

Nutrition in health and disease

The Effect of Including 1 Avocado Daily in a Habitual Diet on the Glycemic Index and Glycemic Load in Free-Living Adults with Overweight/Obesity



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ABSTRACT

Background: Few studies have explored the effect of a single-food intervention on the dietary glycemic index (GI) and glycemic load (GL) within the context of a habitual diet. Avocados are low in carbohydrates but rich in monounsaturated fatty acids, fiber, and other bioactive compounds. This raises the question of whether eating 1 avocado a day could lower the GI and GL of the diet, potentially reducing cardiometabolic risk.

Objectives: This study aimed to assess whether adding 1 large avocado (168 g) daily for 6 mo to the habitual diet of adults with abdominal obesity reduces dietary GI and/or GL.

Methods: This secondary analysis used data from the Habitual Diet and Avocado Trial, a multicenter, randomized, parallel-arm study involving 1008 adults with elevated waist circumference. Participants were randomly assigned to either an avocado-supplemented group, instructed to consume 1 large avocado daily with their usual diet, or a control group who maintained their habitual diet and avoided avocados. Dietary intake was assessed via 3 unannounced 24-h dietary recalls over the 6-mo period, from which dietary GI and GL were calculated using Nutrition Data System for Research software. Linear regression models adjusted for age, sex, BMI, energy intake, race, ethnicity, education level, and study site were used to evaluate between-group differences.

Results: Among 961 participants with complete data (73% females, mean age 50.5 y), the avocado-supplemented group showed a reduction in dietary GL by 13.7 points (95% confidence interval: 17.0, 10.4; $P < 0.001$) compared with the control. Food groups contributed similar amounts to the overall GL, except for avocado.

Conclusions: Daily consumption of 1 avocado within the habitual diet significantly reduced GL by almost 14 points, without requiring significant dietary changes. This suggests that incorporating a single nutrient-dense food like avocado can effectively improve the GL simply and sustainably.

This trial is registered at clinicaltrials.gov as NCT03528031.

Keywords: avocado, glycemic index, glycemic load, cardiometabolic disease, abdominal obesity, elevated waist circumference

Abbreviations: CVD, cardiovascular disease; EVOO, extra-virgin olive oil; GI, glycemic index; GL, glycemic load; HAT, Habitual Diet and Avocado Trial; HEI, Healthy Eating Index; IRB, institutional review board.

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Introduction

The prevalence of cardiometabolic diseases, including type 2 diabetes, cardiovascular disease (CVD), and obesity, has reached alarming levels worldwide and presents a significant public health challenge [1–4]. Although genetics and environmental factors play a role [5,6], dietary patterns are modifiable determinants of cardiometabolic disease risk [7,8]. Glycemic index (GI) and glycemic load (GL) are important metrics for assessing the impact of carbohydrate-containing foods on postprandial glycemic response. GI measures the rise of glucose concentrations after consuming a specific food, compared with the same quantity of a reference food—glucose or bread [9]. GL considers both the quality (GI) and the quantity of carbohydrates [10], thus providing a more comprehensive assessment of a food's impact on glycemic response.

GI and GL may be important dietary targets for improving health. There is some evidence that diets lower in GI and GL may play a role in both the prevention and treatment of type 2 diabetes [11–15], CVD [14,16], lowering the risk of some cancers [14,17], reducing hepatic fat mass [18,19], and is associated with a reduction in all-cause mortality [14]. Few studies have assessed the effect of dietary patterns, macronutrients, or individual foods on GI, GL, or glycemic response. In older adults at risk for CVD, the Mediterranean diet supplemented with extra-virgin olive oil (EVOO) or nuts significantly lowered dietary GI and GL compared with a low-fat diet [20]. Others have shown that the inclusion of dietary fat in a meal reduces glycemic response by slowing gastric emptying [21,22]. For example, adding peanut butter to a high-glycemic meal lowered the glycemic response [23], and adding EVOO reduced the glycemic response in individuals with type 1 diabetes [24]. Fiber plays a role in lowering GI and GL of the diet, with soluble fiber decreasing postprandial glycemia and insoluble fiber lowering carbohydrate availability. Both exert their effects by modulating the gut microbiome and insulin resistance [25,26].

Overall, studies indicate that a single-food intervention can potentially alter the glycemic response to a meal. However, few studies have explored the effect of a single-food intervention on the overall dietary GI and GL, particularly in the context of a Western diet. Avocados are a widely consumed plant food appreciated for their distinctive flavor, creamy texture, and versatile culinary applications. Avocados are a source of MUFA, fiber, micronutrients, phytosterols, and carotenoids [27,28]. The nutritional matrix of avocado, i.e., low in carbohydrates, high in MUFA, and fiber, may contribute to a lower GI and GL. We therefore sought to determine if supplementing 1 avocado a day for 6 mo to the habitual diet would lower the dietary GI and GL in free-living adults with elevated waist circumference.

Methods

Study design

This is a secondary analysis of the Habitual Diet and Avocado Trial (HAT), a multisite, randomized, controlled, parallel-arm intervention study, designed to determine the effects of 1 avocado added to the habitual diet of adults with abdominal obesity over a 6-mo frame. The study details and primary outcomes of the HAT trial are described elsewhere [29,30]. Free-living adults

($n = 1008$) were randomly assigned to either consume 1 large (~168 g) avocado/d or abstain from avocado intake—consuming ≤ 2 avocados/mo—along with their habitual diet over 6 mo. Inclusion criteria were age ≥ 25 y, elevated waist circumference (≥ 35 inches for females and ≥ 40 inches for males), and avocado consumption ≤ 2 avocados/mo. Exclusion criteria were aversion or known sensitivity to avocados; allergy to latex; unwillingness or inability to undergo MRI examinations; unstable medical conditions, such as renal disease on dialysis, cardiac, gastrointestinal, or hepatic disease; cancer (nonmelanoma skin cancer >5 y ago or other cancer in remission for >10 y was acceptable); pregnancy, lactation, or the intent to become pregnant; loss or gain of >10 lbs. of body weight in the last year; restricted or weight loss diet; elevated alcohol intake (>7 drinks/wk for females, >14 drinks/wk for males); oral steroid use >7 d in the last 6 mo; unstable psychiatric medication (dose change in last 6 mo); and principal investigator judgment. The study was reviewed by the institutional review board (IRB) at each study site and was overseen by a central IRB. Informed consent was obtained from all participants. The study is registered at clinicaltrials.gov, identifier: NCT03528031.

Dietary intervention

The avocado-supplemented diet group was provided with avocados (a 2-wk supply at a time) and instructed to consume 1 avocado/d, while maintaining their usual diet and activity levels. They were also given basic instructions on storing, ripening, and preparing avocados for consumption, along with usage ideas and recipes. Participants did not receive any other nutritional guidance or counseling. The habitual diet group was instructed to eat no more than 2 avocados/mo while continuing their usual diet and lifestyle.

Assessment of dietary GI and GL

Diet was measured using a series of 3 unannounced 24-h dietary recalls conducted through telephone interviews by trained dietitians. These recalls were completed at weeks 8, 16, and 26, with the aim of achieving 2 weekday and 1 weekend-day recall. To reflect the marketplace throughout the study, dietary intake data were collected using Nutrition Data System for Research software versions 2017 and 2018, developed by the Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN. Final calculations were completed using NDSR version 2018, which uses the automated multipass method [31]. The NDSR software computes the GI and GL using the following formulas:

$$\text{Dietary GI} = \frac{\sum_{i=1}^n (\text{GI}_i \times \text{CHO}_i)}{\sum_{i=1}^n \text{CHO}_i}$$

$$\text{Dietary GL} = \frac{\sum_{i=1}^n (\text{GI}_i \times \text{CHO}_i)}{100}$$

where GI_i is the GI value of food i from the GI database, n is the number of foods consumed in a day, and CHO_i is the grams of available carbohydrates from food. The mean of the daily GI and GL values for the 3 recalls were calculated to determine the

mean daily GI and mean daily GL for each participant. GI and GL were then compared cross-sectionally between the avocado-supplemented diet group and the habitual diet group. GI and GL values were available using both bread and glucose references; for this study, GI and GL values using the glucose reference were used. Participants were excluded from the analysis if they had incomplete dietary recall information or were missing covariate information ($n = 47$) (Figure 1).

Covariates

Height was obtained at baseline. Weight and waist circumference were obtained at baseline, and at weeks 12 and 26. Intermediate visits were also conducted in weeks 4, 16, and 20, during which measurements were taken, and lifestyle questionnaires were completed. Sex, race, ethnicity, and education were self-reported.

Statistical analysis

GI, GL, and covariates were assessed by means and SDs for continuous variables and frequencies and percentages for categorical variables. Multiple linear regression models were used to determine differences between the avocado-supplemented group ($n = 482$) and the habitual diet group ($n = 479$), which served as the reference, on the mean GI and GL. Models were adjusted for age (y), sex (male and female), BMI (kg/m^2), energy intake (kcal), race [African-American, White, Asian, Other (including American Indian), multiple races], ethnicity (Hispanic and non-Hispanic), level of education (less than college degree, 4-y college degree, and masters or professional degree), and study site (Loma Linda University, University of California at Los Angeles, Pennsylvania State University—University Park and Hershey, and Tufts University). To determine the impact of specific food groups on GL, 13 food groups were defined (Supplementary Table). Each food component/ingredient entry was allocated to one of the food groups. Then, for each intake day, GL and GI were summed for food components within each food group. This produced total GL by food group per intake per day per participant. Statistical analyses were performed using R (R

Core Team, 2024) and IBM SPSS Statistics for Windows, version 29. A P value of < 0.05 was considered statistically significant.

Results

Study participants and nutrient intake

A total of 961 participants were eligible for this substudy [females: 73%; mean age 50.5 y (range: 25.1–86.6 y), mean ($\pm$ SD) for BMI in kg/m^2 : 33.0 (± 5.5)] after removing those who completed only baseline recalls ($n = 19$), did not complete ≥ 2 in-study recalls ($n = 20$), those missing covariates including BMI ($n = 2$), race ($n = 2$), ethnicity ($n = 3$), or both race and ethnicity ($n = 1$) (Figure 1). Table 1 contains details on participant characteristics at baseline. There were no statistically significant differences in demographics between the avocado-supplemented diet and habitual diet groups. The nutrient and food intake during the study is shown in Table 2. The avocado-supplemented diet group had significantly higher energy intake, fiber (both soluble and insoluble), vitamin E, total fat, MUFA, β -cryptoxanthin, lutein, and zeaxanthin intakes than the habitual diet group. The avocado-supplemented diet group had significantly lower protein, specifically animal protein, and lower carbohydrate intake as a percentage of energy.

Differences in GI and GL and contributions by food group to the GL

The GL (glucose reference) in the avocado-supplemented diet group was lower by 13.7 points (95% confidence interval: 17.0, 10.4; $P < 0.001$) as compared with the habitual diet group, after adjusting for age, sex, BMI, kcal intake, race, ethnicity, level of education, and study site. No differences were noted in the GI between the groups in adjusted or unadjusted models (Table 3). In addition, the contributions of food groups to the overall GL of the diet were compared between the avocado-supplemented group and the habitual diet group. Though not significant, some nonsignificant trends were noted, including a slightly lower GL contribution from the dairy and desserts and sweets

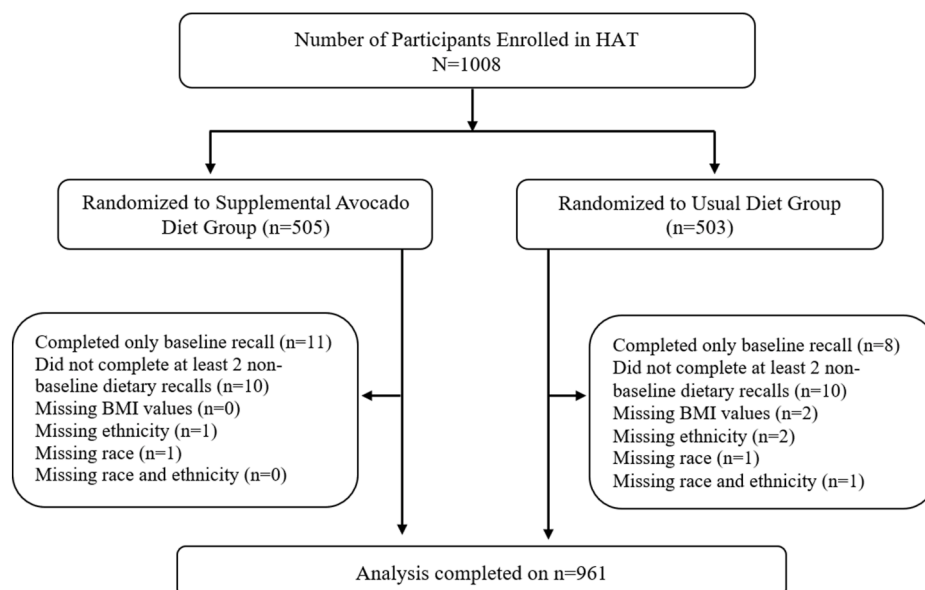


FIGURE 1. The selection of participants/CONSORT diagram. HAT, Habitual Diet and Avocado Trial.

TABLE 1Baseline characteristics of study participants by treatment group ($n = 961$).

	All ($n = 961$) mean (SD) or n (%)	Habitual diet ($n = 479$) mean (SD) or n (%)	Avocado-supplemented diet ($n = 482$) mean (SD) or n (%)
Age (y)	50.5 (14.1)	50.7 (13.7)	50.4 (14.4)
Sex			
Female	702 (73.0%)	357 (74.5%)	345 (71.6%)
Male	259 (27.0%)	122 (25.5%)	137 (28.4%)
BMI (kg/m^2)	33.0 (5.5)	33.2 (5.6)	32.8 (5.3)
Race			
African-American	141 (14.7%)	77 (16.1%)	64 (12.0%)
White	668 (69.5%)	319 (66.6%)	349 (72.4%)
Asian	57 (5.9%)	31 (6.5%)	26 (5.4%)
Other ¹	73 (7.6%)	41 (8.6%)	32 (6.6%)
Multiple races reported	22 (2.3%)	11 (2.3%)	11 (2.3%)
Hispanic			
No	764 (79.5%)	381 (79.5%)	383 (79.5%)
Yes	197 (20.5%)	98 (20.5%)	99 (20.5%)
Education			
<College degree	346 (36.0%)	180 (37.6%)	166 (34.4%)
4-y college	324 (33.7%)	165 (34.4%)	159 (33.0%)
Masters or professional	291 (30.3%)	134 (28.0%)	157 (32.6%)
Site/region			
LLU	246 (25.6%)	123 (25.7%)	123 (25.5%)
UCLA	235 (24.5%)	118 (24.6%)	117 (24.3%)
Penn State	241 (25.1%)	119 (24.8%)	122 (25.3%)
Tufts	239 (24.9%)	119 (24.8%)	120 (24.9%)

Two-sample t -test was used to compare the groups on age and BMI; Pearson χ^2 test was used to determine P value for sex, race, ethnicity, education, and site/region.

No significant differences were found (all P values < 0.05).

Abbreviations: LLU, Loma Linda University; UCLA, University of California at Los Angeles; Penn State, Pennsylvania State University, University Park and Pennsylvania State University, College of Medicine, Hershey; Tufts, Tufts University.

¹ Other refers to Pacific Islander, Native Hawaiian, American Indian, or other.

groups, and a slightly higher GL contribution from the refined grains group, in the avocado intervention arm. The only significant difference in the contributions of food to GL was from avocados (Figure 2).

Discussion

In a large, multisite, randomized study of adults with elevated waist circumference, adding 1 large avocado to the habitual diet for 6 mo without additional dietary advice significantly lowered dietary GL. This effect was robust while controlling for confounders, including age, sex, BMI, kcal intake, race, ethnicity, level of education, and study site. No differences were seen in the GI with the addition of avocado. The findings highlight the potential of a single, nutrient-dense food to drive a meaningful reduction in dietary GL. In the HAT study, avocado intake reduced total cholesterol and LDL cholesterol, but did not significantly affect other cardiometabolic risk markers [30]. Nevertheless, incorporating avocados into the diet may contribute to improvements in overall dietary patterns, including reductions in dietary GL, which have been associated with favorable cardiometabolic outcomes in other studies [11–16].

Previous studies have shown that changes in dietary patterns, macronutrient composition, and individual foods can alter the glycemic response or GI/GL of the diet [20–24,32]. However, to our knowledge, this is the first long-term study (6 mo) to investigate the impact of a single food on both GI and GL within

a Western-style diet. In a prior study, a low-GL intervention resulted in a 15.5-unit reduction in GL, which was associated with a significant decrease in liver fat [33]. In addition, when healthy adults were randomly assigned to either a high-GI or low-GI diet, matched for energy and macronutrients, significant increases in hepatic fat were noted in those consuming a high-GI diet compared with the low-GI diet [34]. A low-GI diet intervention (GI <55) compared with a high-GI diet (GI >70) resulted in a higher body fat reduction (1.8%) compared with the high-GI diet (0.4%) [35]. Another study found that a 10-unit reduction in GL was linked to a 0.04% decrease in hemoglobin A1c concentrations, indicating improved glycemic control in individuals with type 2 diabetes [36]. Thus, reducing the GL by ~ 14 units through a single-food intervention (avocados) may be clinically meaningful.

Both quantity and quality of carbohydrates affect GL, and the changes in GL seen in our study reflect the nutrient composition of avocados. Avocados are a good source of dietary fiber, with a large avocado containing ~ 11 g of fiber, of which $\sim 70\%$ is insoluble [37]. Thus, the increase in fiber from eating avocados may partly explain the reductions in dietary GL. Although most studies have shown that fiber lowers glycemic response [25, 38–40], some have shown null effects [32,41]. The varying effects of fiber observed across studies are likely due to differences in the type of fiber used, as different fibers can have distinct impacts on GI and GL [42]. Soluble fiber appears to have a greater impact on GI and GL, likely due to the slowing of gastric emptying and, therefore, carbohydrate absorption [25]. The insoluble fiber in avocados can also contribute to the glycemic response

TABLE 2Food and nutrient components of interest¹: habitual diet group vs. avocado-supplemented diet group (n = 961).

	Habitual diet group (n = 479)	Avocado-supplemented diet group (n = 482)	P value ²
GI glucose ³	58.7	58.2	0.147
GI bread ³	83.9	83.2	0.147
GL glucose ⁴	107.4	100.7	0.049
GL bread ⁴	153.5	144.0	0.049
Energy intake (kcal/d)	1781.9	1953.4	0.001
Carbohydrates (g/d)	200.4	201.7	0.723
Total sugars (g/d)	73.7	67.9	0.087
Total dietary fiber (g/d)	17.8	28.0	<0.001
Soluble fiber (g/d)	5.7	9.3	<0.001
Insoluble fiber (g/d)	11.7	18.2	<0.001
Carbohydrates (% E)	43.1	40.1	<0.001
Protein (g/d)	79.0	74.8	0.049
Protein, animal (g/d)	51.5	47.4	0.003
Protein, plant based (g/d)	23.8	26.5	<0.001
Protein (% E)	17.3	15.1	<0.001
Total fat (g/d)	76.1	95.4	<0.001
Total fat (% E)	37.7	42.9	<0.001
SFA (g/d)	25.3	26.6	0.259
SFA (% E)	12.2	11.9	0.233
PUFA (g/d)	17.3	19.1	0.005
PUFA (% E)	8.2	8.4	0.384
n-3 PUFA (g)	1.8	1.9	0.540
MUFA (g/day)	27.1	40.8	<0.001
MUFA (% E)	13.2	18.1	<0.001
MUFA 16:1, n-7 (palmitoleic acid) (g)	1.1	2.1	<0.001
Cholesterol (mg)	291.0	263.4	0.177
Vitamin E (total α -tocopherol equivalents)	10.6	13.2	<0.001
Vitamin E (total α -tocopherol) (mg)	8.8	11.3	<0.001
β -Tocopherol (mg)	0.4	0.5	<0.001
γ -Tocopherol (mg)	13.2	13.3	0.923
Delta-tocopherol (mg)	2.8	2.6	0.287
Natural α -tocopherol (RRR- α -tocopherol or d- α -tocopherol) (mg)	8.7	11.0	<0.001
Total α -tocopherol equivalents (mg)	10.6	13.2	<0.001
Carotenoids			
β -Carotene—provitamin A carotenoid (μ g)	2539.6	2552.0	0.974
α -Carotene—provitamin A carotenoid (μ g)	212.9	221.0	0.723
β -Cryptoxanthin—provitamin A carotenoid (μ g)	59.2	99.5	<0.001
Lutein + zeaxanthin (μ g)	1593.5	2077.5	<0.001
Total grains (ounce equivalents)	5.9	5.9	0.923
Whole grains (ounce equivalents)	1.1	1.2	0.384
Refined grains (ounce equivalents)	4.5	4.3	0.583
Added sugar or available carbohydrate (g)	42.5	38.8	0.350
Added sugar by total sugar (g)	37.7	36.1	0.583
Available carbohydrates (g)	180.3	173.4	0.147

Abbreviations: GI, glycemic index; GL, glycemic load.

¹ Median of 3 dietary recalls.² Mann-Whitney *U* test of 2 independent samples (nonparametric t-test).³ GI calculated as the mean of the daily GI values for the 3 dietary recalls to determine the mean daily GI.⁴ GL calculated as the mean of the daily GL values for the 3 dietary recalls to determine the mean daily GL.

indirectly by modulating the gut microbiome, influencing glucose metabolism, and reducing insulin resistance [26].

Given that fat has been shown to have a lowering effect on the glycemic response [21,22], MUFA and PUFA from avocados may also contribute to the lower GL with avocado intake. A previous study found that adding either nuts or EVOO to a Mediterranean diet significantly lowered GI and GL compared with a low-fat version of the Mediterranean diet [20]. Like avocados, nuts, and EVOO are high in unsaturated fatty acids.

A key difference between our study and the previous interventions is the level of dietary guidance provided. Although earlier studies included detailed instructions from registered dietitians to both individuals and groups, our study offered no

additional dietary counseling—participants were simply instructed either to add 1 avocado daily (with basic written preparation guidelines) or to avoid avocados. This contrast underscores a key strength of the current approach: from a public health perspective, the simplicity and low cost of such a strategy offer advantages over more resource-intensive, complex strategies. At the individual level, this approach also supports better adherence and long-term behavior change, as it relies on realistic and sustainable dietary adjustments rather than restrictive or sweeping changes to eating patterns.

Small differences in the contributions of food groups to dietary GL were noted in our study, including a nonsignificant decrease in dairy, desserts, and sweets in the avocado-

TABLE 3

Linear regression model-based estimates of change in glycemic index and glycemic load of the diet between the 2 groups.

	β	SE	95% CI	P value
Model 1 ¹				
GI	-0.47	0.30	-1.06, 0.13	0.123
GL	-3.54	2.97	-9.38, 2.30	0.234
Model 2 ²				
GI	-0.61	0.30	-1.21, -0.20	0.043
GL	-13.73	1.70	-17.06, -10.40	<0.001
Model 3 ³				
GI	-0.56	0.30	-1.15, 0.03	0.063
GL	-13.67	1.68	-16.95, -10.38	<0.001

Habitual diet ($n = 479$) avocado intervention ($n = 482$).

Abbreviations: CI, confidence interval; GI, glycemic index; GL, glycemic load.

¹ Unadjusted model.

² Adjusted for total kcal.

³ Adjusted for age, sex, BMI, kcal intake, race, ethnicity, level of education, and study site.

supplemented diet group, suggesting partial displacement of carbohydrate sources. This observation is consistent with the findings from another ancillary HAT analysis [43], which showed that avocado intake partially displaced carbohydrates (87% displacement), indicating reduced intake of carbohydrates from nonavocado sources in the avocado-supplemented group. Thus, the observed reductions in GL may be partly explained by a lower overall carbohydrate intake. Another ancillary HAT study examining the effect of avocado intake on diet quality showed improvements in Healthy Eating Index (HEI)-2015 scores [44] driven in part by lower intakes of refined grains and added sugars. Although this appears to contrast with our findings of a nonsignificant increase in the contribution of refined grains and sugar-sweetened beverages to GL in the avocado-supplemented group, the 2 analyses capture different dietary constructs [45,46] and used different food group

classifications. Our analyses evaluated the contribution of carbohydrate-containing foods, specifically available carbohydrates, to dietary GL, whereas the HEI-2015 assesses overall dietary quality, including components such as fatty acid ratios and vegetable intake, which have a smaller impact on GL. Accordingly, improvements in HEI-2015 scores may reflect broader changes in dietary pattern and fat quality associated with avocado intake, even when trends in individual carbohydrate food groups contributing to GL differ between analyses.

Lowering GI and GL can offer potentially significant health benefits, particularly for cardiometabolic health. Multiple meta-analyses of both observational studies and randomized controlled trials have shown that a diet with high GI and GL is associated with a higher risk of type 2 diabetes and CVD [14, 47–49]. Although both GI and GL measure glycemic response, their health impacts differ. Although higher GI was linked to increased risk of type 2 diabetes and coronary artery disease, GL showed a stronger association with severe CVD and mortality [49]. Although GL is considered a better predictor of glycemic response, its association with cardiometabolic disease is less robust than GI. This is thought to be because low-GL diets typically contain fewer carbohydrate-rich foods, which are often replaced by red and processed meat, foods linked to an even higher risk of diabetes and coronary artery disease in observational studies [50–52]. In fact, in the avocado-supplemented diet group, intake of avocado displaced red and processed meat [43], suggesting an additional way avocado could improve cardiometabolic risk, beyond the change in GL. Our findings indicate that, although high-GI foods contribute to overall dietary GL, the addition of avocado appears to reduce total available carbohydrate, potentially explaining the lower GL of the diet containing avocado.

In dietary intervention trials involving single-food interventions, the nutritional composition of the food should be interpreted within the context of the overall diet. Avocados are a rich source of MUFA, vitamin E, potassium, fiber, phytosterols,

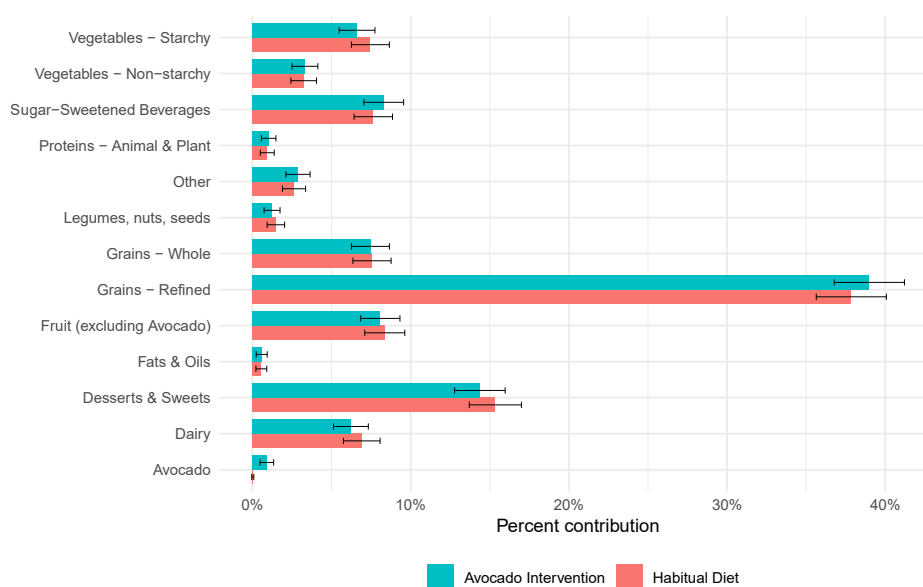


FIGURE 2. Between-group comparison of the percent contribution of food groups to glycemic load (GL). Comparison of the contribution of food groups to GL between the avocado and habitual diet groups. Error bars represent ± 1 SE. No statistically significant differences between the avocado intervention and habitual diet groups for contributions of the food groups to GL, except for avocado.

and carotenoids, most notably lutein and zeaxanthin [27,28,37], all of which increased in the avocado-supplemented group, as expected. Consistent with this, daily avocado consumption improved HEI scores in the HAT trial [44], and the NHANES data have shown that avocado intake is associated with higher diet quality [53], improved nutrient intake, and a lower risk of metabolic syndrome [53]. In the parent HAT trial, avocado intake reduced total cholesterol and LDL cholesterol, but no other cardiometabolic risk factors were significantly affected [30]. However, evidence from other studies suggests that avocado consumption may favorably influence metabolic syndrome and diabetes risk [53–56]. In addition, lower dietary GL can attenuate postprandial glycemic responses and has been associated with modest improvements in other cardiometabolic risk factors, such as blood lipids and blood pressure [15,57].

There are limitations to this study, including the potential for underreporting or overreporting, often observed in self-reported intake [58]. In addition, limitations of GI and GL, including the intraindividual and interindividual variations of GI and GL measurements [59,60], should be considered. There are several strengths of this study, including the large, diverse sample size across 4 geographically distinct sites within the United States. In addition, the use of multiple 24-h dietary recalls with a standardized, automated multipass system [61] contributes to the accuracy of the dietary recall data. The study's 6-mo length and parallel study design reduce any possible seasonal differences in dietary intake.

In conclusion, the daily addition of avocado to the habitual diet produced a clinically relevant decrease in the dietary GL, without requiring broader dietary changes or restrictive interventions. This highlights the potential of simple, sustainable behavior changes, such as incorporating 1 nutrient-dense food, like avocado, to positively influence dietary quality. Even modest reductions in GL have been associated with reduced cardiometabolic risk, suggesting that small, achievable dietary shifts can have meaningful health outcomes.

Author contributions

The authors' contributions were as follows – JS, SR, NRM, KSP, PK-E, ZL, DMR: designed and conducted the primary HAT intervention study; CHG, GS-S, AC, RS, DRR: conducted research and collected data; SR, KL: designed the current research; KL, GS-S, KO: analyzed data and conducted the statistical analyses; KL: drafted the manuscript; KL, SR, GS-S, CH: primary responsible for final content; and all authors: critically reviewed and approved the final manuscript.

Conflict of interest

The authors report no conflicts of interest.

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Data availability

Data described in the manuscript, code book, and analytic code will be made available on request, pending application and approval.

Declaration of generative AI and AI-assisted technologies in the writing process

The authors declare that no generative AI or AI-assisted technologies were used in the writing of this manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.cdnut.2026.107690>.

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