JOURNAL OF
EMERGING INVESTIGATORS

Article

Are Asian foods healthier than Western foods: Evidence collected from St. Louis area grocery stores

Chau Tran[1], Maciej Buchowski[2]

[1] Ladue Horton Watkins High School, St. Louis, Missouri

[2] Department of Medicine, Vanderbilt University, Nashville, Tennessee

SUMMARY

Diets vary substantially across different ethnic groups while also having a significant and long-term impact on general health and well-being. Common perceptions are that the overconsumption of Western-style foods drives the increase in non-communicable diseases in Western society and that Asian-style foods are more nutritious and healthier than Western-style foods. Therefore, our research goal was to identify differences in the nutrient content of Asian-style foods and Western-style foods offered in grocery stores available to the general population in St. Louis County, Missouri. We hypothesized that the nutrient content in foods available at Western grocery stores would not differ from the similar foods available at Asian grocery stores. We hand-collected 648 food items randomized by store and food category in three Asian grocery stores and one Western supermarket in St. Louis and documented their nutritional information. We then characterized and compared the nutrient content of the collected foods at the store and food category levels. We found that foods from Asian stores had statistically significantly lower protein ($p < 0.01$), higher sodium ($p = 0.10$), and similar energy, total carbohydrates, cholesterol, total fat, and sugar content compared to Western stores. Also, we found that foods available in Asian stores had a significantly longer "Time-to-Expiration" period ($p < 0.01$). These findings challenge the common perception that foods from Asian stores are healthier than Western stores and contribute to our understanding of associations between ethnicity, diet, and health.

INTRODUCTION

Unhealthy and poor diets are the leading cause of mortality and morbidity from non-communicable diseases such as cancer, diabetes, chronic respiratory, and cardiovascular diseases worldwide (1,2). In the U.S., dietary risk was the top among 17 leading health risk factors from 1990 to 2016 (3). In 2016 alone, dietary risk factors were responsible for almost 530,000 deaths in the U.S. (3). However, it was also well-documented that key health indicators vary significantly across ethnic groups. According to the Office of Minority Health in the U.S. Department of Health and Human Services, non-Hispanic Whites were 60% more likely to be obese than Asian Americans in the U.S. in 2018 (4). Given the significant impact of diets on health, an important question is whether variations in the diets of various ethnic populations are a factor driving the significant cross-race variation in health risk indicators.

The quest to understand the interplay between cultures, diets, and health has long fascinated researchers and has been a difficult task. First, data on ethnicity-based dietary intakes are typically obtained in surveys such as the National Health and Nutrition Examination Survey that are subject to nonresponse and other selection biases (5, 6). Second, obtaining a reliable measurement of dietary exposure of different populations is notoriously difficult (7). Third, comparing dietary intakes by diverse populations tends to be skewed because these populations reside in different areas and markets. External factors that vary with locations, such as state-specific restrictions and food prices, may also influence the food consumption choices of the local population in a manner that is not related to their ethnic background.

Motivated by these important questions and challenges, our goal was to provide direct field evidence of the nutrient content of food products available to Asian and general populations of St. Louis. To establish whether Asian and Western stores differed in important nutrient measures, we conducted hypothesis testing analysis. At the store level, we hypothesized that the nutrient content in foods available at Western grocery stores would not differ from the foods available at Asian grocery stores. At the food category level, we hypothesized that the nutrient content in a specific food category available at Western grocery stores would not differ from the same specific food category available at Asian grocery stores.

RESULTS

Nutritional information

To gain information about nutrients and their differences for Asian and Western foods we recorded and relied on label contents of food items carried by Asian and Western grocery stores. In the U.S., the Nutrition Labeling and Education Act (NLEA) requires most foods to bear food labels whose contents comply with specific requirements (13). Such requirements assure that the nutrition facts on labels are standardized and can be reliably compared across similar food items.

Given the vast amount of food items carried by the grocery stores, we randomly sampled food items within every food category. Specifically, for each store, we mapped out the location of every food category and estimated its approximate amount and physical arrangement. We then collected a proportional sample randomly and throughout the arrangement of the respective food category for data recording. The random sampling of food items for each food category ensured that the set of collected items fairly represented all food items carried by the stores. The Western

DOI: https://doi.org/10.59720/22-193

A.	Food Categories	# Food Items	B.	Nutrient Measures
	Beverages	88		Energy (kcal/100g)
	Bread and Bakery	21		Cholesterol (mg/100g)
	Canned Goods	37		Total Fat (g/100g)
	Condiments, Spices, and Bakes	90		Sodium (mg/100g)
	Cookies, Snacks, and Candy	278		Total Carbohydrate (g/100g)
	Dairy, Eggs, and Cheese	42		Total Sugar (g/100g)
	Frozen Foods	20		Protein (g/100g)
	Grains, Pasta, and Slides	72		Time to Expiration (days)

Table 1: Food categories and nutrient measures. Panel A shows food categories and the number of observations (food items) per each food category. Panel B shows nutrient measures and Time-to-Expiration listed on a standard label of food items.

supermarket was one of many regional stores operated by the same largest supermarket chain in St. Louis. The uniformity and popularity of this supermarket chain meant that the collected food items from one Western supermarket represented the standard (Western) grocery choices offered by the entire supermarket chain to the population of St. Louis. Three Asian grocery stores located in St. Louis areas with sizeable Asian populations were among the largest and most visited stores by Asian Americans in St. Louis for grocery shopping.

We list the seven energy and nutrient content measures, "Time-to-Expiration", eight standard categories common to Western and Asian foods, and the numbers of observations that we recorded from the Nutrition Facts label of food items collected from four stores (**Table 1**). The seven nutrient measures are Energy, Cholesterol, Total Fat, Sodium, Total Carbohydrate, Total Sugar, and Protein. The eight food categories are Beverages, Bread and Bakery; Canned Goods; Condiments, Spices, and Bakes; Cookies, Snacks, and Candy; Dairy, Eggs, and Cheese; Frozen Foods; and Grains, Pasta, and Sides. We saw that the average values of Time to Expiration and nutrient measures differed for food items collected in different stores (**Table 2**). These preliminary differences motivated a more rigorous statistical study to compare foods from Asian and Western stores.

Nutrient differences between Asian and Western food items

The two central questions our study sought to answer were whether nutrient measures of Asian and Western foods statistically differ, and if they do, in which direction (higher or lower) and for which specific nutrients and specific food categories these differences are. Our results listed below were organized and obtained to address these central questions. Concerning the first question on a possible difference between two types of foods, we found that at the aggregate level of all food categories in a store (that is, the store level), food items carried by Asian and Western groceries were statistically different in all nutrient measures and the Time to Expiration ($p<0.01$, left panel, **Table 3**). At the individual level of each food category (that is, the food category level), food items from Asian and Western groceries were also statistically different in all nutrient measures and the Time to Expiration ($p<0.01$, right panel, **Table 3**). Concerning the second question on the direction of the differences, we found that at the store level, food items from the Asian groceries had statistically significant longer Time to Expiration ($p < 0.01$), lower Protein ($p < 0.01$), and higher Sodium ($p = 0.1$) than those from the Western groceries (**Table 4**). At the food category level, similarly, foods from the Asian groceries had statistically higher contents in some nutrient measures and lower in other measures compared to those from the Western stores (**Table 5**). These results informed consumers about the rich and detailed differences between foods carried by Asian and Western stores, depending not only on the food category but also the specific nutrient measure under consideration. Notably, Beverages, Canned Goods, Condiments, Dairy, Eggs and Cheese, Grains, Pasta, and Sides carried by Asian stores had statistically significant higher Total Fat than those carried by Western stores. For most food categories, items carried by Asian stores also had statistically significant longer Time to Expiration (**Figure 1**).

DISCUSSION

A significant finding from this study is that contrary to

Panel A: Mean	Asian-1	Asian-2	Asian-3	Asian-aggregate	Western
Energy (kcal/100g)	158.39	117.52	151.97	142.63	170.58
Cholesterol (mg/100g)	0.42	12.76	1.56	4.91	11.01
Total Fat (g/100g)	7.79	4.63	4.65	5.69	6.70
Sodium (mg/100g)	1197.28	178.63	93.77	489.89	237.17
Total Carbohydrate (g)	19.30	15.86	25.98	20.38	23.76
Total Sugar (g)	4.45	11.00	12.40	9.28	8.38
Protein (g)	3.02	3.12	2.02	2.72	4.39
Time to Expiration (days)	460.42	428.83	258.12	382.46	197.71
Panel B: Std. Error	**Store 1**	**Store 2**	**Store 3**	**Asian**	**Western**
Energy (kcal/100g)	37.73	5.99	10.99	5.65	9.96
Cholesterol (mg/100g)	0.23	2.61	0.64	0.90	3.52
Total Fat (g/100g)	2.70	0.47	0.60	0.38	0.51
Sodium (mg/100g)	218.41	20.00	16.84	26.85	24.56
Total Carbohydrate (g)	4.78	1.06	2.23	0.88	1.77
Total Sugar (g)	1.11	0.97	1.53	0.47	0.84
Protein (g)	0.68	0.30	0.24	0.16	0.43
Time to Expiration (days)	59.06	25.53	18.97	17.97	14.89

Table 2: Nutrient and energy contents and Time-to-Expiration. Summary statistics for the nutrient measures of the collected food items. Panel A: Mean, Panel B: Standard Error, of the reported measures. "Asian-1", "2", and "3" denote three Asian grocery stores. "Asian-aggregate" represents three Asian grocery stores as if they were from a single consolidated Asian store. "Western" represents the Western store.

DOI: https://doi.org/10.59720/22-193

Across Stores			Across Food Categories		
Nutrient Measures	**F**	**P-value**	**Nutrient Measures**	**F**	**P-value**
Energy (kcal/100g)	12.13	< 0.001	Energy (kcal/100g)	32.24	< 0.01
Cholesterol (mg/100g)	5.99	< 0.001	Cholesterol (mg/100g)	7.13	< 0.01
Total Fat (g/100g)	6.53	< 0.001	Total Fat (g/100g)	8.42	< 0.01
Sodium (mg/100g)	74.49	< 0.001	Sodium (mg/100g)	32.00	< 0.01
Total Carbohydrate (g)	9.11	< 0.001	Total Carbohydrate (g)	45.96	< 0.01
Total Sugar (g)	5.71	0.01	Total Sugar (g)	37.85	< 0.01
Protein (g)	6.31	< 0.001	Protein (g)	20.51	< 0.01
Time to Expiration (days)	24.40	< 0.001	Time to Expiration (days)	28.98	< 0.01

Table 3: F-test results. F-stat and P-value associated with the F-test in one-way analysis of variance (ANOVA) to assess whether nutrient measures are statistically different or indifferent for food items grouped separately at Asian stores and Western stores (left columns) and for food items grouped separately at each food category (right columns). A small P-value indicates that it is highly unlikely that a nutrient measure is the same across groups of food items under consideration.

our hypotheses, nutrient content from foods available at Asian grocery stores differs from similar items at Western grocery stores. In particular, our analysis showed that foods from the Asian stores had significantly lower protein and higher sodium content than foods from Western stores. These findings have significant health implications. First, it has been shown that high sodium consumption raises blood pressure, a well-known risk factor for heart disease and stroke. In countries where people consume diets low in salt, people do not experience increased blood pressure with age seen in most Western countries (8). Similarly, a low protein intake is not beneficial for consumers. A higher-protein diet has been documented to help prevent or reduce obesity, increase muscle mass and strength, and support bone health (9-11). Third, a longer Time to Expiration of food items in Asian stores likely indicated lower sales turnover or a higher preservative nature of imported foods carried in Asian than in Western stores. For example, because it takes longer for food items to be sold or imported and delivered to stores in the U.S., Asian stores may strategically opt to carry food items with longer expiration dates. Foods with long expiration dates, such as canned foods and processed meats, are well-known examples of unhealthy foods.

The observation that, depending on the specific food category, nutrient measures of Asian food items were either higher, lower, or statistically indifferent from those of Western food items, depicted a rich but complex reality in the food markets. Among eight food categories, foods from Asian stores had statistically significant higher Total Fat in five categories, statistically significant lower Total Fat in two categories, and statistically indifferent Total Fat in one category, compared to foods from Western stores. Two food categories stood out: Condiments, Spices, Bakes, and Frozen Foods. For the Condiments, Spices, and Bakes category, all nutrient measures (and Time to Expiration) of food items available at Asian stores were significantly higher than or statistically similar to foods in Western stores. In contrast, for Frozen Foods, all nutrient measures (and Time to Expiration) of Western food items were significantly higher than or statistically indifferent from those of Asian food items. Anecdotally, foods in these two categories tend to be highly specific to the respective ethnicity-based cuisines, befitting their significant differences across Asian and Western stores. These findings provided evidence against the common perception that Asian foods are uniformly healthier than Western foods. The comparative analysis also informs consumers of a healthier choice in each food category if they need to decrease or increase their intake of a specific nutrient. For example, a consumer should opt for Asian Canned Goods if they choose less Sodium and opt for Western Canned Goods if they choose less Total Fat.

Our analysis provided statistical evidence that foods from Asian stores differed from foods available at Western stores in several key nutrient measures at both food category and store levels. Interestingly, these differences resonated with a recent important finding for public health policy. WHO Expert Consultation documented and reported that Asian populations had specific health risks (12). It was then suggested that BMI cut-off points that determine overweight and obesity needed to be population-specific. Our finding that Asian and Western-style foods had significantly different nutrient contents presents, at least in part, a possible food-based explanation for the WHO Expert Consultation's findings and

Nutrient Measures	P-value	T-stat
Energy (kcal/100g)	0.19	-1.33
Cholesterol (mg/100g)	0.15	-1.49
Total Fat (g/100g)	0.62	-0.50
Sodium (mg/100g)	0.10	**1.70***
Total Carbohydrate (g)	0.26	-1.14
Total Sugar (g)	0.83	-0.22
Protein (g)	<0.01	**-3.14*****
Time to Expiration (days)	<0.01	**6.56*****

Table 4: T-test results (Store level). P-value and T-stat associated with the two-sample unpaired T-test to assess whether nutrient measures are statistically higher, lower, or indifferent for food items grouped separately at Asian stores and Western stores. A small P-value indicates that it is highly unlikely that a nutrient measure is the same across groups of food items under consideration. A significantly positive (respectively, negative) T-stat indicates that the food items from the Asian store group has a higher (respectively, lower) content in the nutrient measure under consideration than those from the Western store group.

DOI: https://doi.org/10.59720/22-193

Food Categories	Asian > Western	Western > Asian
Beverages	Time to Expiration, Cholesterol, Total Fat, Sodium, Protein	Total Carbohydrate, Total Sugar
Bread and Bakery	Total Carbohydrate	Energy, Cholesterol, Total Fat, Sodium, Protein
Canned Goods	Time to Expiration, Cholesterol, Total Fat	Sodium, Total Carbohydrate
Condiments, Spices, and Bakes	Time to Expiration, Energy, Cholesterol, Total Fat, Sodium, Protein	N/A
Cookies, Snacks, and Candy	Time to Expiration, Sodium	Cholesterol, Protein
Dairy, Eggs, and Cheese	Time to Expiration, Energy, Cholesterol, Total Fat, Total Carbohydrate	Protein
Frozen Foods	N/A	Energy, Cholesterol, Total Fat, Sodium, Protein, Total Carbohydrate
Grains, Pasta, and Slides	Energy, Total Fat, Sodium, Total Carbohydrate	Time to Expiration, Total Sugar

Table 5: T-test results (Food category level). Results associated with the two-sample unpaired T-test to assess whether nutrient measures are statistically higher, lower, or indifferent for food items grouped separately for each food category at Asian stores and at Western stores. Rows correspond to eight food categories. In each row, Column "Asian > Western" lists the nutrient measures (or Time to Expiration) that are statistically significantly higher ($p < 0.05$) in the food items carried by Asian stores than in Western stores. Column "Western > Asian" lists the nutrient measures (or Time to Expiration) that are statistically significantly higher ($p < 0.05$) in food items carried by Western stores than in Asian stores. Nutrient measures (or Time to Expiration) that are not statistically significantly different ($p > 0.05$) across Asian and Western food items are not listed.

recommendations.

Our research had several limitations. First, the collected data from St. Louis County, a vibrant county with diverse ethnic communities and cultures, might not fully represent Asian and Western dietary intakes in the U.S. Our research approach (i.e., hand-collecting the standardized and regulated nutrient data from various general and specialty grocery stores) presented a starting but scalable step toward a larger demographic region. Second, foods from different Western and Asian grocery stores possibly were not exclusively consumed by respective general and ethnic groups. Similarly, locations of Asian and Western grocery stores may correlate with median incomes and other socioeconomic statuses of local residents, who are likely consumers of these stores. These possibilities may confound the association between food's nutrient contents and the actual nutrients consumed by different ethnic groups because of other confounding socioeconomic differences. This issue is intricate but can be mitigated by sampling these stores' existing customer bases. Third, while fresh vegetables were an important component of Asian and general foods, these were omitted because this research focused more on packaged and quantifiable foods. Similarly, it is a possibility that Asian and Western food products are prepared, cooked, or consumed differently. These differences may create further differences in the ultimate amount of nutrients consumed by end consumers, rendering the Nutrition Facts label less informative for our analysis. Follow-up research could be calorimeter experiments looking at foods consumed in both cultures, but typically cooked differently. Due to this omission, our results and conclusion pertained only to foods included in the eight categories analyzed in this research, assuming that food preparation methods are either similar or inconsequential for Asian and Western food consumption. Finally, while some nutrients have a healthy desirable threshold (e.g., 2300 mg of sodium or less per day for adults recommended by the U.S. Food and Drug Administration), others (such as Trans Fat, Total Sugar, and Protein) do not have % DV (14). A subtle caveat with a comparative analysis of foods was that, without knowing the healthy threshold for a nutrient, we did not know whether a food product containing more of this nutrient was more (or less) desirable than other food products. According to FDA guidelines on Nutrition Facts Label, (i) 5% DV or less (respectively, 20% DV or more) of a nutrient per serving is considered low (respectively, high), and (ii) foods that are lower in saturated fat, sodium, added sugar and higher in dietary fiber are generally more desirable (15). Our study relied on this guideline to holistically characterize a food of higher sodium content as less desirable, while recognizing the caveat mentioned above.

In conclusion we found that foods carried by Asian stores had higher sodium, lower protein and similar energy, total carbohydrates, total sugars, fat, and cholesterol compared to foods carried by Western stores. These findings question the common perception that Asian foods are healthier than Western foods and contribute to our understanding of associations between ethnicity, diet, and health.

MATERIALS AND METHODS

Data collection and random sampling

Our statistical analysis was conducted using the "Nutrition Facts" data from a random selection of food items sampled and collected in grocery stores. Specifically, we compiled the nutrition information as indicated on the Nutrition Facts

DOI: https://doi.org/10.59720/22-193

Figure 1. T-test results (Food category level). T-statistics and the associated 95% confidence intervals (denoted by bars) for the two-sample unpaired T-test to assess whether nutrient measures are statistically higher, lower, or indifferent for food items grouped separately for each food category at Asian stores and at Western stores.

label from a diverse and randomly selected sample of 648 hand-collected food items. These items were collected from a popular Western supermarket and three Asian grocery stores located in St. Louis County, Missouri. Given the extensive range of products offered by the grocery stores, we employed a random sampling approach for each food category. For each food item included in our study, we collected data on "Time-to-Expiration" and the seven essential nutrient measures which are standardized and regulated by the Nutrition Labeling and Education Act of 1990 (**Table 1**).

Statistical analysis

The Nutrition Facts label facilitated a statistical comparison of different food products by providing the Percent Daily Value

DOI: https://doi.org/10.59720/22-193

(% DV) and serving size. Scaling to equalize the serving size of two food products helped normalize their % DV per the same serving size. To illustrate, when two similar food items have serving sizes of 100 grams and 200 grams, the scaling multiplied by a factor of two the nutrient content values listed in the first food item's label before a comparison between food items was implemented. This simple scaling allowed us to compare the nutrient contents of the two foods while controlling for size.

We conducted a one-way ANOVA to assess the equality of means of nutrient measures across multiple food categories or stores. We then employed the two-sample unpaired T-test to further assess whether a nutrient measure was higher, lower, or statistically indifferent for Asian and Western foods, either at store or food category levels. We obtained F-statistics and T-statistics using standard Excel spreadsheet tools.

ACKNOWLEDGMENTS

We gratefully acknowledge the Academy of Science St. Louis Science Fair and the 2022 Bayer Scholarship of Excellence Award for their financial support of the work presented in this paper.

Received: August 4, 2022
Accepted: January 9, 2023
Published: November 29, 2023

REFERENCES

1. Fedacko, J., et al. "Western Diets and Risk of Non-Communicable Diseases." In: Functional Foods and Nutraceuticals in Metabolic and Non-communicable Diseases, edited by Ram Singh, Academic Press, 2021. https://doi.org/10.1016/B978-0-12-819815-5.00042-2.
2. The GBD 2017 Diet Collaborators. "Health Effects of Dietary Risks in 195 Countries, 1990-2017: A Systematic Analysis for the Global Burden of Disease Study 2017." *The Lancet*, 393, 1958–72, 2019. https://doi.org/10.1016/S0140-6736(19)30041-8.
3. The US Burden of Disease Collaborators. "The State of US Health, 1990-2016: Burden of Diseases, Injuries, and Risk Factors Among US States." *The Journal of the American Medical Association*, 319, 1444–72, 2018. https://doi.org/10.1001/jama.2018.0158.
4. "Obesity and Asian Americans," Office of Minority Health, U.S. Department of Health and Human Services. Accessed August 2023.
5. "National Health and Nutrition Examination Survey, 2021-2022," CDC's National Center for Health Statistics.
6. Fakhouri, T., et al. "An Investigation of Nonresponse Bias and Survey Location Variability in the 2017-2018 National Health and Nutrition Examination Survey." *Vital Health Stat*, 2, 185, 1–36, 2020.
7. Fave´, G., et al. "Measurement of Dietary Exposure: A Challenging Problem Which May Be Overcome Thanks to Metabolomics?" *Genes & Nutrition*, 4, 135–41, 2009. https://doi.org/10.1007/s12263-009-0120-y.
8. Stallings, V., et al. "Dietary Reference Intakes for Sodium and Potassium." The National Academies Press. National Academies of Sciences, Engineering, and Medicine, 2019.
9. Westerterp-Plantenga, M., et al. "Dietary Protein – Its Role in Satiety, Energetics, Weight Loss and Health." *British Journal of Nutrition*, 108, S105–S112, 2012. https://doi.org/10.1017/S0007114512002589.
10. Bosse, J., et al. "Dietary Protein to Maximize Resistance Training: A Review and Examination of Protein Spread and Change Theories." *Journal of the International Society of Sports Nutrition*, 9, 1–11, 2012. https://doi.org/10.1186/1550-2783-9-42.
11. Bonjour, J-P. "Dietary Protein: An Essential Nutrient for Bone Health." *Journal of the American College of Nutrition*, 24, 526S–536S, 2005. https://doi.org/10.1080/07325724.2005.10719501.
12. WHO Expert Consultation. "Appropriate Body-mass Index for Asian Populations and Its Implications for Policy and Intervention Strategies." *The Lancet*, 363, 157–63, 2004. https://doi.org/10.1016/S0140-6736(03)15268-3.
13. "Guidance for Industry: Food Labeling Guide." The U.S. Food and Drug Administration (FDA), www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-food-labeling-guide. Accessed August 2023.
14. "Sodium in Your Diet: Use the Nutrition Facts Label and Reduce Your Intake." The U.S. Food and Drug Administration (FDA), www.fda.gov/food/nutrition-education-resources-materials/sodium-your-diet. Accessed August 2023.
15. "The Lows and Highs of Percent Daily Value on the New Nutrition Facts Label." The U.S. Food and Drug Administration (FDA), www.fda.gov/food/new-nutrition-facts-label/lows-and-highs-percent-daily-value-new-nutrition-facts-label.Accessed August 2023.