Title: Harmonization of food frequency questionnaires and dietary pattern analysis in four ethnically diverse birth cohorts[1,2,3,4]

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[2] **Abbreviations**: ABC, Aboriginal Birth Cohort; BMI, Body Mass Index; CHILD, Canadian Healthy Infant Longitudinal Development; FAMILY, Family Atherosclerosis Monitoring In early; FFQ, Food Frequency Questionnaire; mAHEI, modified Alternative Healthy Eating Index; PC, Principal Component; PCA, Principal Component Analysis; SHARE, Study of Health and Risk in Ethnic Groups; START , SouTh Asian birth cohort.

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ABSTRACT

BACKGROUND

Canada is an ethnically diverse nation which introduces challenges for healthcare providers tasked with providing evidence-based dietary advice.

OBJECTIVES

We aimed to harmonize food frequency questionnaires (FFQs) across four birth cohorts of ethnically diverse pregnant women in order to derive robust dietary patterns to investigate maternal and newborn outcomes.

METHODS

The NutriGen Alliance comprises 4 prospective birth cohorts and includes 4,880 Canadian mother-infant pairs of predominantly white European (CHILD and FAMILY), South Asian (START-Canada), or Aboriginal origin (ABC). CHILD used a multiethnic FFQ based on a previously validated instrument designed by the Fred Hutchinson Cancer Research Center, while FAMILY, START, and ABC used questionnaires specifically designed for use in white European, South Asian, and Aboriginal people, respectively. The serving sizes and consumption frequencies of individual food items within the four FFQs were harmonized and aggregated into 36 common food groups. Principal components analysis was used to identify dietary patterns that were internally validated against self-reported vegetarian status and externally validated against a modified Alternative Healthy Eating Index (mAHEI).

RESULTS

Three maternal dietary patterns were identified: “plant-based”, “Western”, and “health conscious” that collectively explained 29% of the total variability in eating habits observed in the NutriGen Alliance. These patterns were strongly associated with self-reported vegetarian status

(OR=3.85; 95% CI:3.47 to 4.29; $r^2 = 0.30$ and $P<0.001$; for plant-based diet), and average adherence to the plant-based diet was higher in participants in the 4th quartile of the mAHEI compared with the 1st (mean difference = 46.1%; $r^2 = 0.81$ and $P<0.001$).

CONCLUSION

Dietary data collected using FFQs from ethnically diverse pregnant women can be harmonized to identify common dietary patterns in order to investigate associations between maternal dietary intake and health outcomes.

KEYWORDS: FFQ, food frequency questionnaire, harmonization, multi-ethnic, PCA, prospective cohort, principal component analysis.

INTRODUCTION

Methodological advances in dietary measurement in large epidemiologic studies, such as the development of valid and reproducible semi-quantitative food-frequency questionnaires(1, 2) has facilitated the study of associations between dietary intake and health and disease outcomes, such as cancer and cardiovascular disease. This is often approached with a “reductionist” lens, examining associations between specific food items(3-6), single nutrients(5, 7), or sources of nutrients(8, 9) and health outcomes. This approach is reflective of public health approaches to food and nutrient recommendations, has advanced our understanding and treatment of specific nutrient deficiency syndromes (e.g. folate fortification to prevent neural tube defects), and facilitated the identification and removal of particularly harmful components of food from the food supply (e.g., the removal of partially-hydrogenated vegetable oils). However, long-term diet is likely a stronger determinant of diet-related chronic disease risk than consumption of any single food item or nutrient (10), and thus single-food (e.g. dietary cholesterol or coffee) or single-nutrient studies are often misleading(11, 12) because they fail to capture the complex interplay between foods and nutrients consumed as meals over long periods of time. To overcome the limitations of single-nutrient or single-food studies, the empirical derivation of dietary patterns — defined as “the quantities, proportions, variety or combinations of different foods and beverages in diets, and the frequency with which they are habitually consumed”(13), has been proposed as a method to characterize diet that more accurately reflects how we consume foods or nutrients, and these patterns can be assessed for their associations with health and disease.(14-18)

Canada is an ethnically diverse nation(19) which introduces challenges for healthcare providers tasked with providing evidence-based dietary advice, because much of what we know about diet and disease is rooted in studies of white European populations. Dietary choice is closely tied to ethnicity (e.g., foods, cooking methods, and eating habits)(20) and the degree to which an individual or community consumes ethnically-traditional foods can be influenced by immigration and residency in a host country.(21)

In preparation for investigations into the role of maternal nutrition on maternal and newborn outcomes in a multiethnic birth cohort consortium, we developed an approach to harmonize dietary patterns in pregnant women. This paper describes the methods used to derive and to validate dietary patterns identified at single time-point in the cross-sectional analysis of a prospective birth cohort and outlines the unique challenges faced and the methodological approaches used to address them.

METHODS

Study population

The *NutriGen* Alliance is a multi-ethnic birth cohort consortium comprised of 4 ethnically-diverse cohorts of pregnant women representing several geographic regions across Canada. These cohorts were assembled in order to understand the early life determinants of cardiometabolic risk, allergy, and asthma. Each cohort enrolled pregnant women in their second or third trimester and will follow the mother and infant from pregnancy through delivery and into childhood. The *NutriGen* Alliance provides a platform to investigate the joint influences of dietary intake, genetics, and the gut microbiome on the development of maternal and infant health outcomes in a Canadian context. As of February 2016, 5,000 women with dietary data have been enrolled across the four cohort studies. There are 3,047 pregnant women from the Canadian Healthy Infant Longitudinal Development(22) study (CHILD); representing 5 ethnic groups [white European (74%), East/South East Asian (12%), Aboriginal (4%), South Asian (3%), and African or other (12%) origin] recruited from 6 urban and rural Canadian cities Vancouver, BC; Edmonton, AB; Winnipeg, MB; Morden, MB; Winkler, MB; Toronto, ON); 839 pregnant women have been included from the Family Atherosclerosis Monitoring In earLY life(23) (FAMILY) study representing 5 ethnic groups [white European (74%), East/South East Asian (1%), Aboriginal (1%), South Asian (1%), and African or other (4%) origin] recruited from the Greater Hamilton Area, Ontario; there are 1,006 South Asian mothers from the SouTh Asian birth cohoRT(24) (START recruited from the Peel Region, ON); and 108 of an anticipated 300 Aboriginal mothers from the Aboriginal Birth Cohort(25) (ABC) recruited from the Six Nations Reserve, ON). Comprehensive clinical and dietary data from all pregnant women have been collected from all 4 cohorts. Ethical approval was obtained for each study independently, and informed consent was obtained from all individual participants included in the study.

For this analysis, women who did not satisfactorily complete the FFQ (i.e., did not answer ≥ 10 questions [(~6%]) or who reported an implausible energy intake (<500 or >6 500 kcal/d) were excluded. One individual reported an implausibly high intake of a single food item (i.e., 64 servings of lettuce per day). Excluding this participant's FFQ, or replacing the implausibly reported value with a value equal to the 99th percentile of the "plausible" values (12 servings/day) produced identical dietary patterns; as such, the implausible value was included. The final number of women included in our analysis was 4,880 (**SUPPLEMENTAL TABLE 1**).

Assessment of dietary intake and dietary patterns

Food frequency questionnaires (FFQs). In the CHILD study, maternal diet was assessed using a semi-quantitative FFQ, adapted from the Fred Hutchinson Cancer Center tool.(26) In the FAMILY, START, and ABC cohorts, semi-quantitative FFQs developed for the Study of Health and Risk in Ethnic Groups study(27) were used to assess maternal dietary intake during pregnancy, modified to capture ethnic-specific foods (SHARE based FFQs). ABC, FAMILY, and START FFQs were analyzed using a database linked to the Canadian Nutrient File, the CHILD FFQ was analyzed using the USDA nutrient database, modified for a Canadian setting(28) allowing a detailed estimation of and energy intake. The development and validation of these tools has been described previously.(29-31)

FFQ harmonization

Frequency of consumption and serving size. The included FFQs used different serving size reference portions and frequency of consumption options. The CHILD FFQ provided respondents with categorical frequency options from which to choose (e.g., never through to >2/day), while in the SHARE-based FFQs, response categories were open-ended . Thus, we harmonized serving sizes of the SHARE-based FFQs to those in CHILD (**SUPPLEMENTAL TABLE 2**).(32, 33) Detailed steps describing the calculations and methods used to harmonize serving sizes across the cohorts are presented in **SUPPLEMENTAL TABLE 3**.

Food groupings. To create common food groups across the cohorts, individual FFQ items from each study were aggregated into groups of foods of similar nutrient profile and type (e.g. poultry, leafy greens, legumes, etc.). In some cases, foods groups contained only a single item that uniquely reflected a particular dietary pattern (e.g., French fries reflect fast and convenience food consumption) (**SUPPLEMENTAL TABLE 4**). We grouped foods in a way that has been used in previous dietary pattern analysis studies that examined associations between dietary habits and cardiometabolic conditions, allergies, or common clinical biomarkers (e.g., fasting plasma glucose, cholesterol and triglycerides).(32-35) For example, bacon, breakfast sausages, low-fat and regular hotdogs, lunchmeats, and canned meats were combined into a single category called 'Processed Meats'.

Dietary pattern analysis

To identify dietary patterns within the FFQ data, we used the 'psych' package (v.1.5.6) within R (v.3.1.2) to perform a principal component analysis (PCA) with an orthogonal 'varimax' rotation.(16) The statistical details of PCA as a means to reduce the dimensionality of the FFQ are beyond the scope of this paper, but we refer interested readers to several excellent reviews.(10, 33, 36-39) The number of dietary patterns retained was determined by visual inspection of scree plots in conjunction with eigenvalues (> 1.0) and principal component interpretability.(15, 40, 41) Three sensitivity analyses of dietary patterns were conducted (using the same PCA approach as described): (i) women diagnosed with type-2 diabetes prior to their current pregnancy (n=107; with or without hypertension); (ii) women diagnosed with hypertension prior to their current pregnancy (n=190; with or without type-2 diabetes); and (iii) those without type-2 diabetes (n=4,720) or hypertension (n=4,632) prior to their current pregnancy.

We labeled each dietary pattern (i.e., groups of foods with similarly high factor loadings) with a descriptor that reflected the highly-loaded food groups (e.g., "Western" vs. "Prudent" patterns). The PCA scores for each pattern obtained for each individual represented how closely their food choices reflected each of the empirically-derived dietary patterns – with a higher score reflecting a greater degree of adherence to that dietary pattern. Dietary pattern scores were adjusted to the mean total population caloric intake using the residual method.(42, 43)

Dietary Pattern Adherence score

We created a dietary pattern adherence score that would more intuitively represent an individual's degree of adherence to each of the identified dietary patterns. To do this, "cardinal food groups" that characterized each dietary pattern were defined as those food groups with an absolute factor (dietary pattern) loading score ≥ 0.30 (**SUPPLEMENTAL TABLE 5**). (44, 45) Daily servings of each of the cardinal food groups was converted into quintiles, using the distribution of servings within the study population and assigned "quintile scores" from 1 (<20th %ile) to 5 (≥80th %ile) (**SUPPLEMENTAL TABLE 6)**. These quintile scores for each of the food groups were summed to derive a numerical indicator of how closely an individual's diet reflected a given pattern. For example, *Processed Foods* had an absolute loading score >=0.30 (0.55) for the "Western" diet but not for 'plant-based' (-0.22) or 'health conscious' (0.13). In this case, the quintile score for *Processed Foods* is added to the total score for the "Western" dietary pattern, but not to the "plant-based" or "health conscious" dietary patterns. An individual's score for that specific diet was divided by the maximum score possible for the diet and multiplied by 100 to quantify the degree to which an individual adheres to each of the given dietary patterns (on a scale of 1 to 100) (**TABLE 1**).

Internal and External Validation of Dietary Pattern Scores: PCA summary scores were validated against self-reported vegetarian practice using a logistic regression model. It was hypothesized that higher plant-based diet scores would be associated with higher odds of self-reported vegetarian status. PCA summary scores were externally validated against the modified Alternative Healthy Eating Index (mAHEI) (46) by comparing differences in mean scores between extreme quartile groups for PCA diet patterns. An mAHEI diet score was calculated for each participant: participants received 10 points for each of the following food items that they consumed above (healthful foods) or below (less-healthful foods) a threshold: ≥ 5 servings of vegetables, ≥ 4 servings of fruit, ≥ 1 serving of nuts or soy proteins, ≥ 3 servings of whole grains, with a ratio of ≥ 4 servings fish to 1 of meat and eggs; and ≤ 0.5 servings of less-healthy foods (i.e., fried foods and processed meats) — intermediate intakes were scored proportionally between 0 and 10. The maximum mAHEI score was 60. For this analysis, ‘processed meats’ was included in the mAHEI ‘fried foods’ category to capture *trans*-fat consumption. The mAHEI category for ‘alcohol consumption’ was not included in this analysis of pregnant women. A design feature of the mAHEI (and other indexes, such as the Healthy Eating Index(47)) is that it rewards the consumption of “healthy” foods (5 items contribute to the score) rather than reward the avoidance of “unhealthy” foods (1 item contributes to the score); however this feature does not preclude its usefulness as a valuable external validation tool for our derived diet patterns. To do this, we compared mean “plant-based”, “health-conscious”, and “Western” diet scores between individuals in the lowest mAHEI points quartile (i.e., < 15 points, “least healthy”) and those in the 4th mAHEI quartile (i.e., ≥ 45 points, “most healthy”). Differences in mean scores between diet groups were used to assess validity (e.g. higher “plant-based” scores were expected in those in the 4^{th} mAHEI vs. 1^{st} quartile; and higher "Western" scores were expected in those in the 1^{st} vs. 4^{th} mAHEI quartile).

RESULTS

PCA-Derived Patterns

Overall, 4,880 valid FFQs were harmonized across 4 cohorts (**SUPPLEMENTAL TABLE 1**). The dimensionality of the food group matrix was reduced from the 152 to 167 items queried within each individual study FFQ to 36 harmonized food groups (**SUPPLEMENTAL TABLE 4**) and 93 food items were common to all 4 instruments. A total of 59 and 70 foods were unique to CHILD and START FFQs, respectively, 64 were unique to the FAMILY FFQ, and 6 were unique to the ABC FFQ (**FIGURE 1**). The PCA identified three primary dietary patterns within the NutriGen Alliance with eigenvalues of 4.08, 3.14, and 3.05, which collectively explained 29% of the diet variability within the harmonized FFQ data set. The dietary patterns were classified as 'plant-based', 'Western', and 'health conscious', to emphasize the prominent food groups that defined each pattern. These categorizations reflect previously described dietary patterns in large cohort studies (**SUPPLEMENTAL TABLE 5**).(32-35, 48) In the sensitivity analyses, the PCA-derived dietary patterns within subgroups of mothers who reported pre-pregnancy diabetes (n=107) or hypertension (n=190), were similar — e.g., plant-based, Western, and health-conscious — to those derived with the entire sample population, or those groups without hypertension (n=4,632) or type 2 diabetes (n=4,720).

The number of food groups with a loading factor greater than ≥ |0.30| were 10 for the plant-based; 13 for the Western, and 14 for the 'health conscious' patterns. The "plant-based" pattern was characterized by fruits and vegetables, legumes, fermented dairy, whole grains, non-meat dishes, and a lack of red meat; the “Western” pattern had high loading of sweets and refined grains, red meat and processed meats, French fries, starchy vegetables, condiments, and sweet drinks; and the ”health conscious” pattern was characterized by seafood and poultry and meats, eggs, cruciferous vegetables, leafy greens, fruits, refined grains, stir-fried dishes, and condiments.

The dietary PCA scores for each individual were: -1.8 to 6.1 (plant-based); -3.7 to 6.6 (Western); and -2.8 to 9.1 (‘health conscious’). When adjusted for total energy intake using the residual method(49) to a mean total energy intake of 2000 kcal per day (equal to the mean energy intake of mothers in the NutriGen Alliance), the range of loading scores for dietary patterns were: -2.2 to 5.5 (plant-based); -5.4 to 4.7 (Western); and -4.0 to 7.8 (‘health conscious’). Negative values indicate that an individual’s dietary pattern is not generally reflective of the specific PCA-derived pattern (i.e. “plant-based”; “Western”; or “health-conscious”); and positive values indicate that an individual’s dietary pattern is generally reflective of the specific PCA-derived pattern.

In a second PCA, indicators for each ethnicity were included in the PCA to evaluate the effect of ethnicity on the derived dietary patterns (**SUPPLEMENTAL TABLE 7**). Despite ‘Other Vegetables’ no longer loading ≥ 0.30 within the “health-conscious” diet pattern, the dietary patterns were equivalent to those observed in the original PCA reported in TABLE 4. Univariate regression demonstrated that the summary scores from the PCA that did not include ethnicity correlated strongly with the summary scores when ethnicity was included: plant-based ($r^2 = 0.97$, $p<0.001$), Western ($r^2 = 0.94$, $p<0.001$), and health-conscious ($r^2 = 0.96$, $p<0.001$).

Diet Scores

The maximum adherence diet scores for the plant-based, Western, and ‘health conscious’ diets were 50, 65, and 70 total quintile points, respectively. Energy-adjusted PCA scores were well-correlated with the energy-adjusted quintile-based diet scores (r^2-values: plant-based=0.75, $p<0.001$; Western=0.47, $p<0.001$; ‘health conscious’=0.51, $p<0.001$).

Using this scoring method, the plant-based diet had a mean adherence of 57.1%, the Western diet 58.6% and the ‘health-conscious’ diet 59.2% (**SUPPLEMENTAL TABLE 8**). There were clear differences across the four major ethnic groups (n≥200) with respect to average dietary pattern scores. South Asians most closely adhered to the plant-based diet [mean score =77.9% (SD=12.5)], while East and South East Asians [47.7% (10.3)] were least adherent. The Western diet was most strongly adhered to by Aboriginal people [63.3% (9.2)] and least strongly by South Asians [47.6% (9.5)]. The ‘Health Conscious’ diet was strongly followed by East/South East Asians [66.9% (9.2)], and least strongly adhered to by South Asians [51.5% (10.1)].

Validation Assessments

Internal Validity. To assess the internal validity and robustness of the harmonized NutriGen dietary patterns, we also derived the patterns within each of the individual cohorts separately (ABC, CHILD, FAMILY, and START) and found that the cohort-specific dietary patterns reflected those of the harmonized NutriGen cohort. CHILD presented two primary diets, ovo-pescetarian (plant-based with fish and eggs) and Western; FAMILY presented two primary diets, health-conscious and Western; START presented three primary diets plant-based, Western, and health-conscious; and ABC presented two primary diets, health-conscious and Western.

The unadjusted and energy-adjusted PCA summary scores were validated against the self-reported dichotomous variable ‘vegetarian status’ (this included self-reports of lactovegetarians, ovo-vegetarians, vegetarians, and vegans). For the unadjusted PCA scores: a single unit increase in the plant-based diet PCA score associated with a 3-fold greater likelihood of self-reporting as a 'vegetarian' or being non-consumer of meat (OR=3.35; 95% CI:3.03 to 3.68; r^2 = 0.26; p<0.001) while an single unit increase in either the Western (OR=0.36; 95% CI:0.31 to 0.42; r^2 = 0.08; p<0.001) or health conscious (OR=0.60; 95% CI:0.53 to 0.68; r^2 = 0.02; p<0.001) diets were negatively associated with self-reported vegetarian status. For energy-adjusted PCA scores the plant-based diet was similarly positively associated with self-reported vegetarian status (OR=3.85; 95% CI:3.47 to 4.29; r^2 = 0.30; p<0.001) and both the Western (OR=0.29; 95% CI:0.24 to 0.34; r^2 = 0.08; p<0.001) and 'health conscious' (OR=0.67; 95% CI:0.59 to 0.75; r^2 = 0.01; p<0.001) diets were negatively associated with self-reported vegetarian status.

External Validity. Individuals in the lowest (least healthy) mAHEI quartile had lower adherence to the plant-based diet score (mean score=35.8 ± 7.9% in Q1 vs. 81.8 ± 11.2 % in Q4; r^2 = 0.81; p<0.001) and "health-conscious" diet score (41.8 ± 8.7 % in Q1 vs. 56.0 ± 13.6 % in Q4; r^2 = 0.23; p<0.001) diet patterns than those in the highest (most healthy) mAHEI quartiles (**SUPPLEMENTAL FIGURE 1**). Individuals in the lowest mAHEI quartile adhered more strongly to the Western diet score (57.7 ± 12.9 % in Q1 vs. 52.9 ± 15.0 % in Q4; r^2 = 0.02; p<0.001) than those in the highest mAHEI quartile.

DISCUSSION

This study describes the novel application of a methodological approach to harmonize dietary data collected with cohort-specific, independently validated FFQs across 4 ethnically diverse birth cohorts. This effort represents an exemplar readily extensible to settings outside of Canada.

Such harmonization efforts are increasingly common(50) for other types of data, and directed criteria and guidelines have been developed (i.e., PhenX Toolkit) to facilitate the pooling of maternal and infant data across birth cohorts.(51)

We identified 3 unique dietary patterns, which we named "plant-based", "Western", and "health conscious", which closely resemble previously documented patterns in a cohort of the Toronto Nutrigenomics and Health (TNH) Study — a multi-ethnic cohort of young Canadian men and women residing in the Greater Toronto Area (n=1,153)(52). In this study, 3 patterns — Prudent, Western, and Eastern — were identified using a single semi-quantitative FFQ and explained 16% of the dietary variance, less than the 29% that our harmonized analysis explained. While dietary pattern studies typically identify 2 major dietary patterns(14, 15, 53), the similarity of the NutriGen and TNH dietary patterns likely reflects a similar ethnic composition of the cohorts.

In the present study, we faced the challenge of post-hoc harmonization. An excellent example of forward thinking about harmonization is provided by the merger of FFQ data collected from two birth cohorts — the Danish National Birth Cohort (DNBC, n=70,183) and the Norwegian Mother and Child Cohort Study (MoBa, n=87,000).(54) Despite some unique regional items within each FFQ, food items were comparable and aggregated into common higher-order food groups (e.g., fruits, legumes, etc.). The harmonization was aided by a high degree of ethnic homogeneity and cooperation between the DNBC and MoBa study teams during MoBa's development, which facilitated the development of an FFQ that was very similar to the DNBC FFQ. Nevertheless, we demonstrate that retrospective harmonization across diverse ethnic cohorts is possible.(27) Furthermore, we were well-powered to detect small differences (i.e. 3-4%) in dietary pattern adherence even within ethnic groups where one may expect homogeneity of dietary intake. (**SUPPLEMENTAL TABLE 8**)

The NutriGen Alliance dietary patterns showed good internal and external validity. The "plant-based" score was strongly associated with self-reported vegetarian status, although even this association is likely diluted because "vegetarian" was inconsistently defined across the cohorts: for example, in the CHILD cohort, pregnant women, "reported abstinence from meats" whereas in the FAMILY, START, and ABC cohorts a Vegetarian status question was asked. A single unit increase in the plant-based score increased the odds of being a vegetarian (i.e., non-meat eater) by more than 3-fold; conversely, a unit increase in the Western diet reduced these odds by ≈70%. The 'health conscious' diet score was less useful at predicting vegetarian status: a single unit increase reduced the likelihood of vegetarian status by ≈40%. These results suggest that three dietary patterns can accurately distinguish between individuals consuming a distinct diet pattern – i.e., vegetarian.

Our external validation against the mAHEI(46), which has been used previously to assess diet quality in pregnant women(55), found that mAHEI score was associated with greater adherence to the plant-based and health-conscious diet patterns and lower adherence to the Western diet, which confirms alignment of our dietary patterns with external methods for assessing diet quality.

Total energy was adjusted for in the analysis to reduce confounding and random error owing to differences in food intake resulting from differences in body size, metabolic efficiency, and physical activity. In some studies, it may be desirable to not account for energy if excess food energy is causally implicated in the relationship between certain foods or diets and specific outcomes (e.g., when modeling the association between high-energy sugar-sweetened beverages and obesity). However, it is often desirable to isolate the effect of a specific food item or nutrient from its unspecific contribution to total energy intake when assessing diet-disease associations (e.g., the unique contribution of *trans* fat from other energy-containing nutrients of the foods in which it is contained). In a comparison of dietary patterns derived with and without energy adjustment, Northstone et al. found that ‘white bread’ was positively loaded on the ‘Processed diet’ in an unadjusted model but, following energy-adjustment, was negatively loaded for the ‘Health Conscious’.(43) Balder et al. proposed that, in an energy-adjusted model, the avoidance of high-energy foods in favour of low-energy healthy alternatives (i.e., choosing lower energy-dense brown bread rather than high energy-dense white bread) is a salient feature of ‘health conscious’ diets;(56) therefore, energy-unadjusted and adjusted models characterize similar dietary patterns and are therefore comparable. In the present study, the likelihood of vegetarian status according to participant plant-based, Western, and ‘health conscious’ dietary pattern scores were comparable in unadjusted and energy-adjusted models. It has been recommended that energy adjustment be performed post-PCA(43, 56) in order to simplify the interpretation of the results.

A salient feature of our cohorts was ethnic diversity. Downstream dietary pattern analyses within diverse cohorts often requires adjustment for ethnicity(16, 57), which is most often accomplished by including ethnicity as a covariate in multivariable models. An alternative approach is to include “ethnicity” in the PCA when deriving dietary patterns, which would help account for the tight conceptual linking of diet and “culture”. In the present study, including ethnicity in the PCA only marginally affected the dietary patterns (Supplemental Table 4) and these dietary pattern scores derived with ethnicity correlated strongly with those derived without including ethnicity in the PCA ($r^2 \geq 0.94$). However, adjusting for ethnicity in the PCA makes it impossible to assess whether the association between dietary patterns and health outcomes are modified by ethnicity. Thus, leaving ethnicity out of the PCA derivation of dietary patterns gives maximum flexibility to the researcher in future analyses of dietary patterns and health outcomes.

A novel diet score approach was developed to simplify the interpretation of the dietary patterns. Individual summary scores for each principal component reflect how closely each person follows a given dietary pattern (e.g., prudent, Western, and 'health conscious'), but factor loading scores are difficult to interpret because the score and the range of scores varies across dietary patterns. However, by only focusing on foods that contribute strongly to each dietary pattern (i.e., "cardinal features" with loading scores ≥ |0.30|) and calculating a diet score ranging from 1% (null adherence) to 100% (full adherence) for each of the diets, the dietary patterns scores have the straightforward interpretation of how closely dietary habits reflects one of the empirically-derived plant-based, Western, and 'health conscious' diets. Because this intuitive approach loses little information, and there is strong correlation between diet scores and PCA scores, the derived dietary scores can be used in place of the summary scores for regression analyses for easier interpretability and presentation of results.

Our study has some limitations. Maternal diet was collected using self-reported FFQs. Though these instruments have been validated, recall bias and measurement error are acknowledged limitations of these tools. However, given the prospective nature of our planed analyses — i.e., the association between maternal food choices and future maternal and infant health — and the large number of individuals involved, we anticipate this to be random error, which can be attenuated if multiple measures of diet are available(58). Also, scree plots identified 3 patterns — with eigenvalues >3.0 each that collectively explained 29% of the dietary variability — of several possible patterns detected by the PCA. Minor patterns, which explain a smaller degree of variation, were not retained. Future studies may need to increase the number of dietary patterns to characterize less common dietary patterns in their study population of interest. We addressed the issue of reverse confounding such that a pre-existing medical condition such as pre-pregnancy diabetes or hypertension may influence dietary intake in pregnancy by conducting a sensitivity analyses among those women with type 2 diabetes or hypertension. Our analyses showed that within each subgroup the PCA-derived diet patterns did not differ substantially from each other or from our patterns derived using the complete sample. In addition while nutrients were not the focus of the present study, future analyses using these four harmonized birth cohorts which focus on macro and micronutrient analyses will require harmonization of the nutrient data where different nutrient databases were used.

In conclusion, this study addressed a novel challenge – the merging and harmonization of multiple FFQ data sets collected from pregnant women of diverse ethnicities using an established methodology for dietary pattern analysis. We have demonstrated a valid approach to merge both similar and distinct FFQ datasets to investigate how maternal diet during pregnancy contributes to maternal and infant health and disease.

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TABLE 1 - Quantification of quintile dietary scores for each individual within the NutriGen Alliance cohort.

Step	Description
1. Identify Characteristic Food Groups for Each Diet	Identify the food groups in each dietary pattern that load most strongly (i.e., ≥ | 0.30|) characterize it (e.g., 'Processed Meat' for Western diet, SUPPLEMENTAL TABLE 5).
2. Assign Quintile Scores for Consumption Frequency	Convert the serving frequencies for each characteristic food group to quintiles, from 1 to 5. This will give individuals in the lowest (< 20 %) and highest (≥ 80 %) consumption frequencies for any food group a score of 1 and 5, respectively.
3. Calculate Participant Quintile Diet Score for Each Diet	For each diet, sum the quintile scores of the foods that characterize the diet (identified in Step 1). For foods that are inversely associated with a diet (e.g., 'Meat' in the prudent diet), individuals with a quintile score of 1, 2, 3, 4, or 5 would receive 5, 4, 3, 2, or 1 point, respectively, for that food group for that diet. When complete, each participant will have a total quintile score for each of the diets identified (e.g., plant-based, Western, and 'health conscious').
4. Calculate Maximum Quintile Score for Each Diet	Multiply the total number of characteristic foods for each diet by 5. This is the maximum score for that diet. For example, the plant-based diet has 10 characteristic food groups, multiplied by 5 gives a maximum score of '50' (e.g., 10 (food items) x 5 (maximum points for each food item) = 50 (maximum possible score)).
5. Determine relative adherence to diet	Divide each person's diet scores (Step 3) by the maximum scores for each diet (Step 4). This will reflect how closely each person's reported

patterns	dietary patterns match each of the identified dietary patterns on a scale from 0% to 100%. For example, a person presenting scores of 34% plant-based, 75% Western, and 47 % ‘health conscious’ would suggest that their diet is most similar to Western pattern, with foods common to the prudent and ‘health conscious’ consumed less frequently.

FIGURE LEGEND

FIGURE 1 Venn diagram of the similarity and differences between the food items queried within individual study cohrts (i.e., ABC, CHILD, FAMILY, and START) that comprise the NutriGen Alliance cohort (*n*=4,880). Unlisted similarities of foods questioned between studies are ≤ 10 % similar.

ABC = Aboriginal Birth Cohort study; CHILD = Canadian Healthy Infant Longitudinal Development study; FAMILY = Family Atherosclerosis Monitoring In earLY life study; START = SouTh Asian birth cohort study.

SUPPLEMENTAL TABLE 1 – Pre-Processing of Food Frequency Questionnaire (FFQ) data collected by individual study cohrots (i.e., ABC, CHILD, FAMILY, and START) that comprise the NutriGen Alliance cohort.

	ABC	**CHILD**	**FAMILY**	**START**	**TOTAL**
Pre-Cleaning	126	3,047	839	1,006	5,018
Excluded					
1. ≥ 10 Blank FFQ Questions [1]	5	11	49	45	110
2. Implausible Caloric Range [2]	9	9	10	0	28
Post-Cleaning	112	3,027	780	961	4,880

Data reflects number of individuals.

[1] Participants who failed to provide information for ≥ 10 individual questions on their returned FFQ were excluded from the PCA (*n*=110)

[2] Participants that reported implausible energy intakes on their returned FFQ of <500 or >6500 kcal per day were excluded from the PCA (*n*= 28)

ABC = Aboriginal Birth Cohort study; CHILD = Canadian Healthy Infant Longitudinal Development study; FAMILY = Family Atherosclerosis Monitoring In earLY life study; START = SouTh Asian birth cohort study.

SUPPLEMENTAL TABLE 2 - Food Frequency Questionnaire (FFQ) details across the ABC, CHILD, FAMILY, and START birth cohorts.

	ABC, FAMILY and START	**CHILD**
Origin	McMaster/Hamilton Health Sciences	Fred Hutchinson Cancer Research Center
Items	157 - 169 questions	152 questions
Ethnic Considerations	Each FFQ included "ethnic" foods common to the respective cohort:	A single questionnaire was administered to all participants, regardless of ethnicity. Some "ethnic" foods included as options, such as: game meat, ghee, milkshakes, parathas, and samosas.
	ABC – Aboriginal/First Nation foods: Indian corn soup, buffalo, and caribou.	
	FAMILY: Western/White European foods: milkshakes and fruit crisps.	
	START: South Asian foods: Ghee, raita, and sabji	
Consumption Frequency	Open-ended	Categorical options (e.g. from <1/month to > 2 times/day)
Serving Size	Equal between ABC, FAMILY, and START	Differences with McMaster-based FFQs
Analysis	Using ESHA Food processor software	Using NDS (Nutrition Data System)
Validation	Kelemen et al.(59)	Fred Hutchinson Research Institute (26)

ABC = Aboriginal Birth Cohort study; CHILD = Canadian Healthy Infant Longitudinal Development study; FAMILY = Family Atherosclerosis Monitoring In earLY life study; START = SouTh Asian birth cohort study.

SUPPLEMENTAL TABLE 3 - Food Frequency Questionnaire (FFQ) Servings per Week Harmonization across individual study cohorts that comprise the NutriGen Alliance cohort.

FFQ Servings Per Week Harmonization	Example
1. FAMILY, START, or ABC reported total consumption of food item per week	FAMILY, START, or ABC participant reports eating potatoes 3 times/week. Estimated intake 3 x ½ cup = 1 ½ cups of potatoes per week
2. Compare Serving Sizes	CHILD: Potatoes (Boiled, baked, or mashed), medium serving size = ¾ cup
	FAMILY, START, or ABC: Potatoes (Boiled, mashed, or baked), medium serving size = ½ cup
3. Scale	To scale FAMILY, START or ABC participant servings to that of CHILD, their servings per week is multiplied by 0.66 (i.e., ½ cup serving size divided by ¾ cup serving size).
4. Rescale	The adjusted serving per week is therefore 2 times/week (i.e., 3 servings/week x 0.666 = 2) using the CHILD serving size of ¾ cup of potatoes (i.e., 2 servings x ¾ cup = 1 ½ cup of potatoes/week)

Note: Where serving sizes differed between the FAMILY, START, or ABC FFQs and CHILD, the servings per week in FAMILY, START, or ABC were adjusted in order to match the serving sizes used in the CHILD FFQ. The nutrient database did not require adjustment as macronutrients and micronutrients were not calculated for this analysis but will require reporgramming in future analyses.

ABC = Aboriginal Birth Cohort study; CHILD = Canadian Healthy Infant Longitudinal Development study; FAMILY = Family Atherosclerosis Monitoring In earLY life study; START = SouTh Asian birth cohort study.

SUPPLEMENTAL TABLE 4 – Aggregated and Harmonized Food Groups across the four cohorts (ABC, CHILD, FAMILY, and START) that comprise the NutriGen Alliance Cohort.

Food Groups	Food Items in Defined Food Groups
Fats	Butter, margarine, oils, or ghee
Full Fat Dairy	Full-fat/homogenized milk, sour cream, cream soups, cottage and ricotta cheese, other cheeses
Low Fat Dairy	Reduced-fat milk (all types) and low/reduced fat cheeses
Fermented Dairy	Yogurt, lassi, and raita
Meat	Beef, pork, ham, lamb, veal, goat, game, and ground meat
Eggs	Boiled or fried whole eggs, egg whites, and egg substitutes
Organ Meats	Organ meats
Fish and Seafood	Fish, canned tuna, tuna salad, tuna casserole, fish curry, and shellfish
Processed Meats	Hot dogs, bacon, breakfast sausages, lunch and canned meats.
Meat Dishes	Meat/chicken stews, pot pies, meat curries, chilies, burritos, tacos, ramen soup, other meat soups
Poultry	Non-fried chicken
Fried Foods	Fried fish and chicken
Leafy Greens	Green salad (lettuce), dark leafy greens, cooked greens, and raw greens
Cruciferous Vegetables	Broccoli, cabbage, naapa and Chinese cabbage, sauerkraut, cauliflower and Brussels sprouts
Legumes	Bean soups, refried and dried beans, sambhar, and other beans.
Fresh Seasonings	Fresh garlic and chilies
Starchy Vegetables	Yams, sweet potatoes, and potatoes (baked, boiled, and mashed)
Vegetable Medley	Corn and hominy, carrots, green peas, and French, green, and string beans
Other Vegetables	Tomatoes, peppers, squash, zucchini, kai lan, onion, okra, leeks, avocados, other vegetables
Tofu	Tofu, tempe, and tofu products (hotdogs, soy, burgers, cheese)
Fruits	Apples, apple sauce, pears, bananas, peaches, nectarines, plums, apricots, berries, melons, lychees, rambuttan, papaya, mango, other fruits, and dried fruits
Whole Grains	Cooked Cereals, granola, cereal bars, roti, chapatis, pitas, naan, and brown and wild rice.
Refined Grains	Cold cereals, pancakes, French toast, waffles, muffins, scones, croissants, puri, idli and dosa, parathas, breads, corn bread, soft pretzels, white rice and noodles.
Pasta	Spaghetti and other pastas with tomato and meat and/or cheese.
Pizza	Vegetable and meat pizzas
French Fries	French fries and hash browns
Non-Meat Dishes	Vegetable, tomato, minestrone, and miso soups, sambar, vegetable and potato curry, kofta, coleslaw, potato, macaroni and pasta salad, sports/meal replacement bars.
Stir-Fried Dishes	Stir-fried noodles and rice, steamed buns, wontons, and dumplings
Snacks	Potato chips, tortillas, corn chips, popcorn, pakoras, papad, bhajia, fried mixtures, and crackers.
Nuts and Seeds	Peanut and other nut butters, peanuts, other nuts and seeds

Sweets	Ice cream/milkshakes, desserts, jam, jelly, honey, pudding, custards, donuts, fruit crisps, pies, cookies, cakes, rasgolla, barfi, rasmali, gulab joman, jalebi, ladoo, candies, pop tarts.
Condiments	Salad dressing, stuffing, sauces, gravies, ketchup, salsa, chutney, and mayonnaise.
Tea	Tea (all types)
Coffee	Coffee and espresso drinks (regular or decaffeinated)
Sweet Drinks	Tomato and other vegetables juices, fruit juices, fortified juices, sugar free juices, meal replacement drinks and shakes, and regular soft drinks.
Artificial Sweets	Artificial sweetener and sugar substitutes and diet soft drinks

ABC = Aboriginal Birth Cohort study; CHILD = Canadian Healthy Infant Longitudinal Development study; FAMILY = Family Atherosclerosis Monitoring In earLY life study; START = SouTh Asian birth cohort study.

SUPPLEMENTAL TABLE 5 – Principal component analysis (PCA) food group loading scores. Food items with a loading score ≥ |0.30| are presented and characterize each of the three dietary patterns within the NutriGen Alliance cohort (n = 4,880).

Food Group	**Plant-based**	**Western**	**Health Conscious**
Fats		0.55	
Full Fat Dairy			
Low Fat Dairy	0.39	0.41	
Fermented Dairy	0.61		
Meat	(-0.35)	0.43	0.33
Eggs			0.36
Organ Meats			
Fish and Seafood			0.50
Processed Meats		0.55	
Meat Dishes			0.49
Poultry and Waterfowl			0.36
Fried Foods			
Leafy Greens			0.38
Cruciferous Vegetables			0.55
Legumes	0.62		
Fresh Seasonings	0.72		
Starchy Vegetables		0.43	
Vegetable Medley	0.43		0.47
Other Vegetables	0.70		0.32
Tofu			
Fruits			0.52
Whole Grains	0.71		
Refined Grains			0.35
Pasta		0.53	
Pizza		0.32	
French Fries		0.47	
Non-Meat Dishes	0.63		
Stir-Fried Dishes			0.47
Snacks		0.42	
Nuts and Seeds			0.35
Sweets		0.46	
Condiments		0.48	0.41
Tea	0.53		
Coffee		0.34	
Sweet Drinks		0.56	
Artificial Sweets			
Eigenvalue	4.02	3.30	3.05
Cumulative Variation [1]	0.11	0.20	0.29
Maximum Diet score	50	65	70

[1] Proportion of the total dietary variation in the dataset that is explained by considering 1, 2, or 3 underlying dietary patterns.

SUPPLEMENTAL TABLE 6 – Range of quintile serving sizes for each food group within the Nutrigen Alliance cohort (*n* = 4,880).

Food Group	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile
Fats	< 0.07	≥ 0.07 to < 0.3	≥ 0.3 to < 0.5	≥ 0.5 to < 1	≥ 1
Full Fat Dairy	< 0.18	≥ 0.18 to < 0.5	≥ 0.52 to < 1.0	≥ 1.0 to < 1.5	≥ 1.54
Low Fat Dairy	< 0.29	≥ 0.29 to < 0.8	≥ 0.8 to < 1.3	≥ 1.3 to < 2	≥ 2.04
Fermented Dairy	< 0.08	≥ 0.08 to < 0.3	≥ 0.3 to < 0.5	≥ 0.5 to < 1	≥ 1
Meat	< 0.03	≥ 0.03 to < 0.2	≥ 0.2 to < 0.3	≥ 0.33 to < 0.6	≥ 0.6
Eggs	< 0.09	≥ 0.09 to < 0.2	≥ 0.24 to < 0.4	≥ 0.4 to < 0.6	≥ 0.6
Organ Meats[1]	0	0	0	0	> 0
Fish and Seafood	0	> 0 to < 0.07	≥ 0.07 to < 0.1	≥ 0.14 to < 0.3	≥ 0.3
Processed Meats	0	> 0 to < 0.1	≥ 0.1 to < 0.2	≥ 0.21 to < 0.5	≥ 0.5
Meat Dishes	< 0.03	≥ 0.03 to < 0.1	≥ 0.12 to < 0.2	≥ 0.24 to < 0.4	≥ 0.42
Poultry and Waterfowl	< 0.03	≥ 0.03 to < 0.1	≥ 0.1 to < 0.1	≥ 0.14 to < 0.3	≥ 0.3
Fried Foods	< 0.01	≥ 0.01 to < 0.06	≥ 0.06 to < 0.1	≥ 0.12 to < 0.2	≥ 0.2
Leafy Greens	< 0.13	≥ 0.13 to < 0.3	≥ 0.3 to < 0.5	≥ 0.54 to < 1	≥ 1
Cruciferous Vegetables	< 0.07	≥ 0.07 to < 0.1	≥ 0.14 to < 0.3	≥ 0.3 to < 0.5	≥ 0.5
Legumes	0	> 0 to < 0.1	≥ 0.1 to < 0.2	≥ 0.2 to < 0.4	≥ 0.4
Fresh Seasonings	< 0.07	≥ 0.07 to < 0.3	≥ 0.3 to < 0.5	≥ 0.5 to < 1.2	≥ 1.2
Starchy Vegetables	< 0.07	≥ 0.07 to < 0.1	≥ 0.14 to < 0.2	≥ 0.21 to < 0.4	≥ 0.4
Vegetable Medley	< 0.18	≥ 0.18 to < 0.4	≥ 0.4 to < 0.6	≥ 0.6 to < 0.9	≥ 0.91
Other Vegetables	< 0.56	≥ 0.56 to < 1	≥ 1 to < 1.5	≥ 1.5 to < 2.4	≥ 2.4
Tofu[1]	0	0	0		> 0
Fruits	< 1.12	≥ 1.12 to < 1.8	≥ 1.8 to < 2.5	≥ 2.53 to < 3.6	≥ 3.6
Whole Grains	< 0.14	≥ 0.14 to < 0.4	≥ 0.42 to < 0.8	≥ 0.83 to < 1.9	≥ 1.9
Refined Grains	< 0.66	≥ 0.66 to < 1.2	≥ 1.2 to < 1.7	≥ 1.7 to < 2.3	≥ 2.32
Pasta	< 0.07	≥ 0.07 to < 0.2	≥ 0.2 to < 0.3	≥ 0.3 to < 0.4	≥ 0.41
Pizza	< 0.07	≥ 0.07 to < 0.1	≥ 0.1 to < 0.1	≥ 0.14 to < 0.2	≥ 0.21
French Fries	< 0.02	≥ 0.02 to < 0.05	≥ 0.05 to < 0.08	≥ 0.08 to < 0.1	≥ 0.14
Non-Meat Dishes	< 0.08	≥ 0.08 to < 0.2	≥ 0.2 to < 0.3	≥ 0.3 to < 0.6	≥ 0.6
Stir-Fried Dishes	0	> 0 to < 0.04	≥ 0.04 to < 0.1	≥ 0.12 to < 0.2	≥ 0.21
Snacks	< 0.08	≥ 0.08 to < 0.2	≥ 0.2 to < 0.3	≥ 0.32 to < 0.6	≥ 0.6
Nuts and Seeds	< 0.09	≥ 0.09 to < 0.3	≥ 0.3 to < 0.6	≥ 0.6 to < 1.1	≥ 1.1
Sweets	< 0.83	≥ 0.83 to < 1.4	≥ 1.4 to < 2	≥ 2.0 to < 2.9	≥ 2.92
Condiments	< 0.3	≥ 0.3 to < 0.7	≥ 0.7 to < 1.1	≥ 1.1 to < 1.7	≥ 1.7
Tea	0	> 0 to < 0.1	≥ 0.1 to < 0.2	≥ 0.21 to < 0.8	≥ 0.8
Coffee	0	> 0 to < 0.03	≥ 0.03 to < 0.1	≥ 0.14 to < 0.5	≥ 0.5
Sweet Drinks	< 0.14	≥ 0.14 to < 0.3	≥ 0.3 to < 0.6	≥ 0.6 to < 1.2	≥ 1.2
Artificial Sweets[1]	0	0	0	0	> 0

[1] Food group was scored as binary, where 0 servings = 1 point and > 0 servings = 5 points.

SUPPLEMENTAL TABLE 7 - Principal component analysis (PCA) food group loading scores with each of the 7 ethnicities included as independent variables alongside FFQ data. Food items with a loading score ≥ |0.30| are presented and characterize each of the three dietary patterns within the NutriGen Alliance cohort (*n* = 4,880).

Food Group	Plant-based	Western	Health Conscious
Fats		0.53	
Full Fat Dairy			
Low Fat Dairy	0.34	0.42	
Fermented Dairy	0.59		
Meat	(-0.33)	0.39	0.36
Eggs			0.37
Organ Meats			
Fish and Seafood			0.51
Processed Meats		0.52	
Meat Dishes			0.49
Poultry and Waterfowl			0.36
Fried Foods			
Leafy Greens			0.35
Cruciferous Vegetables			0.54
Legumes	0.63		
Fresh Seasonings	0.76		
Starchy Vegetables		0.45	
Vegetable Medley	0.42		0.42
Other Vegetables	0.69		
Tofu			
Fruits			0.48
Whole Grains	0.70		
Refined Grains			0.36
Pasta		0.53	
Pizza		0.31	
French Fries		0.42	
Non-Meat Dishes	0.65		
Stir-Fried Dishes			0.54
Snacks		0.40	
Nuts and Seeds			0.30
Sweets		0.44	
Condiments		0.47	0.38
Tea	0.53		
Coffee		0.35	
Sweet Drinks		0.54	
Artificial Sweets			
Aboriginal			
East/South East Asian		(-0.30)	0.38
South Asian	0.78	(-0.31)	

African			
White European	(-0.53)	0.35	
Other			
Don't Know			
Eigenvalue	4.85	3.42	3.15
Cumulative Variation [1]	0.11	0.19	0.27
Correlation with PCA without Ethnicity (r^2)	0.97	0.94	0.96

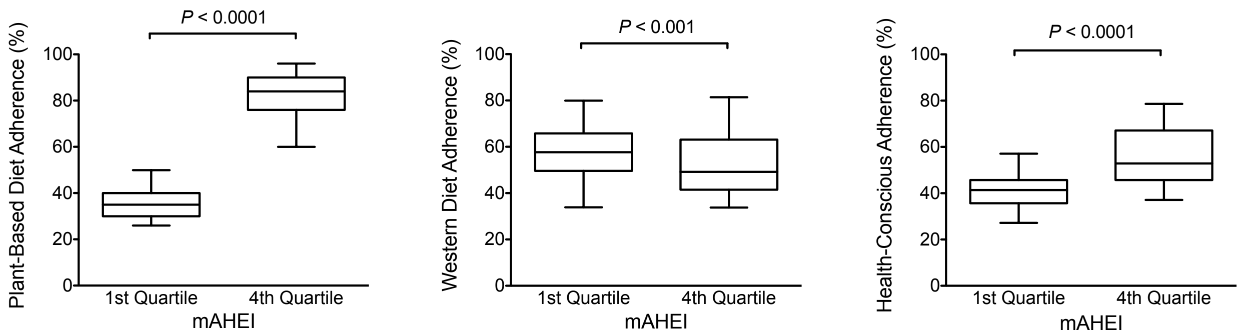
[1] Proportion of the total dietary variation in the dataset that is explained by considering 1, 2, or 3 underlying dietary patterns.

SUPPLEMENTAL TABLE 8 - Unadjusted and energy-adjusted ethnic-specific and overall dietary scores within the Nutrigen Alliance cohort. Values present average % ± SD adherence to defined dietary pattern within specific population.

Self-Reported Ethnicity	N	Energy Adjusted	Plant-based	Western	Health Conscious
White European[1]	2803	Unadjusted	52.2 ± 11.9	63.2 ± 12.4	61.9 ± 12.3
	(CHILD = 2225; FAMILY = 578)	Adjusted	52.0 ± 11.0	62.6 ± 9.0	61.4 ± 10.3
South Asian	1060	Unadjusted	77.0 ± 13.4	45.4 ± 10.9	49.6 ± 11.8
	(CHILD=89; FAMILY=10; START=961)	Adjusted	77.9 ± 12.5	47.6 ± 9.5	51.5 ± 10.1
East/South East Asian	378	Unadjusted	47.6 ± 11.3	54.1 ± 13.0	66.6 ± 12.6
	(CHILD = 369; FAMILY = 9)	Adjusted	47.7 ± 10.3	54.4 ± 9.9	66.9 ± 9.2
Aboriginal[1]	248	Unadjusted	51.2 ± 13.4	68.7 ± 12.7	62.6 ± 15.0
	CHILD = 128; FAMILY = 8; ABC = 112;)	Adjusted	49.2 ± 11.9	63.3 ± 9.2	58.0 ± 11.8
African-Canadians or Other	231	Unadjusted	49.4 ± 11.4	57.1 ± 12.6	60.8 ± 13.5
	(CHILD = 196; FAMILY = 35)	Adjusted	49.6 ± 10.3	57.8 ± 10.0	61.4 ± 10.2
Unknown Ethnicity [2]	160	Unadjusted	56.5 ± 12.6	70.8 ± 12.5	55.9 ± 13.2
	(CHILD = 20; FAMILY = 140)	Adjusted	54.6 ± 11.3	65.8 ± 11.4	51.6 ± 10.1
Total	4,880	Unadjusted	57.2 ± 16.2	58.9 ± 14.5	59.4 ± 13.6
	(ABC=112; CHILD=3,027; FAMILY = 780; START = 961)	Adjusted	57.1 ± 15.8	58.6 ± 11.3	59.2 ± 11.2

[1]We assessed our power to detect differences in mean adherence scores to each of the dietary patterns within the white European (*n*=2,803) and Aboriginal (*n*=248) populations. Assuming an omnibus alpha = 0.0167 to adjust for multiple-testing of 3 dietary pattern scores, in the white European population we have 80% power to detect a 0.9% difference in adherence scores between at least 2 patterns; and 91.4% power to detect a difference of 1.0%, in adherence scores between at least 2 patterns while in the Aboriginal population, we have 80% power to detect a 3.25% difference in scores between at least 2 patterns, and 91.4% power to detect a difference of 3.75% difference in scores between at least 2 patterns.
[2] Participants uncertain of their ethnic origin or those that opted to not divulge self-reported ethnicity.
ABC = Aboriginal Birth Cohort study; CHILD = Canadian Healthy Infant Longitudinal Development study; FAMILY = Family Atherosclerosis Monitoring In earLY life study; START = SouTh Asian birth cohort study.

Supplemental Figure 1. Comparison of percent (%) adherence to the plant-based, Western, and health-conscious diets based on mAHEI quartile within the Nutrigen Alliance cohort (*n*=4,880).



[1]Plant-based, Western, and health-conscious diets were defined using principal component analysis;
[2]1st quartile = less healthy diet, 4th quartile = more healthy diet.
mAHEI = modified Alternative Healthy Eating Index