Adaptation and Validation of a Nutrition Environment Measures Survey for University Grab-and-Go Establishments

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ABSTRACT

Purpose: To adapt and validate a survey instrument to assess the nutrition environment of grab-and-go establishments at a university campus.

Methods: A version of the Nutrition Environment Measures Survey for grab-and-go establishments (NEMS-GG) was adapted from existing NEMS instruments and tested for reliability and validity through a cross-sectional assessment of the grab-and-go establishments at the University of Toronto. Product availability, price, and presence of nutrition information were evaluated. Cohen's kappa coefficient and intra-class correlation coefficients (ICC) were assessed for inter-rater reliability, and construct validity was assessed using the known-groups comparison method (via store scores).

Results: Fifteen grab-and-go establishments were assessed. Inter-rater reliability was high with an almost perfect agreement for availability (mean $\kappa = 0.995$) and store scores (ICC = 0.999). The tool demonstrated good face and construct validity. About half of the venues carried fruit and vegetables (46.7% and 53.3%, respectively). Regular and healthier entrée items were generally the same price. Healthier grains were cheaper than regular options. Six establishments displayed nutrition information. Establishments operated by the university's Food Services consistently scored the highest across all food premise types for nutrition signage, availability, and cost of healthier options.

Conclusions: Health promotion strategies are needed to address availability and variety of healthier grab-and-go options in university settings.

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RÉSUMÉ

Objectif. Adapter et valider un instrument de sondage pour évaluer l'environnement nutritionnel des établissements offrant des mets à emporter sur un campus.

Méthodes. Une version de l'enquête Nutrition Environment Measures Survey for grab-and-go establishments (NEMS-GG) a été adaptée à partir d'instruments NEMS existants, et sa fiabilité et validité ont été vérifiées au moyen d'une évaluation transversale des établissements offrant des mets à emporter à l'Université de Toronto. L'évaluation portait sur la disponibilité et le prix des produits ainsi que sur l'affichage de l'information nutritionnelle. Les coefficients de corrélation intra-classe (CIC) et les coefficients Kappa de Cohen ont été évalués pour déterminer le coefficient d'objectivité, et la validité de construit a été évaluée à l'aide de la méthode de comparaison des groupes connus (par l'entremise des cotes attribuées aux établissements).

Résultats. Quinze établissements offrant des repas à emporter ont été évalués. Le coefficient d'objectivité était élevé; l'accord concernant la disponibilité (κ moyen = 0,995) et les cotes d'établissements (CIC = 0,999) étant presque parfait. L'outil a démontré une bonne validité apparente et une bonne validité de construit. Environ la moitié des établissements offraient des fruits et des légumes (46,7 % et 53,3 % respectivement). En règle générale, le prix des plats principaux standards était le même que celui des plats principaux santé. Le prix des produits céréaliers santé était moindre que celui des options standards. Six établissements affichaient l'information nutritionnelle. Les établissements exploités par les services alimentaires de l'université ont invariablement obtenu les cotes les plus élevées parmi tous les types de services alimentaires pour ce qui est de l'affichage de l'information nutritionnelle, de la disponibilité et du prix des options santé.

Conclusions. Des stratégies de promotion de la santé doivent être mises en place pour aborder la question de la disponibilité et de la variété des options plus santé offertes sur le pouce dans les universités.

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INTRODUCTION

Since the Federal, Provincial, and Territorial Ministers of Health and of Health Promotion/Healthy Living endorsed the Curbing Childhood Obesity Framework to promote healthy weights among Canadian citizens, there have been growing efforts to measure the food environment to influence the accessibility of nutritious foods in Canada [1]. However, university food environments remain a key gap in the measurement literature [1].

University campuses are of particular interest because they are a blend of organizational (i.e., workplaces and schools), community (i.e., geographic access to various off-campus or on-campus food sources), and consumer (i.e., availability, price, quality, and variety of foods) nutrition environments [2]. One Canadian study [3] revealed that roughly one-quarter of students and staff are either overweight or obese within a university community; both groups had poor breakfast consumption and low intake of fruit and vegetables. In terms of

public health impact, university campuses are important given that approximately 53.6% of all young adults attend post-secondary schools in Canada [4]. Providing a healthy mix of foods for the substantial amount of time students, faculty, and staff spend on campus has the potential to therefore improve diets of multiple populations.

Valid and reliable food environment measures have advanced over the last decade with a growing range of adaptations for different food establishments [5–7] including stores and restaurants [8, 9]. Few tools assess the university food environment [10–13]. Existing studies that have assessed university food environments have focused on vending machines, university restaurants, and dining halls [13]. However, more and more students purchase foods from grab-and-go establishments (GGEs) [14, 15]. GGEs are characterized by prepackaged, ready-to-eat prepared food items, typically entrées and not only "snack" foods, offered for sale from either a self-service heated or chilled merchandiser with little or no customer preparation required (e.g., transferring premade soup or chili to a container or reheating a premade sandwich or slice of pizza) [16, 17]. Students' intention to eat on-the-go, long operation hours, close proximity to university facilities, and consistent menu items are among key reasons why GGEs are visited more frequently than a traditional dining hall [18]. Our project aimed to adapt existing Nutrition Environment Measures Survey (NEMS) instruments to develop a reliable and valid measure of the grab-and-go nutrition environment at the University of Toronto, St. George Campus, in downtown Toronto, Ontario.

METHODS

GGEs

For the purpose of this study, we included any food establishment that sells ready-to-eat, prepackaged entrée items or entrée items that one can package at the point of purchase without undergoing any transformation (i.e., sushi, sandwiches, pizza, salads, and soup). Food establishments that do not sell any ready-to-eat, prepackaged entrée items (i.e., vending machines) or only sell entrée items that require assembly or are made to order were excluded (i.e., dining halls and restaurants); specific tools have been developed to measure these venues [6, 7].

Geographic sample

There is no gold standard definition of geographic scale relevant for university food environments. In the current study, the University of Toronto's downtown campus was selected as the geographic locale of interest. A 400 m distance is often used to define service areas around transit stops [19], whereas a comfortable distance in a Canadian urban setting is about 650 m [20]. For this study, we used a midpoint of these 2 references, 525 m, as a reference walking distance. Field observations and consultation with students determined such an estimate is highly relevant to our context and was about a 5–10 minute-walk. A 525 m network distance from the University's Health Sciences Building also captured all relevant GGEs that were run by the University of Toronto Food Services (UTFS).

Development of the survey instrument

Existing NEMS measures have been demonstrated to be feasible, have strong face and content validity, and have high inter-rater and test–retest reliability [9]. They are designed to capture elements of the consumer nutrition environment including food availability, price, quality, and the presence of healthier options, based on typical purchasing patterns in a population and relevant population dietary guidance. Multiple adaptations of the original NEMS tools have been designed to assess the nutrition environment in various settings.

Our design was based on adapting specific elements from existing, validated NEMS instruments to inform the constructs and scoring for a NEMS-Grab-and-Go (GG) tool. Measures regarding the presence of nutrition information, the hours of operation, and its use of proxies to identify healthier options were adapted from the NEMS-Restaurant (R) [9, 21]. Packaged items from the NEMS-Store (S) and NEMS-Corner store (CS) instruments are similar to the grab-and-go setting. The availability and variety of typical whole fruits, bread and other baked goods, and beverages were also adopted into the instrument with little adjustment, other than a specific Canadian adaptation of the original NEMS-S, which takes into account Canadian food consumption patterns and dietary recommendations [8, 22–24]. For example, although it may be impossible to compare the nutritional values of the different breads offered at an establishment, the whole grain characteristic can be used to identify a healthier option as outlined in Canada's Food Guide [25]. Whole vegetable produce constructs were adapted to introduce salads and vegetable trays as products that could better reflect the items found in a GGE. Furthermore, we adopted the criteria used in NEMS-Vending (V) to inform parameters for ranking regular and healthier options of foods in our study [21] (see criteria listed in Supplementary Table 1).[1]

The NEMS-GG included information on: (*i*) hours of operation; (*ii*) evidence of point-of-purchase nutrition information; and (*iii*) the availability, variety, and cost of fruits, vegetables, salads, yogurt, wraps, sandwiches, sushi, yogurt-based parfaits, grain products, soups, pizzas, beverages (including milk, fruit juice, tea and coffee), and their respective healthier options. Some grab-and-go items, such as granola bars, trail mix, and soy beverages, were excluded because they were not viewed as typical purchases.

The scoring guide for NEMS-GG was largely based on NEMS-CS and NEMS-R [8, 9, 22].

To affirm face validity of the NEMS-GG, consultations were conducted with 2 Canadian food environment

[1]Supplementary data are available with the article through the journal Web site at http://dcjournal.ca.www.nrcresearchpress.com/doi/suppl/10.3148/cjdpr-2015-036.

assessment experts and graduate nutrition students at several points during assessment and field testing of the instrument.

Data collection

Ground truthing (systematic direct observation) is considered the gold standard in identifying food establishments [26]. Two of the authors (AC and JH) systematically walked along every street within the 525 m buffer to identify all GGEs (n = 15) in October 2013 and then collected all data in November 2013 on a single day on paper forms. No new establishments were detected on the day of data collection. Both raters visited every food establishment at the same time but made observations independently, such that inter-rater reliability could be determined. Each establishment was visited only once. Although ratings were made independently in-store, discussions occurred between establishments to make appropriate calibrations to the instrument. For example, it soon became evident that 3.25% milk fat (MF) milk was not available at all on campus and that the lowest fat milk available in most establishments was 2% MF. As such, a consensus was reached between the raters that any establishment offering 2% MF plain milk (the healthier but not "healthiest" item in our scoring system) would still receive a perfect score for that category, and the scoring was adjusted accordingly. The low-fat requirement was also adjusted for yogurts and yogurt-based parfaits.

Written field notes were kept for any uncertain items. Peer debriefing was also carried out following data collection and with the senior author. All paper data were entered into Excel spreadsheets and checked for accuracy immediately following data collection.

This research was reviewed and approved by the University of Toronto Health Sciences Research Ethics Board.

Data analysis

Supplementary Table 1[1] provides the breakdown of the scoring system. In general, a score was calculated for each establishment assessed based on the presence of nutrition information, product availability, variety, and price. In general, an establishment received 2 points for the presence of nutrition information at point-of-purchase. One to 3 points were given for the presence of healthier option(s), depending on the type of food item assessed and the number of healthier options available. Where applicable, 1 point was given for the availability of healthier condiments, which were defined as indicated by "low-fat" on the package, vinaigrette or not in syrup for fruit and vegetables, sweeteners and 1% MF or skim milk for coffee and tea. Additionally, 1 point was also given for each food item when its healthier option was cheaper or the same price as the regular option (except for fresh fruit and vegetables, 100% fruit juice, tea, and coffee). The highest possible score was 75.

To assess reliability, percentage of overall agreement and Cohen's kappa (κ) coefficient were calculated for dichotomous measures (product availability). Intra-class correlation coefficient (ICC) was used to assess inter-rater reliability for continuous measures (establishment scores). A κ value of 0.81–1.00 represents an almost perfect agreement, 0.61–0.80 as substantial, 0.41–0.60 as moderate, 0.21–0.40 as fair, 0.00–0.20 as slight, and <0.00 as poor [27]. ICC values were also interpreted in the same way [28]. For price agreement, only prices for the same type of a given food item were used for analysis. Multi-unit prices were transformed into single-unit prices. Any missing variables were excluded for analysis, and any variables that had less than 15 observations were not sufficient to calculate inter-rater reliability [29].

To assess construct validity, the known-groups comparison method was used [30]. After identifying all the GGEs, the sample was categorized into 2 groups, based on whether or not they fell under the UTFS management. This categorization was based on a desire to inform decision makers and knowledge user partners about UTFS establishment performance in contrast to other GGEs. We also hypothesized that in light of recent dedicated efforts by UTFS to increase the availability of local, healthier, and more ecologically sustainable food offerings on campus, that these establishments might be healthier than non-UTFS-managed GGEs. UTFS establishments had other known differences in comparison with other GGEs in the campus geographic area, such as carrying a larger variety of food items due to their larger operational scale. The non-UTFS-managed group (n = 12) consisted of 7 coffee shop franchises, 2 student-run cafes, and 3 other independent establishments. The UTFS-managed group (n = 3) consisted of 2 cafeteria-style establishments with grab-and-go offerings and 1 exclusively grab-and-go station managed by UTFS. Overall scores were compared for the 2 groups of food establishments. If the scale was valid, the scores of these 2 groups would differ significantly.

Data were analyzed using SPSS (version 22.0, IBM Corp., Armonk, NY, 2013).

RESULTS

Description of the sample

All GGEs within the 525 m network buffer were assessed (n = 15). Among the 15 establishments, 3 were establishments managed by UTFS, 7 were coffee shop franchises, 2 were student-run stores, and 3 were independent cafes or takeaway restaurants with prepackaged foods. Only 6 of the establishments provided nutrition information, either on the menu or at the point of purchase. UTFS-managed establishments consistently scored the highest across all food establishment types for nutrition signage and the availability and cost of healthier food options. Their average score (40.1 out of 75) was much higher than other establishment types (average score 15.6 out of 75). The 2 independent student-run food establishments yielded the lowest scores (5 and 10 out of 75) (see Table 1 for breakdowns).

Almost half of the establishments had fresh fruit (46.7%) and fresh vegetables (53.3%) available (Table 1). Table 2 provides information on the availability, variety, and price of food items at the GGEs assessed. The varieties of fruit and

Table 1. Availability of healthier options, pricing features, and scores among different grab-and-go establishments (n = 15).

Measure	University-managed establishments, n = 3 (%)	Coffee shop franchises, n = 7 (%)	Student-run establishments, n = 2 (%)	Independent cafes/ takeaway restaurants, n = 3 (%)	Total, n = 15 (%)
Signage					
Nutrition information posted	3 (100)	2 (28.6)	0	1 (33.3)	6 (40.0)
Availability of food types					
Any fruit (whole fruit and/or fruit cups)	3 (100)	1 (14.3)	0	3 (100)	7 (46.7)
Any vegetables (all vegetables salads and/or salad bar)	3 (100)	2 (28.6)	0	3 (100)	8 (53.3)
Whole-grain or whole-wheat bagel	0	2 (28.6)	1 (50.0)	1 (33.3)	4 (26.7)
Whole-grain or whole-wheat bread	1 (33.3)	0	0	2 (66.7)	3 (20.0)
Low-fat muffin	0	4 (57.1)	0	0	4 (26.7)
Low-fat yogurt	3 (100)	1 (14.3)	0	1 (33.3)	5 (33.3)
Low-fat parfait	3 (100)	4 (57.1)	0	0	7 (46.7)
2% (or less) milk	3 (100)	1 (14.3)	0	1 (33.3)	5 (33.3)
Baked chips	0	0	0	0	0
Healthier wrap	3 (100)	5 (71.4)	1 (50.0)	1 (33.3)	10 (66.7)
Healthier sandwich	3 (100)	6 (85.7)	1 (50.0)	0 (0)	10 (66.7)
Healthier salad	3 (100)	2 (28.6)	0	1 (33.3)	6 (40.0)
Healthier soup	1 (33.3)	1 (14.3)	0	1 (33.3)	3 (20.0)
Healthier sushi	1 (33.3)	0	0	0	1 (7.00)
Healthier pizza	1 (33.3)	0	1 (50.0)	0	2 (13.3)
100% juice	3 (100)	7 (100)	1 (50.0)	3 (100)	14 (93.3)
Decaffeinated coffee and/or tea	3 (100)	7 (100)	1 (50.0)	2 (66.7)	13 (86.7)
Selected price comparison measures[a]					
Bagel					
Lower price for whole-grain/wheat	—	—	—	—	0
Same price for white and whole-grain/ wheat	—	2 (28.6)	1 (50.0)	1 (33.3)	4 (26.7)
Higher price for whole-grain/wheat	—	—	—	—	0
Bread					
Lower price for whole-grain/wheat	—	—	—	—	0
Same price for white and whole-grain/ wheat	1 (33.3)	—	—	2 (66.7)	3 (20.0)
Higher price for whole-grain/wheat	—	—	—	—	0
Muffin					
Lower price for low-fat	—	—	—	—	0
Same price for regular and low-fat	—	4 (57.1)	—	—	4 (26.7)
Higher price for low-fat	—	—	—	—	0
Yogurt					
Lower price for 2% fat or lower	—	—	—	—	0
Same price for regular and low-fat	3 (100)	1 (14.3)	—	1 (33.3)	4 (26.7)
Higher price for 2% fat or lower	—	—	—	—	0
Yogurt parfait					
Lower price for 2% fat or lower	—	—	—	—	0
Same price for regular and low-fat	3 (100)	4 (57.1)	—	—	7 (46.7)
Higher price for 2% fat or lower	—	—	—	—	0

Table 1. (cont'd).

Measure	University-managed establishments, n = 3 (%)	Coffee shop franchises, n = 7 (%)	Student-run establishments, n = 2 (%)	Independent cafes/ takeaway restaurants, n = 3 (%)	Total, n = 15 (%)
Wraps					
Lower price for healthier wrap	—	—	—	—	0
Same price for regular and healthier wrap	3 (100)	5 (71.4)	1 (50.0)	1 (33.3)	10 (66.7)
Higher price for healthier wrap	—	—	—	—	0
Sandwich					
Lower price for healthier sandwich	—	—	—	—	0
Same price for regular and healthier sandwich	3 (100)	4 (57.1)	1 (50.0)	—	8 (53.3)
Higher price for healthier sandwich	—	2 (28.6)	—	—	2 (13.3)
Salad					
Lower price for healthier salad	—	—	—	—	0
Same price for regular and healthier salad	3 (100)	2 (28.6)	—	1 (33.3)	6 (40.0)
Higher price for healthier salad	—	—	—	—	0
Soup					
Lower price for healthier soup	—	—	—	—	0
Same price for regular and healthier soup	1 (33.3)	1 (14.3)	—	1 (33.3)	4 (26.7)
Higher price for healthier soup	—	—	—	—	0
Sushi					
Lower price for healthier sushi	—	—	—	—	0
Same price for regular and healthier sushi	1 (33.3)	—	—	—	1 (7.00)
Higher price for healthier sushi	—	—	—	—	0
Pizza					
Lower price for healthier pizza	—	—	—	—	0
Same price for regular and healthier pizza	—	—	1 (50.0)	—	1 (7.00)
Higher price for healthier pizza	1 (33.3)	—	—	—	1 (7.00)
Composite scores (total possible)			**Mean (SD)**		
Signage (2)	2 (0)	0.6 (1)	0	0.7 (1.2)	0.8 (1.0)
Availability (59)	31.2 (3.3)	13.1 (5.6)	5.5 (3.5)	15 (7.9)	16 (9.7)
Price (14)	7 (1)	3.4 (2.3)	2 (0)	2 (1)	3.7 (2.4)
Total (75)	40.1 (4.2)	17.1 (7.7)	7.5 (3.5)	17.7 (10.0)	20.5 (12.5)

[a]Price comparisons were based on the lowest prices of healthier options and only included establishments that sold both regular and healthier options.

vegetables were limited, but the 3 UTFS-managed establishments offered the greatest varieties (mean of 6 varieties), whereas student-run establishments did not offer any. Prices of packaged, sliced fresh fruits were more expensive than whole fruits.

Of the grain products available, regular options were more readily available than healthier options, especially for muffins (73.3% of establishments offered regular muffins; 26.7% offered low-fat muffins). The majority of healthier grain items were observed at coffee shop franchises. Healthier grain options were generally cheaper than regular options, but variety was limited.

Similar to other items, regular entrées were generally more available than their healthier counterparts. Regular and

Table 2. Availability, variety, and price of food items (n = 15).

Type of food	Availability, no. (%)		Number of varieties, mean (SD)	Price per unit ($), mean (SD)	
Fresh fruit and vegetables					
Banana	5 (33.3)		—	1.00 (0.00)	
Apple	5 (33.3)		—	1.00 (0.01)	
Orange	3 (20.0)		—	1.00 (0.01)	
Fresh fruit package	5 (33.3)		2 (0.71)	4.77 (0.67)	
Vegetable package	7 (46.7)		2.14 (1.68)	4.00 (0.68)	
Salad bar	1 (7.00)		—	—	
	Healthier	**Regular**	**Healthier**	**Healthier**	**Regular**
Grain products					
Bagel	4 (26.7)	6 (40.0)	1.75 (0.96)	1.56 (0.22)	1.64 (0.27)
Bread	3 (20.0)	4 (26.7)	2 (1.00)	1.13 (0.14)	1.25 (0.25)
Muffin	4 (26.7)	11 (73.3)	1 (0.00)	1.70 (0.37)	1.91 (0.41)
Dairy products					
Yogurt	5 (33.3)	5 (33.3)	3.4 (2.3)	1.88 (0.32)	1.88 (0.32)
Yogurt parfait	7 (46.7)	7 (46.7)	1.71 (0.95)	3.26 (0.58)	3.26 (0.58)
Milk	5 (33.3)	5 (33.3)	—	—	—
Snacks					
Chips	0	6 (40.0)	0	—	1.75 (0.14)
Entrée					
Wrap	10 (66.7)	10 (66.7)	3.1 (1.73)	5.00 (1.44)	5.05 (1.49)
Sandwich	10 (66.7)	11 (73.3)	3.6 (1.90)	5.09 (1.22)	4.18 (1.24)
Salad	6 (40.0)	9 (60.0)	1.7 (0.76)	3.98 (1.54)	3.84 (1.57)
Soup	3 (20.0)	4 (26.7)	1.67 (0.58)	3.01 (0.21)	3.07 (0.22)
Sushi	1 (7.00)	1 (7.00)	2 (—)	7.89 (—)	5.99 (—)
Pizza	2 (13.3)	2 (13.3)	1 (0.00)	3.25 (0.28)	3.10 (0.13)
Beverages					
Juice	14 (93.3)	14 (93.3)	—	—	—
Coffee and/or tea	13 (86.7)	15 (100)	—	—	—

Note: — indicates this variable is inapplicable to this food category.

healthier entrées were priced the same, except for healthier sushi (brown rice sushi was more expensive, +$1.90). Three of the 4 establishments offering soup also offered a healthier option.

Low-fat milk was available in all 5 establishments selling milk. Regular and healthier yogurt items were also readily available, with no price differences between regular and healthier options. Only regular chips were available in the establishments assessed.

Reliability

We calculated inter-rater reliability for the presence of nutrition information and product availability. Overall, there was a very high degree of agreement. Among the 37 items assessed, all of them had almost perfect agreement ($\kappa \geq 0.810$). Except for packaged vegetables ($\kappa = 0.842$), other items had a κ of 1. In terms of the scores of the 15 establishments assessed, ICC was 0.999, representing an almost perfect agreement between the 2 raters. However, our study was not able to compute ICC for price, due to the limited observations of food items ($n < 15$).

Construct validity

The known-groups comparison was performed to test instrument validity by assessing the difference between the mean scores obtained from each group of establishments (mean = 15.63 and SD = 8.12 for the 12 non-UTFS-managed establishments; mean = 40.1 and SD = 4.2 for the 3 healthier UTFS-managed establishments). Therefore, the NEMS-GG correctly identifies differences in 2 groups of establishments that were known, a priori, to be different regarding the characteristics assessed with the instrument.

DISCUSSION

To our knowledge, this is the first study examining grab-and-go nutrition environments on the university campus. Our results aligned with previous findings that healthier food options were limited in on-campus food establishments [12, 31],

suggesting the need to improve the quality of campus food establishment environments.

The grab-and-go environment

All of the GGEs assessed in this study carried some healthier food items, although the variety of healthier options available was limited for certain food item types or at particular establishments. UTFS-managed facilities had the largest variety of healthier food offerings and certain healthier food items were priced competitively. In contrast, external independent establishments generally carried limited healthier food items. This could be due to larger franchises' relative inflexibility to change menu items to meet local demand. For smaller independent establishments and student-run establishments, limited healthier options may have resulted from a lack of resources, procurement capacity, or specific interests in incorporating healthier items.

Validity and reliability of NEMS-GG

Findings from the validity testing suggest that the NEMS-GG is a reliable tool to assess the food environment of GGEs in or near the University of Toronto's downtown campus. Other studies that have validated NEMS instruments have demonstrated strong reliability, particularly for availability, quality, price, and store scores [29, 32, 33]. Similarly, our study found that product availability and store scores had almost perfect inter-rater agreement. The high inter-rater reliability scores reflect the importance of rigorous training and consensus building during the initial phases of assessment. Significant store score difference between UTFS-managed and non-UTFS-managed GGEs also suggests the construct of the instrument is valid. Although our study was not able to test the reliability of the price measures, our measures were largely drawn from existing NEMS that were proven valid and reliable [8, 9].

Similar to previous NEMS adaptations, we used current dietary guidance in our jurisdictional context to refine scoring in terms of "healthiness" of specific food items. Researchers considering future adaptations of the NEMS-GG tool should also take this into account, as NEMS adaptation and validation processes present an opportunity to address dietary recommendations that evolve over time.

Study limitations

There are several limitations to this study. The University of Toronto is a large, multi-campus institution. Our sample was specific to the downtown campus and the geographic buffer was selected in relation to the School of Public Health to inform future intervention planning. We consulted with key stakeholders including our project advisors with UTFS; however, to ensure that the geographic sample and stores assessed offered a suitable representation, if not a representative sample, of GGEs for the entire institution. Another potential limitation is generalizability to other universities, particularly those with a different food services management structure and in other contexts such as rural or suburban settings. However, transferrable lessons could be drawn from the principles and process guiding development of the instrument. Generalizability is also a potential issue in terms of cross-sectional data collection for foods such as fresh whole produce that may vary seasonally. Lastly, we were unable to assess the reliability of price and variety due to the low total numbers of items assessed. Future research could use a bigger sample size, and/or a larger geographic area to overcome such limitations.

Despite these limitations, this study is a valuable step forward in the literature on the university nutrition environment. Future research assessing the university nutrition environment should also consider the development of a multi-faceted NEMS tool that can evaluate the broader food retail environments for university settings that feature a mix of food services and retail outlets including restaurants, dining halls, convenience stores, and GGEs.

RELEVANCE TO PRACTICE

The findings of this study begin to shed light on ways to assess and improve the grab-and-go environment, and hence accessibility to healthful options and dietary choices among university students, faculty, and staff. Previous studies have shown success in fostering healthier eating behaviours through competitive pricing strategies [34, 35]. Such strategies are particularly relevant to the increasing financial burden of university students. Another important opportunity for action, that was a key part of our project, was for health and nutrition faculty, staff, and students to work in partnership with institutional food services providers to strengthen nutrition messaging and to collaboratively develop context-specific interventions. For example, the literature is promising in terms of nutrition information improving university students' dietary habits [36, 37]. Finally, with further adaptations, dietitians could potentially apply the NEMS-GG tool even more widely, to evaluate the growing array of grab-and-go food environments in similar university/college settings as well as venues that are predominantly served by GGEs such as workplaces and airports.

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