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Data resource profile: nutrition data in the VA million veteran program

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Abstract

Introduction
The Department of Veterans Affairs (VA) Million Veteran Program (MVP) nutrition data is derived from dietary food/beverage intake information collected through a semiquantitative food frequency questionnaire (SFFQ).

Methods
Estimates of dietary energy, nutrient, and non-nutritive food components intakes data were derived from an extensively validated SFFQ, which assessed the habitual frequency of consumption of 61 food items, added sugar, fried food frequency, and 21 nutritional supplements over the 12 months preceding questionnaire administration.

Results
Complete nutrition data was available for 353,418 MVP participants as of 30$^{\text{th}}$ September 2021. Overall, 91.5% of MVP participants with nutrition data were male with an average age of 65.7 years at enrollment. Participants who completed the SFFQ were primarily White (82.5%), and Blacks accounted for 13.2% of the responders. Mean $\pm$SD energy intake for 353, 418 MVP participants was 1428 $\pm$ 616 kcal/day, which was 1434 $\pm$ 617 kcal/day for males and 1364 $\pm$ 601 kcal/day for females. Energy intake and information on 322 nutrients and non-nutritive food components is available through contact with MVP for research collaborations at www.research.va.gov/mvp.

Conclusions
The energy and nutrient data derived from MVP SFFQ are an invaluable resource for Veteran health and research. In conjunction with the MVP Lifestyle Survey, electronic health records, and genomic data, MVP nutrition data may be used to assess nutritional status and related risk factors, disease prevalence, and determinants of health that can provide scientific support for the development of evidence-based public health policy and health promotion programs and services for Veterans and general population.

Keywords
Energy, nutrient, veteran health, cohort study, calorie intake

Key features

- Estimated daily intake of energy, nutrients, and non-nutritive food components were derived from the semiquantitative food frequency questionnaire (SFFQ) of the Department of Veterans Affairs (VA) Million Veteran Program (MVP), which is a national voluntary research program designed to examine genetic influences on health with the goal of improving health for Veterans.
- As of September 2021, over 850,000 participants have enrolled in MVP with 377,811 participants completing the SFFQ, which assessed the habitual frequency of consumption of 61 food items in addition to questions about added sugar to diet, fried food frequency, and 21 nutritional supplements over the 12 months preceding questionnaire administration.
- Frequency of consumption for specified portions of each food/beverage item in the SFFQ were converted to average estimated daily intake for each participant. Energy intake and information on 322 nutrients and non-nutritive food components were then derived by multiplying the frequency of consumption for each food item by its energy and nutrient content using the Harvard University Food Composition Database and summing across all foods. Energy-adjusted nutrient intakes were estimated using a residual method on a log-scale for both energy (exposure) and nutrients (outcome).
- After removing participants with implausible SFFQ responses, two datasets consisting of information for 353,418 MVP participants were derived: one for raw nutrient intakes and another for energy-adjusted nutrient intakes. Both datasets have 353,418 rows and 325 columns including two IDs, which are linked to complementary MVP data on lifestyle, genetic and VA electronic health record (EHR) information.
- Data are currently available to VA and VA-affiliated investigators through approved MVP research projects. Interested future research collaborators can contact MVP at www.research.va.gov/mvp.

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Background

The Department of Veterans Affairs (VA) Million Veteran Program (MVP) nutrition data is derived from dietary food/beverage intake information collected through a semiquantitative food frequency questionnaire (SFFQ) [1]. MVP is a national research program designed to examine how genes, lifestyle, military experiences, and exposures affect health and wellness in Veterans [1, 2]. MVP enrollment of active Veterans Health Administration (VHA) users began in 2011 with the goal of enrolling at least 1 million Veterans [1, 2]. Upon enrollment in MVP, the MVP Lifestyle Survey which includes the SFFQ is available for self-completion and is returned by mail approximately 4-8 weeks following enrollment.

In September 2021, SFFQ data on 377,811 individuals were combined with the Harvard Food Composition data [3] to derive estimates of daily consumption of energy, nutrients, and non-nutritive food components. MVP nutrition data can be directly linked to a range of health-related data sources including: i) electronic health records (EHRs) with detailed inpatient and outpatient interactions with the VA healthcare system [2]; ii) genetic information originating from blood samples provided by MVP participants [2]; and iii) information on a variety of demographic, lifestyle and health related factors originating from two self-administered questionnaires [1]. MVP nutrition data can also be linked to other outside data sources, such as data compiled from the National Death Index [4], as well as from Medicare and Medicaid [5].

Methods

Estimates of dietary energy, nutrient, and non-nutritive food components intake data were derived from an extensively

Table 1: Characteristics (% or mean+-SD) of participants with nutrition data[1]

Characteristics[2]	Male (n = 323,358)	Female (n = 28,730)	Total[3] (n = 353,418)
Year of enrollment (n=353,418)			
2011–2012	2.1	1.6	2.1
2013	31.2	28.6	31.0
2014	14.4	14.4	14.4
2015	11.8	12.3	11.8
2016	10.9	11.3	10.9
2017	9.7	11.0	9.8
2018	9.0	9.9	9.1
2019	3.7	4.0	3.7
2020–2021	7.3	6.9	7.3
Age (years, mean ± SD)	66.7 ± 11.4	54.8 ± 13.0	65.7 ± 12.1
Age category (n = 353,418)			
<50	7.5	30.4	9.4
50–59	13.0	32.9	14.6
60–69	40.4	26.0	39.2
70–79	26.8	7.6	25.2
≥80	12.4	3.1	11.6
Spanish, Hispanic or Latino (n = 348,023)	5.9	7.5	6.0
Race (n = 353,418)			
White	85.8	76.1	85.0
Black	9.6	18.2	10.3
Asian	3.1	4.4	3.2
Others	1.5	1.4	1.4
Education (n = 312,336)			
≤ High school or GED	24.7	8.7	23.4
Some college	30.0	26.4	29.7
College or above	45.3	64.9	46.9
Annual family income (n = 282,878)			
<30,000	32.4	33.2	32.5
30,000–59,000	36.1	33.3	35.8
≥60,000	31.5	33.5	31.7

Abbreviation: GED: General Educational Development.
[1]Unless otherwise indicated, data are expressed as distribution proportions (column percentages).
[2]N: sample without missing data for the individual characteristic; "Unknown or missing" is not counted in the distribution proportion.
[3]1300 participants did not report gender information.

validated SFFQ [6], which assessed the habitual frequency of consumption of 61 food items, added sugar, fried food frequency, and 21 nutritional supplements over the 12 months preceding questionnaire administration. We asked how often, on average, the participant had consumed a specified portion size of each of the 61 food items over the preceding year on the SFFQ. Pre-specified responses were: "Never or less than once per month"; "1–3 per month"; "once a week"; "2–4 per week"; "5–6 per week"; "once a day"; "2–3 per day"; "4–5 per day"; and "≥6 per day". We also collected the number of teaspoons of sugar added to beverages or food each day, the frequency of eating fried food at home, and the frequency of eating fried food away from home. Frequency of consumption for specified portions of each food/beverage item in the SFFQ were converted to an average estimated daily intake for each participant. Average daily total energy intake was then calculated by multiplying the frequency of consumption of each item by its energy content from the Harvard University Food Composition Database [3] and summing across all foods.

In addition to survey questions regarding food frequency intake, we also asked about types of fats used for baking at home. Data collected was used to derive the nutrients for baking pies at home and the type of fats used for frying which was used to derive the nutrients for fried foods at home.

Supplement use included frequency of multi-vitamin consumption and intake of 20 individual nutritional supplements on a regular basis including Vitamin A, Vitamin C, Vitamin E, Vitamin B6, selenium, iron, zinc, calcium, Metamucil, Vitamin D, B-complex vitamin, cod liver oil, folic acid, omega-3 fatty acid, iodine, copper, Brewer's yeast, beta-carotene, niacin, magnesium or other. For nutrients with supplements, we prepared two separate nutrient intake datasets: nutrient intake from foods and beverages only and nutrient intake with supplements, respectively.

In total, SFFQ data on 377,811 individuals were combined with food composition data to derive energy and nutrient intake. Participants were excluded if a full page was left blank (n = 12,969 SFFQ) or if energy intake was considered implausible which was defined as female energy intake outside the range of 400–4000 kcal/day or 450–4500 kcal/day for males. The final dataset of MVP Nutrition included 353,418 rows and 325 columns (energy intake, two identification numbers and 322 nutrients) with no missing data. This dataset contains absolute nutrient intake values.

For a second MVP nutrition dataset, we applied the residual method on a log-scale for both energy and nutrients of 1400 kcal energy intake per day for females and 1500 kcal per day for males to derive the energy-adjusted dietary intakes [7]. This second MVP nutrition dataset converted the absolute nutrient values in the first nutrient dataset to energy-adjusted nutrient values. Both the first dataset with absolute nutrient intake values and the second dataset with energy adjusted nutrient intake values have 353,418 rows and 325 columns. A comprehensive list of nutrient variables can be found in the online supplement.

Table 2: Mean (Standard Deviation) for Absolute Daily Intakes of energy and nutrients in 353,418 MVP participants

Nutrient	**Male (n = 323,358)**	**Female (n = 28,730)**	**Total[1] (n = 353,418)**
Total energy, kcal/day	1434 (617)	1364 (601)	1428 (616)
Protein, g/day	74.6 (36.7)	74.7 (38.5)	74.7 (36.8)
Protein, % total energy	21.0 (5.1)	22.1 (5.7)	21.1 (5.2)
Animal Protein, % total energy	16.7 (5.5)	17.7 (6.2)	16.8 (5.6)
Vegetable Protein, % total energy	4.3 (1.4)	4.4 (1.6)	4.3 (1.4)
Carbohydrate, g/day	152.7 (78.5)	151.8 (81.6)	152.6 (78.7)
Carbohydrate, % total energy	42.4 (10.0)	44.2 (11.1)	42.5 (10.1)
Starch, % total energy	12.9 (4.9)	12.3 (5.2)	12.9 (4.9)
Added sugar, % total energy	10.7 (7.5)	12.5 (8.3)	10.8 (7.6)
Natural sugar, % total energy	11.2 (5.9)	12.0 (6.3)	11.3 (5.9)
Fiber, g/day	13.3 (7.8)	13.7 (8.7)	13.3 (7.9)
Total fat, g	53.8 (25.7)	49.4 (24.5)	53.5 (25.7)
Total fat, % total energy	34.0 (7.1)	32.8 (7.1)	33.9 (7.1)
Saturated fat, % total energy	11.7 (3.0)	11.3 (3.1)	11.7 (3.0)
Monounsaturated fat, % total energy	12.6 (3.0)	11.9 (2.9)	12.5 (3.0)
Trans fat, % total energy	0.56 (0.18)	0.49 (0.17)	0.55 (0.18)
Polyunsaturated fat, % total energy	6.62 (1.80)	6.55 (1.89)	6.62 (1.81)
α-Linolenic acid (18:3n-3c), % total energy	0.58 (0.16)	0.56 (0.16)	0.58 (0.16)
Long-chain n-3 fatty acids, % total energy	0.25 (0.25)	0.28 (0.28)	0.25 (0.26)
Linoleic acid (18:2n-6cc), % total energy	5.46 (1.60)	5.38 (1.68)	5.45 (1.60)
Arachidonic acid (20:4n-6c), % total energy	0.16 (0.07)	0.17 (0.09)	0.16 (0.08)
Cholesterol, mg	266.4 (164.5)	252.2 (158.3)	265.3 (164.1)
Alcohol, g	7.9 (16.0)	4.1 (10.3)	7.6 (15.7)

Long-chain n-3 fatty acids included docosahexaenoic acid (DHA), docosapentaenoic acid (DPA) and eicosapentaenoic acid (EPA).

Results

Nutrient data collection is ongoing in MVP. Baseline characteristics for the 353,418 MVP participants with available nutrition data as of 30th September 2021 are presented in Table 1. Overall, 91.5% were male. The majority of participants enrolled between 2013 and 2018 with an average age of 65.7 years at enrollment. Participants with Spanish, Hispanic or Latino ethnicity accounted 6% of the study population. Overall, participants who completed the SFFQ were primarily White (82.5%). Blacks accounted 13.2% of the responders with significant gender difference (18.6% of females *vs.* 9.6% of males, $P < 0.001$ using Chi-squared test). Female participants also had a relatively higher educational attainment compared to males: 64.9% of females and 45.3% of males had a college degree or above ($P < 0.001$ using Chi-squared test). Approximately one third of MVP participants (32.5%) had an annual family income <$30,000, Table 1.

Mean ± SD energy intake for 353, 418 MVP participants was 1428 ± 616 kcal/day, which was 1434 ± 617 kcal/day for males and 1364 ± 601 kcal/day for females, Table 2. Animal-derived sources of food contributed 43.6 ± 12.8% to the total energy intake including 16.0 ± 10.5% from dairy and dairy products, 14.1 ± 8.4% from red meat, 9.8 ± 7.8% from chicken, 2.4 ± 2.8% from eggs and 1.4 ± 1.7% from fish. Plant-derived sources of food contributed 56.4 ± 12.8% to energy intake including 20.7 ± 9.4% from grains, cakes, and potatoes. Beverages contributed 8.8 ± 10.8% to energy intake among MVP participants, Figure 1. Selected absolute nutrient intakes are presented in Table 2. Energy contributions from protein, carbohydrate, and fats were 21.1 ± 5.2%, 42.5 ± 10.1% and 33.9 ± 7.1%, respectively, Table 2. Selected energy-adjusted nutrient intakes are presented in Table 3. The energy-adjusted average intake of sodium and potassium was 1258 ± 290 mg/day (1119 ± 259 for females; 1270 ± 290 for males) and 2622 ± 555 mg/day (2541 ± 569 for females and 2629 ± 553 for males), respectively, with an average sodium to potassium ratio (Na:K ratio) of 0.5 ± 0.2 for both female and males. Nutritional supplements were the major contributors to dietary vitamin intake, Table 3. A full list of the nutrients and

Figure 1: food sources of energy intake (%)

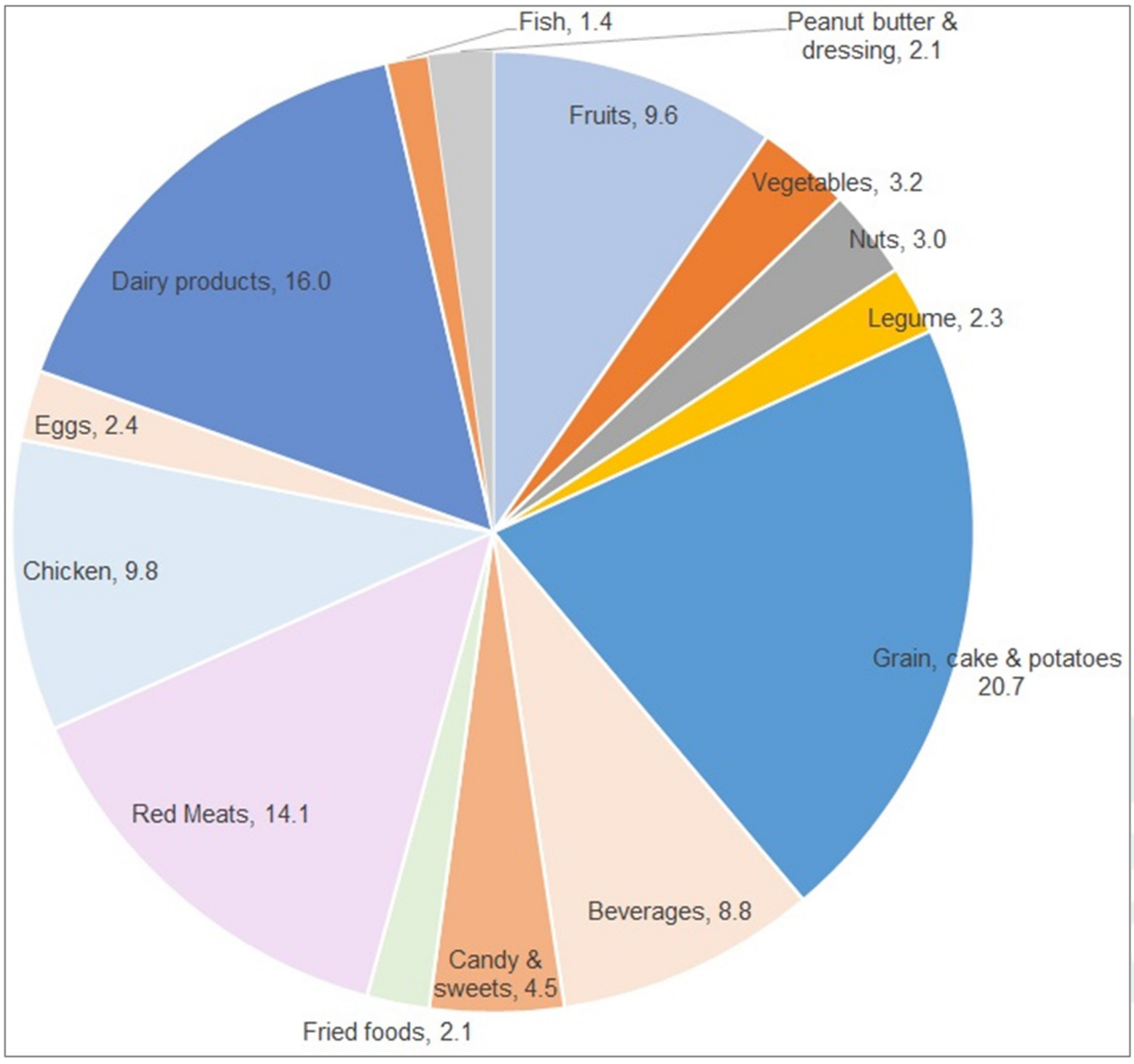

Table 3: Mean (standard deviation) for energy-adjusted nutrient intakes in 353,418 MVP participants

Nutrient	Male (n = 323,358)	Female (n = 28,730)	Total[1] (n = 353,418)
Protein, g/day	78.2 (19.0)	76.9 (19.9)	78.1 (19.1)
Carbohydrate, g/day	159.7 (37.7)	155.5 (38.9)	159.3 (37.9)
Total fat, g/day	56.3 (11.7)	50.8 (11.1)	55.9 (11.8)
Sodium, mg/day	1270 (290)	1119 (259)	1258 (290)
Potassium, mg/day	2629 (553)	2541 (569)	2622 (555)
Sodium : potassium ratio	0.5 (0.2)	0.5 (0.2)	0.5 (0.2)
Calcium, mg/day	705.9 (330.5)	700.9 (322.7)	705.4 (329.8)
With supplements	794.7 (408.0)	895.8 (454.7)	802.7 (412.9)
Magnesium, mg/day	242.9 (50.9)	238.5 (55.9)	242.5 (51.3)
With supplements	268.6 (105.9)	277.1 (125.2)	269.3 (107.6)
Zinc, mg/day	10.7 (2.5)	10.0 (2.3)	10.6 (2.5)
With supplements	14.3 (15.4)	13.2 (14.5)	14.2 (15.3)
Iron, mg/day	11.2 (3.7)	10.5 (3.5)	11.2 (3.7)
With supplements	14.2 (10.9)	14.5 (12.3)	14.2 (11.0)
Retinol Activity Equivalents, μg/day	835 (584)	875 (573)	838 (583)
With supplements	2021 (1984)	1991 (1790)	2018 (1969)
α-Carotene, μg/day	745 (824)	829 (949)	752 (835)
$\beta-$Carotene, μg/day	3960 (3751)	4999 (4662)	4046 (3847)
With supplements	4253 (4342)	5225 (4994)	4333 (4409)
Lycopene, μg/day	864 (1113)	807 (1035)	860 (1106)
Lutein-zeaxanthin, μg/day	2397 (2600)	3252 (3866)	2468 (2738)
Vitamin B1, mg/day	1.0 (0.2)	0.9 (0.2)	1.0 (0.2)
With supplements	10.0 (21.1)	12.0 (23.1)	10.2 (21.3)
Vitamin B2, mg/day	1.9 (0.6)	1.8 (0.5)	1.9 (0.6)
With supplements	11.0 (21.0)	12.8 (23.0)	11.1 (21.2)
Vitamin B3, mg/day	21.3 (5.5)	20.5 (5.9)	21.2 (5.5)
With supplements	70.2 (138.6)	60.9 (113.9)	69.4 (136.7)
Vitamin B6, mg/day	2.1 (0.5)	2.0 (0.5)	2.1 (0.5)
With supplements	21.4 (45.5)	24.5 (48.4)	21.6 (45.7)
Vitamin B12, ug/day	6.9 (5.1)	6.0 (4.4)	6.8 (5.1)
With supplements	18.5 (22.8)	19.7 (24.4)	18.6 (23.0)
Vitamin C, mg/day	77.6 (50.0)	76.6 (49.3)	77.6 (49.9)
With supplements	218.7 (255.7)	214.5 (252.1)	218.3 (255.3)

Energy-adjusted dietary intakes were estimated using the residual method on a log-scale for both energy and nutrients of 1400 kcal energy intake per day for females and 1500 kcal per day for males.

mean intakes may be found in the Supplemental codebook (Supplementary Table 1).

Discussion

The major strength of the MVP nutrition data is its comprehensive estimates of more than 200 nutrients and non-nutritive food components, which is based on food composition data that has been collected, updated, and measured for decades by Harvard dietitians and researchers. Additional strengths include the large sample size of participants with diverse socioeconomic and racial/ethnic backgrounds and the ability to link nutrition data to other datasets for the same participant (i.e. biomarkers, genetics, lifestyle factors, etc.). Lastly, nutrition data can also be linked with local, regional, and national health registries including the VA electronic health record system to provide a valuable resource for research designed to improve the health and healthcare of US Veterans [1, 2]. With ongoing data collection, the potential for repeated measurements in the future will further strengthen and enhance the quality and depth of the MVP nutrition data.

Key weaknesses include potential recall bias due to self-reported dietary intake and the potential for the abbreviated SFFQ in MVP to underestimate nutrient intakes. For example, some major sources of dietary sodium including salt added at the table and salt used in preparation or cooking were not included in the MVP SFFQ [9, 10]. Use of a self-reported questionnaire as the primary means to collect dietary data is also a potential source of measurement error. To control for measurement error to a large degree, we provided nutrients with energy adjustment that negates correlated errors in nutrient and energy intake assessments [7]. Lack of validation in the study population is another limitation that is under consideration in our future research plans.

MVP nutrient data have been used to examine different health conditions affecting Veterans. Based on MVP nutrition data, a study entitled "Dietary Sodium and Potassium Intake

and Risk of Non-Fatal Cardiovascular Diseases" has been published [8], which demonstrated a linear dose-response association between dietary sodium intake and Na:K ratio with risk of cardiovascular disease (CVD) and a nonlinear inverse association between dietary potassium intake and risk of CVD. The observed associations were consistent across racial groups and participants with or without baseline cardiometabolic conditions, but appeared to be slightly stronger among Veterans with low dietary quality [8]. Additional studies have examined the association of dietary fatty acids with risk of atherosclerotic CVD [11] and dietary omega-3 fatty acid consumption and the incidence of atrial fibrillation [12].

Future studies will focus on deriving different dietary patterns based on dietary food intake and nutrient intake data. Dietary patterns include the Alternative Healthy Eating Index, the Alternative Mediterranean diet, Dietary Approaches to Stop Hypertension (DASH), Planetary Health Dietary Index, and the Mediterranean-DASH Intervention for Neurodegenerative Delay (MIND) diet. Additional projects based on MVP nutrition and conjunct data also include different dietary patterns and risk of CVD, neurogenerative diseases, cancers, and mortality among the overall MVP population and among sub-groups with different comorbidities. MVP also anticipates administering a follow-up sFFQ to obtain repeated dietary and nutrient measures in the future.

Data resource access

As described in detail in a Data Resource Profile for MVP surveys [1] and on the MVP website (https://www.research.va.gov/mvp/), access to MVP data and/or MVP samples is governed by the scope of MVP informed consent and VA policies. As such, data/sample access requires scientific review by appropriate VA review committees. Data are currently available to VA investigators and other approved partners with plans for expanding to non-VA investigators in the future. Inquiries can be directed to Xuan-Mai Nguyen, PhD at xuan-mai.nguyen@va.gov. For requests to access this resource, a consortium approach is strongly encouraged and collaborators from university affiliates and other organizations working with VA investigators are encouraged (https://www.research.va.gov/MVP/research.cfm).

Conclusions

Nutritional epidemiology allows researchers to understand how dietary patterns, components, and nutrients are associated with health outcomes and disease etiology in populations. The energy and nutrient data derived from MVP SFFQ are an invaluable resource for Veteran health and research. In conjunction with the MVP Lifestyle Survey, electronic health records (EHR) and genomic data, MVP nutrition data can be used to assess nutritional status, its related risk factors, and disease prevalence to improve our understanding of Veteran health. MVP nutrition data may also provide scientific support for the development of evidence-based public health policy and health promotion programs and services for Veterans and the general US population.

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Ethics statement

This research was conducted according to the guidelines of the Declaration of Helsinki and approved by the Department of Veteran Affairs Central IRB (protocol code MVP001 approved in 2010). Written informed consent has been obtained from the participants in accordance with all VA policies and under the authority of the VA Central IRB.

Conflict of interest statement

None to declare.

Author contributions

Manuscript writing: X-MTN, YL, KLI, LD

Analytics and data summary: YL, X-MTN, KLI, KC, LD, FBH, WCW

MVP Recruitment and Enrollment: SBW, X-MTN, MG

Oversight and critical review of manuscript for content and clarity: LD, MG, KC, WCW

All authors have read and agreed to the published version of the manuscript.

Publication consent

The authors have gained consent to publish detailed descriptions of the VA MVP nutrition data that is available for research as outlined in the Data Access section of this paper.

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Supplementary appendices

Supplementary data are available at IJPDS online.

Data availability statement

Data cannot be shared publicly because of VA policies regarding data privacy and security. Data contain potentially identifying and sensitive patient information. All relevant

summary level data are included in the manuscript. For investigators with appropriate authorizations within the Department of Veterans Affairs, requests for data access can be made.

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Abbreviations

VA:	Veterans Affairs
MVP:	Million Veteran Program
SFFQ:	semiquantitative food frequency questionnaire
EHR:	electronic health record
VHA:	Veterans Health Administration
CVD:	cardiovascular disease
DASH:	Dietary Approaches to Stop Hypertension
MIND:	Mediterranean-DASH Intervention for Neurodegenerative Delay

Supplementary Table 1: MVP nutrition dataset: List of variables

Variable	Label	N
calor	Calories kcal	353418
acar	Alpha Carotene mcg	353418
acar_ wo	Alpha Carotene w/out suppl mcg	353418
acryl	Acrylamide mcg	353418
addfat_ liq	Discretionary Liquid Fat, gms/100 grams, 2009	353418
addfat_ sol	Discretionary Sold Fat, gm/100 grams, 2009	353418
adds_ cer	Added sugar minus cereal fruit for Carb Quality Variables only, gm	353418
adds_ fds	Added Sugar From Foods for Carb Quality Variables only,gm	353418
addsug	Added Sugar, gm	353418
afat	Animal Fat gm	353418
ag18311	Sum of Alpha and Gamma Linolenic Acid, gms, Sacks, 2011	353418
ala	Alanine gm	353418
alco	Alcohol gm	353418
aofib	AOAC Fiber gm, 1993	353418
aprot	Animal Protein gm	353418
arg	Arginine gm	353418
asp	Aspartic Acid gm	353418
aspa	Aspartic Acid, from Aspartame, gm	353418
aspart	Aspartame, 2006	353418
b1	Thiamine mg	353418
b1_ wo	Thiamine w/out suppl mg	353418
b12	Vitamin B12 mcg	353418
b12_ wo	Vitamin B12 w/out suppl mcg	353418
b2	Riboflavin mg	353418
b2_ wo	Riboflavin w/out suppl mg	353418
b6	Pyridoxine mg	353418
b6_ wo	Pyridoxine w/out suppl mg	353418
b6n	Vitamin B6, natural, mg	353418
b6s	Vitamin B6, synthetic, mg, foods only	353418
bcar	Beta Carotene mcg	353418
bcar_ wo	Beta Carotene w/out suppl mcg	353418
bcryp	Beta Cryptoxanthin mcg	353418
bcryp_ wo	Beta Cryptoxanthin w/out suppl mcg	353418
bergamottin	Bergamottin, Furocoumarim, ug	353418
bergapten	Bergapten, Furocoumarin, ug	353418
bergaptol	Bergaptol, Furocoumarin, ug	353418
betaine	Betaine, choline derivative mg	353418
betaine_ wo	Betaine, choline derivative w/out suppl mg	353418
betchol	Sum of Betaine and Choline mg	353418
betchol_ wo	Sum of Betaine and Choline, w/out suppl mg	353418
bioch	Biochanin A, Phytoestrogen mg, Isoflavones	353418
bsit	Beta-sitosterol, Phytosterol, mg	353418
c18111	Total Cis Oleic fatty acid, gms, 2011	353418
caff	Caffeine mg	353418
calc	Calcium mg	353418
calc_ wo	Calcium w/out suppl mg	353418
camp	Campesterol, Phytosterol, mg	353418
carbo	Carbohydrates gm	353418
ceraf	AOAC fiber gms, 1993, from cereal	353418
chol	Cholesterol mg	353418
choline	Total Choline mg, no betaine	353418
choline_ wo	Total Choline w/out suppl mg, no betaine	353418
cla	c9,t11 conjug diene isomer 18:2 Linoleic mg	353418
coum	Coumestrol, Phytoestrogen, mcg	353418
crcaf	AOAC fiber gms, 1993, from cruciferous	353418

Continued

Supplementary Table 1: Continued

Variable	Label	N
ct182n611	9c,12t-Octadecadienoic fatty acid, gms, Sacks T7, 2011	353418
cu	Copper mg	353418
cu_ wo	Copper w/out suppl mg	353418
cys	Cystine gm	353418
daidz	Daidzein, Phytoestrogen, Isoflavone, mg	353418
dcalc	Dairy Calcium mg	353418
dfat	Dairy Fat gm	353418
dfe	Dietary Folate Equivalents, mcg	353418
dii	Dietary Insulin Index , Glucose, (il*100)/calor	353418
dprot	Dairy Protein gm	353418
dvitd	Dairy Vitamin D IU	353418
e02mg	Vitamin E mg atoco Conversion (food+supplement)	353418
e02mg_ wo	Vitamin E w/out suppl mg atoco Conversion (food+supplement)	353418
es2mg	Vitamin E mg atoco Food Fortification Only	353418
exala	Alanine gm Expasy	353418
exarg	Arginine gm Expasy	353418
exasn	Asparagine gm Expasy	353418
exasp	Aspartic Acid gm Expasy	353418
excys	Cysteine gm Expasy	353418
exgln	Glutamine gm Expasy	353418
exglu	Glutamic Acid gm Expasy	353418
exgly	Glycine gm Expasy	353418
exhis	Histidine gm Expasy	353418
exile	Isoleucine gm Expasy	353418
exleu	Leucine gm Expasy	353418
exlys	Lysine gm Expasy	353418
exmet	Methionine gm Expasy	353418
exphe	Phenylalanine gm Expasy	353418
expro	Proline gm Expasy	353418
exser	Serine gm Expasy	353418
exthr	Threonine gm Expasy	353418
extrp	Tryptophan gm Expasy	353418
extyr	Tyrosine gm Expasy	353418
exval	Valine gm Expasy	353418
f100	Capric fatty acid gm	353418
f120	Lauric fatty acid gm	353418
f140	Myristic fatty acid gm	353418
f160	Palmitic fatty acid gm	353418
f161	Palmitoleic fatty acid gm	353418
f180	Stearic fatty acid gm	353418
f181	Oleic fatty acid gm	353418
f182	Linoleic fatty acid gm	353418
f183	Linolenic fatty acid gm	353418
f201	Eicosenoic fatty acid gm	353418
f204	Arachadonic fatty acid gm	353418
f205	Eicosapentaenoic EPA fatty acid gm	353418
f225	Docosapentaenoic 22:5 fatty acid gm	353418
f226	Docosahexaenoic DHA fatty acid gm	353418
f40	Butyric fatty acid gm	353418
f60	Caproic fatty acid gm	353418
f80	Caprylic fatty acid gm	353418
fdfol	Food Folate, SR14 2001 mcg	353418
fol98	Total Folate SR12 mcg, 1998 Foods +Vits	353418
fol98_ wo	Total Folate SR12 w/out suppl mcg, 1998 Foods +Vits	353418
folic	Folic Acid, 2001 mcg	353418
formo	Formononetin, Phytoestrogen mg, Isoflavones	353418
frcho	Free Choline, choline-contributing metabolite mg	353418

Continued

Supplementary Table 1: Continued

Variable	Label	N
frcho_ wo	Free Choline, choline-contributing metabolite w/out suppl mg	353418
frtaf	AOAC fiber gms, 1993, from fruit	353418
frtcb_ njs	Fruit carbohydrate minus juice sugar	353418
fruct	Fructose gm	353418
furo_ dhb	6'7'-Dihydroxybergamottin	353418
furocoumarin	Total Furocoumarin, ug	353418
genis	Genistein, Phytoestrogen, Isoflavone, mg	353418
gid	Glycemic Index	353418
gl	Glycemic Load	353418
glu	Glucose gm	353418
glut	Glutamic Acid gm	353418
gluten	Gluten, gm	353418
gly	Glycine gm	353418
glycit	Glycitein, Phytoestrogen, Isoflavone, mg	353418
gpcho	Choline from Glycerophosphocholine, mg	353418
heme	Heme iron mg	353418
hist	Histidine gm	353418
il	Insulinogenic Load, Glucose	353418
int_ grn	Carbohydrate from intact whole grain, grams	353418
iodine	Iodine mcg, multivitamin only	353418
iron	Iron mg	353418
iron_ wo	Iron w/out suppl mg	353418
iso	Isoleucine gm	353418
jcesug	Sugar from fruit juice	353418
k	Potassium mg	353418
k_ wo	Potassium w/out suppl mg	353418
lact	Lactose gm	353418
laric	Lariciresinol, Phytoestrogen, mcg, Plant Lignan	353418
lcn311	Long Chain Fatty Acids, gm, Sacks, 2011	353418
lcn311_ wo	Long Chain Fatty Acids, w/out suppl gm, Sacks, 2011	353418
leg_ carb	Carbohdyrate from legumes	353418
legaf	AOAC fiber gms, 1993, from legume	353418
leu	Leucine gm	353418
lut	Lutein and Zeaxanthin mcg	353418
lut_ wo	Lutein and Zeaxanthin w/out suppl mcg	353418
lyco	Lycopene mcg	353418
lyco_ wo	Lycopene w/out suppl mcg	353418
lys	Lysine gm	353418
magn	Magnesium mg	353418
magn_ wo	Magnesium w/out suppl mg	353418
malt	Maltose gm	353418
mat	Matairesinol, Phytoestrogen, mcg, Plant Lignan	353418
meth	Methionine gm	353418
mf16111	Total Palmitoleic fatty acid, gms, Sacks, 2011	353418
mf161n7c11	Cis Palmitoleic fatty acid, gms, Sacks M3, 2011	353418
mf18111	Total cis/trans, 2011	353418
mf181n7c11	11-c Octadecenoic Fatty Acid, gms, Sacks M7, 2011	353418
mf181n9c11	Cis Oleic Fatty Acid, gms, Sacks M6, 2011	353418
mf20111	Total Cis Trans Eicosenoic fatty acid, gms, Sacks, 2011	353418
mf201n9c11	11c-Eicosenoic Fatty Acid (Gondoic Acid), gms, Sacks M10, 2011	353418
mft11	Total Monounsaturated Fat, gms, sacks, 2011	353418
mill_ grn	Carbohydrate from milled whole grain, grams	353418
mn	Manganese mg	353418
mn_ wo	Manganese w/out suppl mg	353418
monfat	Total Monounsaturated Fat gm	353418
mufa_ a	Animal Monounsaturated Fat, gm	353418
mufa_ pl	Plant Monounsaturated Fat, gm	353418
n611	Omega 6, no gamma, gms, Sacks, 2011	353418

Continued

Supplementary Table 1: Continued

Variable	Label	N
n611_ wo	Omega 6, no gamma, w/out suppl gms, Sacks, 2011	353418
natsug	Natural Sugar, gm	353418
niacin	Niacin mg	353418
niacin_ wo	Niacin w/out suppl mg	353418
nitrate	Nitrate mg	353418
omega	Omega 3 (f205+f226) gm, no alpha 18:3	353418
omega_ wo	Omega 3 (f205+f226) w/out suppl gm, no alpha 18:3	353418
omg11	Omega 3, gm, Sacks, 2011	353418
omg11_ wo	Omega 3, w/out suppl gm, Sacks, 2011	353418
otn11	Sum of Believed to be Trans, gm, Sacks, 2011	353418
otn111	Believed to be trans, gms, Sacks C2, 2011	353418
otn211	Believed to be Trans, gms, Sacks U12, 2011	353418
panto	Pantothenic Acid mg	353418
panto_ wo	Pantothenic Acid w/out suppl mg	353418
pcho	Choline from Phosphocholine, mg	353418
pf18211	Total Linoleic Acid, gms, Sacks, 2011	353418
pf182ct11	Total Cis/Trans Linoleic Acid, gm, Sacks, 2011	353418
pf182n611	Total Linoleic fatty acid, gms, Sacks, 2011	353418
pf182n6c11	Cis Linoleic fatty acid, gms, Sacks P1, 2011	353418
pf182n7c11	9c,11c-Octadecadienoic Fatty Acid, CIS CLA,gms, Sacks P4, 2011	353418
pf182tct11	Total Trans/Cis Trans Linoleic, gms, sacks, 2011	353418
pf204n6c11	Arachidonic fatty acid, gms, Sacks P8, 2011	353418
pf205n3c11	Eicosapentaenoic EPA Fatty Acid, gm, Sacks, P10, 2011	353418
pf225n3c11	Docosapentaenoic fatty acid, DPA, gms, Sacks P13, 2011	353418
pf226n3c11	Docosahexaenoic DHA Fatty Acid, gm, Sacks P14, 2011	353418
pfa183n3c11	Alpha Linolenic Acid, gms, Sacks, 2011	353418
pfg183n6c11	Gamma Linolenic Acid, gms, sacks, 2011	353418
pfn311	Total Omega 3, gms, Sacks, 2011	353418
pfn311_ wo	Total Omega 3, w/out suppl gms, Sacks, 2011	353418
pfn611	Total Omega 6, gm, Sacks, 2011	353418
pfn611_ wo	Total Omega 6, w/out suppl gm, Sacks, 2011	353418
ph	Phospherous mg	353418
ph_ wo	Phospherous w/out suppl mg	353418
phenyl	Phenylalanine gm	353418
phenyla	Phenylalanine, from Aspartame, gm	353418
phytoestr	Total Phytoestrogens, mcg	353418
phytoster	Total Phytosterols, mg	353418
pino	Pinoresinol, Phytoestrogen, mcg, Plant Lignan	353418
ply11	Total Polyunsaturated Fat, gms, Sacks, 2011	353418
poly	Total Polyunsaturated Fat gm	353418
pot_ carb	Carbohydrate from potato	353418
pro	Proline gm	353418
pro46	Proanthocyanidin, 4-6mers, mg, USDA, 2007	353418
pro710	Proanthocyanidin, 7-10mers, mg, USDA, 2007	353418
prodim	Proanthocyanidin, dimers, mg, USDA, 2007	353418
promon	Proanthocyanidin, monomers, mg, USDA, 2007	353418
propoly	Proanthocyanidin, polymers, mg, USDA, 2007	353418
prot	Protein gm	353418
protrim	Proanthocyanidin, trimers, mg, USDA, 2007	353418
ptdcho	Choline from Phosphatidylcholine, mg	353418
ptdcho_ wo	Choline from Phosphatidylcholine, w/out suppl mg	353418
rae	Retinol Activity Equivalents mcg	353418
rae_ wo	Retinol Activity Equivalents w/out suppl mcg	353418
ref_ grn	Carbohydrate from refined grain, grams	353418
rfgrn	Refined Grain, grams	353418
satfat	Total Saturated Fat gm	353418
se	Selenium mcg, multvitamin only	353418

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Supplementary Table 1: Continued

Variable	Label	N
seco	Secoisolariciresinol, Phytoestrogen, mcg, Plant Lignan	353418
ser	Serine gm	353418
sf10011	Capric fatty acid, gms, Sacks Sb, 2011	353418
sf12011	Lauric fatty acid, gms, Sacks S1, 2011	353418
sf14011	Myristic fatty acid, gms, Sacks S2, 2011	353418
sf15011	Pentadecanoic Fatty Acid, gms, Sacks S3, 2011	353418
sf16011	Palmitic fatty acid, gms, Sacks S4, 2011	353418
sf17011	Margaric Fatty Acid, gms, Sacks S5, 2011	353418
sf18011	Stearic fatty acid, gms, Sacks S6, 2011	353418
sf4011	Butyric fatty acid, gms, 2011	353418
sf6011	Caproic fatty acid, gms, 2011	353418
sf8011	Caprylic fatty acid, gms, Sacks Sa, 2011	353418
sft11	Total Saturated Fat, gms, Sacks, 2011	353418
sodium	Sodium mg	353418
sphingo	Choline from Sphingomyelin, mg	353418
st	Starch gm	353418
stig	Stigmasterol, Phytosterol, mg	353418
sucr	Sucrose gm	353418
sucral	Sucralose sweetener gm	353418
sugtot	Total Sugars gm	353418
sum_ whgcarb	Sum Carbohydrate From Wholegrain, grams	353418
sumoth_ crb_ njs	Sum of carbohydrate from fruit minus juice sugar, plus carb from vegetable, legume, and lact, grams	353418
sumref_ carb	Sum of carbohydrate from potato, added sugar in foods, and refined grain, foods only, grams	353418
sumrf_ nfr	Sum of added sugar minus fruit carb, plus carb from refined grain, cereals only, grams	353418
t161n711	Palmitelaidic trans fatty acid, gms, Sacks T2, 2011	353418
t18111	Total Trans Oleic fatty acid, gms, Sacks, 20	353418
t181n1211	Petroselocidic trans fatty acid, gms, Sacks T3, 2011	353418
t181n711	Vaccenic trans fatty acid, gms, Sacks T5, 2011	353418
t181n911	Elaidic trans fatty acid, gms, Sacks T4, 2011	353418
t182n611	Linolelaidic trans fatty acid, gms, Sacks T6, 2011	353418
tc182n611	9t,12c-Octadecadienoic fatty acid, gms, Sacks T8, 2011	353418
tfat	Total Fat gm	353418
thr	Threonine gm	353418
totisoflav1	Total Isoflavones, No Bioch or Formo, grams, 2012	353418
totisoflav2	Total Isoflavones, Including Bioch and Formo, grams, 2012	353418
totusanth	TOTAL USDA ANTHOCYANIDINS, 2007	353418
totusflav	TOTAL USDA FLAVONOIDS, 2007	353418
totusflavan3ol	TOTAL USDA FLAVAN-3-OLS, 2007	353418
totusflavanone	TOTAL USDA FLAVANONE, 2007	353418
totusflavone	TOTAL USDA FLAVONES, 2007	353418
totusflavonol	TOTAL USDA FLAVONOLS, 2007	353418
totuspolyflav	TOTAL THEAFLAVIN AND POLYMERS PROANTHOCYANIDINS, USDA, 2007	353418
trn11	Total Trans, gm, Sacks, 2011	353418
trypto	Tryptophan gm	353418
ttrn11	Sum of Believed to be Trans and Total Trans, gm, Sacks, 2011	353418
tyro	Tyrosine gm	353418
uapig	Apigenin mg, flavone USDA 2007	353418
uaT3	Alpha Tocotrienol mg, USDA 2001	353418
ubT3	Beta Tocotrienol mg, USDA 2001	353418
ubtoco	Beta Tocopherol mg, USDA 2001	353418
ucat	Catechin mg, flavan-3-ol USDA 2007	353418
ucyn	Cyanidin mg, anthocyanidin USDA 2007	353418
udlp	Delphinidin mg, anthocyanidin USDA 2007	353418
udT3	Delta Tocotrienol mg, USDA 2001	353418
udtoco	Delta Tocopherol mg, USDA 2001	353418

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Supplementary Table 1: Continued

Variable	Label	N
uec	Epicatechin mg, flavan-3-ol USDA 2007	353418
uecg	Epicatechin 3-gallate mg, flavan-3-ol USDA 2007	353418
uegc	Epigallocatechin mg, flavan-3-ol USDA 2007	353418
uegcg	Epigallocatechin 3-gallate mg flavan-3-ol USDA 2007	353418
uerid	Eriodictyol mg, flavonone USDA 2007	353418
ugcat	Gallocatechin mg, flavan-3-ol USDA 2007	353418
ugT3	Gamma Tocotrienol mg, USDA 2001	353418
ugtoco	Gamma Tocopherol mg, USDA 2001	353418
uhesp	Hesperetin mg, flavanone USDA 2007	353418
uisor	Isorhamnetin mg, flavonol USDA 2007	353418
ukaem	Kaempferol mg, flavonol USDA 2007	353418
ulutn	Luteolin mg, flavone USDA 2007	353418
umlv	Malvidin mg, anthocyanidin USDA 2007	353418
umyri	Myricetin mg, flavonol USDA 2007	353418
unarg	Naringenin mg, flavanone USDA 2007	353418
upel	Pelargonidin mg, anthocyanidin USDA 2007	353418
upeo	Peonidin mg, anthocyanidin USDA 2007	353418
upet	Petunidin mg, anthocyanidin USDA 2007	353418
uquer	Quercetin mg, flavonol USDA 2007	353418
uquer_ wo	Quercetin w/out suppl mg, flavonol USDA 2007	353418
usflavnopro	USDA FLAVONOIDS NO PROANTHOCYANIDINS	353418
utf	Theaflavin mg, flavan-3-ol USDA 2007	353418
utf3g	Theaflavin 3'-gallate mg, flavan-3-ol USDA 2007	353418
utfdg	Theaflavin 3,3' digallate mg, flavan-3-ol USDA 2007	353418
utfg	Theaflavin 3-gallate mg, flavan-3-ol USDA 2007	353418
utrg	Thearubigins mg, flavan-3-ol USDA 2007	353418
uttoco	mg Total Tocopherols without supplement USDA 2008	353418
val	Valine gm	353418
vegaf	AOAC fiber gms, 1993, from vegetable	353418
vegcb_ npl	Vegetable Carbohydrate minus potato and legume carbohydrate	353418
vfat	Vegetable Fat gm	353418
vitc	Vitamin C mg	353418
vitc_ wo	Vitamin C w/out suppl mg	353418
vitd	Vitamin D IU	353418
vitd_ wo	Vitamin D IU without supplement	353418
vitk	Phylloquinone Vitamin K1, mcg	353418
vitk_ wo	Phylloquinone Vitamin K1, w/out suppl mcg	353418
vprot	Vegetable Protein gm	353418
whgrn	Whole Grain Amount Grams	353418
zn	Zinc mg	353418
zn_ wo	Zinc w/out suppl mg	353418