Is a traditional Mexican diet better suited for Mexican-descent women?

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Abstract

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Background: People of Mexican descent are the biggest Hispanic population in the US, representing over 11% of the entire US population. Addressing health disparities by improving the dietary intake and the health and well-being of this large Hispanic group would benefit the entire US due to the large population impact. Currently, the Dietary Guidelines for Americans (DGAs) have not been evaluated for effectiveness among people of Mexican descent.

Objective: It is necessary to evaluate whether the DGAs, including the USDA-provided Spanish translation, are effective for adopting and maintaining a healthy diet aimed at improving health outcomes in this population, or if a more culturally tailored approach might be warranted.

Design: First- and second-generation healthy women of Mexican descent (n=20) were randomly assigned to two parallel arms where one arm used study staff to provide instruction on the 2015 Dietary Guidelines for Americans (including the Spanish translations) and the other arm was staff-provided instruction on an adaptation of the DGA to include traditional Mexican foods and cultural aspects of diet (MexD). Participants received instruction on foods but purchased and prepared all their own foods. Metabolic response was measured through glucose, insulin, CRP, lipid panel (Cholesterol, HDL, LDL, VLDL, triglycerides and free fatty acids), and the homeostasis model assessment of insulin resistance (HOMA-IR) at the beginning and end of the intervention. Dietary intake was assessed through validated Food Frequency Questionnaires. For comparison of the effects of each arm on biomarkers and diet, generalized estimating equation (GEE) was used and adjusted for age and BMI. A qualitative analysis was also performed based on an end-of-study survey.

Results: GEE models (n=20) showed that serum FFAs was the only biomarker with a significant difference in pre- and post-intervention values, both before and after adjusting for age and BMI (p=0.004, and p=0.0001, respectively). Serum FFA changes amounted to a total of 35% difference favoring the DGA arm. Between baseline and the 3-month follow-up (n=18), carbohydrate consumption differences between each group amounted to 29% (p=0.028), with the DGA group having a 31% reduction. Participant feedback showed overall positive reception of both arms.

Conclusion: Participants gave positive feedback about both study arms and some minor health improvements were noted on both arms. Therefore,, healthcare workers could

potentially offer either option to their patients or have them choose their preferred option between traditional DGAs or the MexD.

Contents

Introduction

Hispanics are the largest ethnic population group, second only to Non-Hispanic Whites. In the 2019 US Census, there were 60.5 million Hispanics, with 61.4% who identified as having Mexican origin.[1] People of Mexican descent are also the largest population of foreign-born immigrants in the US.[2] This population has increased over the years and it continues to grow to this day.[3] Improving the dietary intake and the health and well-being of this large Hispanic group would benefit the entire US due to the large population impact, as Mexican-descent people account for 11.3% of the total population.[1] To improve the health and wellbeing of this population, innovative approaches are needed. Currently, the Dietary Guidelines for Americans (DGAs) have not been evaluated for effectiveness among people of Mexican descent. Therefore, it is necessary to evaluate whether the DGAs are effective for adopting and maintaining a healthy diet aimed at improving health outcomes in this population, or if a more culturally tailored approach might be warranted.

Overview of health disparities

The Mexican population in the US is affected by structural racism, which in turn influences health disparities. *The Lancet* describes structural racism as the ways in which society fosters discrimination via reinforcing systems which in turn reinforce discriminatory beliefs, values and distribution of resources.[4] It is important to analyze and understand current data on health disparities from this angle, because racialized immigrant groups such as Latinx populations experience health inequities that are not only related to nativity or years of residence but also influenced by citizenship status and a sense of belonging or othering.[5]

Health disparities in the Mexican population in the US are several. For example, Mexican-descent populations have a diabetes rate of 14.4%, whereas non-Hispanic whites have a rate of 7.5%.[6] While the overall percentage of US Mexicans in fair or poor health is similar to their white counterparts, Mexicans living in the US have a much higher rate of obesity.[7,8] A cross-sectional study based on the National Health and Nutrition Examination Survey or NHANES found that for foreign-born Mexican children, obesity prevalence has increased by over 50% since the 1990s, a faster speed than that of white American children (25%).[9] NHANES is a program of surveillance studies designed to assess the health and nutritional status of adults and children in the United States. It examines the health of a nationally representative sample of the population and over-samples for minority populations such as Hispanic.[10] Furthermore, according to NHANES 2011-2016, when compared with non-Hispanic whites and non-Hispanic Blacks, Mexicans have a higher rate of diabetes, but a lower average number of health care visits within the past year.[11] Contributing to health disparities is the fact that Hispanics (including Mexicans) have lower rates of health insurance in the US, with insurance coverage for Mexican-descent people at around 47.9%, but coverage for non-Hispanic whites at 74.7%.[12,13] Although the prevalence of high blood pressure in people of Mexican descent is lower than the average in the US, it has continued to increase in the last two decades.[14] A recent study that examined cancer mortality in the US found that while the overall adjusted mortality rate for both females and males is similar between Non-Hispanic whites and Mexican-Americans, the rates for certain cancers such as liver and stomach are higher among people of Mexican descent.[15]

Migration and citizenship status

Health disparities may be related to generational changes and other factors such as migration. Recent Mexican immigrants are more likely to have had a decline in health in the years soon after their migration to the US.[16] In addition, immigration itself is linked to multiple social and psychological adverse events. For example, child detention at the US-Mexico border and family separation have been shown to detrimentally affect children and their families.[17] In a qualitative study with recent Mexican immigrants, participants reported feeling like they are risking their life, having fear of deportation and overall concern about mental health.[18] The history, perspective, and experiences of people of Mexican descent has also been compared and examined under the lens of historical trauma.[19] As a result, migration status and other factors can adversely influence mental health. For example, one study considered undocumented Mexican immigrants as an at-risk population for certain mental disorders such as depression and anxiety.[20] Mexican populations in the US are also subject to higher rates of unemployment when compared to non-Hispanic whites, which can also have a deleterious effect on mental health.[21] Furthermore, lack of employment may lead to food insecurity. Increased food insecurity has been associated with increased waist circumference, percent body fat and BMI, meaning food insecurity may contribute to unhealthy eating behaviors.[22]

Acculturation

Acculturation is the process by which a migrant person or community comes in contact with a different culture, and change ensues.[23] Although acculturation can be studied in the receiving population, most studies of acculturation are generally concerned about the cultural changes that occur within the migrant community. It is important to acknowledge that newer studies of acculturation point towards bi-dimensionality, where individuals are able to have multiple cultural identities. Bidimensional acculturation posits that a person can acculturate to the culture of the new place, but also that it can acculturate to its culture of origin.[24] An integration (also called biculturalism) approach to acculturation, which maintains cultural heritage but also endorses relations with the new culture has been shown to improve the perceived well-being of other Hispanic population.[25,26] Understanding acculturation as a multifaceted process is key to understand generational differences.[24]

Generational status is associated with acculturation and changes in diet and exercise[27]. For example, a cohort study that compared first generation Mexicans with second and third generation Mexicans found that second and third generations had an increased risk of diabetes, even after adjusting for lifestyle and socio-economic status.[28] These differences in health exposure can help explain health outcomes. For example, one study found that second-generation Mexicans had higher rates of hypertension when compared with first-generation Mexicans. [29] Why there is a difference not only between racial groups but also between different generations is an active field of study.

Higher levels of acculturation may result in improved health perception (in the form of self-rated health), as well as with better sleep measures.[30,31] However, greater levels of acculturation and acculturation stress can also influence eating behavior, and certain measures of obesity such as waist-to-hip ratio, as well as the management of diabetes.[32,33]

Another important acculturation component is language use. Language can sometimes be used as a proxy for acculturation or assimilation to a new culture, and it often helps understand barriers and facilitators for health-related behaviors.[34] One study found that

Spanish monolingualism in Mexicans in the US is more associated with depressive symptoms than in Mexican bilingual populations.[35] In another study of Mexicans, participants reported difficulties establishing trust with nurses if there was a language barrier.[36] Moreover, language acculturation on its own may be related to the same health conditions associated with overall acculturation, such as obesity and diabetes.[34,37]

On its own, higher acculturation to the US mainstream culture is inversely associated with health in Mexican populations, but so is a lower SES.[38] Higher acculturation and lower-SES is associated with an increased health deterioration in Mexicans.[39] This can help explain the Latinx paradox, where US-born Latinx immigrants might have worse health outcomes than their foreign-born peers.[40,41] Higher acculturation is associated with consumption of a less traditionally Mexican diet and higher intake of processed foods.[42] This leads us to the importance of studying the food and food culture of Mexican-descent populations.

Food behaviors and food culture

Eating patterns and food behaviors are influenced by acculturation. While there is no universal definition of a traditional Mexican diet, the predominant eating pattern commonly includes particular food items and preparations. Most frequently included foods are corn and corn products, beans and other legumes, squash, *nopales*, green tomato, red tomato, onion, *chile*, and several fruits and meats.[43] Often, fruits and vegetables are eaten fresh and whole, and corn and its products is generally considered to be a whole grain.[44] In contrast, the standard American diet, as described by NHANES data, is an eating pattern that includes a higher proportion of refined grains and processed foods.[45]

Language has also been shown to be correlated with food behaviors, with English-speaking Mexicans preferring fast food over a home-cooked meal.[46] Also related to food behaviors are the factors affecting food choice, with one qualitative study finding that for Mexican families, price and familiarity are the most important ones.[47] This study also mentions how the interviewed families agreed that future dietary interventions should be community-based and include skills to use traditional Mexican ingredients.

Other environmental factors can affect food behavior, such as availability of foods. Data are lacking on the presence of food deserts or food swamps that is specific to the Mexican or Hispanic population, however one paper found that Hispanic neighborhoods have on average less than a third of the proportion of total chain supermarkets in comparison with non-Hispanic neighborhoods.[48] Lower SES is also associated with food deserts.[49] Cost of fresh produce was also cited as an important concern in a Latinx qualitative study that featured Mexican participants.[50]

Different levels of acculturation play a role in modifying health behaviors and health conditions, with varying effects. For example, there is marked preference of traditional Mexican ingredients and dishes in recent Mexican immigrants,[51] however data are not available in the published literature about the availability of Mexican produce and other products and how that might affect food choice and overall food patterns. Nonetheless, information for food security might offer a perspective into the needs and barriers for Mexican communities in the US. One study found that in Texas, being born in Mexico was associated with high food insecurity.[52] Another study also found high levels of food insecurity in Mexican farm-workers[53]

The relevance of traditional Mexican food and the related food culture also plays a role in food choice. Specifically for women of Mexican descent, preparing culturally relevant foods is a common practice and helps pass on the traditions to the next generation.[51] In a different study, Mexican-American parents (mainly women) recognized that preparing traditional Mexican meals and having family time to eat them helped increase the enjoyment of food.[54] However, a study reported how Mexican women may perceive traditional foods as unhealthy, and the need for tailored nutritional information and or interventions may be granted to improve this perception.[55] Additionally, certain preparations or presentations of traditional food are sometimes perceived to be unhealthy.[56]

The relationship between food and how it is influenced by family traditions has been studied and shown to be relevant for US-born Mexican women. In a study that examined women's descriptions of their eating patterns, the women interviewed all agreed that their mother was the most influential person on their eating pattern. [57] Another study found that interventions targeting Mexican mothers could have an impact in the dietary patterns of their children.[58] Eating dinner with the family was associated with feelings of well-being in Mexican-American families, more so than for Non-Hispanic whites.[54] However, not all Mexican populations might be eating a more traditional Mexican diet or following the same food culture as their ancestors.

Dietary acculturation

Despite the apparent benefits of cooking traditional Mexican meals, the diets of first- and second-generation Mexicans in the US might not always follow a more traditional dietary pattern. With higher acculturation, the diets of both Mexican descent parents and their children can become more “Americanized”. For example, the American diet or Standard American Diet (SAD), contains an average of 57% of calories and 75% of added sugars from processed foods (which includes ultra-processed foods and sugar-sweetened beverages), according to NHANES data.[45] Lower than recommended consumption of fruit, vegetables and whole grains along with higher than recommended consumption of refined grains, protein, sodium and saturated fat are also characteristics associated with the SAD.[59] These dietary characteristics may be associated with several adverse health conditions; ultra-processed foods are associated with increased risk for certain types of cancer, type 2 diabetes, and all-cause mortality, among others.[60]

Shifts in dietary patterns can be concerning because of the specific foods and nutrients that are being substituted, such as polyunsaturated fats and whole grains.[61] Micronutrient composition of diet might also change significantly, as Mexico-born children and adults have different, and often higher, serum concentrations of vitamins, carotenoids and other antioxidants, when compared to US-born Mexicans. [62,63] Data from a study in rats showed that feeding a pre-Hispanic diet (a diet consisting of native Mesoamerican foods prior to the colonial period) after induction of obesity improved the microbiome, cognitive function and metabolic processing.[64]

Previous studies of dietary intervention in the Mexican population

Studies that try to change diet behaviors in the Mexican population are also lacking; however, one previous study found that other members of the social network in Mexican-descent populations can have a positive impact in the consumption of fruits and vegetables.[65] Focusing on the community, and specifically on mothers and women could help increase the effects of dietary intervention.[58,66,67] Dietary intervention trials recommending a traditional Mexican diet and using text and phone interventions have not been specifically studied for the Mexican population, however such studies have been moderately accepted in other populations and further studies are warranted.[68–70] To complicate matters, studying the metabolic effects of a traditional Mexican diet can be more difficult because previous studies focusing on such a diet have not applied a consistent definition of the traditional diet.[43]

Given the specific characteristics of the Mexican population in the US, health interventions that focus on nutrition need to be tailored and should take into consideration the social determinants of health, culturally-relevant meals and other food-related behaviors.[47,51,54,71] Previous clinical trial health interventions in the Mexican population have used *promotoras* (health workers), and have focused on family-based and community-based interventions.[66,67,72,73] These interventions have focused on different aspects, such as diabetes control, portion control, increased fiber, and weight management along with varied methods of contact between the intervention staff and the participating population. The objective of this study, *The Comparing Original Mexican Diets and Standard US Diets At*

Home Study (COMIDAS at home), was to understand better what type of dietary intervention and ensuing guidance better suits a population of Mexican-descent women living in the US.

Methods:

The Comparing Original Mexican Diets and Standard US Diets (COMIDAS) trial and COMIDAS at home

Study design

COMIDAS was a pilot randomized crossover feeding trial that aimed to measure and compare metabolic responses of 53 Mexican-descent women after eating a traditional Mexican diet and a SAD. Each feeding period lasted 24 days, with a 28-day washout period in between. Metabolic response was measured through glucose, insulin, insulin-like growth factor 1 (IGF-1), insulin-like growth factor binding protein 3 (IGFBP-3), adiponectin, C-reactive protein (CRP), and interleukin 6 (IL-6), as well as the homeostasis model assessment of insulin resistance (HOMA-IR) at the beginning and end of each period.[71]

The traditional Mexican diet for COMIDAS was designed to be eucaloric and was based on pre-Hispanic cultural traditions, Hispanic foods before the 1940s, and other peer-reviewed publications. The study hypothesized that the Mexican diet would improve insulin sensitivity and biomarkers for inflammation. The primary study findings were that while most biomarkers studied showed little to no change, biomarkers related to insulin sensitivity improved when Mexican-descent women consumed a traditionally Mexican diet vs the American diet.[71] Other analyses examined whether genetic ancestry could help explain some of the interactions between the dietary pattern and its metabolic response.[74] A secondary analysis concluded that genetic variation might be bigger than expected and regionalized dietary recommendations might be modified depending on the ancestry of the population.[75]

The COMIDAS at home sub-study used the same traditional Mexican diet from COMIDAS, but instead of being a randomized crossover feeding trial, it was a randomized intervention trial where participants received instruction on foods but purchased and prepared all their own foods. The intervention consisted of two parallel arms where one arm used study staff to provide instruction on the 2015 Dietary Guidelines for Americans (including the Spanish translations) and the other arm was staff-provided instruction on an adaptation of the DGA to include traditional Mexican foods and cultural aspects of diet (MexD). Blood samples were collected, and body weight measured before and after the intervention to compare the two arms on biomarkers of metabolic health. Study participants in COMIDAS at home were able to choose their diet. Currently, it has not been scientifically evaluated whether the DGAs are culturally relevant, or whether they are biologically effective in Mexican populations. Culturally relevant materials are a part of cultural competence; cultural competence aims to break down the barriers between patients and healthcare providers. It also strives to ensure improved understanding between patients and their providers.[76] Additionally, it is not known whether recommending the traditional Mexican diet over simply a Spanish translation of the DGAs to individuals living freely and deciding their own food would improve their health status.

Participant recruitment and enrollment

Study participants were first and second-generation Mexican-descent healthy women, ages 18-50 years. Eligibility criteria included having one or two parents born in Mexico or being born in Mexico, living in the Seattle area for the next 6 months, and willing to follow study guidelines.

Exclusion criteria included having food intolerances or allergies that would preclude following the study dietary recommendations, being pregnant or breastfeeding, being outside the age of eligibility, and not willing to follow study guidelines.

Participants were recruited from the parent study of COMIDAS via email, and fliers were also given at a community clinic, and community-targeted social media ads were posted. The Institutional Review Board and Clinical Trials Office of the Fred Hutchinson Cancer Research Center (Fred Hutch) approved the study protocol, and all participants gave written informed consent. Bilingual research staff was available, and all study materials were available in English and Spanish. As a supplement of the original COMIDAS study, it was registered under the National Clinical Trials registry with NCT01369173 as its clinicaltrials.gov identifier, and it was conducted from 2016 to 2017.

After screening for eligibility criteria including self-reported Mexican heritage, age, and pregnancy or breastfeeding, enrolled participants completed several at home pre-study activities, which included a baseline questionnaire that asked about demographic characteristics, and other health information, a validated baseline Food Frequency

Questionnaire (FFQ), and reviewed and signed the consent form. After signing the consent form, FFQs were reviewed by study staff to ensure completeness.

Protocol and data collection

Participants attended two in-person clinic visits at the Fred Hutch Prevention Center. At visit one, participants brought the questionnaires and consent form they completed at home. Next, they were randomized to receive instruction on either dietary recommendations based on the 2015 Dietary Guidelines for Americans (DGAs), or on the -traditional Mexican diet for the next three months. The traditional Mexican diet (MexD) was based in the menu designed for the original COMIDAS study, with a focus on pre-Hispanic foods.[71] 10 participants were randomly assigned to each arm.

Dietary intake data were collected using the FFQ questionnaire which was developed by the Nutrition Assessment Shared Resource (NASR) of Fred Hutchinson Cancer Research Center, Seattle, Washington. Nutrient estimates were obtained with the Nutrition Data System for Research (NDSR) software (version 2020, Nutrition Coordinating Center, University of Minnesota). The FFQ was available in both English and Spanish and participants could choose their preferred language.

At clinic visit one, dual language staff provided information about the DGAs or the MexD. Study notebooks were given to all participants, which included study provided recipes, sample menus, and other dietary tips that followed the dietary pattern (**Table 1**).

After clinic visit one, the remainder of the intervention was delivered remotely through structured phone calls and text messages according to the schedule in **Table 2**. Participants were free living and were instructed to prepare their foods using study guides. After the 12 weeks were over, participants were asked to complete an additional FFQ, complete an additional blood draw, have their height and weight measured, and to fill out a qualitative survey about ease of use, satisfaction, barriers and facilitators and overall experience. Another final FFQ was completed by mail 6 months later.

Table 1: Summary of dietary recommendations for each arm

	DGA arm	MexD arm
Vegetables	Variety of vegetables focusing on 4 categories: dark-green, red and orange, starchy, others and legumes*.	Tomatoes, avocados, onions, garlic, chiles, legumes*
Fruits	Variety	Orange, banana, pineapple, mango.
Dairy	Skim of fat-free milk, other reduced-fat dairy	Whole milk and Mexican cheeses
Grains	Whole wheat bread, whole wheat pasta, oats, quinoa, brown rice.	Corn tortillas, and other corn products like *atole*.
Protein	Lean cuts of red meat, chicken, and fish	Beans*, chicken,

* Standard DGA diet considers legumes in both the vegetable and the protein group.

Table 2: Summary of follow up and materials sent to participants over the duration of the study				
	Clinic visit	Text	Call	Data collection and intervention content delivery schedule
WEEK				
1	✓			FFQ, weighting, baseline questionnaire and blood draw
2				Tips for cooking and keeping in line with dietary recommendations
3			✓	
5		✓		
6				Information about Know your Plate & Recipes
7			✓	
9			✓	
10		✓		
11		Confirm visit		
12	✓			FFQ, weighting, End of study survey, and blood draw
32				Additional mail-in FFQ

Sample collection and analysis

Medical assistants collected 12 hour fasting blood samples on the first day of the study at clinic visit one and after three months of study activities at the final study clinic visit. Samples were processed and stored at -80C until the laboratory analysis.

Blood samples were assayed at the Northwest Lipid Research Laboratories (NWLRL) of the University of Washington for glucose, insulin, lipid panel and high-sensitivity C reactive protein (hsCRP). The lipid panel consisted of total cholesterol, triglycerides, HDL, and LDL and was assayed using standard enzymatic assays on a Roche automated analyzer. Glucose was analyzed on a clinical chemistry autoanalyzer. Insulin was quantified via a 48-hour PEG-accelerated, double-antibody radioimmunoassay, also at the NWLRL. HOMA was computed through the ratio of insulin and glucose levels: Insulin (µU/mL) x Glucose(mg/dL)/405. hsCRP was assayed using a Roche Cobas Mira chemistry analyzer at the NWLRL. Finally, free fatty acids were assayed at the Fred Hutch PHS Biomarker Laboratory using an enzymatic colorometric method using kits from Wako (Richmond, VA).

The coefficient of variation (CV) for insulin was 8.8% using study embedded QC samples. The rest of the CV were 0.9%, 0.9%, 1.9%, 2%, 0.8%, 3.1%, 1.4%, and 1.2% for cholesterol, HDL cholesterol, LDL cholesterol, VLDL cholesterol, glucose, hsCRP, triglyceride, and free fatty acids, respectively.

Statistical analysis

Plots were created and used to examine the distribution of the blood biomarkers data. Next, Kolmogorov-Smirnov, Shapiro-Wilk, Cramer-Von Mises and Anderson-Darling tests were calculated to test normality. Calculations for Shapiro-Wilk were included in **Table 3**. The majority of the data was determined not to be normally distributed and transformed using the ln function. The only exceptions were LDL cholesterol, HDL cholesterol, FFA, total protein intake, and total fat intake, which were found to be normally distributed but were analyzed as geometric means for consistency.

Two-sided T-tests were used to compare demographic continuous variables and dietary intake. A $\chi 2$ test was used for categorical demographic variables and both unadjusted GEE models and GEE models adjusted for confounders were used for biomarker analysis. P values of 0.05 or less were considered statistically significant. Standard deviations were also calculated for all baseline characteristics. Formal power calculations were not performed because of the small convenience sample.

For comparison of the effects of each arm on biomarkers and diet, generalized estimating equation (GEE) was computed and P values of 0.05 or less were considered statistically significant. GEE was adjusted for age and BMI. Analyses were conducted using R statistical software version 4.0.2

End-of-study survey

Out of the 10 questions in the end-of-study survey, 8 were open-ended qualitative, and 2 quantitative that used the Likert scale. For the 2 quantitative questions that asked about ease of use and understanding, percentages were calculated. For the 8 qualitative questions designed to understand if the intervention was well received, if it was useful and to obtain general participant feedback, an inductive iterative approach was used to create a codebook and to analyze the responses. To create the codebook, all the responses were read first, and codes were created afterwards. Later, themes were created, and codes were assigned to different themes. Additional subthemes and codes were later added after having looked at all the data. Although all responses were coded in the same way, responses from different arms were color-coded to facilitate the analysis possible differences between each arm. All interviews were manually coded by a single person using Microsoft Word version 2203.

Results:

Baseline characteristics

A total of 24 women were approached and screened, four declined leaving 20 women who signed the consent and enrolled. **Figure 1** shows the flow diagram of study enrollment. **Table 4** describes the demographic characteristics and other baseline characteristics of the study participants. A total of 20 women were selected, mean age of 38.7 years. Mean energy intake was 1685 Kcal/day and BMI was 29.9 kg/m^2. Most women were married and preferred Spanish over English. All study participants completed blood draws for baseline and after 3 months (12 weeks), as well as the end-of-study survey. 19 women completed the secondary FFQ at 3 months, and only 11 women completed a third FFQ at 6 months. Completed FFQs which reported less than 600 Kcal/day were considered unreliable, which resulted in 18 and 10 FFQs included for the 3-month and 6-month dietary analysis. Participants' body weight remained stable for both diet arms as evaluated by a GEE model adjusted for age and baseline weight (P = 0.85) (data not shown).

Table 3:
Shapiro-Wilk tests for normality (p-values)

	Baseline	3 months	6 months
Cholesterol (mg/dL)	0.044	0.51	
HDL (mg/dL)	0.17	0.98	
LDL (mg/dL)	0.19	0.73	
VLDL (mg/dL)	0.020	<0.0001	
Triglycerides (mg/dL)	0.018	<0.0001	
FFA (mEq/L)	0.097	0.25	
Glucose (mg/dL)	0.00011	<0.0001	
Insulin (µU/mL)	0.0019	0.0032	
CRP (mg/dL)	0.00016	0.00012	
HOMA-IR	0.00019	0.00025	
Energy (Kcal/d)	0.015	0.052	0.0025
Carbohydrates (g/d)	0.0066	0.13	0.0011
Total Fat (g/d	0.17	0.042	0.096
Saturated fat (g/d)	0.082	0.0096	0.033
Protein (g/d)	0.12	0.085	0.25
Dietary fiber (g/d)	0.0097	0.25	0.013
Food servings/d			
Fruit servings	0.00016	0.17	0.060
Vegetable servings	0.0089	0.52	0.034

Table 4:
Demographic characteristics of 20 healthy, Mexican-descent women

Baseline characteristics	All	DGA arm	Mex arm	P value
		Mean (SD)		
Age (years)	38.7 (8.6)	41.1 (8.0)	36.2 (8.9)	0.21
Weight (kg)	73.0 (19.4)	77.5 (21.8)	68.6 (16.5)	0.32
BMI (kg/m^2)	29.9 (7.4)	31.6 (7.5)	28.3 (7.3)	0.33
Energy intake (Kcal/d)	1685 (628)	1742 (528)	1627 (739)	0.69
		Number (%)		
BMI (kg/m^2)				
⩾18.2–24.9	6 (30)	2 (20)	4 (40)	0.33
⩾25–29.9	6 (30)	3 (30)	3 (30)	
⩾30.0	8 (40)	5 (50)	3 (30)	
Education				
<12th grade	4 (20)	1 (10)	3 (30)	0.20
12th grade	6 (30)	2 (20)	4 (40)	
>12th grade	10 (50)	7 (70)	3 (30)	
Marital status				
Married	17 (84)	10 (100)	7 (70)	0.07
Single	3 (16)	0 (0)	3 (30)	
Language				
Spanish	15 (75)	7 (70)	8 (80)	0.63
English	5 (25)	3 (30)	2 (20)	
Occupation				
Full time	8 (40)	5 (50)	3 (30)	0.77
Part time	5 (25)	2 (20)	3 (30)	
House spouse	7 (35)	3 (30)	4 (40)	

Values are means, SDs or n (%). $P<0.05$. *t* tests were used to compare continuous variables, and X^2 tests were used to compare categorical variables.

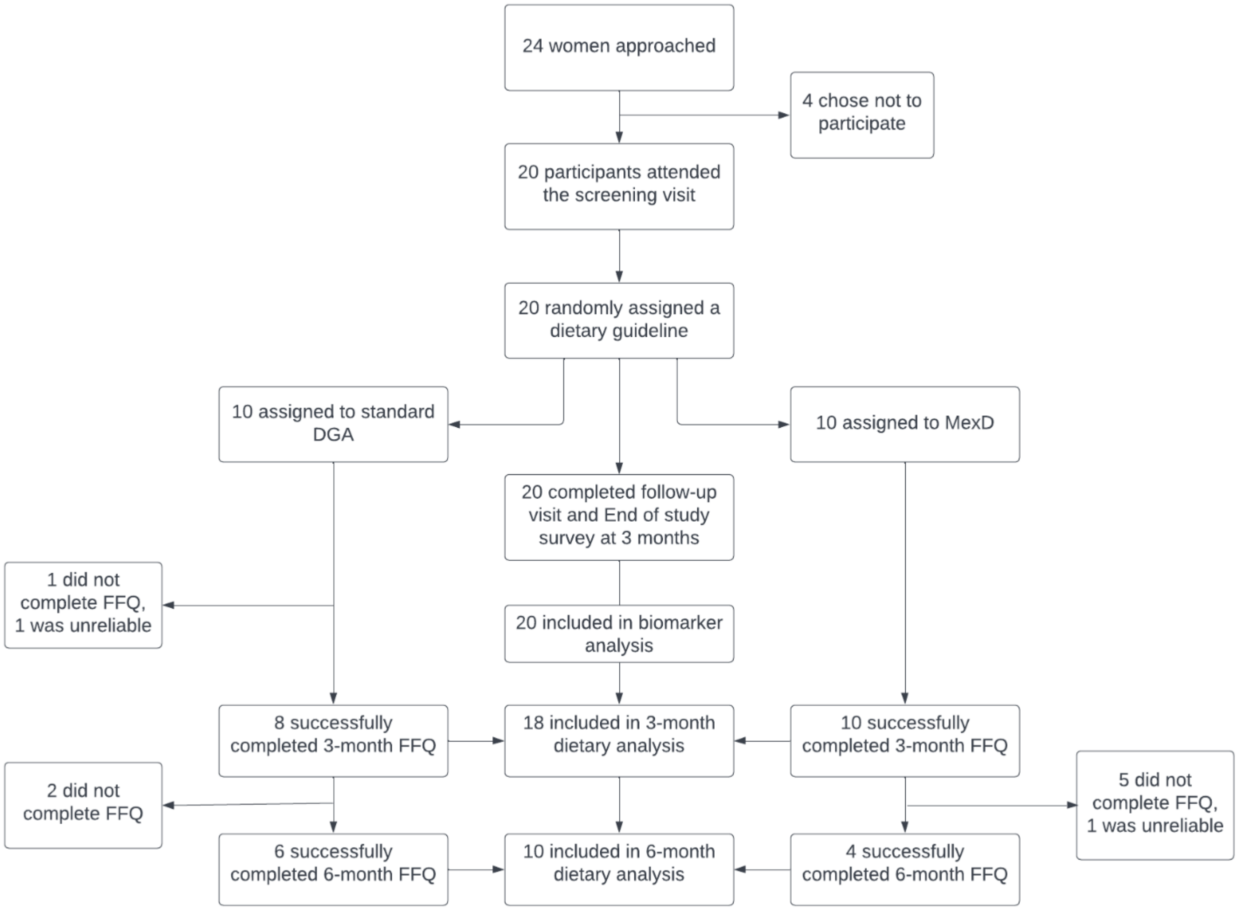

Figure 1: *Flow diagram of study enrollment*

Intervention effect of the recommended guidelines on biomarkers and diet

The effects of each recommendation (DGAs vs MexD) on biomarkers were evaluated by contrasting the biomarkers at baseline and after 3 months and adjusting for age and BMI. Mean differences between both arms were relatively similar, and GEE models showed that the difference of pre- and post-intervention serum FFA was the only biomarker whose p-value was statistically significant, before and after adjusting for age and BMI (p=0.004, and p=0.0001). FFA was reduced by 26% in the DGA arm and increased by 9% in the MexD arm for a total of 35% difference between each arm. Total serum cholesterol in mg/dL tended towards statistical significance after adjusting, with a 32% difference between each arm (p= 0.0859).

Intervention effect on dietary components varied by follow-up time and component (**Table 6 and 7**). Between baseline and the 3-month follow-up (n=18), carbohydrate consumption differences between each group amounted to 29% (p=0.028), with the DGA group having a 31% reduction. Total fat, dietary fiber and fruit servings approximated statistical significance with p values of 0.087, 0.075, and 0.074, accordingly. While fat decreased for the DGA arm, dietary fiber and fruit servings increased for the MexD arm.

As for the secondary analysis with 10 participants (**Table 7**), at 3 months, only fruit servings approximated statistical significance. At 6 months, total energy (kcal/day) (p<0.001), carbohydrate (g/day) (p=0.016), total fat (g/day) (0.025), saturated fat (g/day) (p=0.006) and protein (g/day) (p<0.001) differences between each group were found to be statistically significant. The MexD group had a marked decrease in energy intake, which also reduced intake of other nutrients.

One additional analysis was performed by using t-test to calculate the p values of the effect of both arms combined on biomarkers and dietary intake at 3 months (**Table 8**). This additional t-test analyzed the combined data of 20 participants as a cohort for biomarkers and 18 participants for dietary changes. Change in serum total cholesterol was found to be statistically significant (p=0.0191), with a reduction in both groups. Change in protein intake was also found to be statistically significant, (p=0.0302), with a reduction in both groups.

Table 5

Effect of each arm of the intervention on serum biomarkers

	DGA values		Mean difference	MexD values		Mean difference		
Biomarker	Value at baseline	Follow-up		Value at baseline	Follow-up		p [0]	p [1]
Cholesterol (mg/dL)	203.78 (177.8, 233.56)	192.88 (171.67, 216.70)	10.9	171.49 (155.96, 188.56)	164.06 (144.91, 185.73)	7.43	0.4	0.0859
HDL (mg/dL)	57.83 (48.9, 68.4)	56.04 (46.51, 67.52)	1.79	56.41 (49.78, 63.92)	53.74 (46.31, 62.35)	2.67	0.73	0.62
LDL (mg/dL)	116.78 (96.27, 141.67)	108.85 (90.62, 130.74)	7.93	93.83 (79.46, 110.8)	86.97 (68.63, 110.21)	6.86	0.64	0.38
VLDL (mg/dL)	23.25 (15.03, 35.99)	20.30 (12.69, 32.49)	2.95	18.2 (13.64, 24.27)	18.95 (14.25, 25.18)	-0.75	0.49	0.25
Triglycerides (mg/dL)	115.48 (74.38, 179.31)	101.80 (63.46, 163.30)	13.68	90.96 (68.04, 121.61)	94.35 (70.97, 125.44)	-3.39	0.55	0.3
FFA (mEq/L)	0.50 (0.41, 0.62)	0.37 (0.28, 0.47)	0.13	0.41 (0.33, 0.50)	0.45 (0.38, 0.52)	-0.04	0.004	0.0001
Glucose (mg/dL)	103.43 (89.52, 119.5)	104.47 (89.80, 121.53)	-1.04	95.09 (82.83, 109.15)	97.22 (80.54, 117.36)	-2.13	0.43	0.37
Insulin (µU/mL)	7.79 (4.93, 12.32)	8.10 (5.43, 12.09)	-0.31	8.10 (5.4, 12.16)	7.98 (4.86, 13.09)	0.12	0.9	0.85
CRP (mg/dL)	0.25 (0.10, 0.60)	0.18 (0.06, 0.53)	0.07	0.19 (0.09, 0.38)	0.14 (0.07, 0.29)	0.05	0.92	0.74
HOMA-IR	1.99 (1.11, 3.55)	2.09 (1.24, 3.52)	-0.1	1.90 (1.14, 3.17)	1.91 (1.02, 3.59)	-0.01	0.54	0.55

Values are geometric means (95% CI). N=10 for each arm.

p 0 is p-value obtained from a GEE model comparing the changes in the biomarker from baseline to follow up between the intervention and control groups, unadjusted.

p 1 is p-value obtained from a GEE model comparing the changes in the biomarker from baseline to follow up between the intervention and control groups, adjusted for age and BMI

Table 6

Intervention effect on diet composition for 18 participants

Nutrient	DGA[a] Value at baseline	DGA[a] 3-month follow-up	Mean difference	MexD[b] Value at baseline	MexD[b] 3-month follow-up	Mean difference	p 1
Energy (Kcal/d)	1679 (1375, 2051)	1160 (899, 1498)	519	1496 (1104, 2027)	1434 (1092, 1884)	62	0.54
Carbohydrates (%E/d)	49.3%	49.4%	-0.1	49.8%	51.0%	-1.2	
Carbohydrates (g/d)	206.9 (161.8, 264.6)	143.3 (109.7, 187.3)	63.6	186.2 (135.8, 255.2)	182.7 (142.3, 234.7)	3.5	0.028
Total fat (%E/d)	34.0%	33.1%	0.9	32.9%	33.5%	-0.6	
Total Fat (g/d)	63.5 (52.1, 77.4)	42.6 (30.8, 58.9)	20.9	54.7 (38.5, 77.8)	53.3 (38.2, 74.4)	1.4	0.087
Saturated fat (g/d)	19.9 (16, 24.8)	12.5 (9, 17.4)	7.4	17.2 (11.4, 26)	16.4 (12, 22.3)	0.8	0.12
Protein (%E/d)	16.7%	18.5%	-1.8	17.3%	14.4%	2.9	
Protein (g/d)	70.2 (57.3, 85.9)	53.7 (44, 65.7)	16.5	64.6 (48.1, 86.8)	51.8 (38.2, 70.3)	12.8	0.32
Dietary fiber (g/d)	21.2 (16.7, 26.9)	14.5 (9.9, 21.2)	6.7	20 (14.6, 27.2)	19.5 (14.5, 26.3)	0.5	0.075
Food servings/d							
Fruit servings	1.7 (1.1, 2.6)	1.7 (1, 2.8)	0	1.7 (1.3, 2.3)	1.8 (1.1, 2.9)	-0.1	0.074
Vegetable servings	2.2 (1.3, 3.5)	2 (1.2, 3.4)	0.2	1.5 (0.9, 2.5)	2.4 (1.7, 3.5)	-0.9	0.11

Values are geometric means (95% CI) or percentages.

a: n=8 participants, b: n=10 participants

p 1 is p-value obtained from a GEE model comparing the changes in the dietary components from baseline to 3-month follow up between the intervention and control groups, adjusted for age and BMI.

Table 7

Intervention effect on diet composition for 10 participants

Nutrient	DGA[a]					MexD[b]						
	Value at baseline	3-month follow-up	6-month follow-up	Mean differ-ence1	Mean differ-ence2	Value at baseline	3-month follow-up	6-month follow-up	Mean differ-ence1	Mean differ-ence2	p 1	p 2
Energy (Kcal/d)	1819 (1368, 2419)	1143 (804, 1624)	1194 (688, 2072)	676	625	1829 (1047, 3193)	1416 (868, 2310)	983 (618, 1562)	413	846	0.513	<0.001
Carbohydrates (%E/d)	49.8%	49.1%	52.0%	0.7	-2.2	49.1%	51.3%	48.8%	-2.2	0.3		
Carbohydrates (g/d)	226.5 (158.6, 323.5)	140.3 (101.6, 193.9)	155.1 (85.8, 280.5)	86.2	71.4	224.5 (125.6, 401.5)	181.5 (111.1, 296.6)	119.9 (69.6, 206.6)	43	104.6	0.387	0.016
Total fat (%E/d)	32.5%	33.7%	30.4%	-1.2	2.1	35.5%	34.3%	36.4%	1.2	-0.9		
Total Fat (g)/d	65.7 (46.5, 93)	42.8 (26.5, 69.3)	40.3 (23, 70.7)	22.9	25.4	72.2 (41.8, 124.6)	54 (32.2, 90.8)	39.8 (23.4, 67.6)	18.2	32.4	0.83	0.025
Saturated fat (g/d)	21 (14.5, 30.5)	12.8 (7.9, 20.8)	13.2 (7.4, 23.3)	8.2	7.8	23.1 (12.3, 43.6)	16.4 (9.3, 28.9)	11.8 (6.7, 20.7)	6.7	11.3	0.9	0.006
Protein (%E/d)	17.1%	18.2%	18.4%	-1.1	-1.3	16.2%	12.5%	15.4%	3.7	0.8		
Protein (g/d)	77.9 (62.7, 96.7)	52.1 (41.8, 64.8)	55 (35, 86.5)	25.8	22.9	73.9 (43.1, 126.7)	44.4 (29.8, 66.2)	37.8 (24.5, 58.2)	29.5	36.1	0.48	<0.001
Dietary fiber (g/d)	24.1 (14.5, 33.3)	13.1 (8.5, 20.3)	15.7 (9.1, 27.3)	11	8.4	22.1 (10.1, 48)	20.8 (12.5, 34.4)	13.9 (8.6, 22.4)	1.3	8.2	0.252	0.29
Servings/d												
Fruit servings	1.6 (0.8, 3.4)	1.5 (0.8, 2.9)	1.3 (0.5, 3.6)	0.1	0.3	2.1 (1.4, 3.3)	2.1 (0.4, 9.9)	1.6 (0.6, 4.1)	0	0.5	0.082	0.71
Vegetable servings	2.1 (0.9, 5.3)	1.7 (1, 3.1)	2.2 (0.9, 5.6]	0.4	-0.1	1.4 (0.3, 7.1)	2.2 (0.8, 5.7)	1.5 (0.5, 4.5)	-0.8	-0.1	0.319	0.49

Values are geometric means (95% CI) or percentages.

a: n=6 participants, b: n=4 participants

p 1 is p-value obtained from a GEE model comparing the changes in the dietary components from baseline to 3-month follow up between the intervention and control groups, adjusted for age and BMI.

p 2 is p-value obtained from a GEE model comparing the changes in the biomarker from baseline to 6-month follow up between the intervention and control groups, adjusted for age and BMI

Table 8: Effects of intervention in combined group (DGA +MexD) after 3 months

	Baseline	3 months	P values
Biometric and biomarker data[1]			
Weight (kg)	70.8 (63.1, 79.6)	70.6 (62.8, 79.3)	0.58
BMI (kg/m2)	29.1 (26.1, 32.5)	29 (26, 32.4)	0.58
Cholesterol (mg/dL)	186.94 (171.62, 203.63)	177.88 (163.24, 193.84)	0.019
HDL (mg/dL)	57.11 (51.97, 62.77)	54.88 (49.26, 61.13)	0.10
LDL (mg/dL)	104.68 (92.27, 118.76)	97.30 (84.14, 112.5)	0.88
VLDL (mg/dL)	20.57 (16.14, 26.22)	19.61 (15.31, 25.13)	0.81
Triglycerides (mg/dL)	102.49 (80.29, 130.84)	98.01 (76.4, 125.73)	0.83
FFA (mEq/L)	0.45 (0.39, 0.52)	0.40 (0.35, 0.47)	0.31
Glucose (mg/dL)	99.17 (90.44, 108.74)	100.78 (90.27, 112.51)	0.24
Insulin (µU/mL)	7.94 (6.03, 10.47)	8.04 (6.03, 10.71)	0.78
CRP (mg/dL)	0.22 (0.13, 0.36)	0.16 (0.09, 0.29)	0.43
HOMA-IR	1.95 (1.37, 2.75)	2.00 (1.38, 2.89)	0.37
Dietary intake data[2]			
Calories (Kcal/d)	1585 (1343, 1871)	1305 (1093, 1558)	0.091
Carbohydrates (g/d)	196.3 (163.6, 235.4)	164 (137.8, 195.2)	0.11
Total Fat (g/d)	58.9 (49, 70.9)	48.2 (38.8, 60)	0.15
Saturated fat (g/d)	18.5 (14.9, 22.9)	14.5 (11.8, 18)	0.074
Protein (g/d)	67.3 (57.2, 79.2)	52.7 (44.3, 62.6)	0.03
Dietary fiber (g/d)	20.6 (17.2, 24.6)	17.1 (13.7, 21.4)	0.16
Food servings/d			
Fruit servings	1.7 (1.4, 2.2)	1.7 (1.3, 2.4)	0.56
Vegetable servings	1.8 (1.3, 2.5)	2.2 (1.7, 2.9)	0.62

1: n=20, 2: n=18
Values are geometric means

End--of--study survey results

Questions 1 and 2 had a quantitative component (**Table 9**). Of the 20 responses to Question 1, 55% of participants reported finding the eating guide very easy, 30% of them found it to be easy, and 15% found it to be neither easy nor difficult. Similarly, in response to Question 2, 30% of participants reported it was very easy to use the eating guide, 45% of them reported it was easy and 25% reported it was neither easy nor difficult. However, once broken down into each arm, there was a slight preference towards the control arm (DGA arm): 70% reported it was very easy to understand the DGA eating guide, vs only 40% in the MexD arm (p value of 0.007, data not shown). For question 2, 90% of DGA participants reported the eating guide as very easy or easy to understand, vs 60% of the MexD participants (p value of 0.16, data not shown)

Table 9: Reponses to questions 1 and 2

	All respondents n=20	DGA arm n=10	MexD arm n=10
Question 1: How easy or difficult was it to understand the eating guide?	55% = very easy 30% = easy 15% = neither easy nor hard	70% = very easy 30% = easy	40% = very easy 30% = easy 30% = neither easy nor hard
Question2: How easy or difficult was it to use the eating guide?	30% = very easy 45% = easy 25% = neither easy nor hard	40% = very easy 50% = easy 10% = neither easy nor hard	20% = very easy 40% = easy 40% = neither easy nor hard

For the qualitative component, a total of 38 unique codes were created and coded. 4 total themes were identified: Factors contributing to the adherence of the intervention, factors negatively affecting adherence to the intervention, perceptions of specific dietary components, and information or practices learned from the intervention and suggestions.

The first theme, <u>factors contributing to the adherence of the intervention</u> (**Table 10**) included positive comments about the intervention, its components, its usefulness, feasibility, importance, and ease of adaptation. This theme included a total of 14 codes. Ease of use was the code with the greatest number of comments, or a total of 24. Most intervention components such as calls, texts, in-person guidance, etc., received an overwhelmingly majority of positive comments. By number of positive feedback comments, the intervention component with the most was texts (11 comments), however positive feedback was received from participants of both arms for all other components, including commentaries about how all the intervention components were useful. The only notable difference between the arms was the code *variety*, for which no commentaries were received from the MexD arm.

Table 10: summary of codes and examples for the first theme

Codes	DGA arm	MexD arm
Ease of use	"It's very simple, it gives you freedom to adapt the foods according to your needs […]"	"It wasn't difficult since it's the Mexican guide and it's what I already consume the most […]"
Important or interesting topic	"This topic is very interesting to me and there's a lot of very beneficial information concerning our eating habits and how to prepare and consume foods"	"This was a fun and engaging study, personally. It forged a connection back to my culture and history as a Latina."
Perception of healthiness	"Seeing my plate with the portions and a variety of vegetables is very healthy."	"It seems like a very important topic to me, and it helps us realize that small changes can help us make a big difference in preparing healthier meals without huge sacrifices."
Variety	"All is perfect, like the variety"	Not reported
Intervention components (included 9 codes: guide, recipes, study staff, calls, text, email, in-person guidance, all components, and others)	"How they explained how much you should eat of each group" "All of the information is useful, but for me visuals like the recipes are easier."	"The guide is easy to understand, basic and to the point." "All of the communications were useful (texts/phone calls/in-person conversations) I think 3-4 weeks was an appropriate time to be checking-in."
Extrinsic facilitators: family values	"Continue as I am now because I know it's healthy. For my children, cooking at home is important."	"I eat a lot of traditional Mexican food already, especially with my family"

The second theme was <u>factors negatively affecting adherence to the intervention</u>, (**Table 11**) and included comments about how certain aspects of the intervention were hard to follow, intrinsic factors such as lack of time, and extrinsic factors that made adherence difficult such as family pressure. This theme included a total of 5 codes. Overall, the negative comments or barriers described were significantly less common than the positive ones. Most factors or barriers affecting adherence were not related to the study, as 4 codes related more to lack of time, dislike for certain foods, pushback and others. Only one factor from the study was reported as having a negative impact on participant's experience: the *timeliness of study materials*, which was reported by both arms. Notably, *lack of time* was only reported by participants in the DGA arm.

Table 11: summary of codes and examples for the second theme

Codes	DGA arm	MexD arm
Intrinsic barrier: Lack of time	"Yes, my lack of time is always getting in the way. Exercise is difficult for me, finding the time."	Not reported
Intrinsic barrier: challenge with specific dietary components	"I feel that dairy shouldn't be pushed so much."	"It was difficult to stop using lard, and with the recipes, the portions were difficult. The salt, I consume more salt. I know salt is bad, my doctor told me"
Other barriers (not included in the previous two codes)	"I liked the recipes, but I don't always have the ingredients at home."	"The guide was easy to understand, although I only make/eat traditional Mexican foods like pozole, menudo etc. on special occasions."
Extrinsic barrier: family pushback	"Yes, I had problems [in the form of] family pushing me to eat more meals at restaurants"	"Using more vegetables when cooking because I already eat vegetables. It's difficult because my husband is more of a meat eater."
(un)timeliness of study materials	"Everything was good, but I would have liked to have received the recipes earlier at the beginning"	"Only complaint would be that it seemed we received some of the information too late, would have liked to have all materials at the beginning of the study."

The third theme was <u>perceptions of specific dietary components</u> (**Table 12**) and included all mentions (positive, negative or neutral) of distinct dietary components. Codes included fruits and vegetables, fat, sugar, sugar sweetened beverages (soda), junk food (in general), water, salt, meats, beans, flours, and other not previously classified components. This theme included a total of 11 codes. Codes with a majority of negative comments or comments mentioning how a participant would like to reduce the consumption of that dietary component were mostly present in the codes of fat, sugar, SSB, junk food, salt, and flour. Comments with a more positive outlook or mentioning what a participant would like to eat more of included the codes of fruit and vegetables, water, and beans. Codes with mixed or more neutral undertones were meats, and others. The only notable difference between the DGA arm and the MexD arm was that water was not mentioned in the DGA arm.

Table 12: summary of codes and examples for the third theme

Codes	DGA arm	MexD arm
Fruits and vegetables	"I realized I need to eat more veggies & fruits"	"Eating healthy, like fruits and vegetables"
Fats	"Avoiding red meats and fats (pork, beef)"	"Cooking with less fat because it is easier"
Sugar	"Cutting down on sugars, being more on top of my family's sugar consumption"	"[…] tried to cut down on sugars, but it was a challenge"
SSB	"No more soda, specifically Coca-Cola because of its sugar and caffeine content"	"Yes, switching from Coca-Cola to natural water"
Junk food/processed food (general)	"Tried to eat less junk food, smaller (decent) portions"	"No, just being more conscious to cut out more processed foods like potato chips, pizzas, fast food and cook more Mexican meals/dishes, which is the norm for me and my family anyway"
Water	Not mentioned	"Eating smaller portions and eating more fruits and vegetables and most of all, to drink a lot of water"
Salt/sodium	"Yes, follow a healthy eating pattern for my entire life and limit the consumption of sugars and saturated fats and sodium and also limit calorie consumption"	"The salt, I consume more salt. I know salt is bad, my doctor told me"
Meat	"That my stomach struggles to digest pork and beef"	"I got more ideas for how to cook meats and vegetables in meals"
Beans	"I'm eating a lot more beans than before, in the past I thought they made my gasy, but now I crave them. I used to burp a lot, now I don't, not these past months."	"Beans, they're so good and dynamic, tostadas are a great vehicle for many other ingredients"
Flour	"Not eating white flour, I replaced it with whole wheat flour, or I avoided it"	"Reducing my flour [carb] intake and consuming more grains"
Others	"I tried to drink more pressed green juices, nothing added, just things like coconut water, turmeric."	"I included more vegetables, nuts and eggs in my daily diet."

Finally, the fourth and final theme was <u>information or practices learned from the intervention and suggestions</u> (**Table 13**). Codes included useful information learned, changes made during the intervention, (expressing desire for the) continuation of changes post intervention, portion sizes, frequency, exercise, and suggestions. Although the codes for portion sizes and frequency are also technically useful information learned, they were coded separately as the focus was different. This theme included a total of 7 codes. For the code of *frequency*, no participants of the DGA arm mentioned anything related to that. Suggestions included ideas about including a food record, more information about diseases, timely delivery of materials, creation of guides for kids and for busy people.

Table 13: summary of codes and examples for the fourth theme

Codes	DGA arm	MexD arm
Useful information learned from the intervention	"How to put together meals or dishes and how to economize and buying foods with only $10, fresh or frozen, and the amount that it can yield."	"Knowing that making small changes and eating healthier can prevent chronic illnesses"
Portion sizes	"Reading the quantities of each portion, like granola bars, the amount of sugar it has, fat etc."	"Thankful for teaching us to eat smaller portions"
Frequency	Not reported	"Eating pattern recommendations and keeping in mind to try to eat 1-2 servings of beans each day, vegetables, corn based (masa), fruits, and whole milk."
Changes made during the intervention	"The change I made was to have protein for breakfast every day and to carry healthy snacks/or have them at hand"	"1. More salsa=more vitamin C & other nutrients 2. Meal planning and cooking more"
Continuation of changes post-intervention	"Eating less processed flour products, using less dressing"	"Continue incorporating vegetables to the meals I prepare"
Exercise	"Complimenting with exercise"	"With exercise, and to include more fruits and vegetables in my diet"
Suggestions	"Something that would help busy people like me eat better, guides, food recommendations"	"The recipes could have been more useful if handed out towards the beginning! I'm sad I didn't get to use them. More emphasis on things we should eat less of. Would've liked seeing an on-line (log-in required) sort of method for completing food questionnaires, like a virtual food diary."

One final code was found to be better understood separately. This last code was *using online resources*. Only two participants (one of each arm) reported using online resources to complement their knowledge. One comment was positive because the participant described it as an activity that she liked, and the other comment was neutral:

> MexD arm participant: "I referred more often to the internet and parents' recipes" (neutral)
>
> DGA arm participant: "I didn't have much time and I normally have to put dinner together quickly, so that was difficult. I liked doing my own research online." (positive)

Discussion

The COMIDAS at home study tested the extent to which dietary recommendations (DGA vs MexD) given to free-living Mexican-descent women could improve their dietary intake and health status. By randomizing each participant and analyzing the end-of-study survey, this study also aimed to understand whether the traditional Mexican diet was not only more effective at improving health than the standard DGAs, but also if it was more feasible or easily adopted by participants. After 3 months, the DGA arm showed significant improvement on serum FFA (35% difference). Carbohydrate intake was reduced by 31% on the DGA group, however, that was an absolute reduction but not a relative reduction as the change still amounted to ~49% of total calories. Participants overwhelmingly reported positive comments from both arms, however the DGA arm participants reported slightly higher ease of understanding and of use of their provided materials and guides. 100% of DGA participants reported the guides were very easy or easy to understand, vs 70% of MexD participants. Likewise, 90% of DGA participants reported it was very easy or easy to use their guides, vs 60% of MexD participants.

Furthermore, this trial evaluated the effectiveness of the DGAs on Mexican-descent population living in the US. While the weight and biomarker data after 3 months showed little improvement, participant feedback showed overall feasibility of following and understanding the diet as well as cultural relevance. One key feedback component was how *variety* was mentioned several times by participants in the DGA arm in the end-of-study survey. These results point to the idea that DGA, including the Spanish translation, can be used in populations of Mexican descent living in the U.S. as a tool for dietary intervention and for general dietary guidance. On the other hand, some of the comments received from the MexD participants made comments about connection to their culture, such as “This was a fun and engaging study, personally. It forged a connection back to my culture and history as a Latina;” this points towards the importance of culturally appropriate interventions. Time also seemed less of a concern for the MexD participants, as none of them mentioned it as a barrier for using the guidelines. These results are important because they offer nutrition professionals and other healthcare professionals the opportunity to recommend either pattern to their patients. This last point is supported by the fact that the analysis showed improvement in serum total cholesterol for all participants, regardless of randomization assignment. The possibility that Mexican-descent populations could potentially improve their dietary quality by accessing their own information about the standard DGAs can also be highlighted, as reflected in how 2 participants reported using online resources to complement the study-provided materials.

Diet change induced changes in serum biomarkers between each arm. Overall, at 3 months, the decrease in total energy intake along with carbohydrate and fat intake (when compared with the MexD arm) can account for the decrease in FFA and possibly cholesterol in the DGA arm participants. Increased serum FFA concentrations have been associated with insulin resistance, and overall inflammation.[77] These results contrast with the results obtained by the original COMIDAS study, in which CRP and insulin improved after the feeding trial for the MexD arm. However, in the original COMIDAS study, the control group was not provided with a DGA-adapted diet, but rather with a SAD based off the NHANES data. Increasing the overall quality of a diet could help improve insulin sensitivity and reduce inflammation.[78,79] Nevertheless, FFA functions and effects on the body vary depending on the length and saturation of the chain.[80] It is a limitation of this study that we are not able to distinguish the types of FFA that were increased (or decreased) in our population to better understand whether our findings support or oppose the DGAs as a way to improve insulin sensitivity and or inflammation.

Strengths of this study include the incorporation of qualitative data, being the first of its kind to evaluate guideline recommendations to free-living individuals for them to choose and prepare their own meals, and re-evaluating dietary intake after 3 months of the study end (6 months after the start of the intervention). Limitations include the fact that although several measures of dietary intake were significantly different at 6 months between each arm, data are likely unreliable not only because of the small number of FFQs that were included in the analysis, but also because mean caloric intake for the MexD arm was ~983 Kcal. It was only possible to obtain one FFQ for each dietary assessment, which further limits the reliability of the dietary intake data. Current FFQs might not be entirely culturally adapted enough to capture all culturally relevant foods, which could potentially explain why the MexD arm mean intake at 6 month was below 1000Kcal. However, participants from both arms saw a significant reduction in energy intake, which might point to the need to find better strategies to keep participants engaged with the study activities. Furthermore, participants on the MexD arm could have been limited in their food choices by external factors such as food availability. Additionally, this research study did not delve into the socioeconomic status of its participants, but it is possible that some of the participants from either arm might have been affected by food insecurity. Another limitation was that some participants reported not having recipes to prepare foods and reported how providing that information at the beginning of the study would have helped them follow each guideline better. This study does not evaluate experiences of interpersonal or structural racism, and how that may affect diet quality or health outcomes. Finally, acculturation not was accounted for in our population; in the original COMIDAS study, acculturation was adjusted for in the analysis. Future studies could address these shortcomings.

In conclusion, both the recommendation of the DGAs and the MexD appear to slightly improve some minor, but different health outcomes over the short term. While the DGA recommendations improved serum FFAs, both recommendations significantly reduced serum cholesterol overall. Total energy intake was also reduced for both arms, although not found to be statistically significant. With both arms receiving positive feedback, and the feasibility of the DGAs being confirmed, healthcare workers could potentially offer either option to their patients or have them choose their preferred option. However, more studies are needed to evaluate long-term health outcomes, or as suggested by participants, how interventions like this can benefit other populations such as children.

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