Part 2: Theoretical Intakes of Modern-Day Paleo Diets

Comparison With Dietary Reference Intakes and MyPlate Meal Plans

Micaela C. Karlsen, PhD, MSPH
Kara A. Livingston, MPH
Dasha Agoulnik, MS, RDN
Akari Miki, BSc
Alice H. Lichtenstein, DSc
Cheryl H. Gilhooly, PhD, MPH, RD
Sara C. Folta, PhD
Christina D. Economos, PhD, MS
Nicola M. McKeown, PhD

Background: The Paleo diet is a popular dietary pattern based on interpretation of evolutionary diets.
Objective: The aim of this study was to assess the relative dietary quality of theoretical, modern-day Paleo meal plans, in comparison with national nutrition guidance.
Methods: This analysis used data from the Adhering to Dietary Approaches for Personal Taste survey. Survey respondents who self-identified as following a Paleo diet (N = 925) reported their top sources of food and nutrition information, and a random sample (n = 200) were selected for analysis. Five days of theoretical meal plans identified from each of the top 6 sources cited by Paleo participants (for a total of 30 days of meal plans) as well as 21 days of theoretical MyPlate meal plans, were analyzed using the Nutrition Data System for Research. Food and nutrient levels of Paleo meal plans were compared with the Dietary References Intakes and MyPlate meal plans.

Micaela C. Karlsen, PhD, MSPH, was a graduate student at the Friedman School of Nutrition Science and Policy, Tufts University, Boston, Massachusetts, at the time of this research. Dr Karlsen currently serves as Sr Director of Research for the American College of Lifestyle Medicine. She holds a PhD in Nutritional Epidemiology from the Tufts Friedman School of Nutrition Science and Policy and a master's degree in human nutrition from the Johns Hopkins School of Public Health.

Kara A. Livingston, MPH, is senior project and data manager for the Nutrition Epidemiology Program at the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University, Boston, Massachusetts.

Dasha Agoulnik, MS, RDN, is a nutrition consultant and owner of a private practice, CorePerform. She received her MS degree in Nutritional Epidemiology from the Friedman School of Nutrition Science and Policy at Tufts University in 2019, Boston, Massachusetts.

AkariMiki, BSc, was an undergraduate student in Biochemistry at Tufts University and she was interning at the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University, Boston, Massachusetts, at the time of this research.

Alice H. Lichtenstein, DSc, is the Stanley N. Gershoff Professor of Nutrition Science and Policy at the Friedman School, and Director of the Cardiovascular Nutrition Laboratory and Senior Scientist at the Jean Mayer USDA Human Nutrition Research Center on Aging, at Tufts University. Dr Lichtenstein's is internationally recognized for her research on assessing the interplay between diet, nutritional biomarkers and cardiovascular disease risk.

Cheryl H. Gilhooly, PhD, MPH, RD, is the manager of the Dietary Assessment Unit (DAU) and Metabolic Research Unit (MRU) at the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University. She advises on dietary assessment methodology and interpretation of dietary intake data and her research interests include dietary intake and behavior, dietary intake methodology, obesity prevention and weight management.

Sara C. Folta, PhD, is dean for Diversity and Inclusion and associate professor at the Friedman School of Nutrition Science and Policy at Tufts. Dr Folta's research interests focus on the utilization of community-based strategies for improving dietary intake, physical activity, and body composition. She has particular expertise in behavioral psychology, communications, and qualitative methods.

Christina D. Economos, PhD, MS, is a Professor and Division Chair of Nutrition Interventions, Communication, and Behavior Change at the Friedman School of Nutrition Science and Policy. Dr Economos' research efforts have addressed the interaction among nutrition, exercise, body composition, bone health, and the built environment, toward preventing osteoporosis and obesity, starting in early childhood.

Nicola M. McKeown, PhD, is Scientist I in the Nutritional Epidemiology Program at the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University and an associate professor at the Friedman School of Nutrition Science and Policy at Tufts University. She is primary investigator of the Adhering to Dietary Approaches for Personal Taste (ADAPT) Study, a web-based study to capture data on diet and behavior among followers of popular diets.

Funding information: supported by US Department of Agriculture (USDA) ARS agreement no. 2012-38420-30200 (M.C.K., C.D.E.) and USDA Cooperative Agreements 58-8050-9-004 and 58-8050-9-003 (N.M.M., A.H.L.) a pilot grant from Tufts Collaborates (N.M.M).

Dr McKeown has received an unrestricted gift for research from Proctor & Gamble Company. She has received speaker honorarium from General Mills and Cereal Partners Worldwide.

Correspondence: Nicola M. McKeown, PhD, Jean Mayer US Department of Agriculture Human Nutrition Research Center on Aging at Tufts University, 711 Washington Street, Boston MA 02111 (nicola.mckeown@tufts.edu).

DOI: 10.1097/NT.0000000000000490

Results: Paleo meal plans contain no identifiable refined grains or added sugars and have higher fruit and vegetable intakes than MyPlate meal plans. However, Paleo meal plans exceeded recommended levels of saturated fat (19% kcal/day), resulting in low unsaturated-saturated fat ratios, and did not meet the Dietary References Intakes for total carbohydrate, fiber, calcium, and potassium.
Conclusion: Although certain aspects of promoted Paleo meal plans offer improvements over typical American intakes, Paleo diets should be approached with caution, particularly because of the potential for increased cardiovascular risk owing to low unsaturated/saturated fat ratios. Future research should compare actual intakes with theoretical targets.
Nutr Today. 2021;56(4):158–168

Public health recommendations continue to emphasize the importance of overall dietary patterns that support nutrition adequacy and reduce the risk of chronic disease.[1] Between 2015 and 2018, approximately 17% of adults reported following a special diet, ranging from weight loss diets to low-carbohydrate diets or diets for diabetes management.[2] The popularity of fad diets changes as new diets[3] emerge in the public domain. Currently, a small segment (<4%) of the population reports following a low-carbohydrate (Paleo-type diet) or Paleo diet.[2] The Paleo diet focuses on naturally raised meat and fish, vegetables, and fruits while avoiding dairy products and grains.[4] It also aims to minimize or exclude processed foods but typically does not avoid processed fat and oils.[4] Although interest and research on the Paleo diet has increased in the past decade,[5] few well-controlled randomized trials exist, and the effects of long-term adherence to a Paleo dietary pattern are unknown.[4] Our corresponding work published in the last edition[6] details the history of the Paleo diet, noting the inconsistent definitions of the modern-day Paleo diet and the large variation in macronutrient and dietary fiber intake across studies. Thus, evaluating the potential health effects of the diet or making recommendations regarding the healthfulness of this diet is challenging.[7] Since the first contemporary Paleo diet book was published in 2002 by Dr Cordain, *The Paleo Diet: Lose Weight and Get Healthy by Eating the Food You Were Designed to Eat*,[8] a variety of recipes and meal planning tools have become widely accessible on the web for individuals who choose to follow a modern-day Paleo dietary pattern.[9–11] However, it is unknown how these promoted recipes and meal plans translate into usual nutrient intakes or the nutritional adequacy of adherence to a Paleo dietary pattern. To our knowledge, the nutrient composition of recipes and meal plans from popular Paleo books or online resources and the resulting theoretical nutrient intakes have not been assessed.

Our objective was to assess the relative dietary quality of theoretical, modern-day Paleo meal plans in comparison to US nutrition guidance. In this analysis, we compared food and nutrient levels of theoretical intakes to the Dietary Reference Intakes (DRIs) and MyPlate meal plans based on 30 days of suggested meal plan data.

METHODS

Sources of Theoretical Paleo Diet Information

Respondents in the Adhering to Dietary Approaches for Personal Taste Feasibility Survey reported their sources of diet and nutrition information for their respective diets.[12] The Adhering to Dietary Approaches for Personal Taste Feasibility Survey was a brief online survey targeted at self-identified popular diet followers. The survey was conducted over 8 weeks, from July 14 to September 14, 2015. A total of 13 787 participants consented to enroll. After identifying their usual diet from a multiple-choice question, a follow-up, free-text question was presented that asked participants to report their sources of cooking and nutrition information (books and websites) for their diet, as previously described.[13] Study participants were able to report 1 or more sources. In response to this question, 925 participants (16%) who had identified as following a Paleo diet provided information on sources of dietary information. We restricted our analysis to a random sample of 200 self-identified followers of the Paleo diet.

Creation of Theoretical Meal Plans

Food and nutrient intakes for the theoretical Paleo meals were assessed using the following steps. First, free-text survey responses were coded for unique responses of recipes and nutrition information (ie, books or websites authored by different Paleo proponents or organizations) among self-identified followers of the Paleo diet. Most responses included at least 2, but often more, unique sources. Next, representative meal plans were drawn from the top 6 diet information sources (top 3 websites and top 3 books most consistently cited) that were reported by at least 5% of the selected respondents. Lastly, a 5-day meal plan from each of the 6 sources was identified or created using provided recipes and instructions by 1 researcher (M.C.K.), for a total of 30 representative days. Our research group previously applied the same methodological approach for developing theoretical vegan/whole-food plant-based diets and discussed the strengths of this approach in an earlier publication.[13] The methodological considerations also apply to deriving the theoretical Paleo estimates here. Meal plan selections and quantities were checked by a second researcher.

For comparisons, US Department of Agriculture–compliant meal plans were generated from 21 days of MyPlate meal plans, which have been constructed to fully meet Dietary Guideline recommendations for food and nutrient composition (*Sample Two-Week Menus* and *Sample Menus for a 2000 Calorie Food Pattern*).[14,15] MyPlate and Paleo meal plan data were collected and analyzed by a single researcher

(M.C.K.) using the Nutrition Data System for Research (NDSR) software, version 2016, developed by the Nutrition Coordinating Center, University of Minnesota, Minneapolis.[16] Meal plans for the Paleo diet were also standardized to 2000 kcal/d to match MyPlate meal plans.

Recipes were entered exactly as written to the greatest extent possible (M.C.K.). Ingredients in the NDSR database were selected to maximize consistency with recipe instructions from the books and websites. To select generic ingredient choices and standard portion sizes when instructions were unclear, NDSR data entry rules were used. For example, when entering meats, the nutrient database offers the option to select "unknown" with respect to whether visible fat is eaten, and this option was utilized for many recipes lacking detailed information. With respect to assigning nutrient values to unknowns, the database defaults to values for the form of the food that is believed to be most commonly consumed in the United States. Contents of meal plans were entered in full and divided by the number of servings to produce single-serving portions. Neither Paleo nor MyPlate meal plans included alcohol. The accuracy of recipes and meal plans entered into NDSR was confirmed by a second reviewer (A.M.).

Dietary supplements were included in the meal plans if they were suggested by at least 2 of the meal plan sources. Applying these criteria, we included magnesium and vitamin D from those sources that recommended them. Three sources recommended magnesium supplements (400 mg/d, 400–600 mg/d, and unspecified generic dose per day, respectively), and 2 sources recommended vitamin D (5000 and 2000–5000 IU/d, respectively). Supplement data were entered using the 24-hour supplement intake module in NDSR. Nutrient levels were calculated as total (food plus supplements) and diet only.

Food and nutrient data from the meal plans were exported from NDSR for descriptive analysis into SAS 9.4 (SAS Institute, Cary, North Carolina). Before calculating the mean theoretical food and nutrient levels, the information from the sources were weighted, using an approach previously described.[12] Although this weighted approach was applied to create a more representative estimate of food and nutrient intake, unweighted estimates were similar; hence, the unweighted data (e.g., the average of 30 days) are not presented. The Healthy Eating Index 2015 (HEI-2015),[17] an index of overall dietary quality that measures adherence to the 2015 Dietary Guidelines for Americans (DGA),[1] was used to assess dietary quality.

We compared the mean nutrient and food group levels from theoretical Paleo meal plans with those from MyPlate, as previously described.[13] In addition, the nutrient content of theoretical Paleo meal plans was compared with the relevant DRIs from the National Academy of Medicine[18] for nonpregnant female and male adults (ages 19–70 years) for those nutrients labeled as public health concern by the 2020 US Dietary Guidelines (calcium, potassium, dietary fiber, and vitamin D), as well as other nutrients frequently underconsumed or overconsumed.[19] When there were differences in recommended intakes across ages 19 to 70 years, the highest value for the DRI was selected for comparison purposes. To determine the nutritional profile of Paleo meal plans, we applied several criteria[20] to estimated theoretical nutrient levels as shown in Figures 3 to 5: (1) Estimated Average Requirement (EAR) and Recommended Dietary Allowance (RDA) for vitamin A (retinol activity equivalents, μg), vitamin D (calciferol, μg), vitamin E (mg), folate (μg), vitamin C (mg), calcium (mg), magnesium (mg), and iron (mg); (2) Adequate Intake for potassium (mg) and fiber (g); (3) Chronic Disease Risk Reduction Intake (CDRR) for sodium (g); and (4) recommendations from the 2020 US DGA to limit saturated fat and added sugar to less than 10% of calories. The percentage differences for Paleo meal plans as compared with

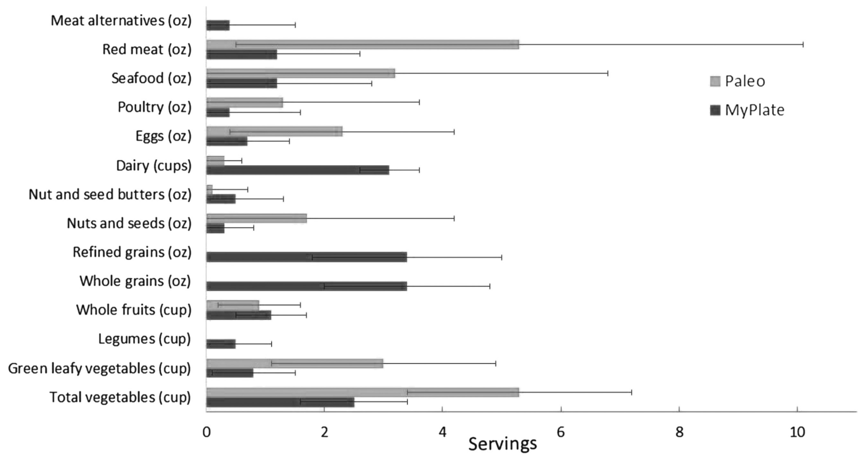

FIGURE 1. Comparison of daily food group (cup and ounce equivalent) content between theoretical the Paleo and MyPlate plans, mean (SD). Solid bars represent means, and black lines represent 1 SD; intakes standardized to 2000 kcal.

TABLE 1 Estimated Nutrient Levels From MyPlate and Paleo Meal Plans

	MyPlate		Paleo	
	Mean	SD	Mean	SD
Energy, kcal[a]	2000	–	2000	–
Fat, g	64	11	134	20
Total fat, % energy	29	5	60	9
Saturated fat, % energy	8	2	19	7
MUFA, % energy	11	2	26	7
PUFA, % energy	8	2	10	6
UFA-SFA[b] ratio	3	1	2	1
CHO, g	272	29	91	31
CHO, % energy	54	6	18	6
Added sugars, g	26	15	3	4
Added sugars, % energy	6	3	1	1
Protein, g	96	11	119	33
Protein, % energy	19	2	24	7
Animal protein, % energy	12	2	20	7
Plant protein, % energy	7	1	4	1
Fiber, g	28	5	25	8
Micronutrients				
Dietary vitamin A activity (RAE), μg	1344	70	1481	11
Total vitamin D[c] (calciferol), μg	10	5	56	55
Dietary vitamin D (calciferol), μg	10	5	12	11
Dietary vitamin E (α-tocopherol), mg	15	5	27	8
Dietary vitamin B_{12}, μg	6	3	7	3
Dietary folate equivalents, μg	458	13	489	15
Dietary vitamin C, mg	134	645	225	91
Dietary calcium, mg	1434	24	562	18
Total magnesium,[c] mg	419	597	539	21
Dietary magnesium, mg	419	597	380	10
Dietary potassium, mg	4071	58	4027	90
Dietary iron, mg	15	34	16	5
Dietary sodium, mg	2301	66	2763	15

Abbreviations: CHO, carbohydrates; MUFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid; RAE, retinol activity equivalents; UFA, unsaturated fatty acid; SFA, saturated fatty acid.

[a]Standardized to 2000 kcal.

[b]Unsaturated-saturated fat ratio.

[c]Includes nutrients from both food and recommended supplements for the Paleo diet only.

MyPlate meal plans or DRIs were calculated as (Paleo value/reference value) × 100 − 100.

RESULTS

A comparison of food groups between the theoretical Paleo and MyPlate plans is presented in Figure 1. MyPlate meal plans contain a variety of servings of all food groups. Although the Paleo diet as popularly promoted typically eliminates dairy, one of the major sources identified did include some dairy ingredients in the recipes, thus explaining the 0.3 cup mean intake of dairy. There are notable differences in food groups in comparison to MyPlate meal plans. Theoretical Paleo meal plans provide more total vegetables (5.3 vs 2.5 cup equivalent [eq] of Paleo vs MyPlate, respectively), green leafy vegetables (3.0 vs 0.8 cup eq), red meat (5.3 vs 1.2 oz eq), eggs (2.3 vs 0.7 oz eq), and seafood (3.2 vs 1.2 oz eq), while also supplying fewer legumes (0 vs 0.5 cup eq), whole grains (0 vs 3.4 oz eq), and refined grains (0 vs 3.4 oz eq) (Figure 1). MyPlate recipes specified lean cuts of meat, whereas a number of the Paleo recipes did not specify whether the cut of meat was lean. Variation in individual sources of meal plans produced overlapping 95% confidence intervals for all food groups except dairy, whole grains, refined grains, and legumes.

The mean nutrient contents of MyPlate and Paleo meal plans are presented in Table 1. With respect to macronutrients, mean percentage energy from carbohydrate, protein, and fat was 54:19:29 versus 18:24:60 for MyPlate and Paleo, respectively. Total grams of carbohydrate for Paleo meal plans were 91, which is below the RDA of 130.[20] Percentage energy of added sugar was 6 for MyPlate and 1 for Paleo. Total dietary fiber was 25 g for Paleo compared with 28 g for My Plate (Table 1). Percentage energy from total protein, plant protein, and animal protein was 19%, 7%,

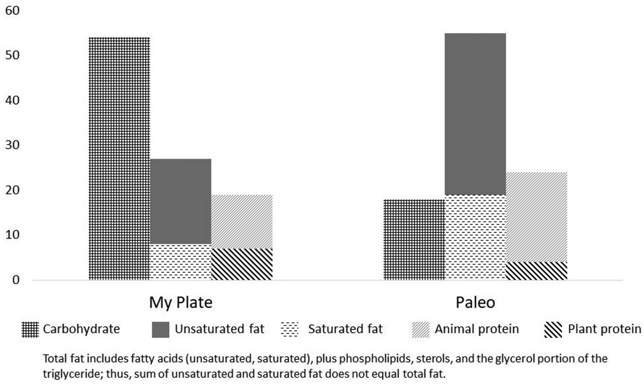

FIGURE 2. Macronutrient intake (% energy) of theoretical Paleo versus MyPlate diet plans.

and 12% kcal for MyPlate and 24%, 4%, and 20% for Paleo, respectively (Figure 2 Table 1). Saturated fat content was 8% for MyPlate and 19% for Paleo (Figure 2 Table 1). Percentage of saturated and polyunsaturated fats in the Paleo diet contributed 19% and 10%, respectively. The ratio of unsaturated to saturated fat was 3:1 for MyPlate compared with 2:1 for theoretical Paleo diets. The HEI-2015 score for estimated theoretical Paleo diets was 72 of 100 available total points, which represents the points that align with the MyPlate plans (MyPlate plans were designed to achieve a score of 100). Median food and nutrient data was similar to mean data for both MyPlate and Paleo meal plans (Table 2).

Comparisons of Paleo meal plans with DRIs are shown in Figure 3 (RDAs and EARs for men), Figure 4 (RDAs and EARs for women), and Figure 5 (AIs and CDRRs). Estimated nutrient levels, including vitamin D and magnesium supplements, from the theoretical Paleo meal plans were as follows: meal plans meet or exceed the RDAs for vitamin A, vitamin D, vitamin E, folate, vitamin C, magnesium, and iron for men, but not for iron among women ages 19 to 50 years or calcium for men or women ages 51 to 70 years. Paleo meal plans do not meet the EARs for calcium or the AIs for potassium or fiber. Estimated levels of sodium are higher than the CDRR in both men and women ages 19 to 70 years. Levels of saturated fat exceed the recommendation, whereas added sugar levels fall within the recommendation (Figure 5).

DISCUSSION

The purpose of this analysis was to estimate the theoretical food and nutrient composition of common Paleo recipes and meal plans and to compare a theoretical Paleo diet with current recommendations. Although there is broad variation and a wide variety of definitions of common Paleo diets,[4] we applied a unique approach to construct meal plans from recipes derived from nutrition and cooking sources being used by self-identified Paleo diet followers in a large online survey.

Based on the results of this analysis, Paleo diets have both advantages and drawbacks with respect to dietary quality as compared with US consumption patterns. National dietary intake data place the average American adult at a score of 59 on the HEI-2015,[17] in comparison with the MyPlate target of 100. The HEI score for the theoretical Paleo meal plans was 72. Paleo meal plans also exceed the levels in the MyPlate meal plans for total vegetables, green vegetables, and nuts and seeds. According to data from the National Health and Nutrition Examination Survey

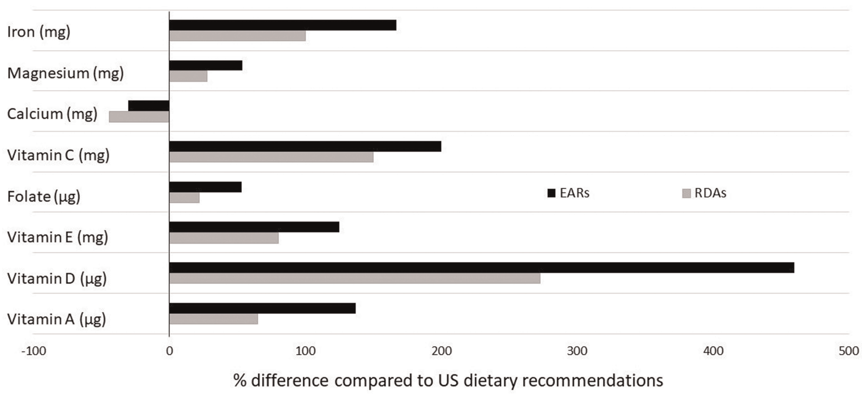

FIGURE 3. Estimated percentage differences in nutrient levels for the Paleo diet compared with Recommended Dietary Allowances (RDAs) and Estimated Average Requirements (EARs) for men. Recommendations used include RDAs for iron (8 mg), magnesium (420 mg), calcium (1000 mg), vitamin C (90 mg), folate (400 µg), vitamin E (15 mg), vitamin D (15 µg), and vitamin A (900 µg) and EARs for iron (6 mg), magnesium (350 mg, age, 31–70 years), calcium (800 mg), vitamin C (75 mg), folate (320 µg), vitamin E (12 mg), vitamin D (10 µg), and vitamin A (625 µg). Percentage differences were calculated as (Paleo/recommendation) × 100 − 100. Percentage differences for the Paleo diet compared with RDAs for men were as follows: iron, 100; magnesium, 28; calcium, −44; vitamin C, 150; folate, 22; vitamin E, 80; vitamin D, 273; and vitamin A, 65. Percentage differences for the Paleo diet compared with EARs for men were as follows: iron, 167; magnesium, 54; calcium, −30; vitamin C, 200; folate, 53; vitamin E, 275; vitamin D, 460; vitamin A, 137. Nutrients from both food and recommended supplements are included.

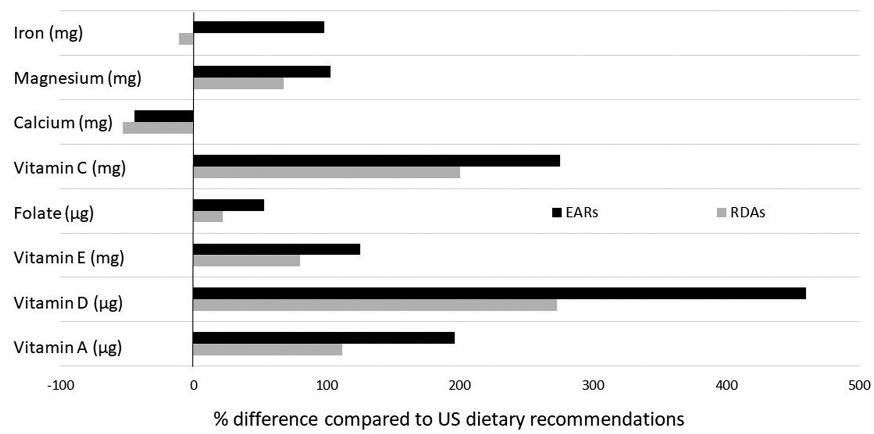

FIGURE 4. Estimated percentage differences in nutrient levels for the Paleo diet compared with Recommended Dietary Allowances (RDAs) and Estimated Average Requirements (EARs) for women. Recommendations used include RDAs for iron (18 mg, women 19–50), magnesium (320 mg, age 31–70 years), calcium (1200 mg, women 51–70), vitamin C (75 mg), folate (400 µg), vitamin E (15 mg), vitamin D (15 µg), and vitamin A (700 µg) and EARs for folate (320 µg), iron (8 mg, women 19–50), magnesium (265 mg, women 31–70), calcium (1000 mg, women 51–70), vitamin C (60 mg), folate (320 µg), vitamin E (12 mg), vitamin D (10 µg), and vitamin A (500 µg women). Percentage differences were calculated as (Paleo/recommendation) × 100 − 100. Percentage differences for the Paleo diet compared with RDAs for women were as follows: iron, −11; magnesium, 68; calcium, −53; vitamin C, 200; folate, 22; vitamin E, 80; vitamin D, 273; vitamin A, 112. 4. Percentage differences for the Paleo diet compared with EARs for women were as follows: iron, 98; magnesium, 103; calcium, −44; vitamin C, 275; folate, 53; vitamin E, 125; vitamin D, 460; and vitamin A, 196. Nutrients from both food and recommended supplements are included.

2009–2010 survey, roughly 14% of total energy consumed in the US is from added sugars,[21] and only 30% of calories comes from unprocessed or minimally processed foods including meat or dairy, grains, legumes, and fruits and vegetables.[22] The theoretical Paleo plans are composed almost entirely of unrefined foods and thus achieve levels of added sugar well below the Dietary Guidelines threshold of 10% for total energy[23] and American Heart Association thresholds of 100 kcal/d for women and 150 kcal/d for men.[24] In addition, the micronutrient profile of Paleo meal plans would make it relatively easy to achieve the EARs and RDAs for most nutrients, including vitamins A, C, E, folate and, when including supplements, magnesium and vitamin D, all typically underconsumed nutrients.[19]

Other aspects of the Paleo meal plans are cause for concern in terms of cardiovascular disease risk. The meal plans have a typical "low-carbohydrate" profile, limiting whole grains and legumes and emphasizing meat, which translates into a theoretical estimated 18% of calories from carbohydrate, 60% total fat, and 19% saturated fat, with lower fiber levels. Both carbohydrate and fat levels fall well outside of the acceptable macronutrient distribution range, which is 20% to 35% for fat and 45% to 65% for carbohydrate.[18] The RDA of 130 g of carbohydrate is not met with the Paleo plans containing only 91 g of carbohydrate. The theoretical fiber content is 25 g/2000 kcal, which, although higher than current estimates of fiber intake in the United States, is somewhat under the Adequate Intake of 14 g/1000 kcal.[20,25] This is also relevant for heart health, as greater intakes of both fiber[26] and fiber-rich foods[27] have been associated with lower cardiovascular mortality risk. The theoretical fiber content is, overall, consistent with

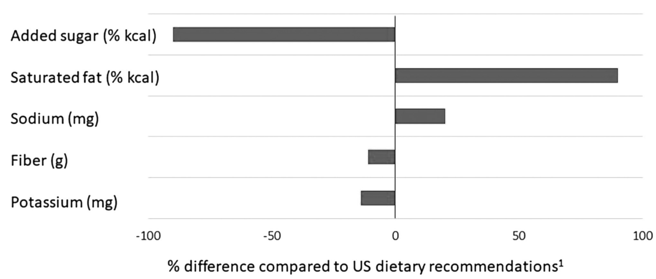

FIGURE 5. Estimated percentage differences in nutrient levels for the Paleo diet compared with US recommendations. Recommendations used include Dietary Guidelines for Americans threshold for added sugar (10% kcal) and saturated fat (10% kcal); Chronic Disease Risk Reduction threshold for sodium (2300 mg); Adequate Intake for fiber (14 g/1000 kcal, men and women); and Adequate Intake for potassium (4700 mg, men and women). Percentage differences were calculated as (Paleo/recommendation) × 100 − 100. Percentage differences for the Paleo diet compared with recommendations were as follows: added sugar, −90%; saturated fat, +90%; sodium, +20%; fiber, −11% for both men and women; and potassium, −14% for both men and women.

TABLE 2 Medians and Interquartile Ranges for Food and Nutrient Intakes

	MyPlate			Paleo		
	Median	Q1	Q3	Median	Q1	Q3
Food group servings, total vegetables, cup	2.5	1.8	3.3	5.3	3.8	6.3
Green leafy vegetables, cup	0.8	0.0	1.2	3.2	1.4	4.7
Legumes, cup	0.4	0.0	0.8	0.0	0.0	0.0
Whole fruits, cup	0.9	0.7	1.5	0.9	0.4	1.2
Whole grains, oz	3.1	2.6	3.8	0.0	0.0	0.0
Refined grains, oz	3.5	2.3	4.4	0.0	0.0	0.0
Nuts and seeds, oz	0.0	0.0	0.3	1.0	0.0	2.6
Nut and seed butters, oz	0.0	0.0	0.9	0.0	0.0	0.0
Dairy, cups	3.1	2.9	3.4	0.2	0.0	0.6
Eggs, oz	0.5	0.0	1.1	2.5	0.6	3.2
Poultry, oz	0.0	0.0	0.0	0.0	0.0	2.4
Seafood, oz	0.0	0.0	2.6	3.4	0.0	5.3
Red meat, oz	0.9	0.0	2.5	3.3	2.3	7.4
Meat alternatives, oz	0.0	0.0	0.0	0.0	0.0	0.0
Nutrients						
Energy, kcal[a]	–	–	–	–	–	–
Fat, g	64	57	70	127	116	153
Total fat, % energy	29	26	31	57	52	69
Saturated fat, % energy	8	6	9	17	14	24
MUFA, % energy	10	10	12	25	21	29
PUFA, % energy	8	6	10	9	7	11
UFA-SFA[b] ratio	2	2	3	2	1	3
CHO, g	272	257	289	97	65	115
CHO, % energy	54	51	58	19	13	23
Added sugars, g	26	15	31	1	0	4
Added sugars, % energy	6	4	8	0	0	1
Protein, g	96	89	102	122	92	137
Protein, % energy	19	18	20	24	18	27
Animal protein, % energy	11	10	13	21	14	23
Plant protein, % energy	7	6	8	4	3	4

(continues)

TABLE 2 Medians and Interquartile Ranges for Food and Nutrient Intakes, Continued	MyPlate			Paleo		
	Median	Q1	Q3	Median	Q1	Q3
Fiber, g	28	26	31	26	21	29
Micronutrients						
Total vitamin A activity (RAE), μg	1216	820	1700	1014	814	2059
Total vitamin D[c] (calciferol), μg	9	7	10	23	5	101
Dietary vitamin D (calciferol), μg	9	7	10	6	4	20
Dietary vitamin E (α-tocopherol), mg	14	12	16	25	21	32
Dietary vitamin B_{12}, μg	6	5	6	7	6	10
Dietary folate equivalents, μg	464	355	512	514	427	588
Dietary vitamin C, mg	114	87	187	214	159	284
Dietary calcium, mg	1428	1277	1613	506	432	698
Total magnesium,[c] mg	395	376	444	537	367	678
Dietary magnesium, mg	395	376	444	369	331	439
Dietary potassium, mg	4056	3610	4374	3878	3585	4692
Dietary iron, mg	14	12	18	15	12	19
Dietary sodium, mg	2205	1874	2852	2196	1654	3532

Abbreviations: MUFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid; UFA, unsaturated fatty acid; SFA, saturated fatty acid.
[a]Standardized to 2000 kcal.
[b]Unsaturated-saturated fat ratio.
[c]Includes nutrients from both food and recommended supplements for Paleo diet only.

previous reported intakes derived from Paleo intervention studies (21 g,[28] 25 g,[29] and 32 g[30]). With such a high proportion of total calories coming from fat, there is limited room to add carbohydrates within an approximately 2000 kcal/d meal plan, and, if strictly adhered to, such intakes could induce ketosis in some individuals.[31] There is some interest in low-carbohydrate and ketogenic diets for weight loss[32] and/or blood glucose control[33] in the short-term. However, there may be a variety of potential health consequences[31,34] associated with long-term adherence to a very-low-carbohydrate diet.[31,35]

Estimates of saturated fat intake are higher than recommended limits from the current Dietary Guidelines for Americans recommendations (<10% kcal/d from saturated fat)[23] and American Heart Association guidelines, which have an even lower threshold for high-risk individuals (5%–6% saturated fat), coupled with a low unsaturated-saturated fatty acid ratio.[36] In terms of food composition, both total meat and red meat intakes in the Paleo meal plans are in excess of accepted guidance to reduce cardiovascular risk.[36]

It is possible that in real-world settings, the intake of saturated fat may be lower than our estimate of 19% of energy. In some intervention studies, participants assigned to a Paleo diet as part of a dietary intervention consumed saturated fat ranging from 12% of energy intake after a 4-week trial,[39] to 11% in a 3-month crossover study (n = 13),[28] and to 6% in a 3-week trial (n = 6).[30] However, although reported saturated fat intakes in these intervention studies are lower than our meal plans' estimates, saturated fat intake in these promoted Paleo meal plans is still higher than current recommendations to promote heart health.[1,24,37]

Drawbacks in terms of micronutrients include inadequate calcium and potassium levels as well as sodium levels in excess of recommendations.[19] Because of the exclusion of dairy, Paleo diets rely on other sources of calcium, including green leafy vegetables and fish with edible bones; however, the meal plans fail to meet the RDAs and EARs for calcium for both men and women. This is consistent with the very low levels of calcium previously reported in intervention trials using the Paleo diet (ranging from approximately 350 mg[28,29] to 400 mg[30]). The EARs for vitamin D were achieved through emphasis on fatty fish, and the RDAs were achieved through inclusion of vitamin D supplements. Lower potassium intake and higher sodium intake have been associated with elevated risk of hypertension, and the sodium-potassium ratio may also play a role.[38–40] Adherent followers of Paleo diets should be advised by their healthcare practitioners that they may be at risk of calcium and potassium deficiencies without supplementation. None of the meal plan sources in our analysis recommended calcium or potassium supplements. This analysis suggests that the Paleo diet, followed closely over the long-term, might lead to problems with bone health, particularly among older Americans who are at greater risk for osteoporotic fractures.[41]

Our analysis had several strengths, which include using 30 days of meal plans; utilizing sources of recipe information cited by free-living Paleo followers; and taking a random sample (n = 200) from among a relatively large total sample (N = 925). However, this methodology of using derived meal plans is also a limitation in that our analysis cannot speak to actual intakes of Paleo followers, and the nutrient composition of Paleo diets in intervention settings and free-living populations may vary from targets estimated here. The validity of the sources of nutrition and cooking information is also limited to those in our self-selected sample (largely White women with Internet access) and who may or may not represent typical Paleo followers. Also, comparisons between MyPlate meal plans and the Paleo meal plans represent theoretical comparisons; it is important to note that MyPlate meal plans were constructed specifically to meet DGA recommendations. Finally, it is possible that theoretical estimates of fat and saturated fat may be overestimated because of the fact that lean meat was not specified in most Paleo recipes.

This work helps to characterize the modern-day Paleo diet followed by free-living individuals and was a first step toward comparing population targets with actual intakes. Assessing the degree of dietary adherence to any diet requires reference data, and as such, these data can serve as a reference point for clinicians or practitioners to estimate patient or client adherence to the prescribed diet. The data generated from these theoretical diets may help health professionals, particularly those who practice nutrition education, to better understand the nutritional benefits (high intake of fruits and vegetables, less added sugar) and shortcomings (higher total and saturated fat, inadequate calcium and potassium) of the Paleo diet.[42–44] It may be more helpful to recognize these specific advantages and incorporate only select components of the diet as opposed to embracing the principles of the Paleo diet in totality, which would include high levels of meat and saturated fat consumption.

CONCLUSION

As Paleo diets are of current interest among the public, there is a need to assess dietary quality and potential health implications of promoted diet guidance. Meal plans derived from popular sources of Paleo recipes offer some improvement over the typical American diet with respect to the consumption of refined grains, added sugars, and fruit and vegetable consumption. However, even with these advantages, popular Paleo diet meal plans result in high saturated fat levels, well above recommendations, which is a concern for cardiovascular risk, and the carbohydrate, fiber, calcium, and potassium levels do not meet DRIs. Overall, adoption of the Paleo diet should be approached with caution. Future research should capture actual intakes and assess adherence by comparing targeted versus actual intakes.

REFERENCES

1. U.S. Department of Health and Human Services and US Department of Agriculture. 2015-2020 Dietary Guidelines for Americans. 8th Edition. December 2015. http://health.gov/dietaryguidelines/2015/guidelines/. Accessed August 6, 2019.
2. Stierman B, Ansai N, Mishra S, Hales C. Special Diets Among Adults: United States, 2015-2018. *NCHS Data Brief*. 2020;(289):1–8.
3. Freire R. Scientific evidence of diets for weight loss: different macronutrient composition, intermittent fasting, and popular diets. *Nutrition*. 2020;69:110549. doi:10.1016/j.nut.2019.07.001.
4. de la O V, Zazpe I, Martínez JA, et al. Scoping review of Paleolithic dietary patterns: a definition proposal. *Nutr Res Rev*. 2021;34(1):78–106. doi:10.1017/S0954422420000153.
5. Basile A, Schwartz D, Stapell HM. Paleo then and now: a five-year follow-up survey of the ancestral health community. *J Evol Health*. 2020;5(1). doi:10.15310/J35147502.
6. Agoulnik D, Lalonde MP, Ellmore GS, McKeown NM. Part 1: the origin and evolution of the paleo diet. *Nutr Today*. 2021;56(3):91–104.
7. Ghaedi E, Mohammadi M, Mohammadi H, et al. Effects of a Paleolithic diet on cardiovascular disease risk factors: a systematic review and meta-analysis of randomized controlled trials. *Adv Nutr*. 2019;10(4):634–646. doi:10.1093/advances/nmz007.
8. Cordain L. *The Paleo Diet: Lose Weight and Get Healthy by Eating the Food You Were Designed to Eat*. Hoboken, NJ: John Wiley & Sons; 2002.
9. Ballantyne S. Meal Plan with Real Plans!. The Paleo Mom. March 25, 2017. https://www.thepaleomom.com/meal-plan-real-plans/. Accessed September 4, 2020.
10. Recipes. The Paleo Diet. https://thepaleodiet.com/recipes. Accessed September 4, 2020.
11. Whole 30 Recipes. The Whole30 Program. https://whole30.com/recipes/. Accessed September 4, 2020.
12. Karlsen MC, Lichtenstein AH, Economos CD, et al. Web-based recruitment and survey methodology to maximize response rates from followers of popular diets: the Adhering to Dietary Approaches for Personal Taste (ADAPT) feasibility survey. *Curr Dev Nutr*. 2018;2(5):nzy012. doi:10.1093/cdn/nzy012.
13. Karlsen MC, Rogers G, Miki A, et al. Theoretical food and nutrient composition of whole-food plant-based and vegan diets compared to current dietary recommendations. *Nutrients*. 2019;11(3):625. doi:10.3390/nu11030625.
14. National Institute on Aging. Sample 2-week menus | ChooseMyPlate. https://www.nia.nih.gov/health/sample-menus-healthy-eating-older-adults. Accessed April 27, 2021.

15. Sample menus for a 2000 calorie food pattern. 2010. http://archive.org/details/CAT31303185. Accessed August 28, 2020.
16. Schakel SF. Maintaining a nutrient database in a changing marketplace: keeping pace with changing food products—a research perspective. *J Food Compos Anal*. 2001;14(3):315–322. doi:10.1006/jfca.2001.0992.
17. US Department of Agriculture, Food and Nutrition Service. Healthy Eating Index (HEI). https://www.fns.usda.gov/resource/healthy-eating-index-hei. Accessed August 28, 2020.
18. Institute of Medicine (US) Subcommittee on Interpretation and Uses of Dietary Reference Intakes; Institute of Medicine (US) Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. *DRI Dietary Reference Intakes: Applications in Dietary Assessment*. Washington, DC: National Academies Press (US); 2000.
19. US Department of Agriculture, Agricultural Research Service, Beltsville Human Nutrition Research Center, Food Surveys Research Group (Beltsville, MD) and U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics (Hyattsville, MD). What We Eat in America, NHANES 2013-2014, individuals 2 years and over (excluding breast-fed children). https://www.ars.usda.gov/ARSUserFiles/80400530/pdf/1314/Table_1_NIN_GEN_13.pdf. Accessed August 28, 2020.
20. Institute of Medicine. *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids*. Washington, DC: The National Academies Press; 2005. https://doi.org/10.17226/10490.
21. Drewnowski A, Rehm CD. Consumption of added sugars among US children and adults by food purchase location and food source. *Am J Clin Nutr*. 2014;100(3):901–907. doi:10.3945/ajcn.114.089458.
22. Martínez Steele E, Baraldi LG, Louzada ML, Moubarac JC, Mozaffarian D, Monteiro CA. Ultra-processed foods and added sugars in the US diet: evidence from a nationally representative cross-sectional study. *BMJ Open*. 2016;6(3):e009892. doi:10.1136/bmjopen-2015-009892.
23. Dietary Guidelines Advisory Committee. *Scientific Report of the 2015 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and the Secretary of Agriculture*. Washington, DC: US Department of Agriculture, Agricultural Research Service; 2015.
24. Johnson RK, Appel LJ, Brands M, et al. Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association. *Circulation*. 2009;120(11):1011–1020. doi:10.1161/CIRCULATIONAHA.109.192627.
25. US Department of Agriculture and U.S. Department of Health and Human Services. Dietary Guidelines for Americans, 2020–2025. 9th Edition. December 2020. Published online December 2020. DietaryGuidelines.gov. Accessed August 6, 2019.
26. Hajishafiee M, Saneei P, Benisi-Kohansal S, Esmaillzadeh A. Cereal fibre intake and risk of mortality from all causes, CVD, cancer and inflammatory diseases: a systematic review and meta-analysis of prospective cohort studies. *Br J Nutr*. 2016;116(2):343–352. doi:10.1017/S0007114516001938.
27. Marventano S, Izquierdo Pulido M, Sánchez-González C, et al. Legume consumption and CVD risk: a systematic review and meta-analysis. *Public Health Nutr*. 2017;20(2):245–254. doi:10.1017/S1368980016002299.
28. Jönsson T, Granfeldt Y, Ahrén B, et al. Beneficial effects of a Paleolithic diet on cardiovascular risk factors in type 2 diabetes: a randomized cross-over pilot study. *Cardiovasc Diabetol*. 2009;8(1):35. doi:10.1186/1475-2840-8-35.
29. Genoni A, Lyons-Wall P, Lo J, Devine A. Cardiovascular, metabolic effects and dietary composition of ad-libitum Paleolithic vs. Australian guide to healthy eating diets: a 4-week randomised trial. *Nutrients*. 2016;8(5):314. doi:10.3390/nu8050314.
30. Osterdahl M, Kocturk T, Koochek A, Wändell PE. Effects of a short-term intervention with a Paleolithic diet in healthy volunteers. *Eur J Clin Nutr*. 2008;62(5):682–685. doi:10.1038/sj.ejcn.1602790.
31. Brouns F. Overweight and diabetes prevention: is a low-carbohydrate-high-fat diet recommendable? *Eur J Nutr*. 2018;57(4):1301–1312. doi:10.1007/s00394-018-1636-y.
32. Bueno NB, de Melo IS, de Oliveira SL, da Rocha Ataide T. Very-low-carbohydrate ketogenic diet v. low-fat diet for long-term weight loss: a meta-analysis of randomised controlled trials. *Br J Nutr*. 2013;110(7):1178–1187. doi:10.1017/S0007114513000548.
33. Westman EC, Tondt J, Maguire E, Yancy WS. Implementing a low-carbohydrate, ketogenic diet to manage type 2 diabetes mellitus. *Expert Rev Endocrinol Metab*. 2018;13(5):263–272. doi:10.1080/17446651.2018.1523713.
34. Johnston CS, Tjonn SL, Swan PD, White A, Hutchins H, Sears B. Ketogenic low-carbohydrate diets have no metabolic advantage over nonketogenic low-carbohydrate diets. *Am J Clin Nutr*. 2006;83(5):1055–1061. doi:10.1093/ajcn/83.5.1055.
35. Joshi S, Ostfeld RJ, McMacken M. The ketogenic diet for obesity and diabetes-enthusiasm outpaces evidence. *JAMA Intern Med*. 2019;179(9):1163–1164. doi:10.1001/jamainternmed.2019.2633.
36. Sacks FM, Lichtenstein AH, Wu JHY, et al. Dietary fats and cardiovascular disease: a presidential advisory from the American Heart Association. *Circulation*. 2017;136(3):e1–e23. doi:10.1161/CIR.0000000000000510.
37. Lee E, Choi J, Ahn A, Oh E, Kweon H, Cho D. Acceptable macronutrient distribution ranges and hypertension. *Clin Exp Hypertens*. 2015;37(6):463–467. doi:10.3109/10641963.2015. 1013116.
38. Yang Q, Liu T, Kuklina EV, et al. Sodium and potassium intake and mortality among US adults: prospective data from the Third National Health and Nutrition Examination Survey. *Arch Intern Med*. 2011;171(13):1183–1191. doi:10.1001/archinternmed.2011.257.
39. Perez V, Chang ET. Sodium-to-potassium ratio and blood pressure, hypertension, and related factors. *Adv Nutr*. 2014;5(6):712–741. doi:10.3945/an.114.006783.
40. Zhang Z, Cogswell ME, Gillespie C, et al. Association between usual sodium and potassium intake and blood pressure and hypertension among U.S. adults: NHANES 2005–2010. *PLoS One*. 2013;8(10):e75289. doi:10.1371/journal.pone.0075289.
41. IOM (Institute of Medicine). *Dietary Reference Intakes for Calcium and Vitamin D*. Washington, DC: The National Academies Press; 2011.https://www.ncbi.nlm.nih.gov/books/NBK56070/pdf/Bookshelf_NBK56070.pdf. Accessed August 2, 2020.
42. Williams RA, Roe LS, Rolls BJ. Comparison of three methods to reduce energy density. Effects on daily energy intake. *Appetite*. 2013;66:75–83. doi:10.1016/j.appet.2013.03.004.
43. Williams RA, Roe LS, Rolls BJ. Assessment of satiety depends on the energy density and portion size of the test meal. *Obesity (Silver Spring)*. 2014;22(2):318–324. doi:10.1002/oby.20589.
44. Rolls BJ. Dietary energy density: applying behavioural science to weight management. *Nutr Bull*. 2017;42(3):246–253. doi:10.1111/nbu.12280.

For more than 78 additional continuing education articles related to Nutrition topics, go to NursingCenter.com/CE.

Lippincott® NursingCenter®

NCPD Nursing Continuing Professional Development

CPE

TEST INSTRUCTIONS

- Read the article. The test for this nursing continuing professional development (NCPD) activity is to be taken online at **www.nursingcenter.com/CE**. Tests can no longer be mailed or faxed.
- You'll need to create an account (it's free!) and log in to access My Planner before taking online tests. Your planner will keep track of all your Lippincott Professional Development online NCPD activities for you.
- There's only one correct answer for each question. A passing score for this test is 7 correct answers. If you pass, you can print your certificate of earned contact hours and access the answer key. If you fail, you have the option of taking the test again at no additional cost.
- For questions, contact Lippincott Professional Development: 1-800-787-8985.
- Registration deadline is June 2, 2023

CONTINUING EDUCATION INFORMATION FOR REGISTERED DIETICIANS AND DIETETIC TECHNICIANS, REGISTERED:

The test for this activity for dietetic professionals is located online at http://alliedhealth.ceconnection.com. Lippincott Professional Development (LPD) is a Continuing Professional Education (CPE) Accredited Provider with the Commission on Dietetic Registration (CDR), provider number LI001. Registered dietitians (RDs) will receive 1.5 continuing professional education units (CPEUs) for successful completion of this program/material, CPE Level 2. Dietetics practitioners may submit evaluations of the quality of programs/materials on the CDR website: www.cdrnet.org. LPD is approved as a provider of continuing education for the Florida Council for Dietetics and Nutrition, CE Broker # 50-1223.

Commission on Dietetic Registration

Accredited Provider

Continuing Professional Education

PROVIDER ACCREDITATION

Lippincott Professional Development will award 2.0 contact hours for this nursing continuing professional development activity.

Lippincott Professional Development is accredited as a provider of nursing continuing professional development by the American Nurses Credentialing Center's Commission on Accreditation.

This activity is also provider approved by the California Board of Registered Nursing, Provider Number CEP 11749 for 2.0 contact hours. Lippincott Professional Development is also an approved provider of continuing nursing education by the District of Columbia, Georgia, and Florida, CE Broker #50-1223. Your certificate is valid in all states.

Payment: The registration fee for this test is $21.95.

Disclosure Statement: The author and planners have disclosed no potential conflicts of interest, financial or otherwise.