BMC Geriatrics

RESEARCH

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Evaluating and simulating long-term care menus to meet nutrient- and food-based standards

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Abstract

Background Most provinces require long-term care (LTC) home menus to meet nutrient requirements and align with Canada's food guide (CFG-2019). However, compliance remains challenging for dietitians and food service staff due to limited tools and guidance to support implementation in practice. This study evaluated current and simulated LTC menus against nutrient- and food-based standards to identify the characteristics of menus meeting both requirements.

Methods A database of 1,365 menu items from a four-week LTC menu cycle provided by a major North American foodservice company was used to simulate 10,000 one-day LTC menus. Compliance with LTC-specific nutrient targets and alignment with CFG-2019 were assessed. Menus meeting both standards were further evaluated using the Canadian Food Scoring System (CFSS) and Healthy Eating Food Index (HEFI)-2019.

Results Current LTC menus ($n=28$) met most macronutrient and 10 micronutrient targets, with a mean HEFI-2019 score of 45.3/80 (57%), below the desired 75% compliance threshold. Of the 10,000 simulated menus, 28 met all nutrient-based targets and six met both nutrient- and food-based standards. These compliant menus provided an average of 2,857 kcal, 107 g protein, 32 g fibre, and a mean HEFI-2019 score of 61.7/80 (77%). On average, 58% of menu items were classified as "Good & Excellent" according to the CFSS, with approximately 10 serving equivalents of fruits and vegetables, 2.5 of whole grains, and 5 of protein foods.

Conclusion Although provincial regulations require LTC menus to comply with both nutrient- and food-based standards, full compliance was not achieved using foods available from a single large provider. Nutrient-compliant menus were characterized by higher energy provision and greater nutrient density, underscoring the need for more healthy options and practical supports, including LTC-specific planning tools, food guide serving benchmarks, and accessible resources to facilitate routine menu planning and regulatory compliance.

Keywords Canada's food guide, Dietary Reference Intakes, HEFI-2019, Long-term care, Menu planning

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Background

Long-term care (LTC) residents are among Canada's most vulnerable populations, with malnutrition affecting up to 60% [1, 2]. As Canada transitions to a "super-aged" society by 2040, with more than 20% of the population aged 65 years or older, the demand for LTC will grow sharply, from an estimated 380,000 residents in 2020 to over 600,000 by 2031 [3, 4]. Ensuring adequate nutrient intake for this rapidly expanding population is therefore an urgent public health priority. While factors such as poor oral health, reduced appetite, and chronic disease contribute to the risk of malnutrition, the food environment within LTC plays a central role [5, 6]. This includes not only the nutritional composition and variety of foods offered but also how meals are prepared, presented, and served, as well as the institutional policies that guide these practices. Because LTC residents rely almost entirely on the meals and snacks provided, their nutritional intake depends directly on the quality and composition of the menu [7, 8]. However, structural barriers, such as limited budgets, staffing shortages, and rigid procurement systems, often hinder menu planning in LTC homes, making it difficult to align menus with national dietary guidelines and residents' needs [9, 10]. These challenges highlight the need for practical recommendations and resources to improve menu quality and ensure residents receive foods and fluids that meet energy and nutrient requirements, thereby supporting physical health, functional ability, and mealtime satisfaction, which are key contributors to quality of life in LTC [9–12].

Current menu planning practices in most LTC homes must adhere to provincial regulations that follow the Dietary Reference Intakes (DRI) and Canada's food guide (CFG) [13–15]. DRI are considered a nutrient-based approach that estimates the amount of nutrients required to maintain good health [16], whereas CFG is a food-based approach that refers to the types and amounts of a variety of foods to maintain good health [15]. Dietitians of Canada recommends that LTC menus must meet 100% of the recommended targets for macronutrients (energy, protein, fibre, carbohydrates) and sodium, and at least 75% of the Recommended Dietary Allowance (RDA) or Adequate Intake (AI) for micronutrients per day [13, 17]. Since DRIs are established for healthy individuals, applying them to LTC populations, who often experience multiple comorbidities, reduced appetite, and increased nutrient needs, requires a conservative approach [17, 18]. Accordingly, nutrient targets are set to reflect the highest recommended intakes within this age-sex group to ensure adequacy across all residents, consistent with Dietitians of Canada's recommendations [13, 17].

Despite these requirements, nutrient intakes among LTC residents frequently fall below recommended levels [1, 2, 19, 20]. Menu analyses report shortfalls in energy, protein, fibre, vitamin D, vitamin E, folate, and potassium, even when supplements are provided [21]. These inadequacies are clinically significant, contributing to reduced bone and muscle strength (vitamin D, calcium, protein), impaired immune and cognitive function (vitamin E, folate), and increased risk of hypertension and cardiovascular disease (potassium, magnesium) [22]. A multisite Canadian study analyzing menus from 32 LTC homes across four provinces found that 9 of 22 nutrients assessed did not meet the DRIs [6]. Even with oral nutrition supplements, over one-quarter of LTC residents failed to achieve recommended intakes for several vitamins and minerals, including fibre, calcium, magnesium, potassium, zinc, folate, and vitamins B6, D, E, and K [6].

Canada's food guide (CFG), required by provincial regulations for LTC home menu planning, provides food-based guidance to support healthy eating through a balanced intake of vegetables and fruits, whole grains, and protein foods [15]. The previous 2007 version of CFG offered age- and sex-specific serving recommendations to help quantify intake [23], whereas the more recent 2019 version shifted to a proportion-based plate model that emphasizes dietary patterns and higher-quality food choices, including increased consumption of plant-based protein foods and whole grains [15]. While the plate-based model promotes healthier dietary patterns, it presents challenges for dietitians and food service staff in institutional settings, where quantitative targets are needed for menu planning and regulatory compliance [12, 13, 24]. In practice, LTC menus continue to rely heavily on animal-based proteins, refined grains, and prepared vegetables or fruits, with limited use of whole grains and plant-based protein sources [25]. Consequently, overall food quality in LTC remains suboptimal, with only 52.8% of menu items classified as "Good" or "Excellent" according to CFG-2019 [15, 26]. Furthermore, CFG-2019 may not fully address nutrients of concern for older adults, such as protein, vitamin D, and calcium, which remain insufficient even when current dietary guidance is followed [20].

To assess alignment with CFG-2019, several validated tools have been developed. The Healthy Eating Food Index (HEFI-2019) is a validated dietary assessment tool developed in collaboration with Health Canada to operationalize and evaluate overall diet adherence to CFG-2019 using total daily intake data [27]. The Canadian Food Scoring System (CFSS) complements this approach by evaluating whether individual food items meet CFG-2019 recommendations using a nutrient profiling model developed using a similar approach to HEFI-2019 [28]. These tools can be used to assess LTC menus for alignment with CFG-2019 recommendations and nutrient requirements, identify gaps at both the menu and food

levels, and support menu planning that better meets the nutritional needs of LTC residents. Therefore, the objective of this study is to evaluate current and simulated LTC menus from a single provider against these standards and identify menu characteristics compliant with both nutrient and food-based guidelines.

Methods

Data source

Data for this study were derived from a four-week LTC menu cycle provided by a major North American food service company. The provider supplied detailed menu items and corresponding nutritional composition data representative of foods typically offered to LTC residents. The menus were designed for the general LTC population, typically older adults aged 70 years and above, following a regular diet without dietary restrictions or modifications, as described in detail elsewhere [26]. While the number of LTC homes served is proprietary, major foodservice providers collectively serve about 46% of Canadian institutions, with LTC accounting for 14% of institutional foodservice sales [29]. The database contained 1,365 menu items, including duplicates across menu cycles, corresponding to 342 unique offerings: foods ($n = 131$), recipes (defined as "prepared meals with more than one ingredient") ($n = 205$), and beverages ($n = 6$). Beverages were available at all eating occasions and included water, milk, coffee or tea, and juice (typically 100% fruit juice, with fruit drink containing added sugar occasionally offered). Dietary supplements and meal replacements were excluded, consistent with a food-first approach recommended by Dietitians of Canada [13]. Both fresh and pre-made foods were represented in the dataset, as determined from the provided nutritional composition data. Nutrient information for menu items was sourced from a leading North American food service provider using GS1 standards (Brussels, Belgium), an internationally recognized system for standardized product identification and data exchange across the food industry. Missing nutrient values were supplemented with the 2015 Canadian Nutrient File, a comprehensive national food composition database for foods commonly consumed by Canadians, by manually matching LTC menu items to corresponding food descriptions [30].

Menu generation

LTC menus are typically planned over a 3- to 6-week cycle; however, each day is evaluated against CFG standards and nutrient targets to ensure compliance with the DRI as per provincial regulations [13]. Because compliance is assessed daily, a simulation algorithm was developed in R version 4.3.3 (R Foundation for Statistical Computing, Vienna, Austria) to generate 10,000 one-day menus (Fig. 1). Each simulated menu included three meals (breakfast, lunch, dinner) and three snacks (morning, afternoon, evening), following predefined menu planning rules (S1 Table 1) and drawing from the LTC menu database of 1,365 total items. Meals were structured to include a main entrée (typically a mixed dish of protein and carbohydrate), a side carbohydrate (e.g., grain or potato), one or more sides of vegetables and/or fruit, an additional protein item (if not already present), and accompanying beverages. Conditional components, such as condiments or sauces, were included as appropriate. Two to three different types of beverages were included per meal, consistent with LTC practices of offering both nutrient-containing (e.g., milk, juice) and non-nutritive (e.g., water, tea, coffee) fluids at and between meals [10].

The frequency of each menu item was constrained by minimum and maximum thresholds based on dietitian expertise and dietary judgment, LTC menu-auditing tools [10, 13], and sample menu patterns to promote variety and maintain nutritional balance. Reference Amounts (RA), defined in Health Canada's Table of Reference Amounts for Foods, are standardized serving sizes representing the typical quantity of food consumed in one sitting and are used in nutrition labelling regulations [31]. In LTC settings, RAs are used as planning standards to ensure that menus meet the DRI and CFG, while also supporting standardized recipes, procurement, and quality assurance across facilities [32]. Although LTC residents may consume smaller portions in practice [12, 33], standardized serving sizes are used for menu planning and evaluation, while actual portions are individually adjusted by dietitians based on residents' needs, preferences, and intake patterns [12, 32, 34]. The HEFI-2019 also uses RA as the reference metric to assess adherence to CFG [27, 31].

Menu assessment

Each simulated one-day menu was evaluated for compliance with nutrient requirements and CFG through a two-step approach.

First, a nutrient-based assessment was conducted using LTC-specific daily nutrient targets outlined in Dietitians of Canada's *Menu Planning in Long-Term Care with Canada's Food Guide (2019)* [13]. Menus were evaluated to meet 100% of the macronutrient (energy, protein, fibre, carbohydrates) and sodium targets, and at least 75% of the RDA or AI for micronutrients, averaging 100% across the full menu cycle [13]. These nutrient targets were derived from the DRI for males aged 70 years and older, following Dietitians of Canada and DRI recommendations for LTC menu planning [13, 14]. The use of RDA values aligns with Health Canada's population coverage principle used in establishing Daily Values for nutrition labelling, which selects the highest recommended intake

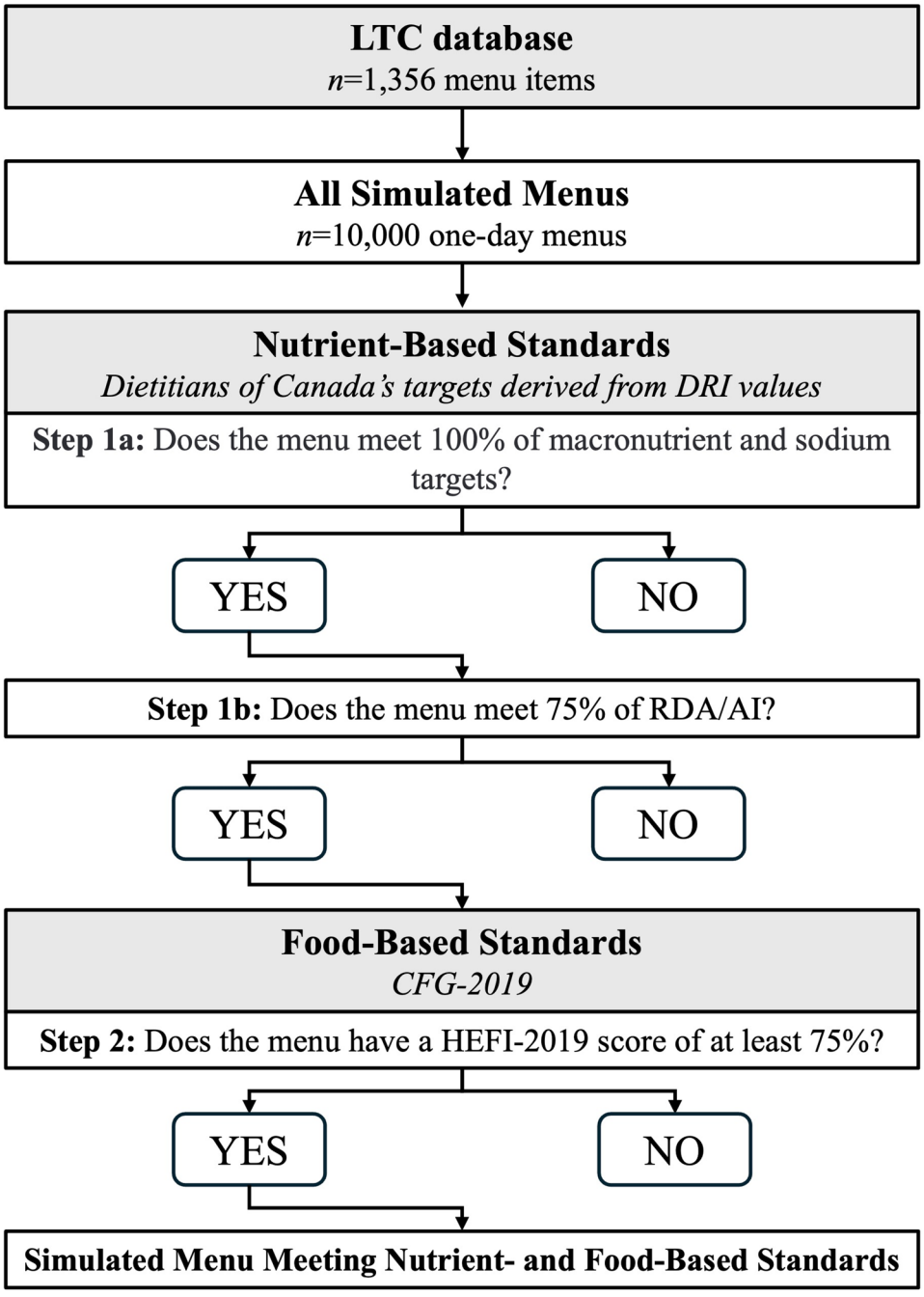


Fig. 1 Overview of the LTC menu simulation and assessment process. A total of 10,000 one-day menus were simulated using current LTC menu items ($n = 1,356$) derived from a four-week sample menu cycle provided by a major North American foodservice provider. Simulated menus were first evaluated against nutrient-based standards established by Dietitians of Canada, which are informed by DRI values. Step 1a assessed whether menus met 100% of macronutrient and sodium targets, while Step 1b evaluated whether menus met at least 75% of the RDA or AI for micronutrients, as the RDA is recommended in LTC by Dietitians of Canada to avoid underestimating requirements in this nutritionally vulnerable population [13]. Menus that met both nutrient-based criteria were then assessed for food quality using the HEFI-2019, based on alignment with CFG-2019. Menus with HEFI-2019 scores of at least 75% were considered fully compliant with both nutrient- and food-based standards. Abbreviations: AI, Adequate Intake; CFG, Canada's food guide; DRI, Dietary Reference Intake; HEFI-2019, Healthy Eating Food Index 2019; LTC, long-term care homes; RDA, Recommended Dietary Allowance

within a population group to ensure adequacy for nearly all individuals [35]. Applying this same rationale in LTC provides a conservative benchmark suitable for a nutritionally vulnerable population, where residents often experience multiple comorbidities, reduced appetite, and elevated nutrient needs. Consistent with this approach, nutrient targets were based on the DRI for males aged 70 years and older, as this age–sex group has the highest

nutrient requirements and therefore establishes higher target values to support adequacy across residents [36]. While individual nutrient needs may vary by sex, age, body weight, and clinical status [37], these are addressed through dietitian-led individualized nutrition care following menu implementation [13]. Sodium was assessed using a pragmatic threshold of 3,500 mg/day, reflecting current LTC menu patterns [38]. Although higher than the Chronic Disease Risk Reduction Intake (CDRR) of 2,300 mg/day, this limit balances chronic disease risk with menu feasibility, palatability, and resident satisfaction [38, 39]. Nutrients with low feasibility for compliance (< 10% of menus meeting thresholds) were excluded from the compliance criteria, as achieving adequacy with existing food items was unrealistic. For example, vitamin D was excluded because no menus met the target; this aligns with national recommendations for adults aged over 50 years to obtain vitamin D through supplementation [40].

Second, a food-based assessment evaluated the nutrient-compliant menus for alignment with CFG-2019 using the HEFI-2019 [27]. HEFI-2019 evaluates overall diet alignment with CFG-2019 using ten components: Vegetables and fruits, Whole-grain foods, Grain foods ratio, Protein foods, Plant-based protein foods, Beverages, Fatty acids ratio, Saturated fats, Free sugars, and Sodium [27]. Scores range from 0 to 80, with higher scores indicating greater adherence to the recommendations of CFG-2019 [27]. Menus scoring at least 75% were considered compliant with CFG-2019, representing meaningful improvement over typical scores among free-living older adults (46 ± 8.9, 58%) [20] and aligning with the 75% nutrient adequacy threshold used for micronutrients [13]. This cutoff provides a balanced and conservative benchmark for assessing menu quality and feasibility within LTC homes.

Characterizing nutrient- and food-compliant simulated menus

Menus that met both nutrient requirements and CFG-2019 were further evaluated using the CFSS and the HEFI-2019. The CFSS is a nutrient profile model that ranks the healthfulness of individual foods based on CFG-2019 recommendations using a process similar to HEFI-2019. It follows a three-step process: (1) foods are classified into nutritious food categories and assigned points based on adherence to CFG-2019 recommendations; (2) points are deducted for levels of saturated fat, sugars, and sodium according to thresholds from Canadian front-of-pack labeling regulations; and (3) a final score is calculated from the first two steps range (10–100), classifying foods into one of five categories: "Very Poor," "Poor," "Fair," "Good," or "Excellent" choice [28]. For menus that met both standards, CFSS scores were summarized at the menu level into three categories: "Good & Excellent," "Fair," and "Very Poor & Poor," reflecting the overall quality of the foods offered. The HEFI-2019 was used to assess overall dietary alignment with CFG-2019 and to estimate serving equivalents for key food groups, including Vegetables and Fruits, Wholegrain Foods, and Protein Foods. Serving equivalents were expressed using RA, the standardized unit used in HEFI-2019 to quantify food group intake [27, 31].

Statistical analysis

All statistical analyses were conducted using R version 4.3.3 (R Foundation for Statistical Computing, Vienna, Austria). Descriptive statistics were used to summarize the nutrient and food-based characteristics across four menu groups: (1) 28 current LTC one-day menus provided by a major North American food service provider, (2) all 10,000 simulated one-day menus, (3) simulated menus meeting all nutrient-based targets, and (4) simulated menus meeting both nutrient- and food-based standards. For each group, mean values and standard deviations were calculated, and the number and proportion of menus meeting nutrient and food-based targets were reported. For menus meeting both standards, CFSS scores were used to categorize food quality as "Good & Excellent," "Fair," or "Very Poor & Poor" by meal level, and food group servings were estimated using HEFI-2019 [27, 31].

Results

Characteristics of a sample of current LTC menus ($n = 28$)

Current LTC menus in the LTC database provided an average of 2,849 kcal and 116 g of protein per day, meeting DRI targets (Table 1). Fluids averaged 2,350 mL, and fat contributed 33% of total energy, within the 20–35% Acceptable Macronutrient Distribution Range and consistent with the 30–35% target recommended to support energy density and palatability in LTC menus. Fibre (32 g) met the 30 g minimum, whereas saturated fat (51 g) exceeded the < 10% of energy benchmark set by CFG-2019 [15]. Major contributors to saturated fat intake included dairy products (24.5%), combination dishes (24.1%), and bakery products (21.4%). Sodium was high at 3,089 mg, exceeding the CDRR of 2,300 mg but remaining below the upper threshold of 3,500 mg used in LTC menu planning. Several micronutrients exceeded targets (e.g., iron, magnesium, vitamins A and C), whereas the food-based assessment indicated suboptimal with CFG-2019, with a mean HEFI-2019 score of 45.3 (65%), falling below the 75% compliance threshold.

Characteristics of all simulated menus ($n = 10,000$)

Of the 10,000 simulated menus generated from combinations of menu items from the sample of the current LTC

Table 1 Nutritional and food-based compliance across current and simulated long-term care menus

Component	Target	Current Menus ($n=28$)		All Simulated Menus ($n=10,000$)		Simulated Menus Meeting Nutrient-Based Standards ($n=28$), mean ± SD	Simulated Menu Meeting Nutrient- and Food-Based Standards ($n=6$), mean ± SD
		Mean ± SD	% Meeting Target	Mean ± SD	% Meeting Target		
Nutrient-based standards							
Macronutrients							
Energy (kcal)	Range: 2,000–3,000 kcal	2,849 ± 478	85%	2,876 ± 340	66%	2,790 ± 145	2,857 ± 152
Fluid (mL)	Min. 2,000mL	2,350 ± 26	100%	2,226 ± 50	100%	2,227 ± 45	2,233 ± 59
Protein (g)	Min. 100 g	116 ± 23	96%	114 ± 16	81%	111 ± 8	107 ± 5
% Energy from fats	Range: 30–35%	33 ± 3	52%	32 ± 4	46%	32 ± 2	32 ± 1
Fibre (g)	Min. 30 g	32 ± 7	56%	27 ± 6	27%	33 ± 3	32 ± 2
Sodium (mg)	Max. 3,500 mg	3,089 ± 585	78%	3,512 ± 780	52%	2,920 ± 357	3,088 ± 392
Micronutrients (threshold evaluated at 75% of target)							
Calcium (mg)	Min. 900 mg (RDA=1200 mg)	1,670 ± 353	100%	1,682 ± 385	100%	1,550 ± 265	1,497 ± 320
Copper (mg)	Min. 0.6 mg (RDA = 0.9 mg)	2.1 ± 0.6	100%	2.4 ± 0.6	100%	2.5 ± 0.5	2.9 ± 0.3
Folate (µg)	Min. 300 µg (RDA=400 µg)	540 ± 193	100%	594 ± 160	99%	642 ± 131	647 ± 180
Iron (mg)	Min. 6 mg (RDA=8 mg)	15 ± 4	100%	14 ± 4	100%	15 ± 3	14 ± 1
Magnesium (mg)	Min. 315 mg (RDA=420 mg)	559 ± 144	100%	477 ± 75	99%	487 ± 76	497 ± 106
Manganese (mg)	Min. 1.7 mg (AI = 2.3 mg)	5.8 ± 1.6	100%	5.6 ± 1.7	100%	5.8 ± 1.5	6.3 ± 2.0
Pantothenic acid (mg)	Min. 3.8 mg (AI=5 mg)	11.4 ± 3.1	100%	9.2 ± 1.8	100%	10.2 ± 1.6	10.2 ± 1.8
Phosphorus(mg)	Min. 525 mg (RDA=700 mg)	2,535 ± 712	100%	2,924 ± 1,118	100%	2,552 ± 803	2,769 ± 1,015
Potassium (mg)	Min. 3,525 mg (AI = 4,700 mg)	5,836 ± 1,890	100%	4,600 ± 652	96%	4,815 ± 512	5,043 ± 180
Selenium (µg)	Min. 41.2 µg (RDA=55 µg)	208 ± 75	100%	186 ± 45	100%	182 ± 43	167 ± 45
Vitamin A (mg)	Min. 675 mg (RDA=900 mg)	791 ± 220	74%	446 ± 288	20%	890 ± 163	847 ± 165
Vitamin B1 (mg)	Min. 0.9 mg (RDA = 1.2 mg)	3.4 ± 2.3	100%	3.2 ± 1.8	100%	3.3 ± 1.9	4.2 ± 2.9
Vitamin B2 (mg)	Min. 0.9 mg (RDA = 1.3 mg)	4.0 ± 1.0	100%	3.3 ± 0.5	100%	3.4 ± 0.4	3.2 ± 0.2
Vitamin B3 (mg)	Min. 12 mg (RDA=16 mg)	40 ± 17	100%	37 ± 10	100%	35 ± 9	34 ± 9
Vitamin B6 (mg)	Min. 1.2 mg (RDA = 1.7 mg)	3.2 ± 1.5	100%	2.6 ± 0.8	100%	2.7 ± 0.7	3.0 ± 0.9
Vitamin B12 (mg)	Min. 1.8 mg (RDA = 2.4 mg)	9.0 ± 2.5	100%	7.2 ± 1.9	100%	7.1 ± 1.1	6.7 ± 0.8
Vitamin C (mg)	Min. 68 mg (RDA=90 mg)	185 ± 69	100%	204 ± 92	99%	196 ± 54	244 ± 59
Vitamin D (µg)	Min. 15 µg (RDA=20 µg)	12 ± 4	19%	7 ± 2	0%	7 ± 2	8 ± 2
Vitamin E (mg)	Min. 11.3 mg (RDA=15 mg)	11.7 ± 4.6	33%	12.5 ± 4.2	56%	14.9 ± 3.5	13.6 ± 1.5
Zinc (mg)	Min. 8.3 mg (RDA=11 mg)	17.7 ± 8.4	100%	16.6 ± 4.9	100%	15.7 ± 4.5	17.5 ± 7.6
Food-based standards							
HEFI-2019 (range: 0–80)	Min. 75%	45.3 ± 6.2	65%	51.6 ± 5.4	68%	55.4 ± 4.7 (69%)	61.7 ± 1.1 (77%)

Values shown as mean ± standard deviation. Nutrient- and food-based targets are compared across current long-term care menus ($n=28$), all simulated menus ($n=10,000$), simulated menus meeting nutrient-based standards ($n=28$), and those meeting both nutrient- and food-based standards ($n=6$). Macronutrients and sodium were assessed at 100% of their respective targets, in accordance with Dietitians of Canada's recommendations [13, 14]. Micronutrients were evaluated at 75% of the RDA (or the AI, when an RDA was not available) for males aged 70 years and older [13, 14]. The percentage of menus that meet each target is reported for both the current and simulated menu groups. Food-based compliance was defined as achieving scaled HEFI-2019 scores of at least 75%. Abbreviations: *AI* Adequate Intake, *HEFI-2019* Healthy Eating Food Index-2019, *RDA* Recommended Dietary Allowance

menus in the database, all menus met nutrient targets for zinc, selenium, calcium, copper, iron, and phosphorus, with high compliance for magnesium (99%), thiamin (99%), vitamin B6 (99%), and potassium (96%) (Table 1). Fewer menus met targets for fibre (27%), vitamin A (20%), sodium (56%), and energy (66%). On average, simulated menus scored 51.6 (68%) for HEFI-2019, falling below the 75% threshold for food-based compliance.

Characteristics of the nutrient-compliant simulated menus (*n* = 28)

A total of 28 of the simulated menus met all nutrient-based targets (excluding vitamin D). These menus averaged 2,790 kcal, 2,227 mL of fluids, 111 g of protein, and 33 g of fibre (Table 1). Fat contributed 32% of energy, and sodium averaged 2,919 mg, which is below the LTC-specific upper limit of 3,500 mg but exceeds the CDRR threshold of 2,300 mg per day [39]. Micronutrient levels were adequate, with calcium (1,550 mg), potassium (4,815 mg), vitamin C (196 mg), B12 (7.1 µg), folate (642 µg), magnesium (487 mg), iron (15 mg), and zinc (15.7 mg) all meeting or exceeding target values. The mean HEFI-2019 score was 55.4 (69%), falling below the 75% threshold for food-based compliance.

Characteristics of the nutrient- and food-compliant simulated menus (*n* = 6)

Six menus met both nutrient- and food-based standards (S2 Table). These menus provided an average of 2,856.5 kcal, 2,233 mL of fluids, 107 g of protein, and 32% of energy from fat, all within target ranges (Table 1). Fibre met the 30 g target (32 g), whereas sodium intake (3,083 mg) was below the 3,500 mg upper limit but remained well above the CDRR [39]. Most micronutrients met or exceeded requirements, including calcium, iron, vitamins A, B1, B2, B3, B6, C, E, folate, and magnesium. The HEFI-2019 score averaged 61.7 (77%), above the 75% threshold for food-based compliance.

The six compliant menus showed a distribution of menu items offered across CFSS categories (Fig. 2). On average, 58.1% of menu items in the compliant menus were classified as "Good & Excellent," followed by 24.5% as "Fair," and 17.3% as "Very Poor & Poor." Breakfast and dinner had the highest proportions of "Good & Excellent" items (68.9% and 61.9%, respectively), including items such as oatmeal and fruit (e.g., bananas, apples) at breakfast and vegetable sides (e.g., steamed asparagus) at dinner. Morning and afternoon snacks had the highest proportions of "Fair" items (33.3% and 38.9%, respectively), such as cookies and muffins. Lunch had the highest proportion of "Very Poor & Poor" items (25.7%),

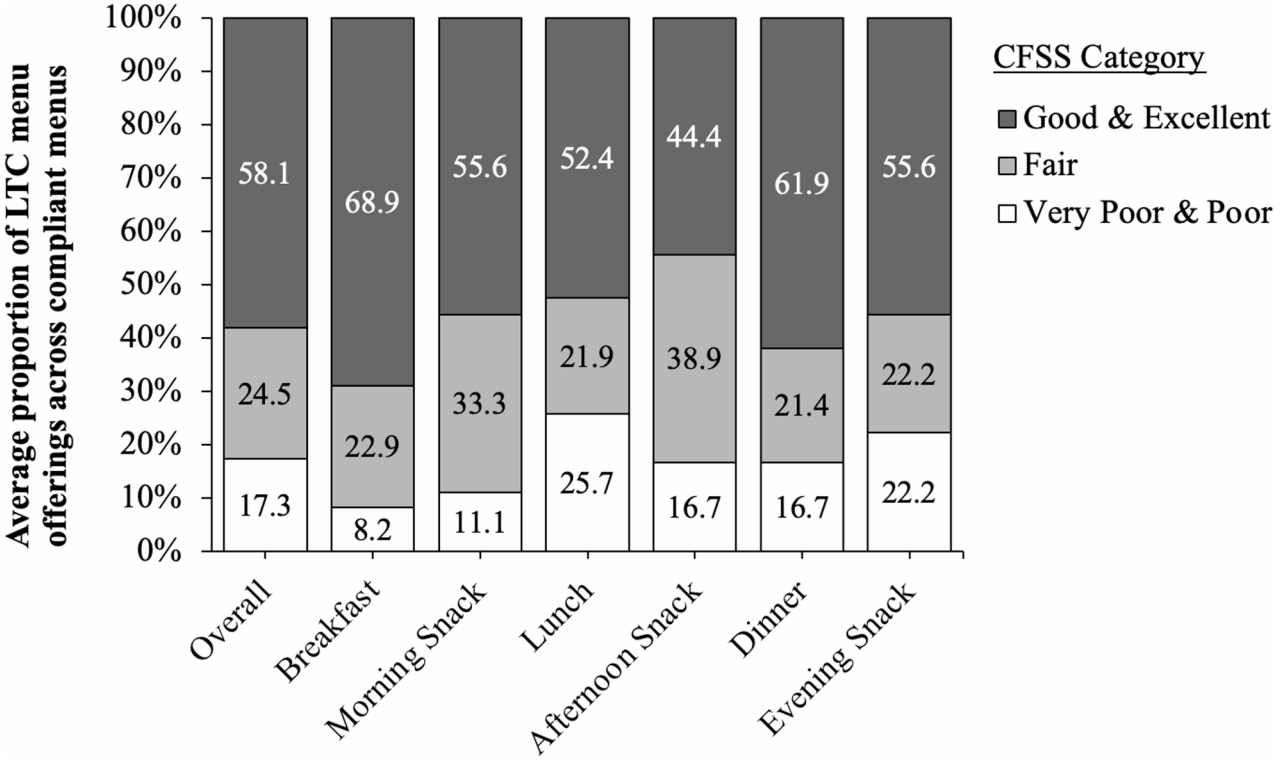


Fig. 2 Proportion of menu offerings by the Canadian Food Scoring System category across six nutrient- and food-based compliant menus (*n* = 6). Menu items from six simulated LTC menus that met both nutrient-based and food-based standards were categorized using the CFSS as "Good & Excellent," "Fair," or "Very Poor & Poor." Abbreviations: CFSS, Canadian Food Scoring System; LTC, long-term care homes

Table 2 Canada's food guide 2019 serving estimates derived from the Healthy Eating Food Index-2019 component scores of six nutrient- and food-based compliant menus ($n=6$)

HEFI-2019 Component	Mean HEFI-2019 Scores for Compliant Menus[a]	Estimated Number of CFG-2019 Servings Required to Meet HEFI-2019 and DRI Targets[b]
Total HEFI-2019, /80	**61.7 (77%)**	
Fruit & vegetables, /20	15.3 ± 1.8	9.9 ± 1.6 RA
Whole grains, /5	2.0 ± 1.6	2.5 ± 1.9 RA
Whole grain / grain foods ratio, /5	4.7 ± 0.6	Choose whole grains more than refined grains
Protein foods, /5	4.9 ± 0.1	4.6 ± 1.1 RA
Plant-based protein foods, /5	0.5 ± 0.8	0.3 ± 0.6 RA
Beverages, /10	8.9 ± 0.7	Choose water, unsweetened coffee, tea, or lower fat milk where possible
Unsaturated/ saturated fatty acid ratio, /5	3.0 ± 1.0	Choose foods with healthy fats
Saturated fats /5	4.0 ± 0.8	< 10% of total calorie intake
Free sugars, /10	10.0 ± 0	< 10% of total calorie intake
Sodium, /10	8.2 ± 1.0	Try to limit intake < 2,300 mg

Values shown as mean ± standard deviation. [a]Mean HEFI-2019 scores summarize overall diet quality among compliant menus ($n=6$) that met both nutrient- and food-based standards. Estimated CFG-2019 daily recommendations were derived using Health Canada's Table of Reference Amounts for Foods (RA) [31] and supplemented with qualitative recommendations for components without defined RA (e.g., fat quality, saturated fat, sodium). [b]Estimated CFG-2019 servings represent the number of daily servings required for menus to meet HEFI-2019 component scores and DRI targets. HEFI-2019 scores were converted to estimated servings by scaling scores to the maximum possible for each component, adjusting for the recommended CFG-2019 plate proportion, and multiplying by the total RA of food provided. For example, a score of 15.3 out of 20 for fruits and vegetables equates to approximately 9.9 servings per day based on the recommended 50% plate allocation and average total menu RA. Abbreviations: *CFG* Canada's food guide, *HEFI-2019* Healthy Eating Food Index-2019, *LTC* long-term care homes, *RA* reference amounts

driven by the inclusion of desserts (e.g., lemon bars) and processed meat side items (e.g., peameal bacon). Using HEFI-2019, the compliant menus included an average of 9.9 serving equivalents of fruits and vegetables, 2.5 of whole grains, and 4.6 of protein foods, including 0.3 of plant-based proteins (Table 2). Corresponding scores for the food-based HEFI-2019 components were 15.3/20 for fruits and vegetables, 2.0/5 for whole grains, 4.9/5 for protein foods, and 0.5/5 for plant-based protein foods. Scores for other HEFI-2019 components reflected mixed alignment with CFG-2019: the unsaturated-to-saturated fat ratio was moderate (3.0/5), saturated fat intake was within recommended limits (4.0/5), free sugar intake fully met the guideline (10.0/10), and sodium intake was somewhat higher than recommended, yielding a score of 8.2/10.

Discussion

This study evaluated the nutrient and food-based compliance of both current LTC menus and simulated one-day menus derived from menu items offered by a major North American foodservice provider. Nutrient targets were set at the higher end of requirements to reflect the needs of a nutritionally vulnerable population. Only 6 of 10,000 simulated menus (0.06%) met both nutrient- and food-based standards, indicating that the foods and recipes available from this provider were insufficient to easily support alignment with both nutrient requirements and CFG-2019 recommendations. These findings highlight the need for reformulation of menu items and recipes, expansion of nutrient-dense options, and integration of evidence-based planning tools to better support compliance with both nutrient- and food-based standards [12].

Current LTC menus examined in this study provided adequate energy and protein and met several micronutrient targets, including calcium, iron, magnesium, and vitamins A and C, but continued to exceed recommended levels for sodium and saturated fat. Vitamin D levels were below recommended intakes in both current (12 µg) and simulated (7 µg) menus, falling short of the 15 µg minimum target and 20 µg RDA, confirming that food sources alone are insufficient to meet requirements; fewer than 40% of LTC residents are reported to receive vitamin D supplementation, highlighting the importance of following national recommendations for supplementation in adults over 50 years [40, 41]. Among the 10,000 simulated menus, only 28 (0.28%) met all nutrient-based targets (excluding vitamin D). Simulated menus met energy requirements in only 66% of cases, indicating limited flexibility within current menu offerings to consistently achieve both energy and nutrient adequacy. The nutrient-compliant menus were characterized by higher energy provision and greater nutrient density, suggesting that targeted improvements to food selection and recipe design, alongside strengthened dietary oversight, are needed to improve nutritional quality in LTC.

The six simulated LTC menus compliant with both nutrient- and food-based standards further illustrate the difficulty of achieving alignment with CFG-2019 using foods available from this provider. Although these menus achieved a mean HEFI-2019 score of 61.7 out of 80, which is well above current LTC averages (43.5/80) and national averages for older adults (46.3–47.5/80) [20],

their overall composition varied across meals. While, on average, 58% of menu items were rated "Good & Excellent" according to the CFSS, the distribution of item quality across meals was uneven, with lunch offerings and snack foods containing a higher proportion of "Fair" and "Very Poor & Poor" items. In LTC settings, both meals and snacks are structured components of daily food provision, with most homes providing food outside of mealtimes (96.9%) [42], indicating that both represent important opportunities to improve menu quality and food-pattern alignment. In addition, many meal combinations within the compliant menus met nutrient targets but did not align with broader food-pattern recommendations in CFG-2019, as illustrated by pairings such as *breakfast sausage* with *stir-fried vegetables* or *Oktoberfest sausage* with *turnip* and *strawberry shortcake*. These meal patterns were characterized by a higher proportion of animal-based proteins, likely reflecting both their greater availability in LTC and their role in meeting residents' high energy and protein needs [43]. However, this reliance on animal-based proteins is not fully consistent with CFG-2019, which emphasizes increased consumption of plant-based protein foods [15]. The one-size-fits-all recommendations in CFG-2019 may not be well-suited for older adults in LTC, who have higher protein requirements and face unique challenges in meeting nutrient needs [20], yet LTC are still required to align menus with these guidelines under provincial regulations. HEFI-2019 component scores for plant-based proteins and whole grains were among the lowest (0.5 and 2.0 out of 5), indicating minimal inclusion of key food groups emphasized in CFG-2019. Including more plant-based protein foods supports alignment with CFG-2019, as required by provincial regulations, and is associated with reduced risk of chronic disease, lower inflammation, and improved overall dietary quality [25]. In LTC, however, most residents already live with chronic disease, and nutrition care therefore prioritizes management, adequate intake, and quality of life through a person-centred, food-first approach rather than disease prevention alone [13]. Addressing these gaps, however, will require intentional menu planning and recipe reformulation to incorporate more plant-based proteins and whole grains while maintaining resident acceptability. Protein quality can be ensured by pairing complementary plant proteins, such as legumes and grains, or by including soy and fortified products that provide complete amino acid profiles [44]. Although in-house fortification of commonly consumed foods may require additional labor and preparation, it is often more cost-effective than relying on commercial nutritional supplements in LTC settings and aligns with food-first approaches recommended for supporting nutritional adequacy [13]. Introducing plant-based proteins through everyday popular recipes such as soups, casseroles, or muffins offers a practical and creative way to enhance dietary diversity, align with CFG-2019, and support nutritional adequacy [45]. However, evidence on the feasibility and effectiveness of these approaches in LTC remains limited [46, 47]. Similarly, low HEFI-2019 component scores for whole grains likely reflect both the limited availability of whole-grain products within current LTC menu offerings by this provider and resident preferences for refined grain products, which tend to be more palatable and widely accepted [13, 25]. Both fresh and pre-made foods were included in the LTC menu database and identified based on their nutritional profiles. CFG-2019 supports the use of pre-made foods, such as frozen or canned produce without added sodium or sugars, as they can offer comparable nutritional quality when appropriately selected [15]. For example, canned peaches packed in water and fresh peaches included in the LTC menu database had similar nutritional compositions, suggesting that well-chosen pre-made foods can provide nutritionally equivalent, cost-effective, and labour-efficient alternatives in institutional settings.

While CFG-2019 is required by provincial regulations for menu planning in LTC, its practical application in institutional settings remains challenging [12]. The CFSS and HEFI-2019 offer practical frameworks to help address this gap. The CFSS applies CFG-2019 and front-of-package labelling nutrient thresholds to classify foods by quality, helping dietitians and food service staff identify and limit foods high in sodium, sugars, or saturated fat [28, 35]. However, this information is often unavailable for business-to-business foodservice products used in LTC because many foods fall under full front-of-package labelling exemptions, including non-retail shipping containers and ready-to-serve or ingredient products intended solely for institutional food service [48]. In this context, the CFSS can help inform procurement and menu planning decisions by identifying the proportion of foods rated "Good & Excellent" versus "Fair" or "Very Poor & Poor" that can be included while maintaining overall alignment with CFG-2019 recommendations. The HEFI-2019 complements this approach by evaluating overall menu alignment with CFG-2019 and estimating servings of key food groups, though its complexity and the technical expertise required to apply it limit its routine use in practice. These findings demonstrate the need for a simplified, user-friendly tool that integrates serving-based assessment with food quality criteria. Such a tool could combine the quantitative clarity of CFG-2007, which provided serving-based guidance aligned with nutrient targets, with the food quality and dietary pattern principles of CFG-2019 to better support consistent, evidence-based menu planning in LTC.

This study demonstrates that compliance with both nutrient- and food-based standards was not easily

achieved in LTC menu planning using foods and recipes from a single large provider, although such compliance may be achievable with foods available from other providers. Provincial regulations require alignment with the DRI and CFG-2019, yet few practical tools exist to support this process [12]. Using menu simulation and validated assessment tools (CFSS and HEFI-2019) [27, 28], the study illustrates the difficulty of meeting both standards when menu planning is limited to foods and recipes from a single provider, and provides preliminary insight into how well these LTC menus align with national dietary recommendations. The findings highlight the need for evidence-based tools and implementation strategies to help dietitians and food service staff translate food-based recommendations into routine menu planning and regulatory compliance. However, several limitations should be acknowledged. First, the study relied on sample menus from one food service provider, with simulated menus generated for one day. This design reflects the menu-planning process used to ensure compliance with daily nutrient targets and CFG-2019 recommendations but may not capture the variability inherent in real-world menu planning, including seasonal changes and product availability [13, 49]. In addition, failure to meet these standards may reflect limitations in the nutritional adequacy of the foods and recipes available from this provider. In Canada, more than 200,000 older adults currently reside in LTC, a number projected to increase rapidly over the next two decades as the population ages [50]. Major foodservice companies collectively supply approximately 46% of Canadian institutional foodservice, with LTC accounting for about 14% of this market [29]. While the specific market share of LTC menus used in this analysis is proprietary, the data were sourced from a major North American foodservice provider that serves LTC homes across Canada. This provider supplies products that support both traditional on-site meal preparation and the use of pre-prepared or re-thermalized foods. In Canada, most LTC homes use traditional production systems (68.8%), with smaller proportions using pre-prepared systems (12.5%) or a combination of both (18.8%) [42]. However, as this analysis did not assess food preparation practices directly and was limited to menus from a single provider, the extent to which production approach influenced menu quality and alignment with dietary guidance remains unclear. Future research should apply this analysis to multi-day menus from multiple providers to improve generalizability. Second, the simulated menus were based on sample foods and recipes from a single food service provider and therefore reflect only the foods available from that provider, which included relatively few whole-grain and plant-based protein options. In practice, menu developers must account for numerous environmental and operational constraints, including cultural preferences, texture modifications, procurement systems, and institutional policies, all within strict budgetary limits [13, 49]. Evidence shows that greater adherence to CFG-2019 recommendations can increase food costs [51], creating a significant barrier for LTC homes striving to improve menu quality within existing resources. Collaborating with food service providers to incorporate fortified, nutrient-dense, and affordable options, such as frozen or canned produce, or foods with greater nutritional density could help address this barrier. Third, the analysis was limited to regular diets and did not include other dietary variations, such as modified texture and vegetarian options, which may limit the scope of the findings to all LTC residents [6]. Lastly, menu offerings may not translate directly into intake [52, 53]. Older adults in LTC often do not consume all the foods offered; studies report food waste exceeding 55% at some facilities, with a key contributing factor being policy requirements that prioritize offering residents multiple meal choices [54]. Therefore, offering healthier or nutritionally adequate menu options alone may not directly translate into improved nutrient intakes. Future work should examine how menu design, mealtime environments, and supportive feeding practices can improve both dietary intake and sustainability outcomes in LTC.

Conclusions

Although provincial regulations require LTC menus to comply with both nutrient- and food-based standards, full compliance was not achieved using the foods and recipes available from a single large provider, as only 6 of 10,000 simulated menus met both requirements. Because this study was based on sample menus from a single provider, the findings may not reflect the full range of product availability or menu quality across all LTC settings. Nonetheless, the findings highlight important gaps in the tools and guidance currently available to support menu planning in LTC. Addressing these gaps requires LTC-specific planning tools, clearer food guide serving benchmarks, and readily accessible resources to support dietitians and food service professionals in translating dietary recommendations into routine menu planning and regulatory compliance. In addition, clearer accountability mechanisms for foodservice providers supplying LTC homes are needed to ensure that the foods and recipes available for menu planning meet both nutrient requirements and CFG-2019 standards, thereby supporting improved menu quality and nutritional outcomes for residents.

Abbreviations

AI	Adequate Intake
CDRR	Chronic Disease Risk Reduction
CFG-2019	Canada's food guide
CFSS	Canadian Food Scoring System
DRI	Dietary Reference Intakes
HEFI-2019	Healthy Eating Food Index-2019
LTC	long-term care homes
RA	Reference Amounts
RDA	Recommended Dietary Allowance

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12877-026-07740-z.

Supplementary Material 1.

Authors' contributions

All authors contributed to the conception and design of the study. CGM and DAZ conducted the statistical analyses. CGM and JJL drafted and revised the manuscript. All authors read and approved the final manuscript.

Funding

This study was partially funded by the Temerty Faculty of Medicine, University of Toronto Pre-Partnership Grant (Grant #473415). CGM was supported by a Canadian Institute of Health Research (CIHR) Master's Award (CGS-M). DAZ was supported by a CIHR Postdoctoral Research Fellowship and a Banting and Best Diabetes Centre DH Gales Family Charitable Foundation Postdoctoral Fellowship. The funders had no involvement in the study design, data collection, analysis, interpretation, decision to publish, or manuscript preparation.

Data availability

The data that support the findings of this study are available from GS1 Standards, but restrictions apply to the availability of these data, which were used for the current study, and so are not publicly available. Data are, however, available from the authors upon reasonable request. For more information on the process for approval to access this data, contact Dr. Mary R. L'Abbe (mary.labbe@utoronto.ca). The analytic code used in this study is publicly available at: https://github.com/dzaltz/cfg_menu_modeling.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 23 May 2025 / Accepted: 26 May 2026
Published online: 13 July 2026

References

1. Keller HH, Lengyel C, Carrier N, Slaughter SE, Morrison J, Duncan AM, et al. Prevalence of inadequate micronutrient intakes of Canadian long-term care residents. Br J Nutr. 2018;119(9):1047–56.
2. Keller HH, Carrier N, Slaughter SE, Lengyel C, Steele CM, Duizer L, et al. Prevalence and Determinants of Poor Food Intake of Residents Living in Long-Term Care. J Am Med Dir Assoc. 2017;18(11):941–7.
3. CSA Public Policy Centre. Aging Canada. 2040: Policy implications of demographic change. CSA Group. 2024. https://www.csagroup.org/wp-content/uploads/CSA_Public-Policy_Aging-Canada-2040_12.04.24_Accessible.pdf. Accessed 5 May 2025.
4. Canadian Medical Association (CMA). Canada's elder care crisis: addressing the double demand. Canadian Medical Association. 2021 Mar 25. https://digitallibrary.cma.ca/link/digitallibrary53. Accessed 4 Nov 2025.
5. Health Canada. Section 4: Implementation of dietary guidelines. Canada's Food Guide. Health Canada. 2023. https://food-guide.canada.ca/en/guidelines/section-4-implementation-dietary-guidelines/. Accessed 5 Nov 2025.
6. Vucea V, Keller HH, Morrison JM, Duncan AM, Duizer LM, Carrier N, et al. Nutritional quality of regular and pureed menus in Canadian long term care homes: an analysis of the Making the Most of Mealtimes (M3) project. BMC Nutr. 2017;3:80.
7. O'Brien L, Wilkinson TJ, Frampton C, Gearry RB, Wall C. A systematic review and meta-analysis of the dietary fiber menu provision and consumption for older adults living in residential care facilities. Am J Clin Nutr. 2024;120(2):431–41.
8. Vucea V, Keller HH, Morrison JM, Duncan AM, Duizer LM, Lengyel CO, et al. Intake and Factors Associated with Consumption of Pureed Food in Long Term Care: An Analysis of Making the Most of Mealtimes (M3) Project. J Nutr Gerontol Geriatr. 2018;37(2):59–81.
9. Vucea V, Keller HH, Ducak K. Interventions for improving mealtime experiences in long-term care. J Nutr Gerontol Geriatr. 2014;33(4):249–324.
10. Ministry of Long-Term Care. Food and nutrition in long-term-care homes. Government of Ontario. 2021. https://www.auditor.on.ca/en/content/annualreports/arreports/en19/v1_305en19.pdf. Accessed 4 Nov 2025.
11. Statistics Canada. A portrait of Canada's growing population aged 85 and older from the 2021 Census. Statistics Canada. 2022. https://www12.statcan.gc.ca/census-recensement/2021/as-sa/98-200-x/2021004/98-200-x2021004-eng.cfm. Accessed 5 Nov 2025.
12. Ducak K, Keller HH. Menu planning in long-term care: toward resident-centred menus. Can J Diet Pract Res. 2011;72(2):83.
13. Dietitians of Canada. Menu Planning in Long Term Care and Canada's Food Guide. (2019). Dietitians of Canada. 2020. https://www.dietitians.ca/DietitiansOfCanada/media/Documents/Resources/Menu-Planning-in-Long-Term-Care-with-Canada-s-Food-Guide-2020.pdf?ext=.pdf. Accessed 4 Nov 2025.
14. Institute of Medicine (US). Subcommittee on Interpretation and Uses of Dietary Reference Intakes; Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Dietary reference intakes: applications in dietary assessment. Washington (DC): National Academies Press (US); 2000.
15. Health Canada. Canada's Food Guide. Health Canada. 2019. https://food-guide.canada.ca/en/. Accessed 4 Nov 2025.
16. Institute of Medicine. Dietary reference intakes: the essential guide to nutrient requirements. Washington, DC: National Academies; 2006.
17. Institute of Medicine (US). Subcommittee on Interpretation and Uses of Dietary Reference Intakes; Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Dietary reference intakes: applications in dietary planning. Washington (DC): National Academies Press (US); 2003.
18. Health Canada. Dietary reference intakes tables: reference values for macronutrients. Health Canada. 2023. Available from: https://www.canada.ca/en/health-canada/services/food-nutrition/healthy-eating/dietary-reference-intakes/tables.html. Accessed 4 Nov 2025.
19. Ahmed M, Praneet Ng A, L'Abbe MR. Nutrient intakes of Canadian adults: results from the Canadian Community Health Survey (CCHS)-2015 Public Use Microdata File. Am J Clin Nutr. 2021;114(3):1131–40.
20. Brassard D, Chevalier S. Relationship between Adherence to the 2019 Canada's Food Guide Recommendations on Healthy Food Choices and Nutrient Intakes in Older Adults. J Nutr. 2023;153(9):2699–708.
21. Lam IT, Keller HH, Duizer L, Stark K. Micronutrients on the Menu: Enhancing the Quality of Food in Long-term Care for Regular, Nontherapeutic Menus. Can J Diet Pract Res. 2015;76(2):86–92.
22. Institute of Medicine (US) Food Forum. Providing healthy and safe foods as we age: workshop summary. Washington (DC): National Academies Press (US). 2010. https://www.ncbi.nlm.nih.gov/books/NBK51837/. Accessed 4 Nov 2025.
23. Health Canada. Eating well with Canada's Food Guide. (2007): development of the food intake pattern. Health Canada. 2007. https://www.canada.ca/en/health-canada/services/food-nutrition/reports-publications/eating-well-canada-food-guide-2007-development-food-intake-pattern.html. Accessed 21 Dec 2023.
24. Trang S, Fraser J, Wilkinson L, Steckham K, Oliphant H, Fletcher H, et al. A Multi-Center Assessment of Nutrient Levels and Foods Provided by Hospital Patient Menus. Nutrients. 2015;7(11):9256–64.
25. Pfisterer KJ, Amelard R, Keller HH, Wong A. Characterizing Canadian long-term care home consumed foods and their inflammatory potential: a secondary analysis. BMC Public Health. 2023;23(1):261.

26. Middleton CG, Lee JJ, L'Abbe MR. Alignment of menu items offered in Canadian long-term care homes with Canada's food guide and the Diabetes Canada Clinical Practice Guidelines. BMC Public Health. 2025;25(1):593.
27. Brassard D, Elvidge Munene LA, St-Pierre S, Guenther PM, Kirkpatrick SI, Slater J, et al. Development of the Healthy Eating Food Index (HEFI)-2019 measuring adherence to Canada's Food Guide 2019 recommendations on healthy food choices. Appl Physiol Nutr Metab. 2022;47(5):595–610.
28. Lee JJ, Mulligan C, L'Abbe MR. Development and validity testing of the Canadian Food Scoring System (CFSS), a nutrient profile model based on the recommendations of Canada's Food Guide 2019. Appl Physiol Nutr Metab. 2024;49(10):1363–76.
29. USDA Foreign Agricultural Service. Canada: Food service – hotel restaurant institutional annual. USDA Foreign Agricultural Service. 2018. https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Food%20Service%20-%20Hotel%20Restaurant%20Institutional_Ottawa_Canada_2-14-2019.pdf. Accessed 4 Nov 2025.
30. Government of Canada. The Canadian Nutrient File 2015. Health Canada. 2015. https://www.canada.ca/en/health-canada/services/food-nutrition/healthy-eating/nutrient-data/canadian-nutrient-file-about-us.html. Accessed 4 Nov 2025.
31. Health Canada. Nutrition labelling – table of reference amounts for food. Health Canada. 2022. https://www.canada.ca/en/health-canada/services/technical-documents-labelling-requirements/nutrition-labelling-table-reference-amounts-food.html. Accessed 4 Nov 2025.
32. Alberta Health Services Nutrition Services. How to plan a menu. Planning a healthy menu: Enhancing health through nutrition. Alberta Health Services. 2022. https://www.albertahealthservices.ca/assets/info/nutrition/if-nfs-pahm-s2-how-to-plan-a-menu.pdf. Accessed 5 Nov 2025.
33. Pilgrim AL, Robinson SM, Sayer AA, Roberts HC. An overview of appetite decline in older people. Nurs Older People. 2015;27(5):29–35.
34. Abbey KL, Wright OR, Capra S. Menu Planning in Residential Aged Care-The Level of Choice and Quality of Planning of Meals Available to Residents. Nutrients. 2015;7(9):7580–92.
35. Health Canada. Front-of-package nutrition symbol labelling guide for industry. Health Canada. 2023. https://www.canada.ca/en/health-canada/services/food-nutrition/legislation-guidelines/guidance-documents/front-package-nutrition-symbol-labelling-industry.html. Accessed 2 May 2025.
36. Dietary reference intakes. : guiding principles for nutrition labeling and fortification. Nutr Rev. 2004;62(2):73–9.
37. Statistics Canada. A profile of nursing and residential care facilities. Statistics Canada. 2019. https://www150.statcan.gc.ca/n1/daily-quotidien/210916/dq210916c-eng.htm. Accessed 4 Nov 2025.
38. Reinders I, Volkert D, de Groot L, Beck AM, Feldblum I, Jobse I, et al. Effectiveness of nutritional interventions in older adults at risk of malnutrition across different health care settings: Pooled analyses of individual participant data from nine randomized controlled trials. Clin Nutr. 2019;38(4):1797–806.
39. National Academies of Sciences, Engineering, and Medicine. Dietary reference intakes for sodium and potassium. National Academies Press. 2019. https://doi.org/10.17226/25353. Accessed 4 Nov 2025.
40. Health Canada, Vitamin D, Health Canada. 2022. https://www.canada.ca/en/health-canada/services/nutrients/vitamin-d.html. Accessed 4 Nov 2025.
41. Cammer AL, Whiting SJ. The challenge of achieving vitamin D adequacy for residents living in long-term care. Public Health Nutr. 2022;25(1):90–3. https://doi.org/10.1017/S136898002100238X.
42. Lagacé C, Carrier N, Villalon L, Lengyel C, Slaughter SE, Morrison JM, et al. Food services in long-term care homes are associated with residents' food intake. J Nutr Health Aging. 2018;4:56–63.
43. Fabek H, Sanchez-Hernandez D, Ahmed M, Marinangeli CPF, House JD, Anderson GH. An examination of contributions of animal- and plant-based dietary patterns on the nutrient quality of diets of adult Canadians. Appl Physiol Nutr Metab. 2021;46(8):877–86.
44. Gueugneau M. The value of dietary plant protein in older people. Curr Opin Clin Nutr Metab Care. 2023;26(1):3–7.
45. Research Institute for Aging. Nutrition in Disguise Recipes. Research Institute for Aging. 2025. https://the-ria.ca/resources/nid/. Accessed 4 Nov 2025.
46. Carballo-Casla A, Sotos-Prieto M, Garcia-Esquinas E, StruijkEA, Caballero FF, Calderon-Larranaga A, et al. Animal and vegetable protein intake and malnutrition in older adults: a multicohort study. J Nutr Health Aging. 2024;28(1):100002.
47. Auclair O, Burgos SA. Protein consumption in Canadian habitual diets: usual intake, inadequacy, and the contribution of animal- and plant-based foods to nutrient intakes. Appl Physiol Nutr Metab. 2021;46(5):501–10.
48. Government of Canada. Food and Drug Regulations (C.R.C., c. 870): Section B.01.350 — Front-of-package nutrition symbol labelling. Justice Laws Website: Government of Canada. 2025 Available from: https://laws-lois.justice.gc.ca/eng/regulations/C.R.C.,_c._870/section-B.01.350.html?txthl=oils. Accessed 15 Dec 2025.
49. Dietitians of Canada. Best practices for nutrition, food service and dining in long-term care homes 2019. Dietitians of Canada. 2019. https://www.dietitians.ca/DietitiansOfCanada/media/Documents/Resources/2019-Best-Practices-for-Nutrition,-Food-Service-and-Dining-in-Long-Term-Care-LTC-Homes.pdf. Accessed 4 Nov 2025.
50. Canadian Institute for Health Information. Long-term care homes in Canada: how many and who owns them? Canadian Institute for Health Information. 2021. https://www.cihi.ca/en/long-term-care-homes-in-canada-how-many-and-who-owns-them. Accessed 4 Nov 2025.
51. Rochefort G, Brassard D, Paquette MC, Robitaille J, Lemieux S, Provencher V, et al. Adhering to Canada's Food Guide Recommendations on Healthy Food Choices Increases the Daily Diet Cost: Insights from the PREDISE Study. Nutrients. 2022;14(18):3818.
52. Keller HH, Carrier N, Slaughter S, Lengyel C, Steele CM, Duizer L, et al. Making the Most of Mealtimes (M3): protocol of a multi-centre cross-sectional study of food intake and its determinants in older adults living in long term care homes. BMC Geriatr. 2017;17(1):15.
53. Wu S, Morrison-Koechl J, Lengyel C, Carrier N, Awwad S, Keller H. Are Therapeutic Diets in Long-Term Care Affecting Resident Food Intake and Meeting their Nutritional Goals? Can J Diet Pract Res. 2020;81(4):186–92.
54. McAdams B, Robinson E, Gordon R. Investigating food waste generation at long-term care facilities in Ontario. Br Food J. 2023;125(8):2902–17.

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