REVIEW

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Self-Report Dietary Assessment Tools Used in Canadian Research: A Scoping Review[1–3]

Sharon I Kirkpatrick,[4]* Lana Vanderlee,[5]* Amanda Raffoul,[4] Jackie Stapleton,[6] Ilona Csizmadi,[7] Beatrice A Boucher,[5,8] Isabelle Massarelli,[9] Isabelle Rondeau,[9] and Paula J Robson[10]

[4]School of Public Health and Health Systems, University of Waterloo, Waterloo, Ontario, Canada; [5]Department of Nutritional Sciences, University of Toronto, Toronto, Ontario, Canada; [6]University of Waterloo Library, Waterloo, Ontario, Canada; [7]Departments of Oncology and Community Health Sciences, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada; [8]Prevention and Cancer Control, Cancer Care Ontario, Toronto, Ontario, Canada; [9]Food Directorate, Health Canada, Ottawa, Ontario, Canada; and [10]Cancer Measurement, Outcomes, Research, and Evaluation (C-MORE), Alberta Health Services Cancer Control, Edmonton, Alberta, Canada

ABSTRACT

Choosing the most appropriate dietary assessment tool for a study can be a challenge. Through a scoping review, we characterized self-report tools used to assess diet in Canada to identify patterns in tool use and to inform strategies to strengthen nutrition research. The research databases Medline, PubMed, PsycINFO, and CINAHL were used to identify Canadian studies published from 2009 to 2014 that included a self-report assessment of dietary intake. The search elicited 2358 records that were screened to identify those that reported on self-report dietary intake among nonclinical, non-Aboriginal adult populations. A pool of 189 articles (reflecting 92 studies) was examined in-depth to assess the dietary assessment tools used. Food-frequency questionnaires (FFQs) and screeners were used in 64% of studies, whereas food records and 24-h recalls were used in 18% and 14% of studies, respectively. Three studies (3%) used a single question to assess diet, and for 3 studies the tool used was not clear. A variety of distinct FFQs and screeners, including those developed and/or adapted for use in Canada and those developed elsewhere, were used. Some tools were reported to have been evaluated previously in terms of validity or reliability, but details of psychometric testing were often lacking. Energy and fat were the most commonly studied, reported by 42% and 39% of studies, respectively. For ∼20% of studies, dietary data were used to assess dietary quality or patterns, whereas close to half assessed ≤5 dietary components. A variety of dietary assessment tools are used in Canadian research. Strategies to improve the application of current evidence on best practices in dietary assessment have the potential to support a stronger and more cohesive literature on diet and health. Such strategies could benefit from national and global collaboration. *Adv Nutr* 2017;8:276–89.

Keywords: self-report dietary assessment, 24-hour recalls, food records, food frequency questionnaires, screeners, Canada, scoping review

Introduction

Measuring diet as accurately as possible is essential to nutrition research of all kinds, including surveillance, epidemiologic, and intervention studies relevant to various nutrition-related conditions (1, 2). However, accurately assessing intake is a challenge (3–5). Consumption patterns vary day to day and across seasons and the life cycle (4, 5). Furthermore, individuals eat and drink multiple foods and beverages with differing nutrient profiles (6) and may also consume dietary supplements (7).

Researchers typically rely on self-report tools (3, 4), which are affected by varying types and degrees of measurement error (8–16). The extent of this error has led to debates about the value of such data (13, 14, 17) and the suggestion that they be abandoned in favor of objective measures. However, biomarkers that reflect true intake are known for only a few dietary components and are costly and burdensome (5, 18), whereas observation is not readily applied outside of controlled environments (3). Furthermore, objective measures often do not provide insights into what people actually eat or drink and related contextual factors (13), essential information for developing dietary guidance and interventions

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*To whom correspondence should be addressed. E-mail: sharon.kirkpatrick@uwaterloo.ca (SI Kirkpatrick), lana.vanderlee@utoronto.ca (L Vanderlee).

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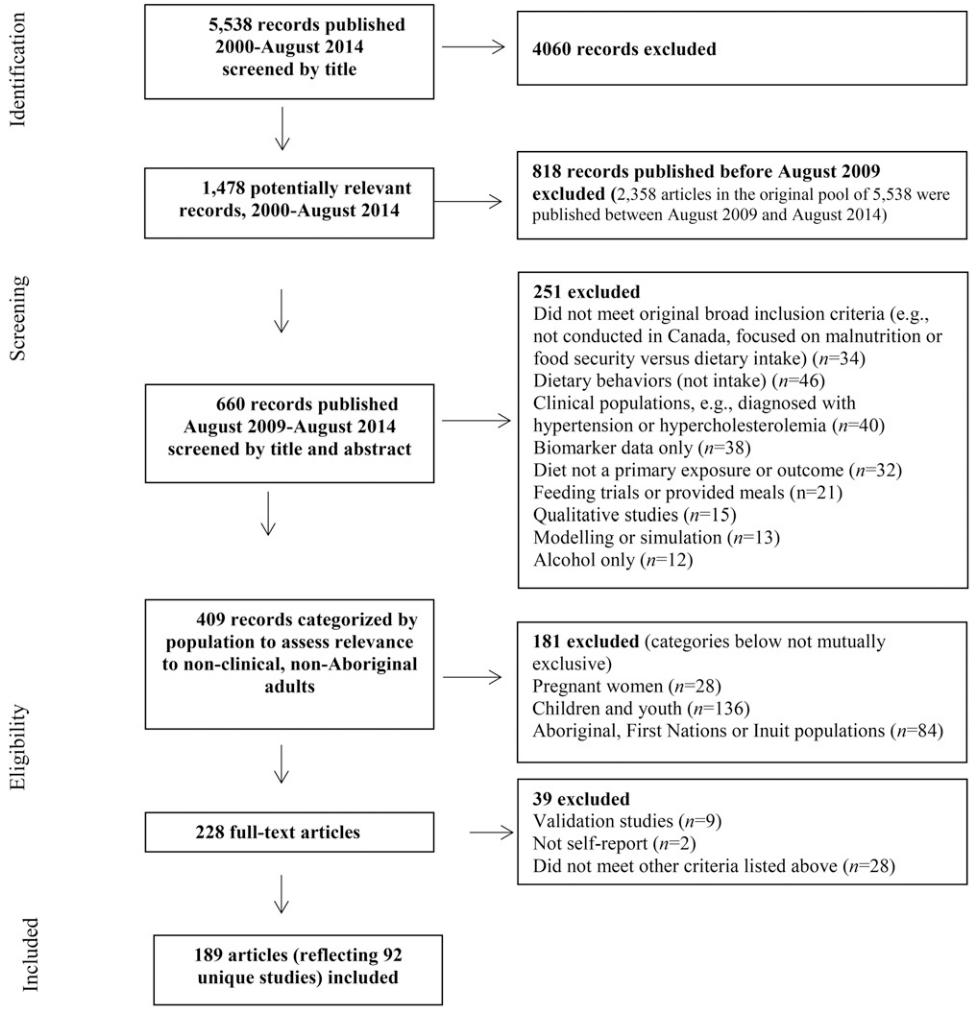

FIGURE 1 Screening process for a scoping review of Canadian research with the use of self-report tools to assess dietary intake in nonclinical, non-Aboriginal, adult populations.

(13, 19). Thus, there is a recognition that there is clear value in the continued use of self-report tools (13, 14), with acknowledgment of each tool's strengths and limitations (3–5).

Extensive work has been undertaken to understand and mitigate errors in self-report data (5, 8–10, 20–23). Growing evidence indicates the emergence of strategies to minimize the implications of error (4, 9, 24, 25), including the selection of the most appropriate tool(s) for a given research question and study design, as well as the use of appropriate statistical methods (4, 18, 25–28). However, the extent to which these strategies are taken up by researchers is unclear. Our previous review of dietary tools used in food environment research showed that researchers often drew upon tools with low cost and burden (e.g., screener, single question), potentially at the expense of data quality (29). Studies that made use of such tools were more likely to report findings that were null or in contradiction to hypotheses, possibly due to error in dietary measures.

The use of dietary assessment tools that are not optimal for the research question, study design, and population undoubtedly contributes to errors in intake estimates and inaccurate and contradictory results. A better understanding of how researchers assess diet is needed to inform approaches to strengthen the evidence on nutrition and health. We conducted a scoping review (30, 31) to characterize self-report dietary assessment tools used in Canadian research. In line with a recent commentary related to methodologies and measures (32), our intent was not to critique particular researchers or studies but to identify patterns.

Methods

This review was conducted according to the steps outlined by Arksey and O'Malley (30). Reporting follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement (33). A previous review was used to guide approaches to summarizing data (34). A core team (SIK, LV, and AR) met regularly to ensure consistency throughout the process. Ethics approval was not required.

Evidence acquisition

A search for relevant studies published in peer-reviewed journals was conducted in September 2014 with the use of the research databases PubMed, Medline, PsycINFO, and CINAHL. The search strategies, developed by a health sciences librarian (JS), used keywords and database-specific subject headings (e.g., MESH) to capture 3 concepts: *1*) food and diet, *2*) tools and instruments, and *3*) Canada or specific Canadian jurisdictions (e.g., Toronto, Ontario, Canada). Articles in English and French were considered. Given the unknown volume of relevant records, we initially searched the literature from 2000 to August 2014. The search, available upon request, captured 7506 records. After 1968 duplicates were removed, 5538 unique records were identified for screening (**Figure 1**).

TABLE 1 Overview of citations for studies for which there were multiple articles[1]

Study name (abbreviation)	References
Adventist Health Study (AHS)	68, 112, 121, 122, 148, 171, 204
Alberta Physical Activity and Breast Cancer Prevention (ALPHA) Trial	97, 200
Atlantic Partnership for Tomorrow's Health (Atlantic PATH)	217, 218
Canadian Community Health Survey (CCHS) Annual Cycles	38, 44, 84, 85, 89, 101,* 104, 110, 145, 151, 172, 175, 177, 178, 211
Canadian Community Health Survey (CCHS) Nutrition Survey (Cycle 2.2)	7, 43, 45, 47, 49, 56, 94, 99, 100, 101,* 111, 130, 132, 150, 160–162, 174, 180, 184, 185, 188, 197, 201, 202, 206, 207
Canadian Health Measures Survey (CHMS)	76, 77, 79, 109, 131, 182, 183
Canadian Multicentre Osteoporosis Study (CaMOS)	51, 132–134, 220
Complex Diseases in the Newfoundland Population: Environment and Genetics Study (CODING)	62, 108
National Enhance Cancer Surveillance System (NECSS)	114–120, 165
Newfoundland and Ontario Colorectal Cancer Study (NOCS)	192, 194–196, 221
Ontario Women's Diet and Health Study (OWDHS)	40, 42, 138, 140, 141
Quebec Family Study	70–73, 88
Quebec Longitudinal Study of Nutrition as a Determinant of Successful Aging (NuAge)	46, 93, 107, 126, 153, 167, 173, 186, 187
Study of Lifetime Total Physical Activity and Endometrial Cancer	53, 54
Tomorrow Project	80, 125, 139
Toronto Nutrigenomics and Health Study	61, 63–65, 81, 82, 98, 209, 222
Unnamed	91, 143

[1] n = 17 studies. Citations marked by an asterisk (*) refer to a study that included data from the CCHS Annual Cycles and CCHS Nutrition Survey and is listed for both.

Screening was conducted by 2 research assistants with oversight from LV and SIK. Pilot screening was conducted by all 4, with an intraclass correlation coefficient (35) of 0.78. Additional piloting was conducted until each research assistant achieved agreement with LV. The remaining records were divided between the 2 research assistants and screened for relevance, yielding 1478 records for further evaluation. Given this volume, the bounds for publication date were reduced to reflect the 5-y period from August 2009 to August 2014, leaving 660 records (2358 records total from the original search fell into this time period). Expanded inclusion criteria (Figure 1) were applied, resulting in 228 records for full-text review. This yielded 189 articles (7, 36–223) that reported on the use of self-report dietary assessment tools among nonclinical, non-Aboriginal populations of adults. These 189 articles represent 92 unique studies; an overview of studies with multiple citations is provided in Table 1. Three potentially relevant records published in French were reviewed by IM and IR during screening and were excluded.

Evidence abstraction and synthesis

Two research assistants conducted data abstraction with oversight from SIK and LV; a final verification was conducted by a PhD-trained researcher not otherwise involved in the review. Abstraction was conducted at the level of studies; for those described in multiple articles, each article was examined and the data were compiled. In addition to identifying study design, tool types and specific tools in studies that used FFQs or screeners were identified. Screeners were defined as short FFQ-type questionnaires, with or without portion-size questions, that assessed 1 or several components of diet or specific nutrients (224). Additional data abstraction fields are summarized in Table 2. For national surveys, online documents such as user guides were identified (225–227) and examined. Referring to sources cited for other studies was also sometimes required to identify details associated with the tools used. We provide citations when summarizing characteristics of studies (e.g., study design, tools used), but consistent with our goal of not critiquing particular studies or researchers (32), we summarize patterns for other variables of interest without attribution to specific studies.

Results

A total of 92 unique studies described in 189 articles were reviewed. All provinces were represented. Some studies were described as national, but none conducted specifically in the 3 territories were identified. The majority of studies (70%) included men and women, 27% included only women, and 3% included men only.

Table 3 outlines the tools used in the 92 studies; the frequencies sum to >92 because 4 studies used multiple tools. Two studies used both an FFQ and a 24-h recall (24HR)[11] [NuAGE (Quebec Longitudinal Study of Nutrition as a Determinant of Successful Aging) and (159)]; 1 used a calcium screener and an FFQ [CaMOS (Canadian Multicentre Osteoporosis Study)] and 1 used 2 FFQs to capture both recent and past intake [OWDHS (Ontario Women's Diet and Health Study)]. In addition, 2 studies administered a 24HR among a subset of participants to evaluate the accuracy of other tool(s) used [AHS (Adventist Health Study); 147]. Another used the same base FFQ in multiple populations but adapted the food list for a subgroup [NOCS (Newfoundland and Ontario Colorectal Cancer Study)]. These 3 latter studies were considered to have used a single tool for the purposes of this review. The majority (64%) made use of FFQs or screeners (or both). Food records (FRs) were used in 18% of studies and 24HRs were used in 14%. Three studies used a single question to characterize intake, and in 3 the dietary measure was not clearly identified (67, 137, 219). For 3 studies, we were able to ascertain the tool type used only by accessing cited references. Less than half of studies (n = 37) were found to report details of the food and nutrient databases used. Of these, 74% appeared to be of Canadian origin.

In terms of study design, 58 were cross-sectional, 11 were case-control studies, 10 were intervention studies or trials, 10 were cohort studies, and 3 were cross-sectional national surveys. Two articles on prospective studies described

[11] Abbreviations used: CCHS, Canadian Community Health Survey; FR, food record; 24HR, 24-h recall.

TABLE 2 Key data abstraction fields for review of dietary assessment tools used in Canadian studies of nonclinical, non-Aboriginal adult populations

Field	Description
Study name (if applicable)	The name of the particular study, if stated
Population sex/gender(s)	Whether the study population included males only, females only, or both
Study design relevant to dietary data	Whether the data being analyzed were from cross-sectional, cohort, case-control, randomized controlled trial, or surveillance studies; the overall study design was captured even though a particular article may have been based on a subset of data (e.g., cross-sectional analysis of 1 wave from a prospective cohort study)
Tool type (from article or cited reference)	The type of tool used in the study (FFQ, screener, food record/diary, 24-h food recall, single question, or not stated)
Tool name	The name of the specific tool used, if stated
Dietary components analyzed/reported	Dietary components reported in the article; only dietary components commonly reported (with a frequency >5) and micronutrients of concern selected a priori (vitamins A, C, D and calcium) are summarized in the present manuscript
If FFQ/screener	The number of items in the FFQ or screener
	The number of administrations
	The mode of administration (online or paper-based)
If 24-h recall	The number of administrations
	Consecutive or nonconsecutive days (if >1 recall)
	Weekdays, weekend days, or both
If record/diary	The number of days in the food record/diary
	The number of times records were administered
	The mode of administration
Origin of tool(s)	Where the tool originated (e.g., whether the tool was created for the study, was created for another study, adapted from another tool, etc.) and the geographical location of the institution where it originated, if applicable
Database/software used	The nutrient database that was used to generate nutritional information (including the database year), as well as the processing software used to generate nutritional information, if stated
Psychometric properties	Psychometric properties (e.g., validity, reliability) of the tool reported for the current study or a cited previous study
Measurement error	Whether measurement error in dietary intake data and the implications for study findings were discussed

planned methods not yet implemented (127, 170). The type of tool by study design is summarized in **Table 4** (the numbers vary slightly from Table 3 in which citations and study names were repeated when >1 tool was used in a single study). There was a tendency toward FFQs and screeners in cross-sectional, case-control, and cohort studies, whereas 6 of 10 intervention studies used 24HRs or FRs. Several articles (n = 41; Table 1) described analyses of national survey data. Annual cycles of the Canadian Community Health Survey (CCHS) assessed fruit and vegetable intake with a screener. In 2004, the CCHS Nutrition Survey (n = 27 articles) used 24HR methodology. A total of 7 articles described

TABLE 3 Self-report tools used to assess dietary intake in Canadian research of nonclinical, non-Aboriginal adult populations[1]

Tool (number of studies)[2]	Study or reference numbers
FFQ (36)	39, 41, 50, 55, 57–59, 66, 75, 102, 105, 127, 128, 146, 152, 156, 163, 166, 169, 176, 193, 205, 213, Toronto Nutrigenomics and Health Study, CHMS, NOCS, NECSS, CODING, Tomorrow Project, Atlantic PATH, ALPHA Trial, Study of Lifetime Total Physical Activity and Endometrial Cancer Risk, Adventist Health Study, CaMOS,* NuAGE,* OWDHS*
Screener (23)	48, 52, 69, 74, 90, 95, 96, 103, 106, 142, 157, 158, 159,* 181, 190, 198, 203, 208, 210, 214, 223, CCHS Annual Component, CaMOS*
Food record (17)	83, 92, 113, 123, 124, 135, 136, 144, 147, 149, 154, 155, 170, 179, 212, Quebec Family Study, Unnamed
24-h recall (13)	36, 78, 86, 87, 159,* 164, 168, 189, 199, 215, 216, CCHS Nutrition Survey, NuAGE*
Single question (3)	37, 129, 191
Not stated (3)	67, 137, 219
Multiple tools (4)*	159, CaMOS, NuAGE, OWDHS

[1] n = 96 tools in 92 studies. ALPHA, Alberta Physical Activity and Breast Cancer Prevention; CaMOS, Canadian Multicentre Osteoporosis Study; CCHS, Canadian Community Health Survey; CHMS, Canadian Health Measures Survey; CODING, Complex Diseases in the Newfoundland Population: Environment and Genetics Study; NECSS, National Enhance Cancer Surveillance System; NOCS, Newfoundland and Ontario Colorectal Cancer Study; NuAGE, Quebec Longitudinal Study of Nutrition as a Determinant of Successful Aging; OWDHS, Ontario Women's Diet and Health Study; PATH, Partnership for Tomorrow's Health.

[2] The total number of tools adds up to >92 because some studies used >1 tool. For studies that used multiple tools, the citation or study name is marked by an asterisk (*) and included for each tool type. The OWDHS used 2 FFQs.

TABLE 4 Self-report dietary assessment tools used in relation to study design in Canadian research with nonclinical, non-Aboriginal adult populations[1]

	Number of studies						
	FFQ	Screener	Record	24-h Recall	Single question	Not stated	Multiple tools
All studies	33	21	17	11	3	3	4
Cross-sectional (*n* = 58 studies)	15	18	11	8	3	2	1
Case-control (*n* = 11 studies)	10	—	—	—	—	—	1
Intervention/RCT[2] (*n* = 10 studies)	3	—	4	2	—	1	—
Cohort (*n* = 10 studies)	4	2	2	—	—	—	2
Surveillance (*n* = 3 studies)	1	1	—	1	—	—	—

[1] *n* = 92 studies. The numbers vary slightly from Table 3, which includes repeated citations for studies that used multiple tools.
[2] RCT, randomized controlled trial.

analyses of data from the Canadian Health Measures Survey, which included screeners to examine several dietary components; these screeners were classified collectively as an FFQ.

Among 36 studies that used FFQs, 6 did not identify or provide a reference for the specific tool, although 1 was determined to be of Canadian origin. The remaining 30 studies used 12 different FFQs (**Table 5**). Half of the tools originated in the United States based on the populations for which the tool was developed and evaluated and the affiliations of the authors cited. Four studies administered the FFQ multiple times, ranging from 2 to 6. None of the studies that identified the method of administration used web-based protocols. Of 23 studies that used screeners, 10 distinct tools were used (**Table 6**). For 4 studies, the specific screener was not noted. Among those that indicated the number of items, this ranged from 3 to 37. Only 1 of the studies that reported the number of times participants completed the screener involved >1 administration. Two studies indicated the use of online screeners.

Of 17 studies that used FRs, 10 included 3-d records, 5 included 7-d FRs, 1 specified recording for 2 d, and 1 for 2–3 d. The majority were administered once, one 7-d record was administered 6 times, and in 2 studies, 3-d records were administered 4 and 6 times, respectively. FR data tended to be averaged over days and used to estimate mean intakes, derive scores representing diet quality, and assess associations between intake and other factors. Among the 13 studies that used 24HRs, 3 conducted 1 recall, 9 administered multiple recalls (ranging from 2 to 6), and 1 (CCHS Nutrition Survey) collected a second recall among a subset. Five of the 13 studies administered recalls face-to-face; in 3, recalls were conducted over the telephone; 3 used both modes of administration; and for 2, this detail was not reported. None used online self-administered recalls. In 7 studies, the days on which recalls were conducted were specified, with 6 including weekdays and weekend days and 1 limited to weekdays. More than half of studies that used multiple recalls noted that they were nonconsecutive, whereas 3 did not provide this detail. In studies that used multiple recalls, intakes were typically averaged over days, sometimes with comparisons to requirement estimates such as the DRIs (228). Modeling to estimate usual intake distributions

TABLE 5 Distinct FFQs used in studies assessing dietary intake in nonclinical, non-Aboriginal adult populations[1]

Tool (or study/first author name affiliated with tool)	Study or reference numbers for research making use of the tool	Canada	United States	Not stated
AHS (AHS-2) FFQ	AHS	x	x	
Atlantic PATH	Atlantic PATH			x
Block FFQ	41,* 146, NECSS,*† OWDHS,* ALPHA Trial, Study of Lifetime Total Physical Activity and Endometrial Cancer Risk, CaMOS		x	
Block FFQ (French-Canadian version)	NuAge		x	
CHMS	76, 77, 79, 109, 131, 182, 183	x		
Diet History Questionnaire	156		x	
Diet History Questionnaire (Canadian version)	127, 193,* Tomorrow Project*	x		
Goulet et al.	50, 57–59, 166	x		
Hawaii Multi-Ethnic Questionnaire	105, NOCS*†		x	
Hawaii Multi-Ethnic Questionnaire (Newfoundland version)	213, NOCS*†	x		
Jain et al.	55, 102, 176, 205	x		
Willett FFQ	169, Toronto Nutrigenomics and Health Study,* NECSS,*† CODING, CaMOS		x	

[1] Citations and studies marked by an asterisk (*) indicate that the tool was modified for use in the study. Citations and studies marked by an asterisk (*) and by a superscript dagger (†) indicate that the tool was created by using items from multiple existing measures. Six studies used an unidentified FFQ (39, 66, 75, 128, 152, 163). One of the tools was of Canadian origin (128), and the origins of the remaining tools were not stated. AHS, Adventist Health Study; ALPHA, Alberta Physical Activity and Breast Cancer Prevention; CaMOS, Canadian Multicentre Osteoporosis Study; CHMS, Canadian Health Measures Survey; CODING, Complex Diseases in the Newfoundland Population: Environment and Genetics Study; NECSS, National Enhance Cancer Surveillance System; NOCS, Newfoundland and Ontario Colorectal Cancer Study; NuAGE, Quebec Longitudinal Study of Nutrition as a Determinant of Successful Aging; OWDHS, Ontario Women's Diet and Health Study; PATH, Partnership for Tomorrow's Health.

appeared limited to analyses of data from the CCHS Nutrition Survey.

In 21 studies (23%), dietary quality or patterns were considered. Multiple dietary components, including dietary quality or patterns in some cases, were reported in two-thirds of studies ($n = 61$). Of these, analysis was limited to ≤5 components in 69% and to a single component in 33% of studies. **Table 7** summarizes dietary components reported in relation to tool type (including components reported in >5 studies). Energy and total fat were the most frequently examined, followed by vegetables and fruit, protein, carbohydrates, vitamin D, and saturated fat. Of studies that reported energy ($n = 39$), 54% used FFQs, 28% used FRs, and 18% used 24HRs. In a minority of cases, energy was used as a covariate, but typically, it appeared to be used as a measure of absolute intake. Food groups were most commonly captured by 24HRs and FFQs. Screeners were used to capture a range of dietary components. Two studies that used a single question queried fruit and vegetables; 1 captured egg yolks.

In articles that reported on 27 of 36 studies that used FFQs, the authors noted that validity had been evaluated, without subsequent modification to the tool. In 59% of these cases, the tool was tested in Canadian populations, in 30% testing occurred in US populations, and in the remainder these details were unclear. In articles that reported on 10 of 23 studies that used screeners, the validity of screeners was noted to have been assessed; 8 of these evaluations were reported to have been conducted in Canadian populations. Some articles that reported on studies that used 24HRs and FRs noted that these have been shown to capture intake accurately or reliably. We observed that many articles made little to no mention of error in intake data and the implications for results and interpretation.

Discussion

Researchers seek dietary assessment tools that are feasible and that provide reasonable data on food and nutrient intakes. However, each self-report tool has strengths and limitations and choosing the best instrument for a given study can be a challenge (4). As shown in a previous review (29), FFQs and screeners were the most common choices and were used in almost two-thirds of studies. Furthermore, a variety of specific tools were used, some of which appeared to have originated in the United States and had not undergone evaluation for use in the particular populations within which they were used. This may be more or less of a concern depending on the specific population group and the extent to which food sources and food composition are comparable to those for which the tool was developed.

Each self-report tool was used to assess an array of dietary components. FFQs, 24HRs, and FRs were each used to ascertain energy intake. Recent recommendations suggest that no self-report tool should be used to derive estimates of absolute energy intake (10, 13, 17), given the extent of misreporting documented with the use of doubly labeled water (a recovery biomarker that serves as a reference for energy intake). The use of self-report tools to estimate energy intake in particular has been the focus of criticisms of self-report data (17). Although recovery biomarkers are limited, examinations of misreporting of potassium intake suggest less error than for energy (10, 13), leading to suggestions that it is more appropriate to use self-report data to assess overall eating patterns and consumption of components likely to be reported with less error (e.g., fruit and vegetables) than for deriving absolute estimates of energy (13).

Consistent with the other tools, screeners were used to assess a range of dietary components. Screeners may have limited ability to capture dietary components spread across the food supply, such as fruit and vegetables that can be consumed in various forms (229). In contrast, they may be of value when the dietary component of interest is more discrete (e.g., soda) (4), although it has been suggested that not querying about specific foods often consumed in concert with the item of interest may affect accuracy of reporting (230). In data from the OPEN (Observing Protein and Energy Nutrition) study, a screener yielded lower estimates of mean daily consumption of numerous components, including fruit and vegetables and added sugars, than the 24HR for both men and women (231). Comparisons between 24HR and screener data from other sources indicate that estimates from screeners may be higher or lower than

TABLE 6 Distinct screeners used in studies assessing dietary intake in nonclinical, non-Aboriginal adult populations[1]

Tool (or study/first author name affiliated with tool)	Study or reference numbers for research making use of the tool	Canada	United States	Not stated
Behavioral Risk Factor Surveillance System Questionnaire	95, 96*†			x
CHAP tool	214			x
CaMOS study tool	CaMOS			x
CCHS Annual Cycles screener	52,* 96,*† 223,* CCHS Annual Cycles	x		
Diet History Questionnaire	48*		x	
Lucas et al.	142	x		
Moubarac et al.	157–159	x		
Owens et al.	181			x
Wu et al. tool	74, 103, 106, 190, 203	x		
Williams et al.	210			x

[1] Citations and studies marked by an asterisk (*) indicate that the tool was modified for use in the study. Citations and studies marked by an asterisk (*) and by a superscript dagger (†) indicate that the tool was created by using items from multiple existing measures. Four studies used an unidentified screener (69, 90, 198, 208). The origin of these tools was not stated. CaMOS, Canadian Multicentre Osteoporosis Study; CCHS, Canadian Community Health Survey; CHAP, Cardiovascular Health Awareness Program.

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TABLE 7 Foods or food components measured by using each type of tool in Canadian research with nonclinical, non-Aboriginal adult populations[1]

	Number of studies						
	Total	FFQ	Screener	Record	24-h Recall	Single question	Not stated
Energy	39	21	—	11	7	—	—
Macronutrients							
Total fat	36	16	2	11	7	—	—
Carbohydrates	30	13	—	10	7	—	—
Protein	31	14	—	10	7	—	—
Saturated fat	24	11	1	8	4	—	—
Poly- and monounsaturated fat	18	9	—	7	2	—	—
Fiber	17	9	—	5	3	—	—
Cholesterol	12	8	—	3	1	—	—
Sugar	8	2	2	1	2	—	1
Micronutrients							
Vitamin D	25	7	8	5	4	—	1
Calcium	22	8	5	4	4	—	1
Vitamin C	12	8	—	3	1	—	—
Vitamin A	10	6	—	3	1	—	—
Salt/sodium	11	3	1	2	4	—	1
Foods/food groups							
Fruit and vegetables	31	15	6	3	4	2	1
Milk	19	10	3	1	3	—	2
Meat	19	13	—	1	3	—	2
Grain	15	8	1	1	4	—	1
Fish	14	9	4	—	—	—	1

[1] n = 92 studies. Dietary components reported with a frequency >5 and nutrients identified a priori (vitamins A, C, and D and calcium) were considered.

those from 24HRs depending on the screener and the population subgroup (231).

Information on psychometric properties was generally limited to statements that a tool had been validated or was found to be valid. Various aspects of validity, which reflects the extent to which a measure reflects true intake, and reliability, which reflects the consistency of a measure, are fundamental in terms of the soundness of inferences made on the basis of the data collected (32). Furthermore, a tool found to be valid and/or reliable in one population may not be so in another. Thus, having examined these properties in one subgroup cannot be inferred to mean that the tool is necessarily valid and/or reliable for other uses. The lack of details on these aspects of tools in manuscripts poses a barrier to appropriate interpretation of results.

Furthermore, despite a longstanding recognition that self-report dietary data are affected by error (15), there was relatively little attention paid to the implications of such error. A previous analysis likewise found that error in the measurement of dietary exposures was largely ignored in published results of epidemiologic studies (232). In addition, there appeared to be little use of statistical approaches to account for sources of error, such as day-to-day variation when interest is in usual intake based on 24HRs and FRs. Interestingly, we found that only analyses making use of data from national surveillance (CCHS Nutrition Survey) appeared to use usual-intake modeling [the recommended approach for questions relevant to distributions of intake, such as estimating proportions below a threshold (228)]. Resources including a user guide (233) and hands-on workshops were provided by Health Canada and Statistics Canada to assist users in appropriately using these data. This suggests that capacity-building approaches to support researchers in the adoption of analytic techniques can be effective, even when these techniques are intensive, as usual intake modeling can be (234).

In some cases, it was necessary to consult secondary sources to identify tools used in a given study, where they originated, and how they were used. Furthermore, as noted above, there was typically little detail on specifics, such as the ways in which validity was assessed and the findings of such assessments. We recognize that authors are faced with tight word limits; however, this lack of detail makes it difficult to interpret the results of single studies and to synthesize across studies. Reporting guidelines recently published for nutritional epidemiology, STROBE-nut (Strengthening the Reporting of Observational Studies in Epidemiology—Nutritional Epidemiology) (16), provide guidance on improving transparency by describing dietary assessment methods more clearly and fully within scientific manuscripts. Briefly, details to be included encompass how the tool was developed and administered, the number of days and items recorded, and how portion size was estimated. Food-composition data should be described and justified. The evidence on the validity of the tool and efforts to address potential sources of bias should also be detailed. The systematic adoption of guidelines such as these and their extension to other types of research, including intervention studies, can help to advance the evidence by providing information critical to the appropriate interpretation of findings.

Given the broad scope of the literature, we focused on studies in non-Aboriginal adult populations in nonclinical settings. Others have used a random selection of articles from targeted journals to assess methodologic issues (232); however, given our goal of providing insights into the dietary assessment landscape in Canada, we opted for a comprehensive review of articles focused on a commonly studied population. Given the feasibility of different types of assessment such as FFQs compared with 24HRs in large samples until recently (with technological advances), it is unlikely that our findings would be substantially different had we focused on other specific groups, such as children or Aboriginal populations.

In sum, researchers use a range of tools to assess dietary intake. In some cases, there is likely a mismatch between the tool used, the population, the study design, and the dietary component of interest. Growing knowledge from biomarker-based validation studies and other pursuits supports the emergence of recommendations on the most appropriate tools for different study designs and the specific variables of interest (e.g., estimates of usual intake of a component, regression coefficients describing a diet-health association) (4, 5, 9, 24, 26, 27). Concerted efforts are needed to help researchers keep abreast of this evolving field and to measure dietary exposures and outcomes as robustly as possible. Although capacity-development initiatives (e.g., webinars, websites to guide tool selection, reporting guidelines) have been conducted or are underway in some jurisdictions (4, 5, 16, 26, 27, 229, 235), greater collaboration among researchers nationally and globally may allow for sharing of lessons learned, as well as avoiding duplication of efforts and possible contradictions in recommendations across sources that can contribute to researcher confusion. An international effort to build consensus on best practices for dietary assessment could be supported by special interest groups coordinated by key professional associations and, in the long term, potentially through a linked network of centers for excellence in dietary assessment. Such efforts could go a long way in building a more cohesive literature on nutrition and health on which to base policy and program recommendations. This is critical given that diet is now recognized as the largest contributor to the burden of disease globally (236).

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