labelling among some members of the population.

5.4 The impact of menu labelling on purchasing behaviours

In the first wave of data collection, there were significantly fewer calories and less sodium, saturated fat and total fat purchased at the Civic cafeteria, which had implemented a comprehensive nutrition information program while also improving the nutritional profile of the food items offered in the cafeteria, supporting *Hypothesis 3ai*. Given that the changes to the menu and menu labelling occurred concurrently, it is not possible to distinguish how much of the difference in calories purchased between sites was due to the reformulation of food items versus menu labelling intervention. Nonetheless, the results suggest that it is possible to influence food choices in a cafeteria setting using product reformulation, choice architecture, and menu labelling interventions.

From Wave 1 to Wave 2, there was an overall trend of a decrease or no change (in the case of calories) in nutrients purchased at the General cafeteria, and an increase or no change (in the case

of saturated fat) at the Civic cafeteria, which resulted in statistically significant positive improvement at the General cafeteria compared to the Civic cafeteria, and provides general support for *Hypothesis 3aii,* and an overall positive impact of menu labelling from Wave 1 to Wave 2.

When the trends from Wave 1 to Wave 3 are considered, the results are less clear. There were significant differences between the change in sites for saturated fat and total fat, but not for calories or sodium. This provides partial support for *Hypothesis 3aiii* for saturated fat and total fat, but not for calories and sodium. There was also an increase in sodium purchased from Wave 2 to 3 at the General cafeteria, which was not hypothesized. Taken together, the results suggest there was a positive influence of menu labelling for some nutrients, with less effect on calories over the longer term.

The reasons for the increase in purchasing calories, sodium and total fat at the Civic cafeteria are unclear. In this study design, the Civic site was meant to represent secular changes in food purchases that were occurring over time. Although the increases at the Civic cafeteria may represent real secular changes, it is also possible that the change to the intervention with the addition of advertisements to the menu labelling program resulted in a decrease in noticing of menu labelling (which was observed), and ultimately led to an increase in calories purchased. Additionally, the content of the advertisements was not analyzed, and may have been advertising meals that had poorer nutritional quality, which could have resulted in greater purchasing of calories, sodium, saturated fat and total fat in the cafeteria in Waves 2 and 3. Although this finding is inconclusive, it suggests that menu labelling did influence the food purchases at both the Civic and General cafeterias.

There were small differences in the overall trends for saturated fat and total fat compared to the overall trend for calories; however, there were increases in purchasing of all of these nutrients at the Civic cafeteria, with no change or a decrease at the General cafeteria, with the exception of sodium. The increase in sodium at the General cafeteria is an anomaly. Anecdotally, The Ottawa Hospital informed us that they made a change to the type of french fries that they provided in the

cafeteria between data collection for Wave 1 and Wave 2, which did not affect the calorie content of the item but had a higher sodium content. Given the large number of participants that ordered french fries, it is likely that this influenced the results for sodium. Few studies have examined the effect of calorie labelling on nutrient outcomes other than calories. Those that have considered other nutrients have suggested that there were no appreciable differences between calories and other nutrient outcomes in the changes in response to menu labelling.[74,124] Previous research testing various types of menu labelling found that although calorie labelling alone was the most effective type of menu labelling, it also resulted in the greatest reduction in the fiber content of meals purchased, compared to labels that provided information for additional nutrients.[184] Taken together, these results suggest that labelling calories can serve as a reasonable proxy for the overall 'healthiness' of the product, but is more likely to adequately predict caloric nutrients, such as saturated fat and total fat content, than sodium content.

This study indicated that those who reported that they used the menu labelling chose items with significantly fewer calories, even after adjusting for other factors, supporting *Hypothesis 3bi*. This is consistent with most,[76,80,83,86,87,128,185] but not all,[74] previous research. This suggests that patrons who were trying to use the menu labelling to inform their food choices were indeed able to use this information to make healthier food selections.

When considering the overall nutritional quality of consumers' food choices, there were healthier choices made at the Civic cafeteria where a comprehensive menu labelling program was implemented in addition to changes to the number of 'healthy' menu items that were offered. This included the reformulation of products so they would meet the criteria for the *Hospital Check* nutrition standards. There were no systematic changes to the food products offered at the General cafeteria, which may contribute to the more modest changes in food consumption at that site. For example, if fewer 'healthier' choices were available, there may have been a ceiling effect on the reduction in calories, sodium, saturated fat or total fat purchased. If mandating menu labelling in chain restaurants results in product reformulation to increase the number of 'healthy

choices' available, those who use menu labelling may select even fewer calories than currently observed.

With respect to individual-level differences, there were no significant differences in the impact of the menu labelling intervention among the socio-demographic or individual factors examined in this study, which rejects *Hypothesis 3bii*. Interventions that are primarily based on information provision, such as nutrition labelling, have been identified as having potential to widen the gap between low and high socioeconomic demographic groups.[186] A recent review on the impact of menu labelling among those with lower socio-economic status suggested that there is a lesser effect of menu labelling among those with lower income and education level.[99] This study did not reach these same conclusions, and suggests that in this context, the intervention was equally effective among population sub-groups.

5.5 Calorie estimation associated with menu labelling

Menu labelling has the potential to improve consumer understanding of the nutritional quality of the food items they purchase in restaurants. In the current study, only 1 in 10 participants accurately estimated the number of calories in their meal within 50 kcal of the actual calorie amount, and 1 in 4 participants did not know and were not able to provide an estimate. Overall, the results show that very few participants can accurately estimate the calorie content of their meal, with or without menu labelling present.

Previous research from fast food settings has found that participants are likely to underestimate the calorie content of their meals.[38-41,148,149] Contrary to this, similar proportion of participants in the current study overestimated (33%) and underestimated (29%) the calories in their meals. The difference between this study and others may be a result of the type of food that was provided by the hospital cafeterias, which had lower mean calories per meal than the fast food restaurants that are typically examined in other studies.

When calorie estimations were examined over time in the study, there were no significant differences between waves and sites in the number of calories that were estimated in the food

items, and thus, *Hypothesis 4aii and 4aii* are rejected. This is in contrast to other research that has suggested that menu labelling may improve calorie estimations among consumers.[148,149] The likelihood of correctly estimating the calories in a meal was lower as the overall calorie content of the meal increased. These findings are consistent with previous research.[40,148,149] It is intuitive that it is more difficult to accurately estimate the calorie content of larger meals, which may include multiple items. It is also easier to estimate within 50 kcal for lower calorie items compared to higher calorie items, as a proportion of the total calories in the meal.

There were more correct estimates among those who noticed menu labelling. The cross-sectional nature of this research does not allow us to interpret the direction of this relationship; however, these results may suggest that those who saw menu labelling were more likely to correctly estimate the calories in their meal. Females, those with better knowledge of calories, and those with higher income were more likely to correctly estimate the calorie content, which supports *Hypothesis 4bi*. Other research has found that calorie estimation is improved among those with higher socioeconomic position and among females, although the findings for gender were less conclusive.[149] In the current study, there were, however, no differences in the impact of the intervention between demographic subgroups.

The study also assessed the accuracy of calorie estimations and magnitude of underestimation, using the outcomes of gross underestimation as well as the difference between the estimated and actual amount. In this study, only fewer than 1 in 10 participants grossly underestimated the calorie content of their meal by more than 50% of the calories in the meal, a significantly smaller proportion than previously reported research,[40,148,149] and this did not vary over time or by site. There appeared to be a trend towards improved calorie estimations at the General cafeteria in waves when there was higher noticing of calorie information, and poorer calorie estimations at the Civic cafeteria when there was lower noticing of calorie information, but this finding was not statistically significant. Taken together with the finding of improved estimation among those who noticed menu labelling information, this may suggest that there is some improvement in calorie estimations when menu labelling is present, and is an area that deserves further research.

In the conceptual model, estimation of calorie content can be used as a measure of how consumers comprehend or process the information provided on menus. These results suggest that exposure to this information alone is likely not sufficient to change knowledge and understanding of menu labelling information, and that consumers need to notice information in order for it to influence understanding. The effect of menu labelling on comprehension of menu labelling, as well as the influence of menu labelling on overall nutritional knowledge, is an area that deserves additional attention.

5.6 Limitations and strengths

The current study has several limitations and strengths common to natural experiments. First, the two cafeterias participating in this study differed on a number of factors other than nutritional labelling. For example, the food selection offered at the Civic cafeteria had a more favourable nutrition profile overall. As a result, differences in calorie, sodium and fat consumption observed during Wave 1 cannot be attributed to any one factor. Using the Civic cafeteria as a comparison site while collecting information at the General cafeteria before and after the implementation of menu labelling controls for secular changes that might have occurred over the same time; however, the Civic cafeteria is not a 'perfect' control condition, and the findings require interpretation. The second wave of data collection took place in November/December, and therefore there may have been some effect of seasonality in the findings. A high-level review of sales data and conversations with the Nutrition and Foodservices staff at The Ottawa Hospital suggest that there were few differences in sales patterns between these two periods.

It is important to note that in Wave 1 at the General cafeteria, there was an 'inconsistent' menu labelling program in place prior to implementation of the digital menu boards, and 11% of the sample used this information to inform food choices. The nutritional information provided at the General cafeteria during the baseline data collection in Wave 1 exceeded what most restaurants currently provide at the point-of-sale. Thus, there was never a true 'no labelling' control roup. Additionally, even when the intervention was rolled out, only a portion of items available for sale had menu labelling. For example, drinks did not have any posted nutrition information, nor did

many meal items that were available but were not listed on the menu at the various cafeteria stations. It was not possible for the analysis to separate items that were labelled from items that were not labelled. Many participants selected both labelled and unlabelled items, and only examining those participants that had labelled items would have significantly reduced the sample size and not been an accurate representation of the habits of the overall sample. Due to these limitations, it is therefore likely that this study provides a conservative estimate of the impact of menu labelling, and had this been a true 'control' group and had all menu items been labelled, there may have been an even greater effect seen via greater differences between sites and over time in noticing, use, purchasing and calorie estimation.

For many participants, assumptions were required to assign nutrition information to food selections, such as salad bar items, which have no fixed quantity. For example, although salad bar selections varied across individuals, all respondents were assigned the same mean value. This approach will result in measurement error at the individual level within each site; however, the same method was used at both Civic and General cafeteria, and this approach should yield accurate estimates for the purpose of calculating differences between sites. In the second and third wave of data collection, a different recording method was used by interviewers to collect nutrition information in order to obtain more consistent and accurate recordings of the food ordered. This may have resulted in small changes in the number of items for which assumptions were used in the calculation of nutrition information for food items; however, it would result in overall more accurate measures of food intake in Wave 2 and 3, and this difference would be similar across sites.

As with all exit-survey research, there are limitations to self-reported data. The study relied upon accurate recall of food items purchases. Although food recall can be subject to recall biases, patrons in the current study were surveyed immediately after they had finished their meal. Analysis of receipts from exit survey participants suggested that recall was fairly accurate, and that among those who recalled incorrectly, there was a similar amount of over and underestimation. Due to the limited detail available in sales data from The Ottawa Hospital,

participant recall was the only feasible method of collecting purchasing information. Overall, the receipt analysis suggested that the self-report measures used in this study were adequate for assessing nutritional consumption of the food items ordered. Other self-reported measures, such as height and weight used to calculate BMI, are also subject to biases. Any measurement error associated with self-report questions would apply to both sites and is unlikely to account for the differences observed between cafeterias.

This study used an intercept technique to select potential participants as they exited the cafeteria after they had finished their meal. An alternative approach is to intercept patrons before they have entered the eating establishment,[40,74,75,87,124] or immediately after they have ordered.[38,82] The method used was selected in order to minimize social desirability bias as a result of awareness of future participation in the study that may have resulted in changes to ordering or eating patterns. The intercept technique used may have resulted in less accurate recall of meal options and may have decreased response rates; however, this did allow for some examination of the consumption of the items. The study had reasonably high response rates, given that the surveys were taking place in a hospital cafeteria, although slightly lower than other studies.[40,86,87,187] It is not possible to examine how non-response bias may have influenced the study; however, the study population included sufficient participants from the various socio-demographic groups to examine differences between these sub-groups. There were some participants who did not provide complete information for all of the variables included in the study, and were removed for the purposes of comparability between models. To reduce missing data bias, 'not reported' categories were created for variables in which a large proportion of participants had missing information, when possible. Less than 3% of the entire sample was excluded for incomplete data, and there were no differences in noticing or use of menu labelling among those who were excluded. It is unlikely that this would have significantly influenced the outcome of the study.

Several variables were only measured in two of the three waves of data collection. This was addressed as best as possible in an exploratory analysis for these variables, and the results suggest that these variables had little effect on the outcome of the study. In the analysis, the

model fit for linear regressions was a challenge; however, the transformations that improved model fit did not have any bearing on the significance for the variables of importance, and had implications for the interpretation of the results, and thus untransformed models were used.

This study was conducted within the context of a hospital cafeteria, which may provide a different population compared to other studies, given the high proportion of staff that work in the health care field, as well as a setting that may encourage individuals to make healthier food choices. Those that were 'visitors' to the cafeteria may have had additional stressors that affected their food patterns as a result of the hospital setting, which may have influenced the results. The definition of 'staff' in this study was any individual who worked in the hospital setting, and may not be associated with greater knowledge or interest in nutrition, per se. The profile of the sample in this study, of which approximately half were those employed in the health care field, may have influenced outcomes relating to socio-economic status outcome and others, and these results require further confirmation among the greater Canadian population.

This study, as with other studies on menu labelling, is also limited in that it cannot conclusively determine if menu labelling may have led to other changes in food or activity choices over the course of the day as a result of the labelling. Some research has suggested that menu labelling may not impact immediate decisions, but may play a role in food choices for the remainder of the day.[188] Finally, this study tested the changes to purchases among consumers, but did not examine if consumers changed the frequency with which they ate at the hospital cafeterias after they became aware of the nutrition quality of food items. Avoiding eating away from home has been predicted as one potential positive outcome of menu labelling, and few studies have had the ability to examine this to date.[69]

The study had several strengths. The naturalistic environment within which the study was conducted and the quasi-experimental study design allowed for the examination of the impact of menu labelling in a real-world situation. The use of the same data collection methodologies between sites for comparison and the use of multiple waves to track these changes over time was also a considerable strength, as many menu labelling studies have not assessed the impact of

menu labelling over the longer term. This is among the first naturalistic studies to test menu labelling for multiple nutrients, and this unique labelling format provided an opportunity to assess how additional information may influence the outcome of menu labelling. Finally, analytical models adjusted for differences in the sample profile at each site.

5.7 Methodological contributions

The study developed a method to collect information for food orders in exit surveys that has been subsequently used in other research by this research group.[81,142,181,189] The method is particularly useful in situations where verification of purchases via receipts is not possible. The analysis of receipt data suggested that the method used to capture self-reported food orders was reasonable. In fact, the results from the analysis of receipts may suggest that self-report was more accurate than the recorded receipt information for receipts containing information for multiple patrons. The addition of advertising to the digital menu board screens provided a unique opportunity to assess how the 'dose' of menu labelling may affect the impact of menu labelling. Given that many restaurants use 'moving' digital menu board screens with rotating advertising, much in the same way as the advertising that was implemented in the hospital cafeterias, this research suggests that advertising on menus may dilute any effect that menu labelling has on consumers noticing and use of that information. This study examined links between use of menu labelling and use of labelling on food packages, which has been seldom examined in other research. Finally, the current study adapted a conceptual model that is specific to menu labelling, providing a unique contribution to this area of research.

5.8 Future research

In the current study, the use of a health logo was not particularly effective, likely due to poor consumer knowledge of the meaning of the logo, although this was not explicitly tested in this study. Future research should examine the various other types of labelling that may improve consumer uptake and understanding of this information, which has been suggested to improve consumer use of menu labelling information.[69,177] This study is limited to a 2 year post-implementation window. Research from the US has suggested that noticing and use of menu

labelling significantly decreases 5-years after implementation, and the long term effect of menu labelling in Canada in unknown.[176] The current study was conducted in a hospital cafeteria that served the general public, and other Canadian research has also examined cafeteria-type settings.[81,82] Additional research in other Canadian restaurant settings in which local, provincial or national regulations would apply, such as fast-food and sit-down restaurants, will help build this evidence base.

Intervention characteristics that may improve consumer understanding or use of menu labelling are also warranted. For example, Ontario has proposed regulations that would require a contextual statement to help consumers understand how calories would fit into the total diet. The current intervention did not include a 'contextual statement, which may motivate use of menu labelling and improve consumers' understanding of the information. Research examining the effect of the contextual statement from the US has been mixed,[118,190] and Canadian evidence will help inform local policy decisions.

Broadly, this study found that there were several individual factors relating to diet and nutrition that may influence the use of menu labelling. Greater attention should be paid to factors that represent motivation to make healthy food choices, such as use of nutrition labels on packaged food, ratings of the importance of nutrition, or trying to make healthy decisions outside of the home, in order to better understand the role motivation plays in the decision making process. This study also did not consider the price of items as a potential moderating factor between menu labelling and healthier food choices. Recent research has found that providing half-size portions and adjusting the price for half and full size portions can lead to increases in the impact of menu labelling.[191] The relationship between price and calorie labelling deserves further study.

Although the study provides general support for the proposed conceptual model, the analysis did not formally test the model. This could be accomplished through formal mediational analysis, and is an area for further research. Additionally, several elements of the conceptual model were not measured in this study, such as comprehension of the nutrition information in the context of total diet, environmental factors such as social cues or 'special occasions' which may influence

food choices, and other aspects of nutritional knowledge that may influence levels of noticing and use of menu labelling. From a methods perspective, future research may examine how accurately participants can estimate how much of their food item they consumed, and whether the estimations required in this type of analysis can accurately predict the nutritional value of the food items that are not entirely consumed.

Finally, recent analysis from the US has provided some suggestion that the effect of menu labelling could be cost-saving; however, this analysis was inconclusive due to the wide variation in estimates of the calorie reduction that could occur as a result of menu labelling.[192] Improving the quality of data that is required to conduct cost-benefit or cost-effectiveness analyses, using Canadian-specific research, will advance understanding of the economic implications of this policy. The cost-effectiveness analysis is also limited in that it examines menu labelling as an independent intervention, but does not consider how menu labelling may interact with or complement other policies or population-level interventions aimed at addressing diet and chronic disease.[192] Research examining the economic impacts of menu labelling, and how menu labelling may work alongside other diet-related population interventions, will advance understanding of the overall impact of actions taken to prevent chronic disease.

6.0 POLICY IMPLICATIONS

The evidence from the current study can inform several policy gaps in the area of menu labelling in Canada and elsewhere. The results from the current study, taken together with the body of literature of menu labelling, suggest that menu labelling policy is likely have a modest positive impact on food habits in away from home settings among some consumers, in particular those who are motivated to improve their food choices. There are five primary policy implications from the current study.

First, the results from this study reiterate the importance of the format and location of nutrition information in the restaurant setting, in order to increase the number of consumers that notice this information. This study, and others, suggest that between one-quarter and one-third of consumers

will use nutrition information if they notice the information in a restaurant setting. Increasing the proportion of consumers that are aware of nutrition information in away-from-home settings is likely to increase the impact of menu labelling interventions. These results also support the suggestion that providing nutrition information elsewhere in the restaurant, such as via posters or brochures, will be less effective in changing behaviours, as fewer consumers are likely to notice, and therefore, use, that information. Current voluntary policies require consumers to request information on-site, or access nutrition information via restaurant websites. Although nutrition information is readily accessible in most chain restaurants, the effort required to access this information is an important barrier to any impact of this information. Menu labelling schemes that provide information at the point-of-purchase, such as on menus, are more likely to increase use and healthy choices among those who may not proactively ask nutrition information but may use that information when it is readily available.

Second, the results found an equal impact of menu labelling between population sub-groups. Health disparities are an important issue when evaluating population-level interventions, to ensure that interventions do not increase already apparent health inequities. Like other research, the results from this study indicate that there were indeed several disparities in noticing menu labelling, and fewer disparities in the use of menu labelling. The effect of the intervention on noticing nutrition information, self-reported use of nutrition information, and calories purchased was the largely the same across population subgroups. The results from this study suggest that menu labelling is unlikely to exacerbate, nor improve, current health disparities.

Third, this study reinforces the importance of reformulation in the impact of menu labelling. Reformulation is a key aspect of menu labelling, as it can indirectly influence consumer behaviours and would positively affect all consumers, regardless of whether or not consumers choose to engage with menu labelling. The implementation of the menu labelling program incentivized the Nutrition and Foodservices program at The Ottawa Hospital to reformulate menu options so that there was a *Hospital Check* item available on each menu, and as a result of perceived pressure to offer ‘healthier’ choices that did not have notably high values for any of the

nutrients listed.[171] The healthier nutritional profile at the Civic hospital cafeteria is evidence of the potential impact of reformulation on meal quality. To date, there is some evidence of reformulation among fast food chains in the US in jurisdictions where menu labelling has been implemented; however, nation-wide regulations may increase the likelihood of reformulation and therefore amplify the influence of menu labelling in the overall population.[154] Although local policy can stimulate reformulation within singular outlets, a more wide-reaching policy at the provincial or national level would be more likely to effect change among larger chain restaurants.

Fourth, calorie information appears to be the most salient and requested type of nutrient information among consumers. Calories are typically considered the energy 'currency', and given the high and rising levels of overweight and obesity afflicting the Canadian population, they are an important target for improving food choices. There is some hesitation in the dietetic community to increase the focus on calories, compared to the overall nutritional quality of food items. This study found that calories were a fairly good proxy for the other nutrients measured, with the exception of sodium. The findings indicate that information on sodium levels are important to consumers, in addition to calorie labelling. A large proportion of participants in this study purposefully selected items with less sodium when they were provided with that information. This study did not find conclusive evidence supporting the use of a summary health logo to improve food choices, although this was likely due to consumer unfamiliarity with the logo and an abundance of nutrition information the menu.

Fifth, menu labelling is only one intervention to address the current food environment and improve consumer eating habits. Complementary interventions may supplement menu labelling policy, and increase the uptake and use of menu labelling among those population sub-groups that are less likely to notice and engage with nutrition information. Targeted media campaigns and education initiatives to increase awareness of menu labelling aimed at those in low socioeconomic positions, those with lower levels of nutrition knowledge, and those with low motivation to make healthy food choices, may increase the impact of the policy.

Finally, this study found overwhelming support for menu labelling policy in public institutions and in restaurants more generally, suggesting that individuals would like to know the nutritional content of their food items. This may represent consumers exercising the right to know how many calories are in the food items for sale, irrespective of whether or not they choose to use that information.[193-195]

7.0 CONCLUSION

To date, literature on menu labelling has been inconclusive. The findings from the current study indicate modest, but significant, positive effect of menu labelling. The policy was equally effective across socio-demographic groups. As the first natural experiment on menu labelling in a public setting over several waves of data collection in Canada, the findings from this study support the implementation of menu labelling policy more broadly, as it has potential to support positive food choices in away-from-home settings. Overall, nutritional labelling is one of many population-level interventions that, when combined, are likely to have greater impact on food choices, with downstream effects on rates of obesity and chronic disease.

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9.0 APPENDICES

Appendix 1

Interview questionnaire from Waves 1, 2 and 3. Questions only asked in particular waves are denoted with an asterisk in the column on the left.

Approach Script & Screener	
Approach	Hello, my name is _____ from the University of Waterloo Health Studies Department. We are conducting a 10-minute survey on food consumption in cafeterias. We would like to ask you a few questions about the type of food available and what you ordered today. To thank you for your participation, you can choose to enter into a draw for $150 gift certificate. Are you interested in participating? Would you prefer to do the survey in English or French? Did you purchase your meal here today? **If no:** Thank you for your interest, but our research is examining food choices from cafeterias. Have you participated in this study in the past? **If yes:** Thank you for your interest, but for the relevance of our research, we can only include responses from each individual once. If participant may be under 18, ask: Are you over 18 years of age? **If no:** Thank you for your interest but we can only conduct the study with people over the age of 18. **If yes:** Have you participated in this survey in the last month? **If yes:** Sorry, but you are only eligible to participate in this survey once each year. **If no:** Interviewer to review Information Letter and ascertain verbal consent
Review Information Letter	• You are being asked to participate in a research study examining food choices from Ottawa hospital cafeterias • Approximately 1,000 people will take part in the 10-minute survey • We will ask you questions about your meal, including what you ordered and why you selected those items, as well as general questions about nutrition, other lifestyle behaviours and demographic information. • You may choose to enter a draw for a $150 gift certificate • There are no known risks or discomforts in relation to this study

	• Feel free to decline any questions you wish, and you can withdraw from the study at any time. • This study has been reviewed and received ethics clearance from the University of Waterloo Office of Research Ethics, as well as the Ottawa Health Sciences Research Ethics Board. • Contact information is available at the bottom of the information letter. After reviewing Information Letter and ascertaining consent: "Thank you. I would now like to begin with the survey."

	Use & Understanding of Nutritional Information
Gender	Indicate gender of respondent: [DO NOT read out loud] Male Female
Consumer Type	Are you: 1. Staff 2. Visitor 3. In-patient 4. Out-patient 5. Medical student 6. Don't know 7. Refused
Previous visit	Have you ever eaten in this cafeteria before today? 1. No 2. Yes 3. Don't know 4. Refused
Meal Type (Wave 2 and 3 only)	I'll start with some questions about your purchase here today. Please do NOT include items ordered for anyone else. Would you describe this as your… [read options out loud]: 1. Breakfast 2. Lunch 3. Dinner 4. Snack 5. Other - Specify: ___ 77. Don't know 88. Refused

Frequency at Cafeteria	**Only ask if "YES" to Previous Visit:** **If "NO" to Previous Visit, skip to Food Order.** In a typical week, how often do you buy food at this cafeteria? 1. Never 2. Less than once per week 3. Once per week 4. Two or three times per week 5. Four or more times per week 6. Don't know 7. Refused
Food order	FO1: What was the main food item you ordered today? _____ FO2: Did you modify or add anything to this item, for example adding extra cheese or asking for no sauce? _____ FO3: Did you choose any additional side dishes with this meal? _____ FO4: Did you purchase a drink? _____ -Was this diet or low-calorie, or regular? FO5: Did you purchase a dessert or any other snack items? _____
Finish Meal Quantity food item	Did you eat all of your meal today? 1. No 2. Yes 3. Don't know/can't remember 4. Refused **If NO:** How much of your [insert source separately: FO1, FO3, FO4, FO5] do you think you ate/drank? 1. One quarter 2. One half 3. Three quarters 4. Entire item 5. None/takeout 6. Don't know 7. Refused

Receipt Check (Wave 3 only) Receipt.1	We'd like to check the items you ordered on your receipt. Would you mind if we looked at your receipt? 1. No 2. Yes 3. I don't have a receipt
Receipt Verify (Wave 3 only) Receipt.2	Does the receipt include only your food or food you bought for others? 1. Only self 2. Others (Interviewer note: if receipt includes food for others, ask them to identify "own" food. Only record "own" food items) Item 1: _____ [programmer note: open text box, long length] Item 2: _____ Item 3: _____ Item 4: _____ Item 5: _____ Item 6: _____ Item 7: _____
Importance of factors	When you selected your food items today, how important was each of the following factors? I'd like you to use a scale from 1 to 10, where 1 is not at all important, and 10 is very important. Price Nutrition Taste 1 -10, Don't know Refused (Randomized order)

Allergies (Only Wave 1 and 2) Dietary needs	Do you have any food allergies, dietary needs or conditions that influenced your meal choice? 5. No 6. Yes 7. Don't know 8. Refused If YES: What are your dietary needs? _____
Healthy Choice	Overall, do you think your meal choice today was a healthy choice? 9. No 10. Yes 11. Don't know 12. Refused
Menu Label Noticing	Did you notice any nutritional information anywhere in the cafeteria? 1. No 2. Yes 3. Don't know/can't remember 4. Refused
Labelling Location	**Only ask if "YES" to Menu Label Noticing:** **If "NO" to Menu Label Noticing, skip to Perceived Calorie Count.** Where was this information located? [Do Not read options out loud – select all that are mentioned] 1. On the digital menu board / tv screen 2. On a sign 3. On the information board/at the entrance to the cafeteria ** 4. On the item packaging/wrapper 5. In a pamphlet 6. Other: _____ 7. Don't know/can't remember 8. Refused ** INTERVIEWER NOTE: If **On the information board** is selected, say "Just to clarify, do you mean the information board at the entrance of the cafeteria, or in the cafeteria itself?"
Labelling Identification	**If "YES" to Menu Label Noticing:** **Programmer Note: Please go through questions: Labelling identification, Menu Label Impact, Menu Label Influence, and Menu Label Important Factors for each**

	answer selected in Labelling Location. Please ask all questions for first location, then all questions for second location, and so on. What type of nutritional information did you notice on the [insert sources identified in Q: Labelling Location]? [Do Not read options out loud – select all that are mentioned] 1. Calories 2. Total Fat 3. Saturated fat 4. Sodium 5. Apple Icon logo 6. General nutrition information 7. Other: _____ 8. Don't know/can't remember 9. Refused
Menu Label Impact	**If "YES" to Menu Label Noticing:** Did the nutritional information presented on [insert sources identified in Q: Labelling Location] influence which food or drink items you selected for your meal? 1. No 2. Yes 3. Don't know/Prefer not to say 4. Refused
Menu Label Influence	**If "YES" to Menu Label Impact, ask:** **If "NO" to Menu Label Impact, skip to Menu Label Important Factors** What influence did the nutritional information [insert sources identified in Q: Labelling Location] have? [Do not read options out loud – circle all options that apply] 1. Selected healthier items 2. Selected item with logo 3. Avoided item with logo 4. Selected items with less calories 5. Selected items with less fat 6. Selected items with less saturated fat 7. Selected items with less sodium 8. Selected items with more calories 9. Selected items with more fat 10. Selected items with more saturate fat 11. Selected items with more sodium, 12. Other: _____ 13. Don't know 14. Refused

Menu Label Important Factors	**If more than one to Labelling Identification :** Was there one type of information on the [insert sources identified in Q: Labelling Location]that influenced your meal choice more than others? [Do not read options out loud] ***1. Depends on what they selected in Lblf1*** 2. Other: _____ 3. Don't know/can't remember 4. Refused
Perceived Calorie Count	Approximately how many calories were in the [Insert source: FO1, FO3, FO4 & FO5] that you just ordered? *If you are not sure, please provide your best estimate.* **Programmer Note: Ask of each item individually.** _____ calories (kcal) 1. Don't know 2. Refused
Eating Outside Home	In a typical week, how often do you eat out for lunch or dinner at a restaurant, fast food outlets, drive-through or cafeterias, including this cafeteria? 1. Never 2. Less than once per week 3. Once per week 4. Two or three times per week 5. Four or more times per week 6. Every day 7. Don't know 8. Refused
Healthy decisions in Cafeteria (Wave 1 and 2 only)	**Only ask if "YES" to Menu Label Noticing and YES to previous visit:** **If "NO" to Menu Label Noticing go to Health Decisions** In the past month, have you made an effort to choose healthier food items when you are eating in this cafeteria? 1. No 2. Yes 3. Don't know 4. Refused
Healthy Decisions	In the past month, have you made any effort to choose healthier food items when you are eating at sit-down restaurants, fast food outlets, drive-throughs or cafeterias?

	1. Yes 2. Maybe 3. No 4. Don't know 5. Refused
Overall Support for Ottawa (Wave 1 and 2 only)	Overall, do you think it is a good idea for Ottawa Hospital to have nutritional information on menus in the cafeterias? 1. Yes 2. Maybe 3. No 4. Don't know 5. Refused
Support for all restaurants (Wave 1 and 2 only)	Do you think that ***all*** fast-food and other chain restaurants should list nutrition information on menus and menu boards? 1. Yes 2. Maybe 3. No 4. Don't know 5. Refused
Preferred label info (Wave 1 and 2 only)	What nutritional information, if any, would you like to see displayed on the menu boards? [Do Not read options out loud - Select all that apply] 1. Same as provided 2. Calories 3. Total Fat 4. Saturated Fat 5. Trans fat 6. Cholesterol 7. Sodium 8. Carbohydrates 9. Added sugars 10. Fibre content 11. Protein content 12. Symbols 13. Serving sizes in relation to Canada's food guide 14. Percent daily values 15. Other: _____ 16. Don't know 17. Refused

Support for health logo (Wave 1 and 2 only)	Do you think it is a good idea to put a logo or symbol beside food items on menus to indicate healthier options? 1. Yes 2. Maybe 3. No 4. Don't know 5. Refused
	Diet & Lifestyle Questions
Estimated Energy Requirements	On average, how many calories should an adult consume per day to maintain a healthy weight? _____calories (kcal) 1. Don't know 2. Refused
General Health	In general, how would you rate your overall health? 1. Poor 2. Fair 3. Good 4. Very Good 5. Excellent 6. Don't know 7. Refused
Dieter	During the past year, have you been on a popular weight-loss diet (such as Weight Watchers, Atkins Diet, etc.) or *actively tried to lose weight?* 1. No 2. Yes 3. Refused
Perceived Weight	Do you consider yourself: 1. Overweight 2. Underweight 3. Just about right 4. Don't know 5. Refused
Physical activity	Over a typical or usual week, on how many days do you engage in moderate to vigorous physical activity, such as brisk walking, bike riding, jogging or cross-country skiing, for a total of at least 30 minutes per day? 1. None (zero days)

	2. 1 day 3. 2-3 days 4. 4 days or more 5. Every day 6. Refused
Label Use	When shopping for food for you and your family, do you usually look at the nutrition information provided on the package? 1. Never 2. Sometimes 3. Usually 4. Always 5. Refused

Background and Demographics	
	I have a few final questions to ask about your background. As a reminder, all information will be kept strictly confidential.
Age	Can I ask your age: _____ years Refused
Education	What is the highest level of education you have completed? 1. Some elementary school or less 2. Some high school 3. Completed high school 4. Some college or university 5. Completed college or university 6. Graduate or professional school (e.g. MSc, MBA, PhD) 7. Refused
Employment	What is your current employment status? 1. Working full-time (35 or more hours per week) 2. Working part-time (less than 35 hours per week) 3. Self-employed 4. Currently unemployed, but looking for work 5. Student 6. Retired

	7. Not in workforce (Homemaker/Unemployed, not looking for work) 8. Other 9. Refused
Income	What is your best estimate of your current yearly household income, **before** taxes? Interviewer note: If the participant is a student, they should state the income of their family if that is their permanent address 1. Less than $5,000 2. $5,000 or more but less than $10,000 3. $10,000 or more but less than $15,000 4. $15,000 or more but less than $20,000 5. $20,000 or more but less than $30,000 6. $30,000 or more but less than $40,000 7. $40,000 or more but less than $50,000 8. $50,000 or more but less than $60,000 9. $60,000 or more but less than $70,000 10. $70,000 or more but less than $80,000 11. $80,000 or more but less than $90,000 12. $90,000 or more but less than $100,000 13. $100,000 or more but less than $150,000 14. $150,000 and over 15. Refused
Ethnicity	People living in Canada come from many different cultural and racial backgrounds. Which of the following are you? [Show screen to participant – select all that apply] **1.** White/Caucasian 2. Chinese 3. South Asian (e.g., East Indian, Pakistani, Sri Lankan) 4. Black 5. Filipino 6. Latin American 7. Southeast Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese) 8. Arab 9. West Asian (e.g., Afghan, Iranian) 10. Japanese 11. Korean 12. Aboriginal (including North American Indian, Metis or Inuit) 13. Other 14. Refused
Participation in the past	Did you participate in this study and answer this questionnaire LAST YEAR? 1. No 2. Yes

	3. Refused
Awareness of Study	Before you were approached today, did you know that this study was taking place? 1. No 2. Yes 3. Refused
Self-report Height and Weight	It is helpful for us to know the height and weight of our survey participants. Would you be comfortable telling us your height and weight? Height: _____ (in feet and inches or cm) Weight:_____ (in kg or lbs) Prefer not to say.

Debriefing	
	Thank you so much for completing our survey today. Your participation allows us to better understand whether or not consumers notice and use nutritional labels when they are presented in a restaurant setting, and what information is most useful to consumers. As I mentioned earlier, we are holding a draw for a $150 gift certificate to thank you for your assistance. Would you like to enter? **-If yes**, have participant fill out draw ballot. Keep half of draw ballot with participant's information in an envelope separate from survey responses, and give participant half with information regarding draw to keep with them. **-If no**, move to feedback letter. Here is a short feedback letter, outlining the objective of our research, and contact information if you have any questions or concerns about the study. Do you have any questions at this time? Great, thank you again for your participation. Have a good day!

Appendix 2 Additional results

TABLE A1. Secondary covariate characteristics among the sample of exit survey patrons stratified by wave and site (N=3061) % (n)

	Civic			General				
	Wave 1 (n=489)	**Wave 2 (n=488)**	**Wave 3 (n=507)**	**Wave 1 (n=491)**	**Wave 2 (n=550)**	**Wave 3 (n=536)**	**X^2**	**p-value**
Frequency of eating out [a b d]								
Never	4.7 (23)	5.5 (27)	4.1 (21)	3.3 (16)	2.4 (13)	4.1 (22)	[a]=22.88	0.01
Less than once per week	11.0 (54)	14.8 (72)	16.0 (81)	13.2 (65)	14.2 (78)	15.5 (83)	[b]=19.12	0.04
Once per week	23.9 (117)	16.4 (80)	20.5 (104)	17.7 (87)	18.9 (104)	19.6 (105)	[c]=11.72	0.04
2-3 times per week	31.3 (153)	37.7 (184)	35.3 (179)	31.6 (155)	38.2 (210)	36.0 (193)		
4 or more times per week	19.4 (95)	20.1 (98)	17.9 (91)	25.9 (127)	18.2 (100)	19.2 (103)		
Every day	9.6 (47)	5.5 (27)	6.1(31)	8.4 (41)	8.2 (45)	5.6 (30)		
Effort to make healthy choices in the past month [a b]								
Yes	74.8 (366)	76.6 (374)	82.4 (418)	77.4 (380)	77.5 (426)	84.1 (451)	[a]=9.21	0.01
							[b]=9.87	0.007
Estimation of recommended calorie intake [b d]								
Correct	50.7 (248)	49.6 (242)	50.9 (258)	51.5 (253)	57.1 (314)	55.8 (299)	[b]=8.84	0.012
							[d]=5.85	0.02
Self-reported general health [a]								
Poor	3.9 (19)	3.1 (15)	3.2 (16)	2.6 (13)	3.8 (21)	2.1 (11)	[a]=16.00	0.042
Fair	12.1 (59)	14.8 (72)	19.3 (98)	16.3 (80)	16.7 (92)	16.8 (90)		
Good	40.5 (198)	41.4 (202)	37.1 (188)	39.3 (193)	36.9 (203)	38.1 (204)		
Very good	30.5 (149)	30.7 (150)	32.0 (162)	30.1 (148)	32.9 (181)	34.1 (183)		
Excellent	13.1 (64)	10.0 (49)	8.5 (43)	11.6 (57)	9.6 (53)	9.0 (48)		

a indicates significant differences between waves at Civic at a significance level $p<0.05$
b indicates significant differences between waves at General at a significance level $p<0.05$
c indicates differences within Wave 1 between sites at a significance level $p<0.05$.
d indicates differences within Wave 2 between sites at a significance level $p<0.05$.
e indicates differences within Wave 3 between sites at a significance level $p<0.05$

TABLE A1 (cont.) Secondary covariate characteristics among the sample of exit survey patrons stratified by wave and site (N=3061) % (n)

	Civic			General				
	Wave 1 (n=489)	**Wave 2 (n=488)**	**Wave 3 (n=507)**	**Wave 1 (n=491)**	**Wave 2 (n=550)**	**Wave 3 (n=536)**	**X^2**	**p-value**
Dieting in the previous year [a]								
Yes	35.4 (173)	33.4 (163)	28.2 (143)	33.6 (168)	32.4 (178)	33.6 (180)	[a]=6.28	0.043
Perceived weight								
Overweight	48.3 (236)	49.0 (239)	49.1 (249)	44.0 (216)	46.0 (253)	43.8 (235)	-	n.s.
Underweight	2.7 (13)	2.3 (11)	3.6 (18)	4.3 (21)	2.0 (11)	4.7 (25)		
About the right weight	49.1 (240)	48.8 (238)	47.3 (240)	51.7 (254)	52.0 (287)	51.5 (276)		
Physical activity								
None (zero days)	11.9 (58)	10.7 (52)	10.8 (55)	11.0 (54)	12.4 (68)	11.2 (60)	-	n.s
1 day	7.6 (37)	7.8 (38)	8.7 (44)	5.7 (28)	9.3 (51)	7.5 (40)		
2-3 days	31.9 (156)	33.4 (163)	32.9 (167)	35.4 (174)	35.8 (197)	33.8 (181)		
4 -6 days	30.9 (151)	29.9 (146)	28.0 (142)	27.1 (133)	28.5 (157)	30.8 (165)		
Every day	17.8 (87)	18.2 (89)	19.5 (99)	20.8 (102)	14.0 (77)	16.8 (90)		

a indicates significant differences between waves at Civic at a significance level $p<0.05$
b indicates significant differences between waves at General at a significance level $p<0.05$
c indicates differences within Wave 1 between sites at a significance level $p<0.05$.
d indicates differences within Wave 2 between sites at a significance level $p<0.05$.
e indicates differences within Wave 3 between sites at a significance level $p<0.05$

TABLE A2. Logistic regression results examining noticing of menu labelling between intervention modes (N=3,061)

	Wald X^2	**Odds ratio**	**95% CI**	***p*-value**
Intervention format				
Digital menu boards w/ no ads vs. Paper signage	174.62	0.14	0.11-0.19	<0.001*
Digital menu boards w/ no ads vs. Digital menu boards w/ ads		0.37	0.29-0.46	<0.001*
Paper signage vs. Digital menu boards w/ ads		0.38	0.31-0.48	<0.001*
Consumer type	24.30			<0.001
Staff/Medical Student vs. Visitor		0.67	0.54-0.82	<0.001*
Staff/Medical Student vs. Out- or In-patient		0.52	0.39-0.69	<0.001*
Staff/Medical Student vs. Not reported		0.83	0.47-1.45	0.51
Visitor vs. Out- or In-Patient		0.78	0.60-1.02	0.074
Visitor vs. Not reported		1.24	0.71-2.19	0.45
Out- or In-patient vs. Not reported		1.59	0.87-2.90	0.13
Frequency of visiting the cafeteria	17.49			0.002
Never vs. < once per week		1.18	0.94-1.48	0.17
Never vs. Once per week		1.23	0.93-1.62	0.14
Never vs. 2-3 times per week		1.61	1.24-2.09	<0.001*
Never vs. 4 or more times per week		1.61	1.21-2.15	0.001*
< once per week vs. Once per week		1.05	0.81-1.35	0.73
< once per week vs. 2-3 time per week		1.37	1.08-1.73	0.008*
< once per week vs. 4 or more times per week		1.37	1.05-1.79	0.022
Once per week vs. 2-3 times per week		1.31	1.02-1.69	0.036
Once per week vs.4 or more times per week		1.31	0.98-1.74	0.067
2-3 times per week vs. 4 or more times per week		0.99	0.74-1.30	0.99
Gender Female vs. Male	1.09			0.30
Age	27.89			<0.001
18-34 years old vs. 35-44 years old		0.80	0.63-1.02	0.066
18-34 years old vs.45-54 years old		0.74	0.59-0.93	0.011*
18-34 years old vs.55+ years old		0.55	0.44-0.69	<0.001*
35-44 years old vs. 45 – 54 years old		0.93	0.73-1.19	0.56
35-44 years old vs. 55+ years old		0.69	0.54-0.88	0.003*
45-54 years old vs. 55 years old		0.74	0.60-0.92	0.007*
Education level	9.94			0.019
High school or less vs. some college or university		1.67	1.21-2.32	0.002*
High school or less vs. Completed college or university		1.23	0.96-1.57	0.10
High school or less vs. Graduate or professional school		1.18	0.89-1.57	0.25
Some college or university vs. Completed college or university		0.73	0.56-0.96	0.025*
Some college or university vs. Graduate or professional school		0.71	0.52-0.96	0.025*
Completed college or university vs. Graduate or professional school		0.96	0.79-1.17	0.72

	Wald X^2	Odds ratio	95% CI	*p*-value
Income level	19.00			<0.001
$0-$40,000 vs. $40-80,000		1.70	1.33-2.17	<0.001*
$0-$40,000 vs.$80,000 +		1.59	1.24-2.03	<0.001*
$0-$40,000 vs. Not reported		1.51	1.10-2.06	0.01*
$40-80,000 vs. $80,000 +		0.93	0.77-1.13	0.47
$0-$40,000 vs. Not reported		0.89	0.67-1.17	0.40
$80,000 + vs. Not reported		0.95	0.73-1.24	0.72
Ethnicity Other vs. White	0.24	1.05	0.86-1.28	0.62
Body Mass Index	5.54			0.24
Label use	11.56			0.009
Never vs. Sometimes		1.25	0.97-1.60	0.082
Never vs. Usually		1.37	1.06-1.78	0.016*
Never vs. Always		1.50	1.18-1.91	0.001*
Sometimes vs. Usually		1.10	0.89-1.37	0.39
Sometimes vs. Always		1.20	0.99-1.47	0.07
Usually vs. Always		1.09	0.89-1.34	0.40
Knowledge of EER	8.00	1.26	1.07-1.47	0.005

*Significant after post hoc adjustment using Benjamini-Hochner procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A3. Logistic regression results examining the impact of meal type on noticing of menu labelling in Wave 2 and 3 (n=2,081)

	Wald X^2	Odds ratio	95% CI	*p*-value
Wave	4.65			0.03
Site	4.09			0.043
Wave*Site interaction	1.59			0.21
Meal type	22.95			<0.001
Breakfast vs. Lunch		0.90	0.60-1.34	0.60
Breakfast vs. Dinner		0.92	0.59-1.43	0.72
Breakfast vs. Snack		0.45	0.28-0.72	<0.001*
Breakfast vs. Other		0.68	0.31-1.53	0.35
Lunch vs. Dinner		1.03	0.80-1.32	0.84
Lunch vs. Snack		0.50	0.37-0.67	<0.001*
Lunch vs. Other		0.76	0.37-1.56	0.45
Dinner vs. Snack		0.49	0.34-0.70	<0.001*
Dinner vs. Other		0.74	0.35-1.56	0.43
Snack vs. Other		1.52	0.71-3.24	0.28
Consumer type	7.83			0.049
Staff/Medical Student vs. Visitor		0.76	0.59-0.98	0.04
Staff/Medical Student vs. Out- or In-patient		0.64	0.46-0.90	0.01
Staff/Medical Student vs. Not reported		1.09	0.25-4.72	0.91
Visitor vs. Out- or In-Patient		0.84	0.61-1.16	0.29
Visitor vs. Not reported		1.43	0.33-6.19	0.63
Out- or In-patient vs. Not reported		1.70	0.39-7.47	0.48
Frequency of visiting the cafeteria	18.78			<0.001
Never vs. < once per week		1.38	1.05-1.82	0.02
Never vs. Once per week		1.34	0.96-1.88	0.08
Never vs. 2-3 times per week		1.84	1.35-2.52	<0.001*
Never vs. 4 or more times per week		1.91	1.33-2.74	<0.001*
< once per week vs. Once per week		0.97	0.72-1.31	0.86
< once per week vs. 2-3 time per week		1.33	1.01-1.75	0.04
< once per week vs. 4 or more times per week		1.38	1.00-1.92	0.05
Once per week vs. 2-3 times per week		1.37	1.01-1.85	0.04
Once per week vs.4 or more times per week		1.42	1.00-2.02	0.05
2-3 times per week vs. 4 or more times per week		1.04	0.75-1.44	0.83
Gender Female vs. Male	0.23			0.63
Age	34.94			<0.001
18-34 years old vs. 35-44 years old		0.71	0.53-0.95	0.02
18-34 years old vs.45-54 years old		0.65	0.49-0.86	0.002
18-34 years old vs.55+ years old		0.45	0.34-0.59	<0.001
35-44 years old vs. 45 – 54 years old		0.91	0.68-1.22	0.55
35-44 years old vs. 55+ years old		0.63	0.47-0.84	0.002
45-54 years old vs. 55 years old		0.69	0.53-0.89	0.005

	Wald X^2	Odds ratio	95% CI	*p*-value
Education level	5.33			0.15
Income level	19.05			<0.001
$0-$40,000 vs. $40-80,000		1.80	1.34-2.41	<0.001*
$0-$40,000 vs.$80,000 +		1.84	1.37-2.46	<0.001*
$0-$40,000 vs. Not reported		1.66	1.13-2.44	0.01*
$40-80,000 vs. $80,000 +		1.02	0.81-1.28	0.85
$0-$40,000 vs. Not reported		0.92	0.65-1.30	0.65
$80,000 + vs. Not reported		0.90	0.65-1.26	0.55
Ethnicity Other vs. White	0.27			0.60
Body Mass Index	2.63			0.62
Label use	8.73			0.03
Never vs. Sometimes		1.22	0.91-1.63	0.19
Never vs. Usually		1.32	0.98-1.79	0.07
Never vs. Always		1.51	1.14-2.00	0.005*
Sometimes vs. Usually		1.09	0.84-1.41	0.53
Sometimes vs. Always		1.24	0.98-1.57	0.08
Usually vs. Always		1.14	0.89-1.46	0.30
Knowledge of EER Incorrect vs. Correct	4.93	1.24	1.03-1.50	0.03

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A4. Logistic regression results examining the impact of having a special dietary need on noticing of menu labelling in Wave 1 and 2 (n=2,015†)

	Wald X^2	Odds ratio	95% CI	*p*-value
Wave	0.71			0.40
Site	128.18			<0.001
Wave*Site interaction	67.48	5.10	3.46-7.53	<0.001
Wave 1 vs. Wave 2 at Civic		0.48	0.36-0.64	<0.001
Wave 1 vs. Wave 2 at General		2.46	1.88-3.22	<0.001
Dietary needs No vs. Yes	0.16			0.70
Consumer type	15.84			0.001
Staff/Medical Student vs. Visitor		0.72	0.55-0.94	0.016*
Staff/Medical Student vs. Out- or In-patient		0.48	0.33-0.70	<0.001*
Staff/Medical Student vs. Not reported		0.77	0.43-1.39	0.41
Visitor vs. Out- or In-Patient		0.67	0.47-0.95	0.028
Visitor vs. Not reported		1.07	0.58-1.95	0.82
Out- or In-patient vs. Not reported		1.60	0.83-3.08	0.16
Frequency of visiting the cafeteria	13.19			0.01
Never vs. < once per week		1.06	0.79-1.42	0.68
Never vs. Once per week		1.16	0.82-1.64	0.41
Never vs. 2-3 times per week		1.57	1.13-2.18	0.007*
Never vs. 4 or more times per week		1.64	1.14-2.34	0.007*
< once per week vs. Once per week		1.09	0.79-1.50	0.60
< once per week vs. 2-3 time per week		1.47	1.10-1.98	0.01*
< once per week vs. 4 or more times per week		1.54	1.10-2.15	0.01*
Once per week vs. 2-3 times per week		1.35	0.98-1.86	0.06
Once per week vs.4 or more times per week		1.41	0.99-2.02	0.06
2-3 times per week vs. 4 or more times per week		1.04	0.75-1.45	0.80
Gender Female vs. Male	2.62			0.11
Age	16.42			<0.001
18-34 years old vs. 35-44 years old		0.74	0.55-1.01	0.06
18-34 years old vs.45-54 years old		0.74	0.56-0.99	0.04
18-34 years old vs.55+ years old		0.56	0.43-0.74	<0.001*
35-44 years old vs. 45 – 54 years old		0.99	0.73-1.35	0.97
35-44 years old vs. 55+ years old		0.75	0.56-1.03	0.07
45-54 years old vs. 55 years old		0.76	0.58-1.00	0.046
Education level	6.96			0.07
Income level	7.28			0.06
Ethnicity Other vs. White	0.06			0.80

	Wald X^2	Odds ratio	95% CI	*p*-value
Body Mass Index	2.81			0.59
Label use	5.70			0.13
Knowledge of EER Correct vs Incorrect	5.01	1.25	1.03-1.53	0.025

† One participant refused to answer the question regarding dietary needs and was excluded.
*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A5. Self-reported influence of menu labelling among the entire sample (N=3,061) % (n)

	Civic			General		
	Wave 1 (n=492)	**Wave 2 (n=492)**	**Wave 3 (n=507)**	**Wave 1 (n=497)**	**Wave 2 (n=554)**	**Wave 3 (n=539)**
Purchased…						
Less sodium	9.4 (46)	5.5 (27)	3.7 (19)	3.7 (18)	4.5 (25)	7.6 (41)
Less calories	9.6 (47)	6.8 (33)	3.9 (20)	2.0 (10)	3.8 (21)	6.5 (35)
Select healthier (overall)	7.4 (36)	6.4 (31)	4.7 (24)	2.6 (13)	4.5 (25)	4.3 (23)
Less fat	4.9 (24)	2.0 (10)	1.6 (8)	1.4 (7)	2.4 (13)	3.2 (17)
Select health logo	0.8 (4)	0.8 (4)	0.2 (1)	0.0 (0)	0.9 (5)	0.0 (0)
Less saturated fat	0.4 (2)	0.6 (3)	0.6 (3)	0.0 (0)	0.5 (3)	0.4 (2)
More calories	0.4 (2)	0.2 (1)	0.0 (0)	0.0 (0)	0.5 (3)	0.2 (1)
More fat	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.2 (1)	0.0 (0)
More saturated fat	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
More sodium	0.2 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
Other	3.1 (15)	3.5 (17)	3.2 (16)	2.6 (13)	1.6 (9)	2.8 (15)
Were not influenced by menu labelling	73.6 (360)	79.9 (390)	88.0 (446)	89.8 (441)	85.3 (469)	82.8 (444)

*Participants could select more than one response.

TABLE A6. Nutrients that were most influential among those who noticed multiple nutrients (n=351) %(n)

	Civic			General		
	Wave 1 (n=95)	**Wave 2 (n=68)**	**Wave 3 (n=37)**	**Wave 1 (n=34)**	**Wave 2 (n=53)**	**Wave 3 (n=64)**
None were more influential than others	28.4 (27)	26.5 (18)	24.3 (9)	29.4 (10)	18.9 (10)	31.3 (20)
Calories	27.4 (26)	33.8 (23)	27.0 (10)	38.2 (13)	30.2 (16)	28.1 (18)
Sodium	24.2 (23)	22.1 (15)	32.4 (12)	26.5 (9)	26.4 (14)	18.8 (12)
Fat	17.9 (17)	13.2 (9)	10.8 (4)	5.9 (2)	17.0 (9)	18.8 (12)
Saturated fat	2.1 (2)	2.9 (2)	5.4 (2)	0.0 (0)	1.9 (1)	3.1 (2)
Health logo	0.0 (0)	1.5 (1)	0.0 (0)	0.0 (0)	5.7 (3)	0.0 (0)

TABLE A7. Logistic regression results examining use of menu labelling between intervention mode among the entire sample (n=3,061)

	Wald X^2	Odds ratio	95% CI	*p*-value
Intervention format	51.08			<0.001
Digital menu boards vs. Paper signage		0.26	0.18-0.39	<0.001
Digital menu boards vs. Digital menu boards w/ advertising		0.51	0.40-0.66	<0.001
Paper signage vs. Digital menu boards w/ advertising		0.51	0.36-0.73	<0.001
Consumer type	8.11			0.044
Staff/Medical Student vs. Visitor		0.70	0.52-0.94	0.019
Staff/Medical Student vs. Out- or In-patient		0.61	0.40-0.94	0.025
Staff/Medical Student vs. Not reported		1.09	0.55-2.17	0.80
Visitor vs. Out- or In-Patient		0.88	0.58-1.33	0.54
Visitor vs. Not reported		1.56	0.77-3.16	0.22
Out- or In-patient vs. Not reported		1.78	0.83-3.85	0.14
Frequency of visiting the cafeteria	2.57			0.63
Gender Female vs. Male	0.002			0.97
Age	3.78			0.29
Education level	5.96			0.11
Income level	4.05			0.26
Ethnicity Other vs. White	2.67			0.10
Body Mass Index	3.26			0.52
Label use	119.15			<0.001
Never vs. Sometimes		2.07	1.24-3.48	0.006
Never vs. Usually		4.94	3.01-8.11	<0.001
Never vs. Always		7.30	4.52-11.80	<0.001
Sometimes vs. Usually		2.38	1.74-3.27	<0.001
Sometimes vs. Always		3.52	2.64-4.70	<0.001
Usually vs. Always		1.48	1.16-1.89	0.002

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A8. Logistic regression results examining influence of menu labelling between intervention mode among those who noticed menu labelling (n=1,618)

	Wald X^2	**Odds ratio**	**95% CI**	***p*-value**
Intervention mode	4.97			0.083
Consumer type	0.91			0.82
Frequency of visiting the cafeteria	2.83			0.59
Gender Female vs. Male	0.10			0.76
Age	0.94			0.82
Education level	3.45			0.33
Income level	1.97			0.58
Ethnicity Other vs. White	4.57	0.74	0.56-0.98	0.032
Body Mass Index	4.22			0.38
Label use	105.12			<0.001
Never vs. Sometimes		1.83	1.07-3.14	0.027*
Never vs. Usually		4.56	2.72-7.65	<0.001*
Never vs. Always		6.79	4.11-11.23	<0.001*
Sometimes vs. Usually		2.49	1.78-3.48	<0.001*
Sometimes vs. Always		3.70	2.72-5.05	<0.001*
Usually vs. Always		1.49	1.13-1.96	0.004*
Healthy choices in the past month No vs. Yes	5.79	1.45	1.07-1.96	0.016

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A9. Logistic regression results exploring the impact of meal type on use of menu labelling across in Wave 2 and 3 (n=2,073)†

	Wald X^2	Odds ratio	95% CI	*p*-value
Wave Wave 2 vs. Wave 3	3.11			0.08
Site	0.009			0.92
Wave*Site interaction	4.67	1.76	1.05-2.94	0.03
Wave 2 vs. Wave 3 at Civic cafeteria		0.60	0.41-0.87	0.007
Wave 2 vs. Wave 3 at General cafeteria		1.05	0.74-1.50	0.77
Meal type	22.96			<0.001
Breakfast vs. Lunch		1.98	1.03-3.81	0.04
Breakfast vs. Dinner		2.52	1.25-5.06	0.009*
Breakfast vs. Snack		0.73	0.32-1.68	0.6
Breakfast vs. Other		0.56	0.12-2.74	0.48
Lunch vs. Dinner		1.28	0.92-1.77	0.15
Lunch vs. Snack		0.37	0.21-0.65	<0.001*
Lunch vs. Other		0.28	0.07-1.23	0.09
Dinner vs. Snack		0.29	0.16-0.53	<0.001*
Dinner vs. Other		0.22	0.06-0.98	0.05
Snack vs. Other		0.77	0.16-3.61	0.74
Consumer type	0.45			0.80
Frequency of visiting the cafeteria	4.06			0.40
Gender Female vs. Male	0.24			0.62
Age	4.58			0.21
Education level	3.50			0.32
Income level	2.42			0.49
Ethnicity Other vs. White	1.08			0.30
Body Mass Index	2.85			0.58
Label use	72.06			<0.001
Never vs. Sometimes		1.77	0.97-3.26	0.06
Never vs. Usually		4.14	2.32-7.38	<0.001*
Never vs. Always		5.99	3.43-10.46	<0.001*
Sometimes vs. Usually		2.33	1.58-3.45	<0.001*
Sometimes vs. Always		3.38	2.36-4.82	<0.001*
Usually vs. Always		1.45	1.07-1.96	0.02*

† Due to small numbers in the 'not reported' category of consumer type, those with missing data for this variable were excluded for this analysis.
*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A10. Logistic regression results exploring the impact of having a dietary need or allergy on use of menu labelling across in Wave 1 and 2 (n=2,015)[†]

	Wald X^2	Odds ratio	95% CI	*p*-value
Wave Wave 1 vs. Wave 2	0.83			0.36
Site	35.78			<0.001
Wave*Site interaction	13.85	2.68	1.60-4.51	<0.001
Wave 1 vs Wave 2 at Civic		0.69	0.50-0.96	0.03
Wave 1 vs Wave 2 at General		1.85	1.23-2.79	0.003
Dietary concern	0.03			0.87
Consumer type	9.93			0.02
Staff/Medical Student vs. Visitor		0.68	0.47-0.97	0.03
Staff/Medical Student vs. Out- or In-patient		0.41	0.22-0.75	0.004*
Staff/Medical Student vs. Not reported		0.93	0.44-1.96	0.85
Visitor vs. Out- or In-Patient		0.60	0.33-1.10	0.10
Visitor vs. Not reported		1.37	0.64-2.96	0.42
Out- or In-patient vs. Not reported		2.28	0.92-5.67	0.08
Frequency of visiting the cafeteria	2.05			0.73
Gender Female vs. Male	0.03			0.86
Age	1.53			0.68
Education level	6.95			0.07
Income level	3.31			0.35
Ethnicity Other vs. White	4.55			0.03
Body Mass Index	2.79			0.59
Label use	70.26			<0.001
Never vs. Sometimes		1.94	1.06-3.58	0.03*
Never vs. Usually		4.85	2.71-8.69	<0.001*
Never vs. Always		6.26	3.55-11.05	<0.001*
Sometimes vs. Usually		2.49	1.70-3.65	<0.001*
Sometimes vs. Always		3.22	2.26-4.59	<0.001*
Usually vs. Always		1.29	0.96-1.74	0.09
General health	11.23			0.02
Poor vs. Fair		0.29	0.14-0.62	0.0014*
Poor vs. Good		0.49	0.5-0.97	0.04
Poor vs. Very good		0.49	0.24-1.00	0.05
Poor vs. Excellent		0.51	0.24-1.10	0.09
Fair vs. Good		1.69	1.07-2.67	0.02
Fair vs. Very good		1.69	1.05-2.73	0.03

	Wald X^2	Odds ratio	95% CI	*p*-value
Fair vs. Excellent		1.76	1.01-3.08	0.05
Good vs. Very good		1.00	0.74-1.35	0.99
Good vs. Excellent		1.04	0.69-1.57	0.85
Very good vs. Excellent		1.04	0.69-1.56	0.85

† One participant refused to answer the question regarding dietary needs and was excluded.
*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A11. Linear regression results examining calories purchased across all waves and sites (n=2,781)

	Test statistic	Parameter Estimate (B)	95% CI	*p*-value
Site Civic vs. General	$F_{(df=1)}$=62.75			<0.001
Wave	$F_{(df=2)}$=2.05			0.13
Site X Wave interaction	$F_{(df=2)}$=3.01			0.0496
Wave 1 vs 2 at Civic cafeteria		51.80	11.44-92.17	0.01*
Wave 1 vs 3 at Civic cafeteria		48.03	8.04-88.02	0.02*
Wave 2 vs 3 at Civic cafeteria		-3.77	-43.39-35.84	0.85
Wave 1 vs 2 at General cafeteria		-17.70	-56.62-21.22	0.37
Wave 1 vs 3 at General cafeteria		10.82	-29.08-50.72	0.60
Wave 2 vs 3 at General cafeteria		28.52	-9.78-66.83	0.14
Civic vs. General in Wave 1		127.44	87.51-167.37	<0.001*
Civic vs. General in Wave 2		57.93	19.06-96.81	0.004*
Civic vs. General in Wave 3		90.23	51.13-129.32	<0.001*
Difference in Δ between Wave 1 vs 2 at Civic vs General		-69.51	-125.10- -13.91	0.01*
Difference in Δ between Wave 1 vs 3 at Civic vs General		-37.21	-93.08-18.66	0.19
Difference in Δ between Wave 2 vs 3 at Civic vs General		32.30	-22.81-87.10	0.25
Consumer type	$F_{(df=3)}$=7.03			0.0001
Staff/Medical Student vs. Visitor		74.08	41.88-406.28	<.0001*
Staff/Medical Student vs. Out- or In-patient		52.61	9.08-96.13	0.02
Staff/Medical Student vs. Not reported		63.88	-18.26-146.02	0.13
Visitor vs. Out- or In-Patient		-21.47	-61.69-18.75	0.30
Visitor vs. Not reported		-10.20	-93.53-73.14	0.81
Out- or In-patient vs. Not reported		11.27	-77.02-99.57	0.80
Frequency of visiting the cafeteria	$F_{(df=4)}$=1.23			0.30
Gender Female vs Male	$F_{(df=1)}$=23.30	61.15	36.31-86.00	<0.001
Age	$F_{(df=3)}$=11.06			<0.0011
18-34 years old vs. 35-44 years old		-38.19	-73.80- -2.58	0.04*
18-34 years old vs.45-54 years old		-55.01	-88.71- -21.31	0.001*
18-34 years old vs.55+ years old		-96.68	-123.83- -63.53	<.0001*
35-44 years old vs. 45 – 54 years old		-16.82	-52.77-19.13	0.36
35-44 years old vs. 55+ years old		-58.49	-94.37- -22.60	0.001*
45-54 years old vs. 55 years old		-41.67	-74.16- -9.17	0.01*
Education level	$F_{(df=3)}$=0.82			0.48
Income level	$F_{(df=3)}$=2.11			0.10
Ethnicity Other vs. White	$F_{(df=1)}$=0.10			0.75

	Test statistic	Parameter Estimate (B)	95% CI	*p*-value
Body Mass Index	$F_{(df=4)}$=4.33			0.002
Underweight vs. Normal weight		35.46	-54.18-125.11	0.44
Underweight vs. Overweight		62.54	-28.77-153.86	0.18
Underweight vs. Obese		106.12	13.10-199.14	0.03
Underweight vs. Not reported		52.39	-45.99-150.78	0.30
Normal Weight vs. Overweight		27.08	-1.5-55.66	0.06
Normal Weight vs. Obese		70.66	35.81-105.50	<.0001*
Normal Weight vs. Not reported		16.93	-31.79-65.65	0.50
Overweight vs. Obese		43.58	10.27-76.88	0.01
Overweight vs. Not reported		-10.15	-59.11-38.81	0.68
Obese vs. Not reported		-53.73	-105.11- -2.34	0.04
Label use	$F_{(df=3)}$=5.74			<0.001
Never vs. Sometimes		-29.25	-65.78-7.28	0.12
Never vs. Usually		-67.28	-104.90- -29.66	<0.001*
Never vs. Always		-63.00	-98.66- -27.35	<0.001*
Sometimes vs. Usually		-38.03	-70.23- -5.83	0.02*
Sometimes vs. Always		-33.75	-63.36- -4.14	0.03*
Usually vs. Always		4.28	-26.04-34.60	0.78
General Health	$F_{(df=4)}$=2.61			0.034
Poor vs. Fair		-23.13	-94.13-47.87	0.52
Poor vs. Good		-71.90	-140.40- -3.40	0.04
Poor vs. Very good		-59.23	-129.30 – 11.15	0.10
Poor vs. Excellent		-67.11	-144.00-9.79	0.09
Fair vs. Good		-48.77	-83.16- -14.38	0.01
Fair vs. Very good		-36.10	-73.13-0.94	0.06
Fair vs. Excellent		-43.98	-92.21-4.25	0.07
Good vs. Very good		12.68	-15.08-40.43	0.37
Good vs. Excellent		4.80	-36.41-46.00	0.82
Very good vs. Excellent		-7.88	-48.93-33.17	0.71
Dieting in the previous year No vs. Yes	$F_{(df=1)}$=3.87			0.049

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A12. Linear regression results examining sodium purchased across all waves and sites (n=2,781)

	Test statistic	Parameter Estimate (B)	95% CI	*p*-value
Site Civic vs. General	$F_{(df=1)}$=69.80			<0.001
Wave	$F_{(df=2)}$=10.77			<0.001
Site X Wave interaction	$F_{(df=2)}$=12.31			<0.001
Wave 1 vs 2 at Civic cafeteria		89.19	-14.14-192.51	0.09
Wave 1 vs 3 at Civic cafeteria		86.91	-15.45-189.27	0.10
Wave 2 vs 3 at Civic cafeteria		-2.27	-103.66-99.12	0.96
Wave 1 vs 2 at General cafeteria		-190.46	-290.07- -80.85	<0.001*
Wave 1 vs 3 at General cafeteria		139.17	37.03-241.31	0.008*
Wave 2 vs 3 at General cafeteria		329.63	231-58-427.69	<0.001*
Civic vs. General in Wave 1		323.81	221.60-426.02	<0.001*
Civic vs. General in Wave 2		44.16	-55.35-143.67	0.38
Civic vs. General in Wave 3		376.06	275.99-476.13	<0.001*
Difference in Δ between Wave 1 vs 2 at Civic vs General		-279.65	-421.95- -137.34	<0.001*
Difference in Δ between Wave 1 vs 3 at Civic vs General		52.26	-90.75-195.27	0.47
Difference in Δ between Wave 2 vs 3 at Civic vs General		331.90	190.85-472.95	<.001*
Consumer type	$F_{(df=3)}$=2.88			0.04
Staff/Medical Student vs. Visitor		106.51	24.08-188.94	0.01
Staff/Medical Student vs. Out- or In-patient		130.23	18.82-241.63	0.02
Staff/Medical Student vs. Not reported		135.14	-75.11-345.38	0.21
Visitor vs. Out- or In-Patient		23.72	-79.24-126.68	0.65
Visitor vs. Not reported		28.63	-184.69-241.95	0.79
Out- or In-patient vs. Not reported		4.91	-221.10-230.93	0.97
Frequency of visiting the cafeteria	$F_{(df=4)}$=0.80			0.52
Gender Female vs. male	$F_{(df=1)}$=4.58	69.39	5.80-132.98	0.03
Age	$F_{(df=3)}$=6.90			<0.001
18-34 years old vs. 35-44 years old		-83.22	-174.37-7.93	0.07
18-34 years old vs.45-54 years old		-108.32	-194.58- -22.06	0.01*
18-34 years old vs.55+ years old		-196.24	-281.10- -111.39	<.0001*
35-44 years old vs. 45 – 54 years old		-25.10	-117.11-66.92	0.59
35-44 years old vs. 55+ years old		-113.02	-204.88- -21.16	0.02*
45-54 years old vs. 55 years old		-87.92	-171.10- -4.74	0.04
Education level	$F_{(df=3)}$=0.29			0.83
Income level	$F_{(df=3)}$=0.55			0.65
Ethnicity Other vs. White	$F_{(df=1)}$=1.82			0.18

	Test statistic	Parameter Estimate (B)	95% CI	*p*-value
Body Mass Index	$F_{(df=4)}$=7.33			<0.001
Underweight vs. Normal weight		147.22	-82.24-376.67	0.21
Underweight vs. Overweight		223.76	-9.99-457.51	0.06
Underweight vs. Obese		379.13	141.02-617.23	0.002*
Underweight vs. Not reported		202.08	-49.74-459.91	0.12
Normal Weight vs. Overweight		76.55	3.39-149.70	0.04
Normal Weight vs. Obese		231.91	142.72-321.10	<.0001*
Normal Weight vs. Not reported		54.87	-69.83-179.57	0.39
Overweight vs. Obese		155.37	70.12-240.61	<0.001*
Overweight vs. Not reported		-21.68	-147.00-106.64	0.73
Obese vs. Not reported		-177.04	-308.56- -45.52	0.01*
Label use	$F_{(df=3)}$=5.18			0.001
Never vs. Sometimes		-63.38	-156.89-30.12	0.18
Never vs. Usually		-148.52	-244.81-52.23	0.003
Never vs. Always		-158.63	-249.90- -67.37	<0.001
Sometimes vs. Usually		-85.14	-167.57- -2.71	0.04
Sometimes vs. Always		-95.25	-171.04- -19.46	0.01
Usually vs. Always		-10.11	-87.72-67.49	0.80
General Health	$F_{(df=4)}$=2.58			0.04
Poor vs. Fair		-157.72	-339.47-24.03	0.09
Poor vs. Good		-244.47	-419.81- -69.13	0.006
Poor vs. Very good		-195.18	-375.32- -15.04	0.03
Poor vs. Excellent		-236.77	-443.60- -39.94	0.02
Fair vs. Good		-86.75	-174.78-1.28	0.05
Fair vs. Very good		-37.45	-132.26-57.35	0.44
Fair vs. Excellent		-79.05	-202.50-44.40	0.21
Good vs. Very good		49.29	-21.74-120.33	0.17
Good vs. Excellent		7.70	-97.77-113.17	0.89
Very good vs. Excellent		-41.60	-146.68-63.49	0.44
Dieting in the previous year No vs. Yes	$F_{(df=1)}$=6.18	-33.66	-149.67- -17.68	0.01

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A13. Linear regression results examining saturated fat purchased across all waves and sites (n=2,781)

	Test statistic	Parameter Estimation (B)	95% CI	*p*-value
Site Civic vs. General	$F_{(df=1)}$=74.58			<0.001
Wave	$F_{(df=2)}$=1.88			0.15
Site X Wave interaction	$F_{(df=2)}$=7.54			<0.001
Wave 1 vs 2 at Civic cafeteria		0.51	-0.08-1.09	0.09
Wave 1 vs 3 at Civic cafeteria		0.36	-0.22-0.94	0.22
Wave 2 vs 3 at Civic cafeteria		-0.15	-0.72-0.43	0.62
Wave 1 vs 2 at General cafeteria		-0.73	-1.30- -0.17	0.01*
Wave 1 vs 3 at General cafeteria		-1.15	-1.73- -0.57	<0.001*
Wave 2 vs 3 at General cafeteria		-0.42	-0.98-0.14	0.14
Civic vs. General in Wave 1		2.38	1.79-2.96	<.0001*
Civic vs. General in Wave 2		1.13	0.57-1.70	<.0001*
Civic vs. General in Wave 3		0.86	0.29-1.43	0.003*
Difference in Δ between Wave 1 vs 2 at Civic vs General		-1.24	-2.05- -0.43	0.003*
Difference in Δ between Wave 1 vs 3 at Civic vs General		-1.51	-2.33- -0.70	<0.001*
Difference in Δ between Wave 2 vs 3 at Civic vs General		-0.27	-1.07-0.53	0.51
Consumer type	$F_{(df=3)}$=2.06			0.10
Staff/Medical Student vs. Visitor		0.47	0.00-0.94	0.05
Staff/Medical Student vs. Out- or In-patient		0.40	-0.23-1.03	0.22
Staff/Medical Student vs. Not reported		1.09	-0.10-2.29	0.07
Visitor vs. Out- or In-Patient		-0.07	-0.66-0.52	0.82
Visitor vs. Not reported		0.63	-0.59-1.84	0.31
Out- or In-patient vs. Not reported		0.70	-0.59-1.98	0.29
Frequency of visiting the cafeteria	$F_{(df=4)}$=1.31			0.26
Gender Female vs. Male	$F_{(df=1)}$=8.69	0.54	0.18-0.89	0.003
Age	$F_{(df=3)}$=3.41			0.02
18-34 years old vs. 35-44 years old		-0.22	-0.74-0.30	0.41
18-34 years old vs.45-54 years old		-0.41	-0.90-0.08	0.10
18-34 years old vs.55+ years old		-0.77	-1.25- -0.29	0.002*
35-44 years old vs. 45 – 54 years old		-0.19	-0.71-0.34	0.48
35-44 years old vs. 55+ years old		-0.55	-1.07- -0.03	0.04
45-54 years old vs. 55 years old		-0.36	-0.84-0.11	0.13
Education level	$F_{(df=3)}$=1.10			0.35
Income level	$F_{(df=3)}$=0.98			0.40
Ethnicity Other vs. White	$F_{(df=1)}$=0.82			0.36

	Test statistic	Parameter Estimation (B)	95% CI	*p*-value
Body Mass Index	$F_{(df=4)}$=5.12			<0.001
Underweight vs. Normal weight		0.81	-0.49-2.12	0.22
Underweight vs. Overweight		0.83	-0.49-2.15	0.22
Underweight vs. Obese		1.77	0.43-3.12	0.01*
Underweight vs. Not reported		1.26	-0.17-2.69	0.08
Normal Weight vs. Overweight		0.02	-0.39-0.42	0.93
Normal Weight vs. Obese		0.96	0.47-1.45	<0.001*
Normal Weight vs. Not reported		0.45	-0.25-1.15	0.21
Overweight vs. Obese		0.94	0.46-1.43	<0.001*
Overweight vs. Not reported		0.43	-0.28-1.14	0.23
Obese vs. Not reported		-0.51	-1.26-0.24	0.18
Label use	$F_{(df=3)}$=3.37			0.02
Never vs. Sometimes		-0.27	-0.80-0.26	0.33
Never vs. Usually		-0.74	-1.29- -0.20	0.008*
Never vs. Always		-0.66	-1.17- -0.14	0.01*
Sometimes vs. Usually		-0.47	-0.94- -0.01	0.05
Sometimes vs. Always		-0.39	-0.82-0.04	0.08
Usually vs. Always		0.09	-0.36-0.53	0.70
General Health	$F_{(df=4)}$=3.62			0.006
Poor vs. Fair		0.11	-0.92-1.14	0.83
Poor vs. Good		-0.78	-1.78-0.22	0.12
Poor vs. Very good		-0.31	-1.34-0.71	0.55
Poor vs. Excellent		-0.48	-1.60-0.63	0.40
Fair vs. Good		-0.89	-1.39- -0.39	<0.001*
Fair vs. Very good		-0.42	-0.96 -0.11	0.12
Fair vs. Excellent		-0.60	-1.30-0.11	0.10
Good vs. Very good		0.47	0.06-0.87	0.02
Good vs. Excellent		0.30	-0.30-0.89	0.33
Very good vs. Excellent		-0.17	-0.77-0.43	0.57

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A14. Linear regression results examining total fat purchased across all waves and sites (n=2,781)

	Test statistic	Parameter Estimation (B)	95% CI	*p*-value
Site Civic vs. General	$F_{(df=1)}$=144.09			<0.001
Wave	$F_{(df=1)}$=0.81			0.44
Site X Wave interaction	$F_{(df=2)}$=8.43			<0.001
Wave 1 vs 2 at Civic cafeteria		2.84	0.97-4.72	0.003*
Wave 1 vs 3 at Civic cafeteria		3.02	1.16-4.88	0.002*
Wave 2 vs 3 at Civic cafeteria		0.17	-1.67-2.02	0.85
Wave 1 vs 2 at General cafeteria		-2.18	-3.99- -0.38	0.02*
Wave 1 vs 3 at General cafeteria		-1.31	-3.17-0.54	0.17
Wave 2 vs 3 at General cafeteria		0.87	-0.92-2.65	0.34
Civic vs. General in Wave 1		9.60	7.74-11.45	<0.001*
Civic vs. General in Wave 2		4.57	2.76-6.38	<0.001*
Civic vs. General in Wave 3		5.26	3.45-7.08	<0.001*
Difference in Δ between Wave 1 vs 2 at Civic vs General		-5.03	-7.61- -2.44	<0.001*
Difference in Δ between Wave 1 vs 3 at Civic vs General		-4.33	-6.93- -1.73	0.001*
Difference in Δ between Wave 2 vs 3 at Civic vs General		0.69	-1.87-3.26	0.60
Consumer type	$F_{(df=3)}$=1.68			0.17
Frequency of visiting the cafeteria	$F_{(df=4)}$=0.73			0.57
Gender Female vs. Male	$F_{(df=1)}$=5.85	1.41	0.27-2.55	0.02
Age	$F_{(df=3)}$=4.63			0.003
18-34 years old vs. 35-44 years old		-1.04	-2.70-0.61	0.22
18-34 years old vs.45-54 years old		-1.21	-2.77-0.36	0.13
18-34 years old vs.55+ years old		-2.89	-4.43- -1.35	<0.001*
35-44 years old vs. 45 – 54 years old		-0.16	-1.84-1.51	0.85
35-44 years old vs. 55+ years old		-1.85	-3.52- -0.18	0.03
45-54 years old vs. 55 years old		-1.68	-3.20- -0.17	0.03
Education level	$F_{(df=3)}$=1.13			0.34
Income level	$F_{(df=3)}$=1.47			0.22
Ethnicity Other vs. White	$F_{(df=1)}$=2.73			0.10
Body Mass Index	$F_{(df=4)}$=2.54			0.04
Underweight vs. Normal weight		1.66	-2.51-5.83	0.43
Underweight vs. Overweight		1.68	-2.55-5.91	0.44
Underweight vs. Obese		3.86	-0.43-8.16	0.08
Underweight vs. Not reported		2.19	-2.38-6.75	0.35

	Test statistic	Parameter Estimation (B)	95% CI	*p*-value
Normal Weight vs. Overweight		0.01	-1.29-1.32	0.98
Normal Weight vs. Obese		2.20	0.63-3.78	0.006*
Normal Weight vs. Not reported		0.52	-1.73-2.77	0.65
Overweight vs. Obese		2.19	0.64-3.73	0.006*
Overweight vs. Not reported		0.51	-1.77-2.79	0.66
Obese vs. Not reported		-1.68	-4.07-0.71	0.17
Label use	$F_{(df=3)}$=3.02			0.03
Never vs. Sometimes		-1.49	-3.18-0.21	0.09
Never vs. Usually		-2.62	-4.36- -0.87	0.003*
Never vs. Always		-1.95	-3.60- -0.30	0.02
Sometimes vs. Usually		-1.13	-2.63-0.37	0.14
Sometimes vs. Always		-0.46	-1.83-0.91	0.51
Usually vs. Always		0.67	-0.74-2.08	0.35
General Health	$F_{(df=4)}$=2.75			0.03
Poor vs. Fair		0.39	-2.91-3.70	0.82
Poor vs. Good		-2.05	-5.24-1.13	0.21
Poor vs. Very good		-0.66	-3.94-2.61	0.69
Poor vs. Excellent		-1.08	-4.66-2.49	0.55
Fair vs. Good		-2.45	-4.05- -0.85	0.00
Fair vs. Very good		-1.06	-2.78-0.67	0.23
Fair vs. Excellent		-1.48	-3.72-0.77	0.20
Good vs. Very good		1.39	0.10-2.68	0.03
Good vs. Excellent		0.97	-0.94-2.89	0.32
Very good vs. Excellent		-0.42	-2.33-1.49	0.67

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A15. Linear regression results examining calories purchased for food only across all waves and sites (n=2,781)

	Test statistic	Parameter Estimation (B)	95% CI	*p*-value
Site Civic vs. General	$F_{(df=1)}$=85.85			<0.001
Wave	$F_{(df=1)}$=1.98			0.14
Site X Wave interaction	$F_{(df=2)}$=3.77			0.02
Wave 1 vs 2 at Civic cafeteria		45.54	8.25-82.82	0.02*
Wave 1 vs 3 at Civic cafeteria		38.97	2.07-75.87	0.04
Wave 2 vs 3 at Civic cafeteria		-6.57	-43.13-30.00	0.72
Wave 1 vs 2 at General cafeteria		-25.22	-61.17-0.73	0.17
Wave 1 vs 3 at General cafeteria		13.77	-23.07-50.61	0.46
Wave 2 vs 3 at General cafeteria		38.99	3.62-74.36	0.03*
Civic vs. General in Wave 1		131.19	94.31-168.08	<0.001*
Civic vs. General in Wave 2		60.43	24.52-96.35	0.001*
Civic vs. General in Wave 3		105.99	69.94-142.05	<0.001*
Difference in Δ between Wave 1 vs 2 at Civic vs General		-70.76	-122.12- -19.40	0.01*
Difference in Δ between Wave 1 vs 3 at Civic vs General		-25.20	-76.77-26.37	0.34
Difference in Δ between Wave 2 vs 3 at Civic vs General		45.56	-5.31-96.43	0.08
Consumer type	$F_{(df=3)}$=4.17			0.006
Staff/Medical Student vs. Visitor		52.12	22.40-81.84	0.001*
Staff/Medical Student vs. Out- or In-patient		32.85	-7.31-73.01	0.11
Staff/Medical Student vs. Not reported		52.67	-23.19-128.53	0.17
Visitor vs. Out- or In-Patient		-19.27	-56.41-17.87	0.31
Visitor vs. Not reported		0.55	-76.43-77.54	0.99
Out- or In-patient vs. Not reported		19.82	-61.74-101.39	0.63
Frequency of visiting the cafeteria	$F_{(df=4)}$=0.94			0.44
Gender Female vs. Male	$F_{(df=1)}$=16.45			<0.001
Age	$F_{(df=3)}$=8.01			<0.001
18-34 years old vs. 35-44 years old		-35.51	-68.39- -2.64	0.03
18-34 years old vs.45-54 years old		-45.33	-76.45- -14.20	0.004*
18-34 years old vs.55+ years old		-76.27	-106.87- -45.66	<.0001*
35-44 years old vs. 45 – 54 years old		-9.82	-43.02-23.39	0.56
35-44 years old vs. 55+ years old		-40.75	-73.88- -7.62	0.02*
45-54 years old vs. 55 years old		-30.94	-60.95- -0.93	0.04
Education level	$F_{(df=3)}$=0.60			0.62
Income level	$F_{(df=3)}$=2.13			0.09
Ethnicity Other vs. White	$F_{(df=1)}$=0.13			0.72

	Test statistic	Parameter Estimation (B)	95% CI	*p*-value
Body Mass Index	$F_{(df=4)}$=3.00			0.02
Underweight vs. Normal weight		33.35	-49.41-116.12	0.43
Underweight vs. Overweight		53.31	-30.64-137.26	0.21
Underweight vs. Obese		84.90	-0.39-170.20	0.05
Underweight vs. Not reported		41.91	-48.61-132.44	0.36
Normal Weight vs. Overweight		19.96	-5.85-45.77	0.13
Normal Weight vs. Obese		51.55	20.30-82.80	0.001*
Normal Weight vs. Not reported		8.56	-36.13-53.24	0.71
Overweight vs. Obese		31.59	0.93-62.26	0.04
Overweight vs. Not reported		-11.40	-56.62-33.83	0.62
Obese vs. Not reported		-42.99	-90.39-4.41	0.08
Label use	$F_{(df=3)}$=3.54			0.01
Never vs. Sometimes		-28.25	-61.96-5.47	0.10
Never vs. Usually		-54.40	-89.03- -19.77	0.002*
Never vs. Always		-43.18	-75.92- -10.44	0.01*
Sometimes vs. Usually		-26.16	-55.86-3.55	0.08
Sometimes vs. Always		-14.94	-42.19-12.31	0.28
Usually vs. Always		11.22	-16.78-39.21	0.43
General Health	$F_{(df=4)}$=2.84			0.02
Poor vs. Fair		-19.58	-85.16-46.00	0.56
Poor vs. Good		-67.29	-130.54- -4.03	0.04
Poor vs. Very good		-55.71	-120.70-9.27	0.09
Poor vs. Excellent		-61.62	-132.60-9.36	0.09
Fair vs. Good		-47.71	-79.47- -15.95	0.003*
Fair vs. Very good		-36.13	-70.33- -1.93	0.04
Fair vs. Excellent		-42.04	-86.57-2.49	0.06
Good vs. Very good		11.58	-14.05-37.20	0.38
Good vs. Excellent		5.67	-32.38-43.71	0.77
Very good vs. Excellent		-5.91	-43.82-32.00	0.76

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A16. Linear regression results examining calories purchased for drinks only across all waves and sites (n=2,781)

	Test statistic	Parameter Estimation (B)	95% CI	*p*-value
Site Civic vs. General	$F_{(df=1)}$=4.81			0.029
Wave	$F_{(df=1)}$=1.50			0.22
Site X Wave interaction	$F_{(df=2)}$=1.77			0.17
Consumer type	$F_{(df=3)}$=7.89			<0.001
Staff/Medical Student vs. Visitor		22.71	13.17-32.26	<0.001*
Staff/Medical Student vs. Out- or In-patient		21.75	9.09-34.40	<0.001*
Staff/Medical Student vs. Not reported		12.40	-11.98-36.79	0.32
Visitor vs. Out- or In-Patient		-0.97	-12.78-10.85	0.87
Visitor vs. Not reported		-10.31	-35.04-14.43	0.41
Out- or In-patient vs. Not reported		-9.34	-35.45-16.77	0.48
Frequency of visiting the cafeteria	$F_{(df=4)}$=0.47			0.76
Gender Female vs. Male	$F_{(df=1)}$=19.55	16.68	9.28-24.07	<0.001
Age	$F_{(df=3)}$=6.46			<0.001
18-34 years old vs. 35-44 years old		-3.48	-14.07-7.11	0.52
18-34 years old vs.45-54 years old		-10.24	-20.26- -0.23	0.045
18-34 years old vs.55+ years old		-20.87	-30.70- -11.04	<0.001*
35-44 years old vs. 45 – 54 years old		-6.76	-17.46-3.93	0.22
35-44 years old vs. 55+ years old		-17.39	-28.04- -6.74	0.001*
45-54 years old vs. 55 years old		-10.63	-20.29- -0.97	0.03
Education level	$F_{(df=3)}$=1.02			0.39
Income level	$F_{(df=3)}$=0.89			0.45
Ethnicity Other vs. White	$F_{(df=1)}$=0.001			0.98
Body Mass Index	$F_{(df=4)}$=2.01			0.09
Label use	$F_{(df=3)}$=9.33			<0.001
Never vs. Sometimes		-1.67	-12.52-9.19	0.76
Never vs. Usually		-14.73	-25.91- -3.55	0.01*
Never vs. Always		-22.03	-32.60- -11.45	<0.001*
Sometimes vs. Usually		-13.06	-22.64- -3.50	0.008*
Sometimes vs. Always		-20.36	-29.15- -11.56	<0.001*
Usually vs. Always		-7.30	-16.37- 1.72	0.11
Dieting behaviour in the past year Yes vs. No	$F_{(df=1)}$=6.63	10.07	2.40-17.74	0.01

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A17. Linear regression results examining the effect of noticing calorie information on calories purchased (n=2,781)

	Test statistic	Parameter Estimation (B)	95% CI	*p*-value
Menu label noticing Did not notice vs. noticed	$F_{(df=1)}$=0.53			0.47
Consumer type	$F_{(df=3)}$=7.85			<0.001
Staff/Medical Student vs. Visitor		79.21	46.71-111.71	<0.001*
Staff/Medical Student vs. Out- or In-patient		62.71	18.64-106.79	0.005*
Staff/Medical Student vs. Not reported		58.54	-26.57-140.64	0.16
Visitor vs. Out- or In-Patient		-16.49	-57.19-24.20	0.43
Visitor vs. Not reported		-20.67	-103.81-62.47	0.63
Out- or In-patient vs. Not reported		-4.18	-92.36-84.01	0.93
Frequency of visiting the cafeteria	$F_{(df=4)}$=0.83			0.51
Gender Female vs. Male	$F_{(df=2)}$=26.29	64.91	40.08-89.73	<0.001
Age	$F_{(df=3)}$=10.84			<0.001
18-34 years old vs. 35-44 years old		-38.20	-74.27- -2.13	0.04*
18-34 years old vs.45-54 years old		-59.24	-93.38- -25.10	<0.001*
18-34 years old vs.55+ years old		-96.89	-130.63- -63-15	<0.001*
35-44 years old vs. 45 – 54 years old		-21.04	-57.40-15.31	0.26
35-44 years old vs. 55+ years old		-58.69	-95.06- -22.32	0.002*
45-54 years old vs. 55 years old		-37.65	-70.57- -4.73	0.03*
Education level	$F_{(df=3)}$=0.88			0.45
Income level	$F_{(df=3)}$=2.65			0.047
$0-$40,000 vs. $40-80,000		-24.97	-61.51-11.57	0.18
$0-$40,000 vs.$80,000 +		-49.37	-86.24- -12.49	0.01
$0-$40,000 vs. Not reported		-16.80	-62.97-29.37	0.48
$40-80,000 vs. $80,000 +		-24.40	-53.19-4.40	0.10
$0-$40,000 vs. Not reported		8.17	-33.09-49.43	0.70
$80,000 + vs. Not reported		32.57	-7.13-72.26	0.11
Ethnicity Other vs. White	$F_{(df=1)}$=0.17			0.68
Body Mass Index	$F_{(df=4)}$=2.92			0.02
Underweight vs. Normal weight		28.63	-62.03-119.30	0.54
Underweight vs. Overweight		47.76	-44.25-139.78	0.31
Underweight vs. Obese		85.43	-8.06-178.92	0.07
Underweight vs. Not reported		38.04	-61.18-137.25	0.45
Normal Weight vs. Overweight		19.13	-9.19-47.44	0.19
Normal Weight vs. Obese		56.79	22.55-91.04	0.001*
Normal Weight vs. Not reported		9.40	-39.39-58.19	0.71
Overweight vs. Obese		37.67	4.04-71.29	0.03
Overweight vs. Not reported		-9.73	-59.11-39.66	0.70
Obese vs. Not reported		-47.39	-99.17-4.38	0.07

	Test statistic	Parameter Estimation (B)	95% CI	*p*-value
Label use	$F_{(df=3)}$=5.85			<0.001
Never vs. Sometimes		-32.82	-69.74-4.10	0.08
Never vs. Usually		-68.26	-106.22- -30.30	<0.001*
Never vs. Always		-66.10	-101.97- -30.22	<0.001*
Sometimes vs. Usually		-35.44	-67.96- -2.92	0.03*
Sometimes vs. Always		-33.28	-63.14- -3.41	0.03*
Usually vs. Always		2.17	-28.48-32.81	0.89
General Health	$F_{(df=4)}$=2.85			0.023
Poor vs. Fair		-11.94	-83.75-59.88	0.74
Poor vs. Good		-65.94	-135.27-3.39	0.06
Poor vs. Very good		-51.46	-122.67-19.75	0.16
Poor vs. Excellent		-63.04	-140.85-14.76	0.11
Fair vs. Good		-54.01	-88.76- -19.25	0.00
Fair vs. Very good		-39.52	-77.00- -2.05	0.04
Fair vs. Excellent		-51.11	-99.80- -2.42	0.04
Good vs. Very good		14.48	-13.61- 42.57	0.31
Good vs. Excellent		2.90	-38.78-44.58	0.89
Very good vs. Excellent		-11.58	-53.10- 29.93	0.58

*Significant after post-hoc testing using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A18. Linear regression results examining the effect of self-reported use of calorie information on calories purchased (n=2,781)

	Test statistic	**Parameter Estimation (B)**	**95% CI**	***p*-value**
Use of menu labelling No vs. Yes	$F_{(df=1)}$=8.27	-47.32	-79.60- -15.05	0.004
Consumer type	$F_{(df=3)}$=7.27			<0.001
Staff/Medical Student vs. Visitor		76.06	43.64-108.48	<.0001*
Staff/Medical Student vs. Out- or In-patient		58.03	14.09-101.96	0.01*
Staff/Medical Student vs. Not reported		59.01	-22.97-140.99	0.16
Visitor vs. Out- or In-Patient		-18.03	-58.66-22.59	0.38
Visitor vs. Not reported		-17.05	-100.10-65.99	0.69
Out- or In-patient vs. Not reported		0.98	-87.10-89.06	0.98
Frequency of visiting the cafeteria	$F_{(df=4)}$=0.80			0.52
Gender Female vs. Male	$F_{(df=1)}$=26.00	64.46	39.67-89.24	<0.001
Age	$F_{(df=3)}$=11.66			<0.001
18-34 years old vs. 35-44 years old		-38.90	-74.88-2.93	0.03*
18-34 years old vs.45-54 years old		-60.01	-94.05- -25.97	<0.001*
18-34 years old vs.55+ years old		-99.89	-133.40- -66.39	<0.001*
35-44 years old vs. 45 – 54 years old		-21.11	-57.41-15.20	0.25
35-44 years old vs. 55+ years old		-60.99	-97.27- -24.71	0.001*
45-54 years old vs. 55 years old		-39.88	-72.72- -7.05	0.02*
Education level	$F_{(df=3)}$=0.77			0.51
Income level	$F_{(df=3)}$=2.38			0.07
Ethnicity Other vs. White	$F_{(df=3)}$=0.11			0.74
Body Mass Index	$F_{(df=4)}$=3.07			0.02
Underweight vs. Normal weight		31.10	-59.42-121.61	0.50
Underweight vs. Overweight		50.65	-41.17-142.47	0.28
Underweight vs. Obese		88.79	-4.2-182.09	0.06
Underweight vs. Not reported		38.91	-60.12-137.94	0.44
Normal Weight vs. Overweight		19.55	-8.71-47.81	0.18
Normal Weight vs. Obese		57.69	23.50-91.88	0.001*
Normal Weight vs. Not reported		7.81	-40.93-56.55	0.75
Overweight vs. Obese		38.14	4.56-71.72	0.03
Overweight vs. Not reported		-11.74	-61.08-37.59	0.64
Obese vs. Not reported		-49.88	-101.61-1.85	0.06
Label use	$F_{(df=3)}$=4.23			0.005
Never vs. Sometimes		-30.97	-67.	0.10
Never vs. Usually		-61.76		0.002*
Never vs. Always		-55.97		0.003*
Sometimes vs. Usually		-30.80		0.06
Sometimes vs. Always		-25.00		0.11
Usually vs. Always		5.80		0.71

	Test statistic	Parameter Estimation (B)	95% CI	*p*-value
General Health	$F_{(df=3)}$=2.91			0.02
Poor vs. Fair		-17.80	-89.60-53.99	0.63
Poor vs. Good		-71.23	-140.53- -1.93	0.04
Poor vs. Very good		-55.99	-127.14-15.16	0.12
Poor vs. Excellent		-67.05	-144.78-10.38	0.09
Fair vs. Good		-53.42	-88.14- -18.71	0.003*
Fair vs. Very good		-38.19	-75.62- -0.76	0.05
Fair vs. Excellent		-49.25	-97.88- -0.61	0.05
Good vs. Very good		15.24	-12.82-43.29	0.29
Good vs. Excellent		4.18	-37.45-45.80	0.84
Very good vs. Excellent		-11.06	-52.52-30.40	0.60

*Significant after post-hoc testing using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A19. Logistic regression results examining the likelihood of correctly estimating calorie content of meal within ± 50 kcal in Wave 1 and Wave 2 (n=1,844)

	Wald X^2	Odds ratio	95% CI	*p*-value
Site Civic vs. General	16.83			<0.001
Wave	0.74			0.39
Site X Wave interaction	1.23			0.27
Consumer type	1.36			0.71
Frequency of visiting the cafeteria	1.37			0.85
Gender Female vs. Male	9.39	0.60	0.43-0.83	0.002
Age	3.87			0.41
Education level	0.25			0.97
Income level	8.03			0.046
$0-$40,000 vs. $40-80,000		0.95	0.57-1.57	0.83
$0-$40,000 vs.$80,000 +		1.55	0.95-2.54	0.08
$0-$40,000 vs. Not reported		1.12	0.61-2.04	0.72
$40-80,000 vs. $80,000 +		1.64	1.13-2.37	0.009
$0-$40,000 vs. Not reported		1.18	0.70-1.99	0.54
$80,000 + vs. Not reported		0.72	0.44-1.17	0.18
Ethnicity Other vs. White	0.10			0.76
Body Mass Index	9.09			0.06
Label use	5.23			0.16
Knowledge of EER Incorrect vs. Correct	4.32	1.37	1.02-1.84	0.04
Total calories purchased	17.96	0.999	0.998-0.999	<0.001

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A20. Logistic regression results examining the likelihood of correctly estimating calorie content of meal within ± 50 kcal across all waves (n=2,781)

	Wald X^2	Odds ratio	95% CI	*p*-value
Site Civic vs. General	17.74			<0.001
Wave	0.75			0.69
Site X Wave interaction	2.17			0.34
Consumer type	0.97			0.81
Frequency of visiting the cafeteria	2.44			0.66
Gender Female vs. Male	6.03	0.72	0.56-0.94	0.01
Age	3.50			0.32
Education level	2.19			0.53
Income level	10.54			0.01
$0-$40,000 vs. $40-80,000		0.98	0.66-1.46	0.91
$0-$40,000 vs.$80,000 +		1.50	1.02-2.21	0.04
$0-$40,000 vs. Not reported		1.00	0.60-1.57	0.99
$40-80,000 vs. $80,000 +		1.53	1.14-2.06	0.005*
$0-$40,000 vs. Not reported		1.02	0.65-1.61	0.93
$80,000 + vs. Not reported		0.67	0.43-1.02	0.062
Ethnicity Other vs. White	0.17			0.68
Body Mass Index	6.93			0.14
Label use	7.21			0.07
Knowledge of EER Incorrect vs. Correct	9.19	1.46	1.14-1.86	0.002
Total calories purchased	39.93	0.999	0.998-0.999	<0.001

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A21. Logistic regression results examining the likelihood of correctly estimating calorie content of food items only within ± 50 kcal across all waves (n=2,783)

	Wald X^2	Odds ratio	95% CI	*p*-value
Site Civic vs. General	12.42			<0.001
Wave	0.37			0.83
Site X Wave interaction	3.90			0.14
Consumer type	1.68			0.64
Frequency of visiting the cafeteria	1.33			0.86
Gender Female vs. Male	6.57	0.72	0.55-0.92	0.01
Age	4.88			0.18
Education level	3.62			0.31
Income level	10.98			0.01
$0-$40,000 vs. $40-80,000		0.79	0.54-1.16	0.22
$0-$40,000 vs.$80,000 +		1.27	0.88-1.83	0.20
$0-$40,000 vs. Not reported		0.88	0.53-1.44	0.60
$40-80,000 vs. $80,000 +		1.61	1.20-2.17	0.002*
$0-$40,000 vs. Not reported		1.11	0.71-1.75	0.65
$80,000 + vs. Not reported		0.70	0.45-1.05	0.08
Ethnicity Other vs. White	0.01			0.93
Body Mass Index	5.22			0.27
Label use	7.73			0.05
Knowledge of EER Incorrect vs. correct	7.38	1.39	1.10-1.77	0.007
Food calories purchased	40.79			<0.001

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A22. Logistic regression results examining the likelihood of correctly estimating calorie content of drink items only within ± 50 kcal across all waves (n=1,567)

	Wald X^2	Odds ratio	95% CI	*p*-value
Site Civic vs. General	22.96			<0.001
Wave	11.06			0.004
Site X Wave interaction	11.23			0.004
Wave 1 vs 2 at Civic cafeteria		1.55	1.05-2.29	0.03
Wave 1 vs 3 at Civic cafeteria		1.43	0.98-2.11	0.07
Wave 2 vs 3 at Civic cafeteria		0.93	0.63-1.35	0.69
Wave 1 vs 2 at General cafeteria		1.30	0.89-1.89	0.18
Wave 1 vs 3 at General cafeteria		0.60	0.41-0.89	0.01*
Wave 2 vs 3 at General cafeteria		0.46	0.32-0.67	<0.001*
Civic vs. General in Wave 1		0.83	0.56-1.22	0.34
Civic vs. General in Wave 2		0.69	0.48-1.01	0.05
Civic vs. General in Wave 3		0.35	0.24-0.51	<0.001*
Difference in Δ between Wave 1 vs 2 at Civic vs General		0.84	0.49-1.44	0.52
Difference in Δ between Wave 1 vs 3 at Civic vs General		0.50	0.30-0.85	0.01*
Difference in Δ between Wave 2 vs 3 at Civic vs General		0.42	0.24-0.72	0.002*
Consumer type	3.93			0.27
Frequency of visiting the cafeteria	3.41			0.49
Gender Female vs. Male	9.06	0.70	0.55-0.88	0.003
Age	4.55			0.21
Education level	9.19			0.03
High school or less vs. some college or university		1.24	0.79-1.94	0.35
High school or less vs. Completed college or university		1.27	0.91-1.79	0.16
High school or less vs. Graduate or professional school		1.80	1.21-2.70	0.004
Some college or university vs. Completed college or university		1.03	0.71-1.51	0.88
Some college or university vs. Graduate or professional school		1.46	0.95-2.24	0.08
Completed college or university vs. Graduate or professional school		1.42	1.07-1.88	0.02
Income level	6.40			0.09
Ethnicity Other vs. White	0.17			0.68
Body Mass Index	8.69			0.07

	Wald X^2	Odds ratio	95% CI	*p*-value
Label use	3.52			0.32
Knowledge of EER Incorrect vs. Correct	8.73	1.40	1.12-1.76	0.003
Drink calories purchased	127.64	0.99	0.992-0.995	<0.001

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A23. Logistic regression examining socio-demographic variables associated with correctly estimating calorie content of meals purchased with ±50 kcal (n=1,255)

	Wald X^2	**Odds ratio**	**95% CI**	***p*-value**
Noticed menu labelling No vs. Yes	4.55	1.30	1.02-1.65	0.03
Consumer type	1.07			0.78
Frequency of visiting the cafeteria	2.22			0.69
Gender Female vs. Male	5.20	0.74	0.57-0.96	0.02
Age	2.65			0.45
Education level	2.11			0.55
Income level	10.55			0.01
$0-$40,000 vs. $40-80,000		0.96	0.64-1.43	0.83
$0-$40,000 vs.$80,000 +		1.46	0.99-2.15	0.06
$0-$40,000 vs. Not reported		0.93	0.56-1.57	0.81
$40-80,000 vs. $80,000 +		1.52	1.14-2.04	0.01*
$0-$40,000 vs. Not reported		0.98	0.62-1.55	0.93
$80,000 + vs. Not reported		0.64	0.42-0.98	0.04
Ethnicity Other vs. White	0.24			0.62
Body Mass Index	7.68			0.10
Label use	5.78			0.12
Knowledge of EER Incorrect vs. Correct	7.59	1.40	1.10-1.79	0.006
Calories in meal purchased	46.50	0.998	0.998-0.999	<0.001

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A24. Logistic regression examining 'gross underestimation' among all waves and sites (n=2,084)

	Wald X^2	Odds ratio	95% CI	*p*-value
Site Civic vs. General	9.39			0.002
Wave	2.15			0.34
Site X Wave interaction	3.99			0.14
Consumer type	2.19			0.53
Frequency of visiting the cafeteria	3.10			0.54
Gender Female vs. Male	0.30			0.58
Age	16.84			<0.001
18-34 years old vs. 35-44 years old		2.26	1.40-3.64	<0.001*
18-34 years old vs.45-54 years old		1.91	1.20-3.04	0.01*
18-34 years old vs.55+ years old		2.40	1.53-3.76	<0.001*
35-44 years old vs. 45 – 54 years old		0.85	0.54-1.34	0.48
35-44 years old vs. 55+ years old		1.06	0.68-1.66	0.79
45-54 years old vs. 55 years old		1.25	0.83-1.89	0.28
Education level	16.59			<0.001
High school or less vs. some college or university		0.55	0.32-0.96	0.04
High school or less vs. Completed college or university		0.48	0.32-0.72	<0.001*
High school or less vs. Graduate or professional school		0.36	0.21-0.60	<0.001*
Some college or university vs. Completed college or university		0.86	0.53-1.41	0.56
Some college or university vs. Graduate or professional school		0.64	0.36-1.15	0.14
Completed college or university vs. Graduate or professional school		0.74	0.49-1.13	0.17
Income level	9.85			0.02
$0-$40,000 vs. $40-80,000		1.01	0.65-1.56	0.97
$0-$40,000 vs.$80,000 +		0.58	0.369-0.92	0.02
$0-$40,000 vs. Not reported		0.80	0.45-1.45	0.47
$40-80,000 vs. $80,000 +		0.57	0.40-0.83	0.003
$0-$40,000 vs. Not reported		0.80	0.47-1.36	0.41
$80,000 + vs. Not reported		1.39	0.81-2.37	0.23
Ethnicity Other vs. White	8.48	0.59	0.41-0.84	0.004
Body Mass Index	8.55			0.07
Label use	4.54			0.21

	Wald X^2	Odds ratio	95% CI	*p*-value
Knowledge of EER Incorrect vs. Correct	18.35	0.51	0.38-0.70	<0.001
Total calories purchased	15.86	1.01	1.000-1.001	<0.001

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.

TABLE A25. Linear regression results examining the absolute difference between the estimated and actual amount (n=2,071)

	Test statistic	Parameter Estimation (B)	95% CI	*p*-value
Total calories purchased	$F_{(df=1)}$= 189.12			<0.001
Site Civic vs. General	$F_{(df=1)}$=0.36			0.51
Wave	$F_{(df=2)}$=1.12			0.26
Site X Wave interaction	$F_{(df=2)}$=2.15			0.10
Consumer type	$F_{(df=3)}$=1.04			0.56
Frequency of visiting the cafeteria	$F_{(df=4)}$=1.00			0.13
Gender Female vs Male	$F_{(df=1)}$=6.71	29.04	7.05-51.03	0.01
Age	$F_{(df=3)}$=0.41			0.74
Education level	$F_{(df=3)}$=1.84			0.14
Income level	$F_{(df=3)}$=0.64			0.59
Ethnicity Other vs. White	$F_{(df=1)}$=0.001			0.97
Body Mass Index	$F_{(df=4)}$=0.98			0.42
Label use	$F_{(df=3)}$=4.38			0.004
Never vs. Sometimes		-31.06	-64.90-2.78	0.07
Never vs. Usually		-56.47	-90.83- -22.10	0.001*
Never vs. Always		-52.27	-84.86- -19.67	0.002*
Sometimes vs. Usually		-25.41	-53.89- 3.07	0.08
Sometimes vs. Always		-21.21	-47.21-4.79	0.11
Usually vs. Always		4.20	-22.15-30.56	0.75
General Health	$F_{(df=4)}$=3.54			0.007
Poor vs. Fair		88.46	21.86-155.06	0.01*
Poor vs. Good		41.66	-22.60-105.92	0.20
Poor vs. Very good		49.71	-16.10-115.51	0.14
Poor vs. Excellent		23.12	-48.09-94.33	0.52
Fair vs. Good		-46.80	-78.19- -15.41	0.004*
Fair vs. Very good		-38.75	-72.31- -5.19	0.02
Fair vs. Excellent		-65.34	-108.58- -22.09	0.003*
Good vs. Very good		8.05	-16.34-32.44	0.52
Good vs. Excellent		-18.54	-54.74-17.67	0.32
Very good vs. Excellent		-26.58	-62.28-9.11	0.14

*Significant after post hoc adjustment using Benjamini-Hochberg procedure.
Variable listed first is the reference variable
Pairwise contrasts not shown for variables that did not have a significant overall effect.